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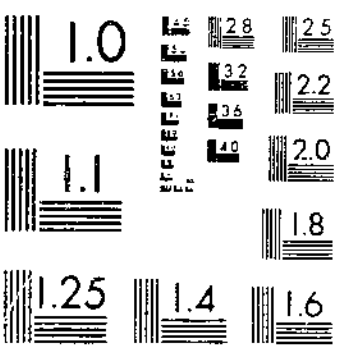

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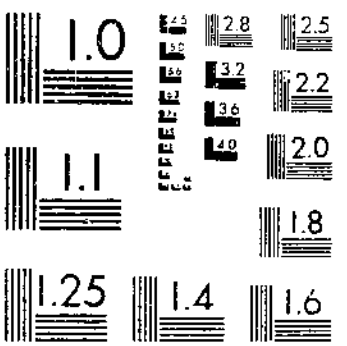

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IRRIGATION REQUIREMENTS OF THE ARID AND SEMIARID LANDS OF THE MISSOURI AND ARKANSAS RIVER BASINS

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CONTENTS

INTRODUCTION

In this report all dependable data on water requirements of crops in the basins of the Missouri and Arkansas Rivers and adjacent territories are presented in tabular form. The results of some experiments are reviewed and compared, some of the main factors influencing the quantity of water used are discussed, and, by way of conclusion, an estimate is made of the irrigation requirements of the arid and semiarid lands in the territory covered. This estimate is based not only on the results of experiments but also on anticipated improvements in irrigation practice, including better methods of farming and a more economical use of water. Since the object of the experiments has been the determination of the quantities of water required for crop production in the several divisions of the area, consideration is given to the crops grown, the climate, and the soil.

The irrigation requirements, commonly called the "duty of water," of arable lands must be considered from several angles. The data

included in this bulletin, and especially the concluding estimates have been assembled not only for the benefit of farmers but also for legal, administrative, and engineering agencies having to do with effecting the proper use of water in the irrigated areas with which this report is concerned. This should be kept in mind in judging the fairness and practicability of the author's concluding recommendations. They should be considered as a yardstick by which the ultimate requirements may be approximated. Often it will not be economical to attain the "duties" specified and it is recognized that they can be attained generally only when present irrigation practices are improved. Nevertheless, the author has not hesitated to adopt in his recommendations the ideal "duties" indicated by the many experiments which formed the foundation for the study leading to this publication, in the belief that they can be used safely by engineers in planning new irrigation developments of large size, by officials of irrigation enterprises having to consider in bulk the needs of their communities, and by attorneys and courts which have in hand the difficult task of bringing about the ultimate ideally beneficial use of water over large areas the requirements of which are necessarily divergent.

Investigations have been carried on for more than 25 years in various localities of the Missouri and Arkansas River basins by Federal, State, and private agencies to determine the quantity of water used in irrigation and the effect produced on the yield and quality of crops by varying the quantities furnished. Many of the results of the earlier investigations were published either by the Government or by local agricultural colleges, but most of the publications are not now easily procured. The results of various later investigations by the Bureau of Public Roads [1] and its collaborators have not heretofore been published.

The duty of water in western Canada has been investigated by the Dominion's reclamation service and department of agriculture. Because the climate and soil products of the southern part of Alberta are similar to those of the basins of the Missouri and Arkansas Rivers, some of the results of the Alberta investigations are summarized in this report.

Units and forms of expression are those defined in the preceding bulletin (*20*)[2] of the series.

THE BASINS OF MISSOURI AND ARKANSAS RIVERS

This report, as indicated by the accompanying map (fig. 19), does not deal with the entire basins of the Missouri and Arkansas Rivers but only with their arid and semiarid portions. These comprise the portions of Montana, Wyoming, and Colorado east of the Continental Divide and the western portions of Kansas, Nebraska, South Dakota, and North Dakota.

Notwithstanding its wide extent and the diversity of the conditions which influence the water requirements of crops, several features may be said to be common to the entire area, such as the elevation

[1] The irrigation work of the United States Department of Agriculture was originally conducted under the supervision of the Office of Experiment Stations and designated as "irrigation investigations." Later, under a reorganization of the department, this and other agricultural engineering activities were grouped in a division of agricultural engineering and made a part of the Bureau of Public Roads.

[2] Italic numbers in parentheses refer to literature cited, p. 110.

above sea level of the irrigable lands as compared with the cultivated lands of the rest of the United States, the scanty yearly precipitation, and the large percentage of the annual precipitation which occurs during the crop-growing period. These characteristics can best be outlined separately for each of the seven States involved.

MONTANA

By far the larger part of Montana's total area and about 83 per cent of its total irrigated area lie in the Missouri River Basin. The central and southwestern parts of the State are drained by the three main forks of the Missouri River and their tributaries; the southeastern part by the Yellowstone River and its tributaries; and the northern part east of the Rockies by Milk River and its tributaries. The irrigated lands are to be found in the valleys bordering these streams. The annual precipitation is about 14 inches in the cultivated valleys, but at the higher elevations near the sources of the streams it is much more. The greater part of the precipitation, especially the spring snows and early summer rains, comes at a favorable time to nourish crops.

President Alfred Atkinson, of the Montana State College of Agriculture and Mechanic Arts, has classified the lands of Montana as follows (*24*): Farming land, 30,000,000 acres; mountain and forest land, 26,000,000 acres; grazing land, 37,000,000 acres. In the December, 1920, report of the Montana Irrigation Commission (*35*), the area irrigated in that year is given as 2,136,974 acres and the irrigable area of the State as 5,288,517 acres.

The average altitude of the State is 3,400 feet, but one-fourth the total area is less than 2,000 feet and one-half is less than 3,000 feet in elevation. These elevations are low as compared with those of the other Rocky Mountain States and the protection afforded the cultivated valleys by high mountain ranges, the fertility of the soils, and the propitious climate are conditions favorable for the production of good crops.

WYOMING

Fully three-fourths of the area of Wyoming and nearly three-fourths of its irrigated lands lie in the Missouri River Basin. The elevation varies from 3,000 to 14,000 feet, with a mean of 6,700 feet. Most of the irrigated lands are at elevations between 3,500 and 5,000 feet, but profitable irrigation farming is carried on in certain localities between 6,000 and 7,000 feet. For an arid State, Wyoming is well watered. The North Platte River with its tributaries drains most of the southeastern portion. Seven important streams drain the northeast and eight others equally large drain the northwest. The mean annual discharge of all of the streams of the State, including those of the western slope, has been estimated as approximately 11,000,000 acre-feet (*27*), of which about 7,000,000 acre-feet are furnished by streams of the Missouri River Basin.

When properly controlled, the entire supply should irrigate 6,200,000 acres and the streams of the Missouri River Basin some 3,000,000 acres. The annual precipitation in northeastern Wyoming varies from a normal of 6 inches in the Big Horn Basin to 25 inches on the Big Horn Mountains. The plains of the southeastern part have a normal precipitation of about 15 inches per year, while in the

valleys of western Wyoming the annual precipitation ranges from 11 to 22 inches. More than two-thirds of the total precipitation occurs between April 1 and September 30 throughout the Missouri River Basin.

COLORADO

About 50 per cent of the total land area of Colorado and about 60 per cent of its irrigated area are east of the Continental Divide in the basins of the Missouri and Arkansas Rivers. The eastern half consists of high plains with elevations of 5,000 to 6,000 feet near the base of the mountains and 3,500 to 4,200 feet at the State line. The irrigated portions of these plains are mostly along the courses of the Arkansas and South Platte Rivers and their main tributaries. The rainfall on the arable lands averages less than 18 inches along the eastern border and decreases to 12 to 15 inches near the mountains at the west, about 80 per cent falling between March 1 and September 30.

KANSAS

Kansas, which is 400 miles from east to west and 208 miles from north to south, may be regarded as one vast undulating plain which slopes gently eastward from an elevation of 4,400 feet to less than 1,000 feet, lying altogether within the Missouri and Arkansas watersheds. The annual precipitation varies from over 40 inches in the southeastern counties to less than 15 inches near the Colorado boundary, but since about three-fourths of the total occurs between April 1 and October 1, it is favorable for crop production, the chief drawback being midsummer droughts. The Weather Bureau estimates that in a 20-year period there were 33 periods of 30 days duration each in which little effective rainfall occurred (*50*). These protracted dry spells, accompanied by dry winds and excessive evaporation, create a need for supplemental irrigation over much of the western half of the State. Streams can not be depended upon for irrigation supplies to any great extent, since the run-off is extremely limited and economical opportunities for storing flood flow on a large scale are not numerous. However, there is available a dependable supply from certain underground sources, and the future irrigation development of Kansas must be based largely upon well water, of which there is estimated to be enough within economical lifts for the irrigation of 5,000,000 acres (*30*).

NEBRASKA

Nebraska lies wholly within the Missouri River Basin. Its elevation increases from about 1,000 feet at the Missouri River to more than 4,500 feet near the Wyoming State boundary. As the elevation increases, the precipitation decreases, being more than 32 inches in some of the eastern counties, while in the western part it is less than 18 inches. However, since more than three-fourths of the State's annual precipitation occurs between April 1 and September 30, it is favorable to crop production.

In 1919, 442,690 acres were irrigated in Nebraska, the water supply being derived almost wholly from the Platte, Republican, White, and Niobrara Rivers. The need for supplementing the rainfall by irrigation will be felt more keenly in the future, but on account of the limited water supply only a small area, estimated at less than 3

per cent of Nebraska's total land surface, can be irrigated. This estimate anticipates the utilization of not only all the stream flow in the western half of the State but also the available ground water to be profitably pumped from wells. The extent of land for which a water supply actually can be furnished bears but a small ratio to the area of land which, if the water were available, might profitably be irrigated. The precipitation over much of the western counties is not sufficient to grow ordinary crops in rotation with leguminous crops and thereby maintain the productivity of the soil, hence crop yields, farm profits, and farm land values probably will decrease unless more moisture is made available by artificial means.

SOUTH DAKOTA

South Dakota is divided into two nearly equal parts by the Missouri River, which flows in a southerly direction from the midpoint of the northern boundary as far as Pierre and thence to its junction with the Big Sioux River at the southeastern corner, the entire State being drained by the Missouri River and its tributaries. The extremes in elevation are at Big Stone Lake in the northeastern part, which is 967 feet above sea level, and Harney Peak in the southwestern part, which has an altitude of 7,216 feet. The elevations of the western counties range from about 1,500 feet at the Missouri River to about 3,200 feet near the eastern border of the Black Hills district. With the exceptions of the rocky formations of the Black Hills, the Bad Lands, and several landmarks in the way of buttes, the State consists of open prairie and tablelands with gently sloping or undulating surfaces. The Black Hills comprise about 3,200,000 acres and the Bad Lands about 1,250,000 acres. The average annual precipitation for the State is about 20 inches, but that of the eastern half averages about 5 inches more than that of the western half. The low precipitation of the western counties is partly compensated for by the time of its occurrence, over four-fifths of the annual amount being received between March 1 and September 30.

NORTH DAKOTA

Being distinctively a prairie State, North Dakota has few hills and forested areas; 93 per cent of its lands are arable, and of this area 1,540,000 acres are classed as irrigable. The elevation above sea level increases from east to west, being about 1,000 feet in the eastern tier of counties and 3,000 feet near the southwestern boundary. The normal yearly precipitation throughout the State is a trifle below 18 inches, the western half receiving materially less. Mean precipitation of all the years of record to 1922, inclusive, at the Weather Bureau stations in western North Dakota, ranges from 13.63 to 17.46 inches, and averages 15.56 inches (*51*). The seasonal distribution however, is well adapted to the moisture requirements of the crops grown. The largest streams are the Missouri River, with a basin within the State of 20,000,000 acres, Mouse River, Red River of the North, and James River. Irrigation has been mainly confined to a small part of the Missouri River Basin, but with continuous cropping to cereals the naturally fertile soil becomes less productive and retains less moisture. As profits from dry farming decline, more interest will be taken in providing supplemental water supplies, and in the future it is likely that much more land will be irrigated.

SOILS OF MISSOURI AND ARKANSAS RIVER BASINS

Montana, Wyoming, and Colorado are traversed by the Rocky Mountain Range with its many lofty peaks and high mesas and have much land that can never be cultivated. All three States contain extensive grazing areas which are too rough and stony to be plowed, and much of the forested area is high, rocky, or otherwise unsuitable for cultivation. The area of arable land is relatively small and the portion which can be irrigated is still smaller, because of the scarcity of water and the cost of its diversion. Less than 7 per cent of Montana east of the Continental Divide is irrigable. The corresponding percentage in Wyoming is about 10 while in Colorado it is about 8. Whitney says: (*56, p. 85*) "The rough topography in itself would prevent the cultivation of a large part of the area. The portions that are adapted to cultivation consist mainly of old valley fillings and river flood plains."

The following paragraphs, descriptive of the soils of the basin, have been abstracted from reports of soil surveys by the Bureau of Soils, the Bureau of Reclamation, and the local State experiment stations. Some types of soils described in early reports of the Bureau of Soils have been reclassified and their designations have been changed from those given.

In general, the soils of Gallatin Valley, Mont., comprising 208,000 acres, are fine textured, heavy alluvial, or silty loams. The Bozeman silt loam was found on over a third of the area and the Yakima silt loam on one-fourth, while the Gallatin gravelly loam occupied more than a seventh of the total area surveyed. Silt predominates in the Bozeman silt loam, more clay being present than fine sand or very fine sand. Silt likewise predominates in the Yakima silt loam, with more very fine sand than clay. The Gallatin gravelly loam contains less silt than either of these loams, but more coarse sand and a small amount of fine gravel.

In a portion of the Yellowstone Valley, Mont., comprising over 68,000 acres extending eastward from Park City to Billings, the Bureau of Soils found four soil types. In the order of their extent these are the Billings clay, which is a clay loam underlaid by a tough and sticky clay; the Billings loam, which ranges in texture from sandy loam to clay; the Billings sandy loam, which is productive and free from alkali; and the Laurel sandy loam, composed of materials transported in past geologic time by the Yellowstone River.

A soil survey of a portion of the Laramie plains near Laramie, Wyo., showed that the soil of 43.6 per cent of an area of more than 197,000 acres was Laramie sandy loam; Redfield sandy loam comprised 21.6 per cent; and Laurel sandy loam 14.9 per cent. The Laramie sandy loam has been transported from the hills and mountains by water, wind, and ice, and contains varying percentages of sand, silt, clay, and gravel. The Redfield sandy loam is derived from the rocks over which it lies and consists principally of very fine sand, silt, and fine sand with some clay. The Laurel sandy loam is an alluvial deposit consisting of sand, silt, and a small percentage of clay.

In 1925 a soil survey of a proposed Federal reclamation project in Carbon County, Wyo., made by the State university, the Bureau

of Reclamation, and the State engineer, included an area of 102,360 acres along the east bank of the North Platte River, with elevations from 6,900 to 7,100 feet. Topographically it is a series of terraces, some of which have steep slopes. About 64,000 acres, or 62 per cent, found to be irrigable, had soil consisting chiefly of loam and fine sandy loam. The soils were classified on the basis of steepness of slope, depth and quality of soil, alkali accumulation, and drainage conditions. Good soils having favorable conditions and slopes of 1½ to 6 per cent were designated class A. Similar soils having 6 to 12 per cent slope were called class B, while class C soils were deep and had slopes of 12 to 20 per cent.

Most of the soils of northern Colorado east of the divide are of the sandy loam type in which sand, silt, and a medium percentage of clay are present. Two productive soils, the Colorado fine sandy loam and the Colorado loam, characterize extensive areas near Greeley. The former contains 30 to 40 per cent very fine sand, 25 to 32 per cent silt, 17 to 22 per cent fine sand, and 10 to 13 per cent clay. It is of residual origin, easily cultivated, well drained, and free from an excess of alkali. The Colorado loam is similar in texture but contains more clay. In the soils of the Arkansas Valley of Colorado clay and silt are more abundant. There are the silt and clay loams of the Lamar series, the silt loam, clay loam, or gravelly loam of the McClave series, the sandy or loamy soils of the Holbrook series, and heavy soils of other series.

A reconnaissance soil survey of more than 25,000,000 acres in western Kansas was made by the Bureau of Soils in 1910 (*10*). Throughout nearly 36 per cent of this area was found the Colby silt loam, on over 15 per cent the Summit silt loam and Summit silty clay loam, on 13.2 per cent the Richfield silt loam, and on 6.1 per cent the Richfield sands and sandy loams.

The Colby silt loam usually contains about 70 per cent of silt, the other main constituents being sand and clay. The Summit silt loam and silty clay loam are derived from cretaceous formations and contain 70 to 80 per cent silt, 10 to 20 per cent clay, and 5 to 10 per cent very fine sand. The Richfield silt loam is a weathered product of the plains marl modified by a small amount of fine sand. The principal ingredients in its content are silt, very fine sand, and clay. The Richfield sands and sandy loam contain little clay and about 20 per cent of silt. Sand of various degrees of fineness is the principal ingredient.

According to the Bureau of Soils, the normally developed deeper soils of the North Platte irrigation project in western Nebraska show in their profiles (1) a loose friable surface soil, (2) a subsurface compact layer, (3) a loose friable highly calcareous silty layer, and (4) the parent rock. The more important soils of the upland derived from the older rocks belong to the Rosebud, Dawes, Goshen, Orella, Epping, and Canyon series. The first three series are either silt loams or very fine sandy loams, free from an excess of alkali and easily cultivated. The Orella and Epping series are characterized by more clay, inferior natural drainage, and more alkali. The Canyon series occupies an eroded country which has little irrigable land.

A reconnaissance soil survey of the western half of South Dakota made by the Bureau of Soils in 1909 (*9*) showed that the common types of soils of that part of the State are Pierre clays, Morton loams, Morton fine sandy loam, Rosebud silt loam, and the Pierre loams and clay loams. These five constituted 80 per cent of the area investigated exclusive of the Bad Lands and the rough stony land. Silt and clay combined constitute about 80 per cent of the Pierre clay soil. It is of a heavy sticky nature and cracks when dry. The Morton loams, next in extent to the Pierre clays, vary in texture from a loam containing a considerable quantity of fine sand to a heavy silt loam in which only a small percentage of sand is present. Nearly 60 per cent of the Rosebud silt loam is silt, about 25 per cent very fine sand, and 15 per cent clay, the remaining ingredients being coarser sand. It is loose and friable but erodes readily on account of the fineness of its sand. The Pierre loams and clay loams vary from a loose friable loam to a silty clay loam, possessing some of the characteristics of the Pierre clay.

In 1908 the Bureau of Soils made a survey of 25,000,000 acres in western North Dakota (*31*), finding the Williams loam, a soil of glacial origin, on 53 per cent of the territory surveyed. This soil is easily cultivated and maintained in a good condition of tilth and is sufficiently open to absorb water readily.

Other common soils of this territory are the Morton loams and the Morton clay and clay loams described elsewhere in this bulletin.

CLIMATIC CONDITIONS

Precipitation, temperature, and the duration of the frost-free period influence the quantity of water required for profitable crop production. Data compiled from the records of the Weather Bureau for 18 localities are summarized graphically in Figures 1, 2, and 3. The normal annual precipitation is small, but its monthly distribution is well adapted to the needs of crops, much of it falling in April May, June, and July. In parts of the basins the August rainfall is also considerably above the monthly average. The precipitation in winter is low, often being less than one-half inch and seldom exceeding 1 inch per month.

In some cases the total amount of precipitation may not be effective in producing plant growth. A light shower may add no moisture to the soil, while a heavy rain may result in a considerable loss through run-off. A moderate rainfall generally is absorbed by the soil with little or no loss.

While the average annual precipitation for any locality serves as a general index to the quantity of supplemental water required, the percentage of dry years in a cycle should also be known, as well as the duration and intensity of droughts and the percentage of the annual precipitation which is effective in nourishing crops. The normal precipitation may be raised unduly in a period of years by a few wet seasons. Figure 4 (*7*) shows the annual precipitation at Hastings, Nebr., for each year of a 20-year period. In this case the abnormal wet years of 1905 and 1915 raised the average to 23.35 inches, whereas the average of the 13 years in which the precipitation was below the normal was 19.29 inches and the average of the five driest years was only 16.74 inches.

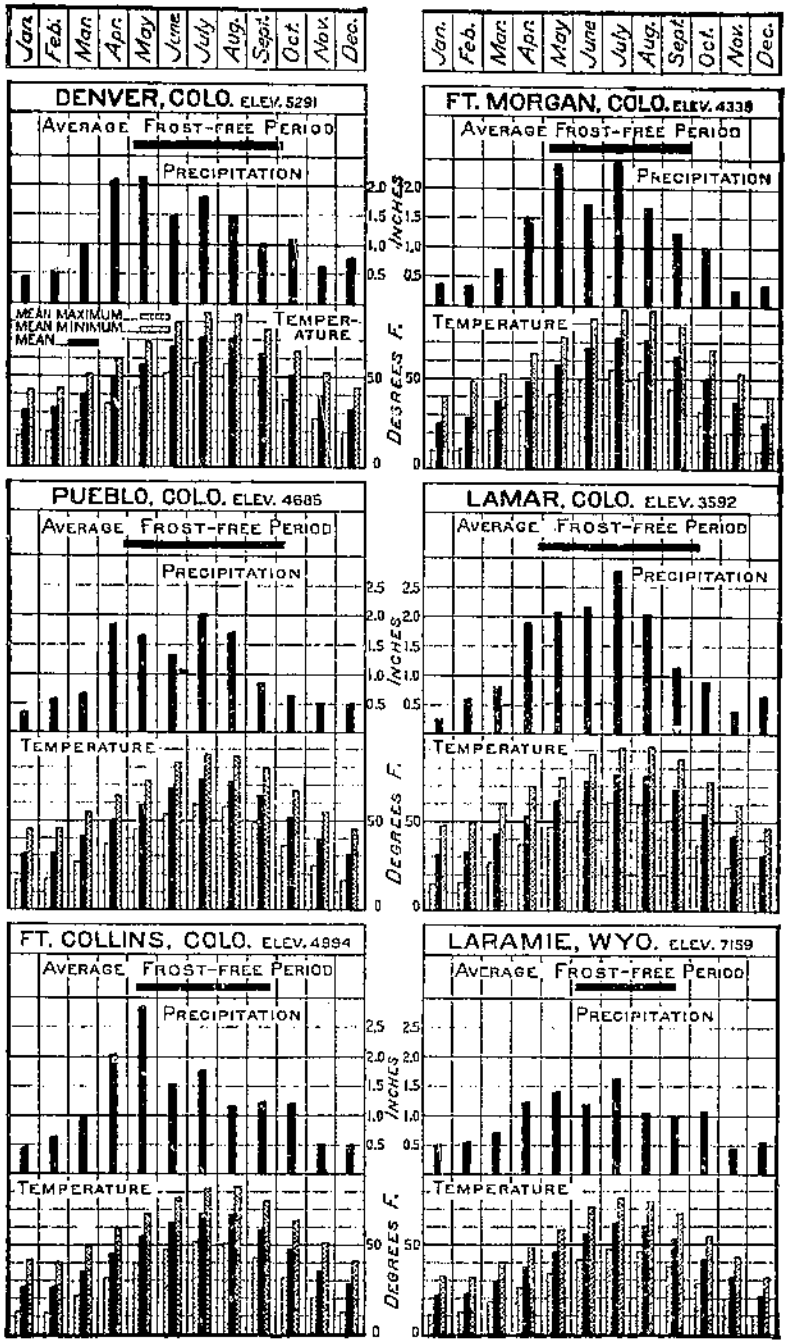

FIG. 1.—Condensed climatology of typical stations in Colorado and Wyoming, showing average frost-free period, mean monthly precipitation, mean maximum temperatures (double-shaded bars), mean minimum temperatures (lightly shaded bars), and mean temperatures (solid bars)

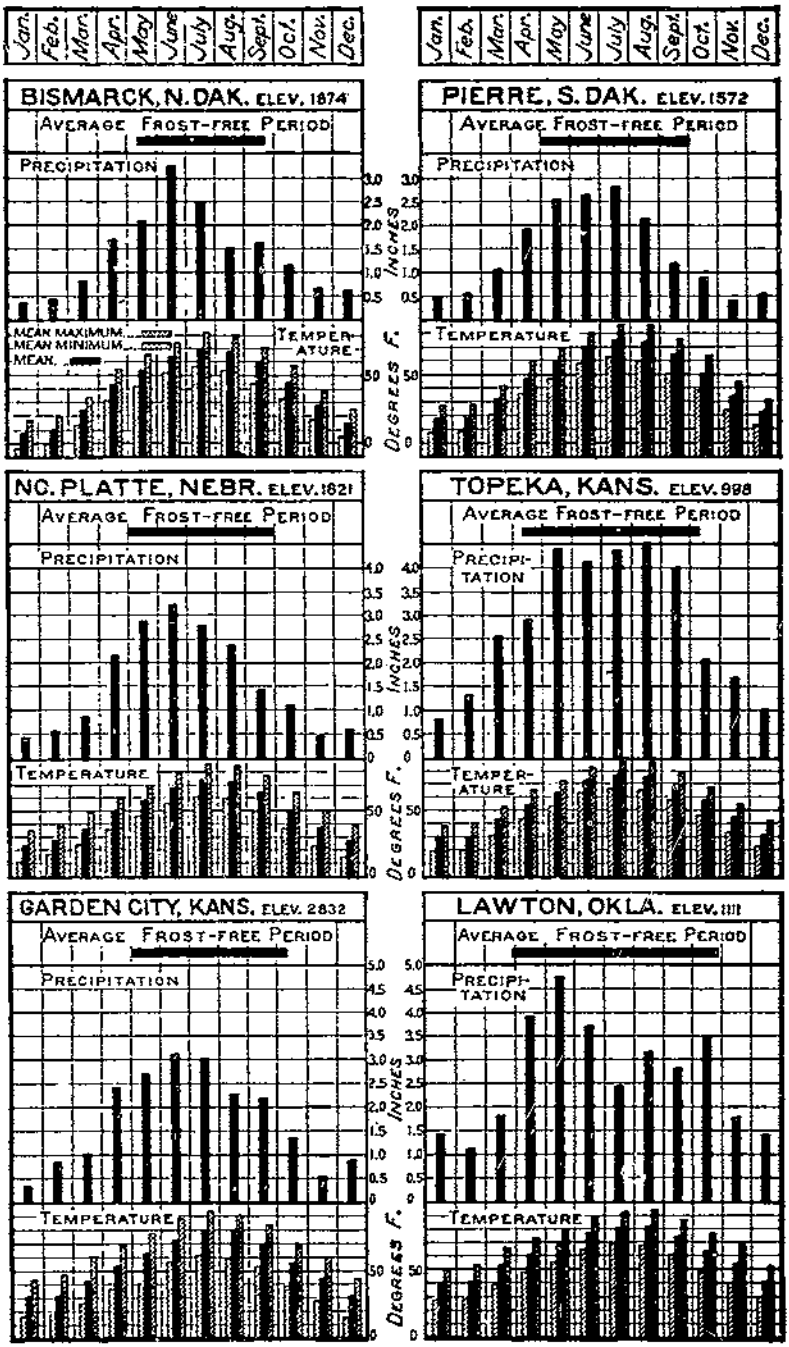

FIG. 2.—Condensed climatology of typical stations in North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma, showing average frost-free period, mean monthly precipitation, mean maximum temperatures (double-shaded bars), mean minimum temperatures (lightly shaded bars), and mean temperatures (solid bars). Temperature and frost-free period for Garden City were taken at Lakin, 15 miles west of that city

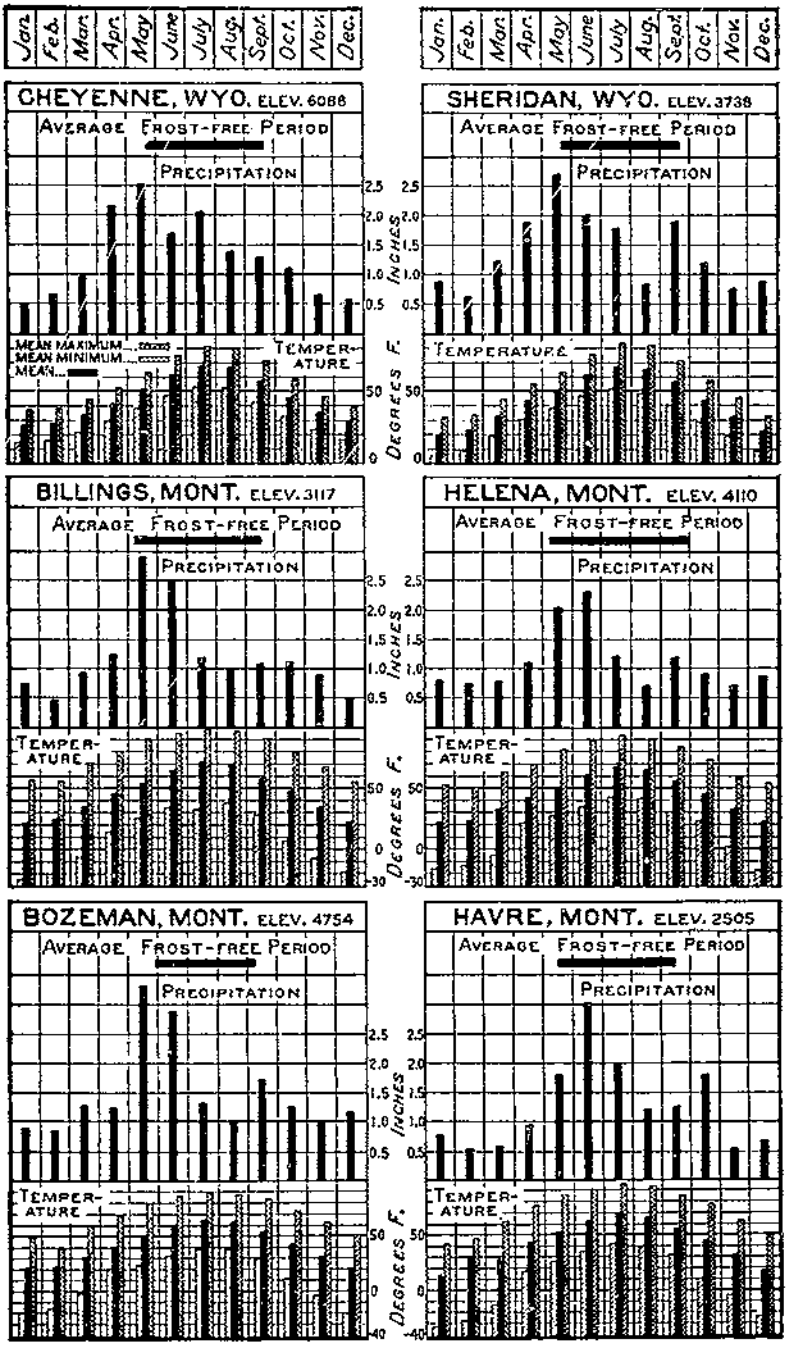

FIG. 3.—Condensed climatology of typical stations in Wyoming and Montana, showing average frost-free period, mean monthly precipitation, mean maximum temperatures (double-shaded bars), mean minimum temperatures (lightly shaded bars), and mean temperatures (solid bars)

The frost-free period is short when compared with those of the Southwest or Pacific Coast States. In the more elevated agricultural districts killing frosts may occur after May 15 and before September 15. In valleys of lower altitude the period between May 1 and September 30 is usually free from injurious frosts.

July and August are the warmest months and December and January the coldest. There is a fairly gradual increase in mean temperature from 10° F. in December and January to 65° to 75° in July and August.

Evaporation from water surfaces is low throughout the basin, chiefly because of relatively low temperatures. The rate of evaporation has been determined in several ways and the results are not always comparable. At the State and Federal experiment stations galvanized pans, occasionally square but more often circular, of varying sizes and depths, have been installed, most frequently in the ground with the tops of the pans projecting a few inches, and less

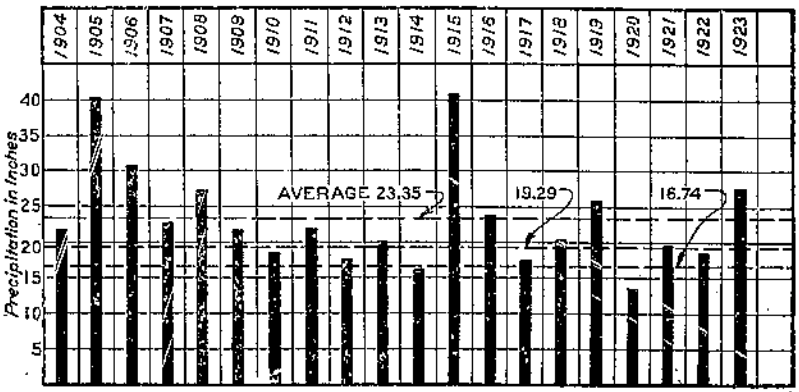

FIG. 4.—Annual precipitation at Hastings, Nebr., 1904 to 1923

frequently on the ground surface. The pans are nearly filled with water and a record is kept of the quantity of water evaporated. Other conditions being similar, the smaller the area of water exposed and the shallower its depth, the greater the rate of evaporation. The evaporation from the surface of reservoirs usually is ascertained by means of floating pans about 9 square feet in surface area and 12 inches in depth. On account of ice and snow, evaporation records have been confined almost wholly to the frost-free period of each year. At Fort Collins, Colo., however, the record is practically continuous since 1887. This record of 38 years shows an average yearly evaporation of 42.04 inches, of which 30.31 inches or 72.13 per cent occurred between April 1 and September 30 and 11.71 inches or 27.87 per cent between October 1 and March 31. The monthly averages for the 38-year record from 1887 to 1925, inclusive, are shown graphically in Figure 5. By means of this record it is possible to estimate approximately the yearly evaporation at stations having a record for only part of the year. Table 1 gives the average monthly evaporation in inches from ground tanks during the summer months at several localities in the basins of the Missouri and Arkansas Rivers. The number of years of record, elevation above sea level, form of pan, and area are also given.

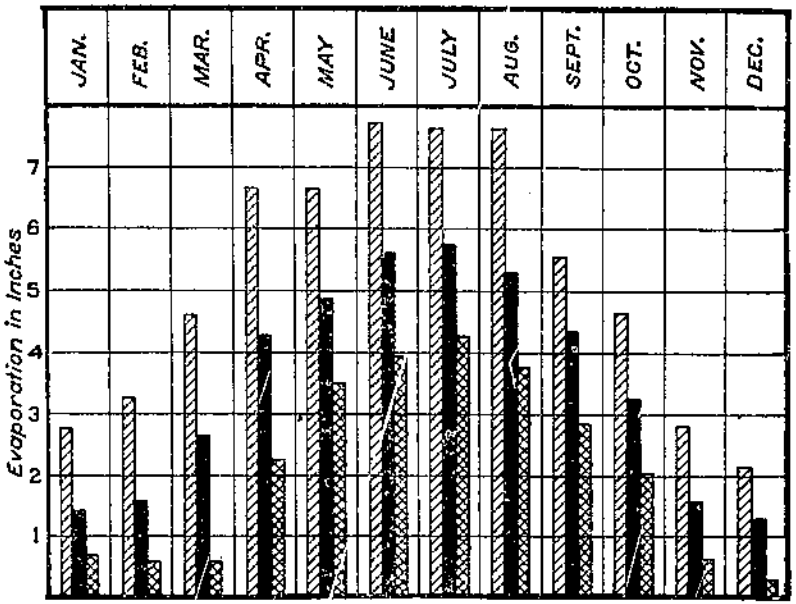

FIG. 5.—Monthly averages for evaporation at Fort Collins, Colo., for 38-year period from 1887 to 1925, inclusive. Maximum evaporation, lightly shaded bars; minimum evaporation, double shaded bars; mean evaporation, solid bars

TABLE 1.—*Average evaporation from water in pans from April 1 to September 30, at several localities of the Missouri and Arkansas River Basins*

Station	Length of record	Elevation above sea level	Form of pan	Surface area of pan	Evaporation in—						
					April	May	June	July	August	September	Total in 6 months
	Years	*Ft.*		*Sq. ft.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Bozeman, Mont.	4	4,865	Cubical, 3 feet on each side.	9.0	2.00	4.37	4.37	3.97	4.03	3.13	21.87
Havre, Mont.	7	2,505	Circular	28.3	3.59	6.10	6.79	8.18	6.90	4.17	35.73
Moccasin, Mont.	12	4,228	do	28.3	3.03	5.10	5.88	7.15	7.21	4.47	33.74
Archer, Wyo.	8	6,012	do	28.3	3.68	5.68	7.16	7.70	6.99	5.26	36.47
Sheridan, Wyo.	4	3,790	do	28.3	2.87	5.03	6.60	8.39	7.82	4.81	35.52
Fort Collins, Colo.	38	5,000	Cubical, 3 feet on each side.	9.0	4.29	4.92	5.61	5.78	5.33	4.38	30.31
Akron, Colo.	13	4,650	Circular	28.3 and 50.3	4.89	6.54	7.91	9.16	7.93	6.31	42.74
Garden City, Kans.	13	2,836	do	28.3 and 50.3	6.33	8.46	9.88	9.95	9.60	7.41	51.72
Hays, Kans.	14	2,000	do	28.3 and 50.3	5.78	8.72	8.22	9.90	9.22	6.93	46.77
North Platte, Nebr.	12	2,841	do	28.3 and 50.3	5.50	6.42	9.11	9.17	8.00	6.05	43.38
Ardmore, S. Dak.	8	3,557	do	28.3	3.63	5.35	6.69	8.36	7.74	5.87	37.04
Williston, N. Dak.	8	1,875	do	50.3	4.31	5.52	6.55	7.07	6.01	3.73	33.19
Dickinson, N. Dak.	14	2,543	do	28.3 and 50.3	3.75	5.01	6.13	7.11	6.40	4.27	32.67

The average monthly and annual wind movement in miles per hour at 24 localities in the basins of the Missouri and Arkansas Rivers is given in Table 2.

TABLE 2.—*Average monthly and annual wind movement in miles per hour, at 24 localities of the Missouri and Arkansas River Basins*

Locality	Length of record	Average wind movement, in miles per hour in—												
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
	Years													
Las Animas, Colo.	6	7.1	8.0	8.7	10.7	9.9	8.8	7.2	7.2	7.6	7.3	6.1	6.4	7.9
Pueblo, Colo.	34	7.0	7.3	8.2	8.5	8.0	7.2	6.7	6.2	6.2	6.2	6.3	6.5	7.0
Denver, Colo.	49	7.6	7.6	8.2	8.4	7.7	7.3	6.9	6.6	6.7	7.0	7.2	7.3	7.4
Cheyenne, Wyo.	51	13.6	13.0	12.9	12.4	11.1	10.0	8.9	8.4	9.4	10.4	11.6	12.5	11.2
Lander, Wyo.	29	3.9	3.7	5.0	5.3	5.3	4.9	4.5	4.3	4.3	3.7	3.8	3.3	4.3
Sheridan, Wyo.	13	5.4	5.3	6.7	8.9	8.1	6.3	5.5	5.1	5.1	5.6	5.0	5.2	5.9
Helena, Mont.	31	6.9	6.8	7.8	8.5	8.2	8.0	7.6	7.3	7.4	7.2	7.1	6.9	7.5
Yellowstone Park, Wyo.	19	9.2	8.2	8.7	8.1	8.0	7.4	6.9	6.5	7.4	7.4	8.0	8.0	7.8
Havre, Mont.	33	9.7	9.0	9.5	9.6	9.6	8.7	7.7	7.4	8.2	8.4	9.5	10.3	9.0
Williston, N. Dak.	39	7.5	7.0	9.0	9.9	10.3	9.0	7.8	7.5	8.0	8.1	7.4	7.4	8.3
Bismarck, N. Dak.	43	8.8	9.3	10.5	12.0	11.1	10.3	9.0	8.8	9.7	9.8	9.2	8.6	9.8
Pierre, S. Dak.	27	8.4	9.0	10.6	12.1	11.0	9.8	9.1	8.8	9.0	8.3	8.2	7.7	9.3
Rapid City, S. Dak.	33	7.7	7.7	8.9	9.5	8.8	8.3	7.7	7.2	8.2	8.3	7.9	7.7	8.2
Huron, S. Dak.	39	11.3	11.4	12.3	13.6	12.4	11.2	10.1	10.0	11.4	11.5	10.9	10.5	11.4
Yankton, S. Dak.	19	8.9	8.6	9.4	10.5	9.3	7.8	6.6	6.7	7.4	8.0	8.0	8.2	8.2
North Platte, Nebr.	46	8.3	8.8	10.3	11.6	10.8	9.6	8.7	8.3	8.8	9.0	8.3	7.9	9.2
Valentine, Nebr.	32	9.9	9.8	11.4	12.7	11.6	11.0	10.0	9.3	10.3	10.5	9.9	9.6	10.5
Omaha, Nebr.	48	9.1	9.6	10.9	10.4	9.2	7.9	7.0	6.6	7.7	8.4	8.8	8.7	8.6
Lincoln, Nebr.	26	10.9	11.4	12.7	13.2	11.4	10.1	9.0	8.7	9.8	10.7	10.5	10.1	10.7
Concordia, Kans.	37	8.8	9.2	10.6	11.5	10.0	9.1	8.2	7.8	8.7	8.9	8.6	8.5	9.2
Dodge City, Kans.	48	11.6	12.3	14.1	15.1	14.6	13.7	12.4	11.7	12.7	12.6	11.6	11.7	12.8
Iola, Kans.	17	9.8	10.5	11.1	10.8	9.4	8.0	7.1	7.1	7.7	8.4	9.2	9.1	9.0
Topeka, Kans.	24	10.0	10.5	11.5	11.5	10.5	9.0	8.0	7.8	8.7	9.6	9.6	9.4	9.7
Wichita, Kans.	11	12.1	13.0	15.1	14.7	13.0	11.8	10.8	10.3	11.8	12.2	12.9	11.7	12.4

WATER SUPPLY

That part of the Continental Divide which forms the western boundary of the Missouri and Arkansas River Basins extends from Canada southward a distance of 1,100 miles. The elevated peaks and table-lands of this range form a catchment area for winter snow which in melting creates a number of streams that discharge into the Missouri and Arkansas Rivers, being further supplemented by spring and summer rains. The discharges of these snow-fed watercourses fluctuate widely, as may be noted from the mean monthly flow of four typical streams given in Figure 6. These hydrographs show great differences between the quantity of water available for irrigation during the first and last stages of the crop-growing season, and emphasize the necessity of storing a part of the flood flow for later use. The 1920 census (*52*) reports 1,220 reservoirs with a combined capacity of 4,860,616 acre-feet on the watershed of the Missouri River and its tributaries, and 367 reservoirs of 1,155,259 acre-feet capacity on the watershed of the Arkansas River and its tributaries. It is apparent that considerable work has been done in the conservation of water in these basins, but much must still be done before the total available run-off is effectively controlled.

Much of the water carried in artificial channels in earth is absorbed by porous material along the route. While the water so absorbed fails to reach the place of intended use, often much is recoverable for other localities and other enterprises. This so-called waste water

augments the return flow of rivers and replenishes underground water supplies.

In the summer of 1903 the writer and his assistants made a series of measurements to determine the return flow to that portion of Bitterroot River which flows through the Bitterroot Valley, Mont. The loss by absorption and the gain by return flow in 48 miles of river channel between June 12 and August 12, are shown in Figure 7 (*21*).

The results of a series of measurements (*39*) made in 1919 and 1920 to determine the return flow of the South Platte River between Kersey and Julesburg, Colo., a distance of 140 miles, are shown, with previous measurements, in Figure 8.

Rating stations maintained on the Cache la Poudre River in Colorado, its tributaries, and the canals diverting from it, provided continuous records for 1916 and 1917, from which the seepage returns shown in Figure 9 were determined (*25*).

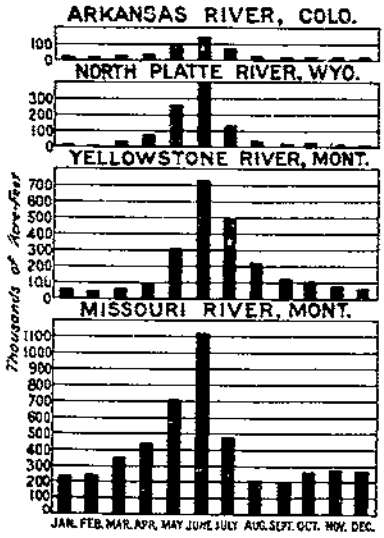

FIG. 6.—Mean monthly flow of four typical streams of the Missouri and Arkansas River Basins

Little underground water has been used in the territory considered. Throughout most of it surface water is still available and conveyance by gravity canals is cheaper than pumping from underground sources. However, as surface waters become scarcer and more valuable and

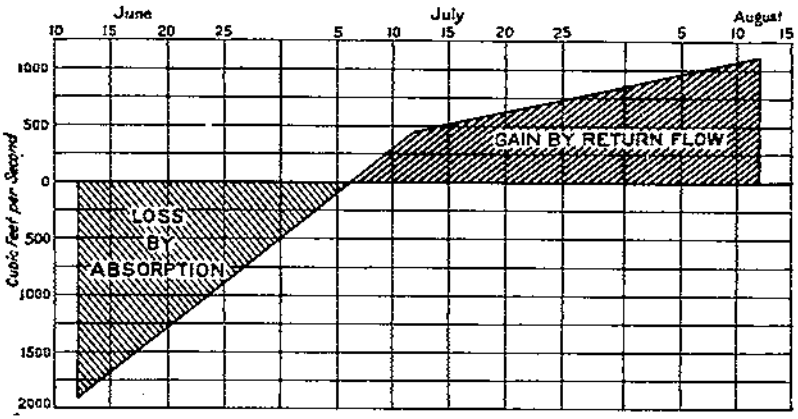

FIG. 7.—Loss by absorption and gain by return flow in 48-mile section of Bitterroot River, Mont.

more water accumulates and rises nearer the surface in underground depressions, it may often be found cheaper to sink wells and install pumps than to build long lines of gravity canals over rough and uneven country.

IRRIGATION PRACTICE

In determining the quantity of water needed for arable lands yet to be reclaimed, consideration should be given to the irrigation methods now followed, and more particularly to the improvement of methods which have resulted in a more economical use of water.

With the coming of white settlers to this section, domestic stock superseded the buffalo, and it was largely to provide forage during summer droughts and winter storms that irrigation was adopted. There were to be had for the taking comparatively smooth, level tracts

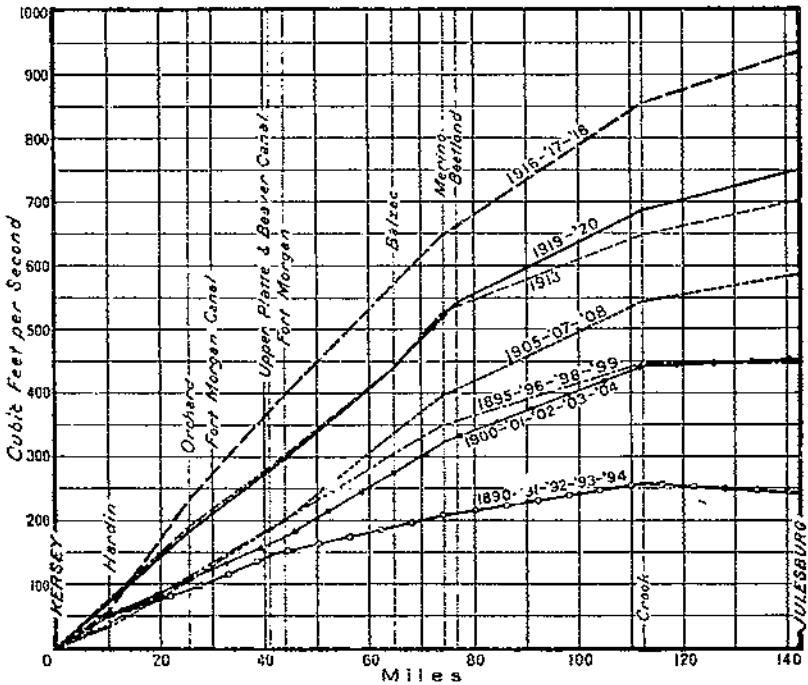

FIG. 8.—Return flow to the South Platte River for the various periods of years from 1890 to 1920 in the section between Kersey and Julesburg, Colo.

bordering streams on which native grasses grow. With meager equipment the settlers dug ditches from near-by streams and distributed the water over the meadows. This practice, simple and crude though it was, served to demonstrate the value of irrigation. The irrigation of alfalfa, cereals, and root crops followed, but owing to the existence of extensive grazing areas and conditions favoring the raising of cattle, sheep, and horses, the irrigation of forage crops has occupied and continues to occupy a prominent place in the agriculture of this territory. The small ditches of the pioneers were poorly constructed and much of the water taken from the streams was lost in transit. Wild flooding was also the common practice and much of the water applied to fields served no useful purpose.

Such ditches did not long satisfy the needs of the fast-increasing numbers of new settlers. The later comers wished to occupy the fertile bench lands which lay somewhat above the river bottoms, but ditches that would convey water to higher lands would have to be so long and costly as to be entirely beyond the financial means of individuals. This handicap was partly overcome by the enlargement and extension of existing ditches through the joint efforts of several landowners, or by the formation of cooperative companies of farmers.

Under these organizations the cost of the water system is apportioned either on an acre basis or according to ownership of shares of stock which may or may not be attached to the land, and each landowner or stockholder contributes his share in labor or money or both. In return for this outlay he is entitled to receive his share of the flow of the ditch. The irrigation systems of cooperative companies were more carefully located and better built than the individually owned ditches of the pioneers, and almost without exception both classes proved highly profitable investments. It was largely this economic success which led promoters to believe that large profits could be made by building canals to irrigate cheaply acquired lands, selling water rights, and collecting water rentals from the purchasers. Many land and water companies were formed between 1880 and 1900. The systems were carefully planned and built; but, with a few exceptions, they were unprofitable investments, chiefly because little attention had been paid to the farmer's part in irrigation. Inexperienced settlers with insufficient means were permitted to locate and build farm ditches and structures, prepare land for irrigation and adopt ways and means of wetting the surface, with little advice or assistance. The resulting failures deprived companies of the revenue upon which the success of their enterprises depended and led to bankruptcy.

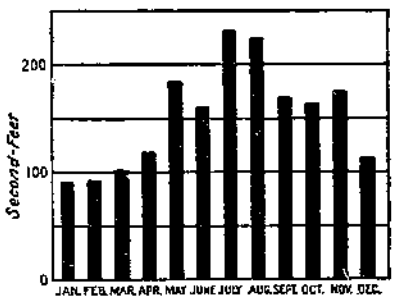

FIG. 9.—Seepage return to the Cache la Poudre River. Mean monthly flow for the years 1916 and 1917

Many commercial enterprises were finally taken over by the farmers who owned land under them. Conditions soon began to improve and a greater interest was manifested in the revenue-producing possibilities of irrigated farms. During recent years transmission losses in channels have been reduced by the use of flumes, pipes, and concrete ditch lining, more efficient systems of water measurement and delivery have been adopted, more care and skill exercised in the preparation of land and the application of water, and canal managers and water users have acquired a truer conception of the importance of the right methods of irrigation.

However, much remains to be done to lessen the waste of water. A large saving can be effected by providing impervious channels and conduits for its conveyance and in many cases these will be economically worth while. Farm irrigation practice might be much improved, but obviously the cost of irrigation must be kept within economical limits. In estimating the benefits of all changes of this character,

there should be a careful consideration of cost as compared with the advantages to be gained.

CROPS GROWN UNDER IRRIGATION

About 5,000,000 acres in the Missouri and Arkansas River Basins are irrigated. Stock raising is still the principal agricultural pursuit of the irrigators, especially in Montana, Wyoming, and Colorado, and the leading crops are alfalfa, native grasses, clover, timothy, and other stock feeds. The cereals are next in importance. Wheat, oats, and barley are the most common, but the total irrigated area on which cereals are grown is much less than that occupied by forage crops, the ratio being about 1 to 3. The acreage in vegetables is relatively small, being confined mainly to potatoes. The climate is not well adapted to orchard fruits other than the hardier varieties of apples and cherries, except in a few of the lower and warmer valleys, where there are small acreages of peaches, pears, and grapes. Small fruits, on the other hand, are successfully grown throughout the basin. Sugar-beet growing is an important industry in localities of relatively low altitude and long growing season. Nearly 200,000 acres of sugar beets grown for sugar were irrigated in 1919.

With the exception of a few special crops like sugar beets, canning vegetables, and fruit, the returns from such farming as is practiced is not high. An average gross return of about $32 per acre of cropped area is about all that can be depended upon under conditions existing during the past decade. The more general adoption of scientific systems of crop rotation, better preparation of soil surfaces to receive water, and a more skillful application of water to crops coupled with other better farming methods will increase present revenues from irrigated farms, providing other factors remain as they are. It is not to be expected, however, that any improvements in farming methods which can be brought about economically, will greatly increase the present revenue, and the cost of irrigation water should be kept at a reasonably low figure. So too, the cost of farm ditches, structures, and land preparation to facilitate the distribution and use of water should not pass economic limits.

RELATION OF WATER APPLIED TO CROP YIELD

The relationship between the quantity of water applied to crops, and crop yields, usually is determined by selecting a tract of land having uniform soil and subsoil and on which crops can be grown without deriving any part of their water supply from seepage or a high water table. The tract may be divided into a number of parts and each part devoted to a particular crop. These parts may be subdivided into plots, the number in each preferably being large enough for duplicates, which may have the same treatment, each being some readily computed fraction of an acre. The surface of each plot is prepared in such a way that it can readily be irrigated with a measured quantity of water.

The purpose of growing crops in such plots is to provide conditions approximately uniform except as represented by the water supply. In the usual procedure one or two plots receive no water other than the natural supply from soil moisture and rain. The remaining plots or sets of plots receive, in addition to the natural supply, variable quantities of water artificially applied.

It is possible to secure nearly uniform rainfall, temperature, and sunshine, as well as cultural methods, but the spread of disease, the attacks of insects, and the destructive effects of hail and wind rarely affect alike all the plots of a series. Accordingly the results obtained in the form of crop products may depend at times on factors other than the quantity of water applied.

The yield depends also on the time of irrigation. When a small quantity is applied in one irrigation, the usual practice is to time its application to meet the greatest need of the crop for water. The use of larger quantities of water calls for two or more waterings. Ordi-

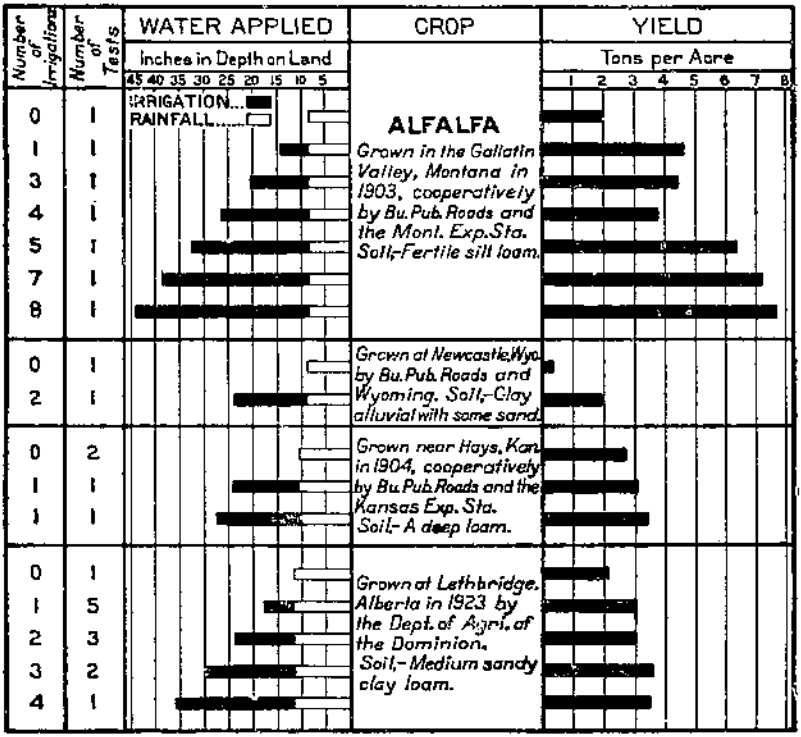

FIG. 10.—Relationship between the quantity of water applied and the crop yield of alfalfa at various places between 1903 and 1924

narily the number of waterings is more or less proportional to the total quantity used.

When plants receive too little irrigation water for their maintenance they usually draw on any reserve moisture that may remain in the soil from winter rainfall or previous irrigations. In such cases the supply of moisture in the soil is less at harvest time than it is at seed time. On the other hand, when plants are heavily irrigated part of the surplus may be stored in the soil.

The results shown graphically in Figures 10 to 18 have been selected from the data given in Tables 9 to 31 and include alfalfa, wheat, oats, barley, sugar beets, potatoes, Kafir corn, and a group of miscellaneous crops.

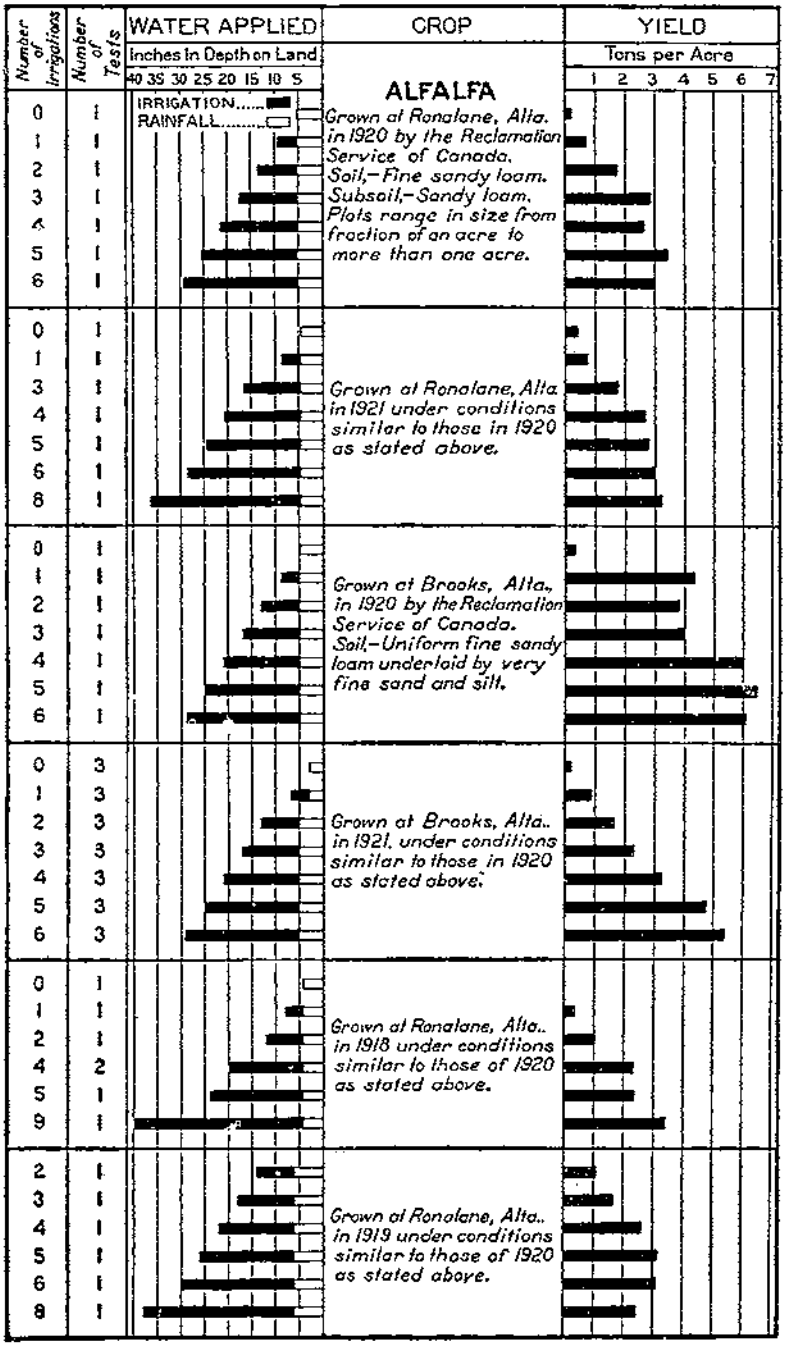

FIG. 11.—Relationship between the quantity of water applied and the crop yield of alfalfa at Ronalane and Brooks, Alberta, between 1918 and 1920

WATER REQUIREMENT OF CROPS

When "water requirement" is determined in a laboratory it indicates the ratio of the weight of water transpired during the period of growth of any plant to the weight of dried crop produced. The ratio given in Table 3 (4) for each crop listed indicates the wide diversity in water requirement under laboratory conditions.

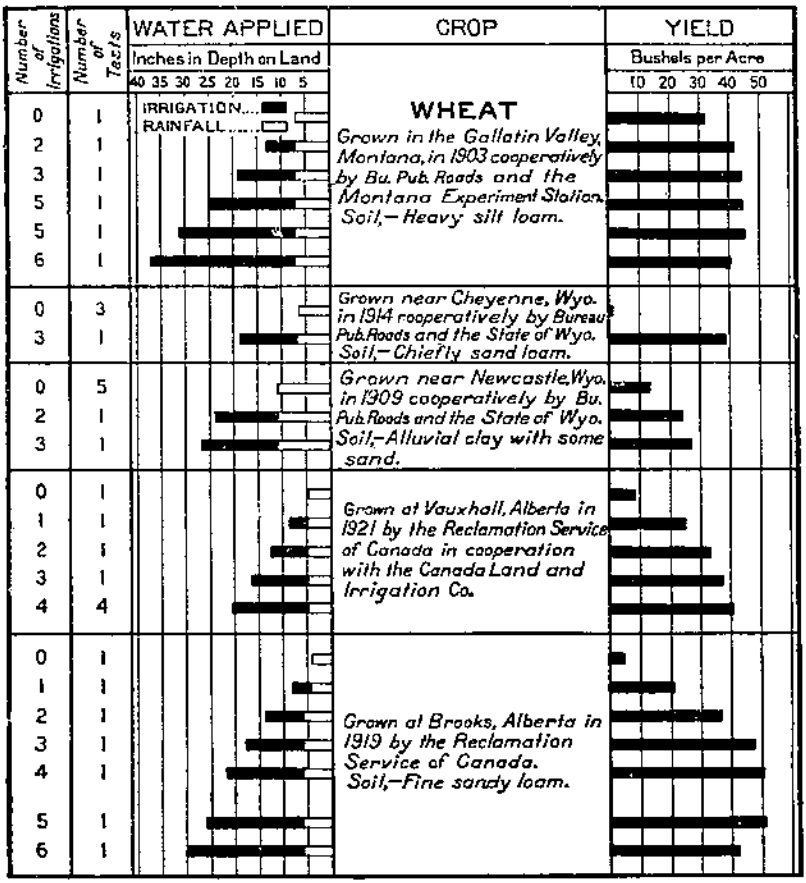

FIG. 12.—Relationship between the quantity of water applied and the crop yield of wheat at various places between 1903 and 1921

TABLE 3.—*Water requirement of crops based upon the means of different varieties*

	Ratio 1 to—		Ratio 1 to—		Ratio 1 to—
Alfalfa	1, 068	Buckwheat	578	Sugar beets	377
Canada field pea	800	Barley	539	Corn	369
Spring rye	724	Wheat	507	Sorghum	306
Sweet clover	709	Potatoes	448	Millet	275
Oats	614	Rape	441		

In this report the term "water requirement" applies to field conditions and means that quantity of water, expressed in acre-feet per acre, which will produce the most satisfactory yield. The use of water includes not only transpiration from plants but evaporation from soils, a fairly uniform distribution, and, in porous soils, some deep percolation loss. In other words, water requirement of crops as

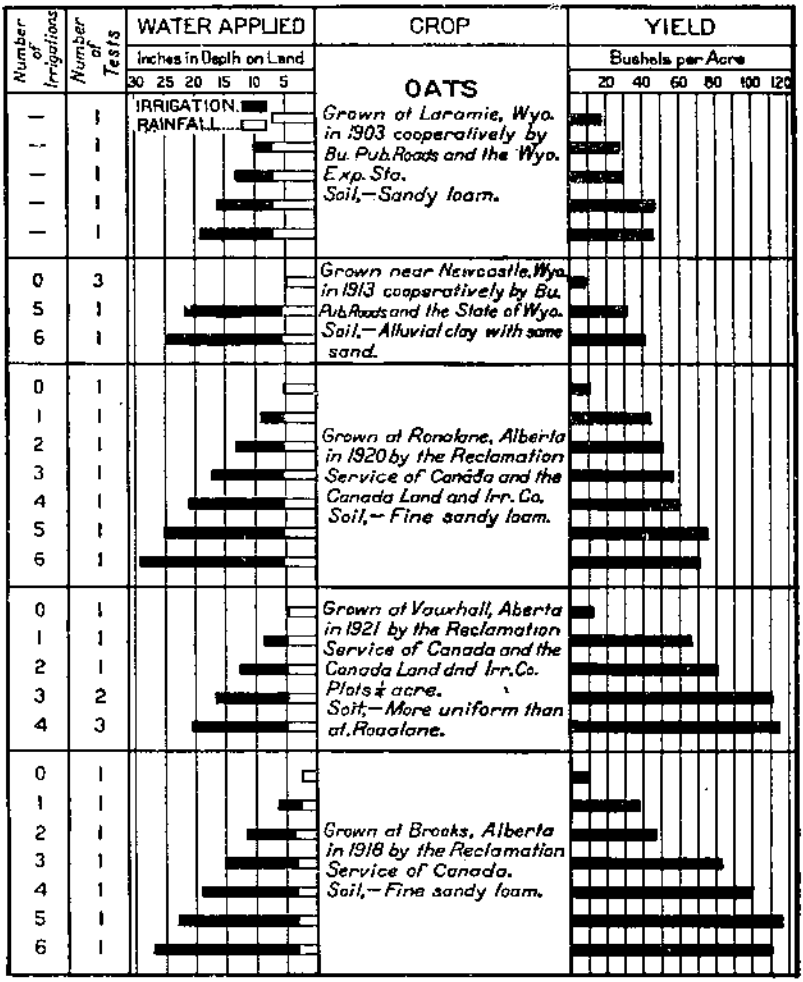

FIG. 13.—Relationship between the quantity of water applied and the crop yield of oats as determined at various places between 1903 and 1921

here used, is that quantity of water which, when skillfully applied to plots and fields, will produce the most profitable crops. The largest yields may not be the most profitable. Some crops respond to an increase in the number of applications and also in the seasonal quantity of water, but the resulting increase in yield may be more than offset by the value of the extra water, the cost of applying it, and the damage to soil from overirrigation.

EXPERIMENTS WITH ALFALFA

During the years 1913 to 1915 inclusive, the quantity of water applied to each of 62 tracts of alfalfa in Yellowstone County, Mont., was accurately determined by the Bureau of Public Roads acting in cooperation with the Montana Agricultural Experiment Station. The tracts (Table 9) ranged in size from 1.45 to 35.1 acres and averaged 6.71 acres. The rainfall during the growing season was 0.67 foot in 1913, 0.82 foot in 1914, and 1.23 feet in 1915. Because of the influence of factors other than the quantity of water applied, no well-defined relationship can be established between the quantity of water applied and the yield. It is worthy of note, however, as indicative

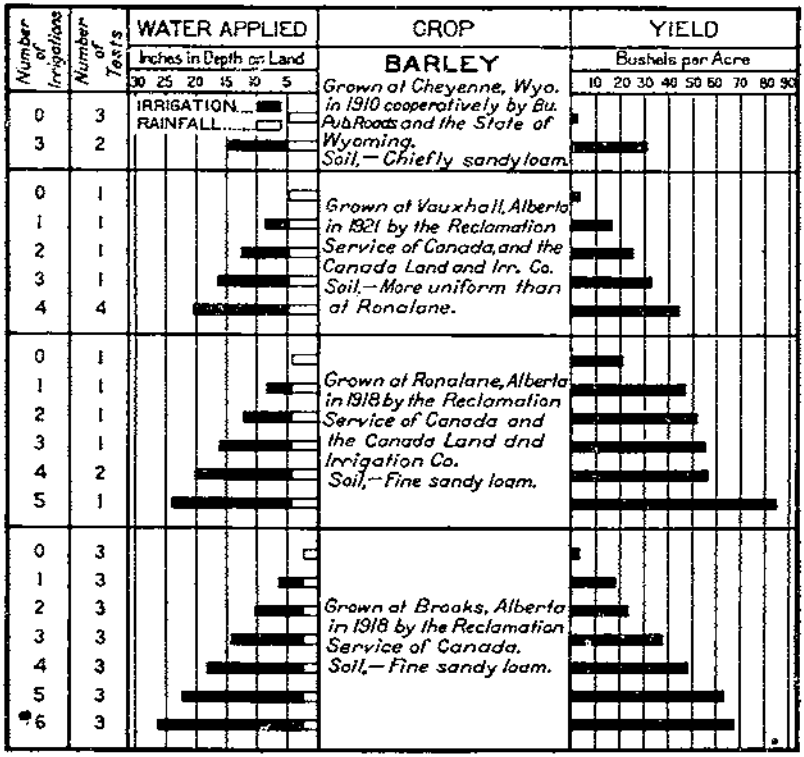

FIG. 14.—Relationship between the quantity of water applied and the crop yield of barley as determined at various places between 1910 and 1921

of a close approach to economical use that the 13 experiments producing the highest yields of 5 tons or more per acre used an average of 2.48 acre-feet of water per acre, including rainfall.

The use of water in irrigation in northern Colorado was investigated in 1916 and 1917 by the Bureau of Public Roads in cooperation with the Colorado Agricultural Experiment Station. Part of the investigation sought to determine the customary practices of the individual farmers in watering their crops, unaffected by any experimental considerations, and included determination of the quantity of water applied and the yield on each of 74 tracts of alfalfa, averaging 22.27 acres in extent. The rainfall from April 1 to September 30 was

nearly normal and averaged 0.72 foot for the two seasons. The soil in this locality is well drained naturally and the prevailing type is a light sandy loam. Of these 74 tracts (Table 20), 6 yielded from 4 to 6 tons per acre with an average use of water of 3.23 acre-feet per acre including rainfall, and 23 tracts yielded from 3 to 4 tons per acre with an average use of water of 2.79 acre-feet per acre.

In the plot experiments with alfalfa in southern Alberta the greatest seasonal yield in a four-year period at Ronalane was 4.04 tons which was obtained with the use of 1.94 acre-feet per acre of water, including

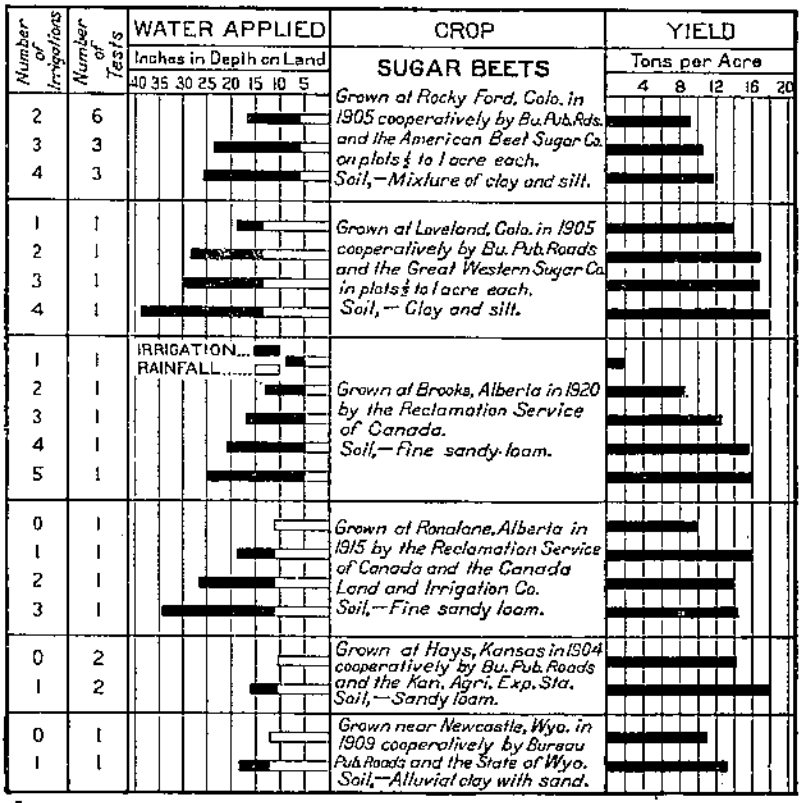

FIG. 15.—Relationship between the quantity of water applied and the crop yield of sugar beets as determined at various places between 1904 and 1920

rainfall. The greatest yield in a six-year period at Coaldale was 5.17 tons with the use of 1.92 acre-feet per acre including rainfall.

It will be noted from Table 32, which summarizes the large number of plot experiments carried on at Brooks, that a yield of 7.56 tons per acre was obtained with the use of 2 acre-feet of irrigation water and 0.61 acre-foot of rain, a total of 2.61 acre-feet.

The conclusion that may be drawn from the available data regarding the water requirement of alfalfa is that a combined seasonal water supply of 2 acre-feet per acre made up of irrigation water, rainfall, and soil moisture, will suffice for southern Alberta and the more elevated portions of the Missouri River Basin, that 2.5 acre-feet per acre will suffice for the Yellowstone Valley, Mont., and other

localities having similar climatic and physical conditions, and that 3 acre-feet per acre may be economically used on the irrigable lands bordering the Platte and Arkansas Rivers.

EXPERIMENTS WITH SMALL GRAINS

The small grains grown in the Missouri River Basin in the order of their acreage are: Spring and winter wheat, oats, barley, and rye.

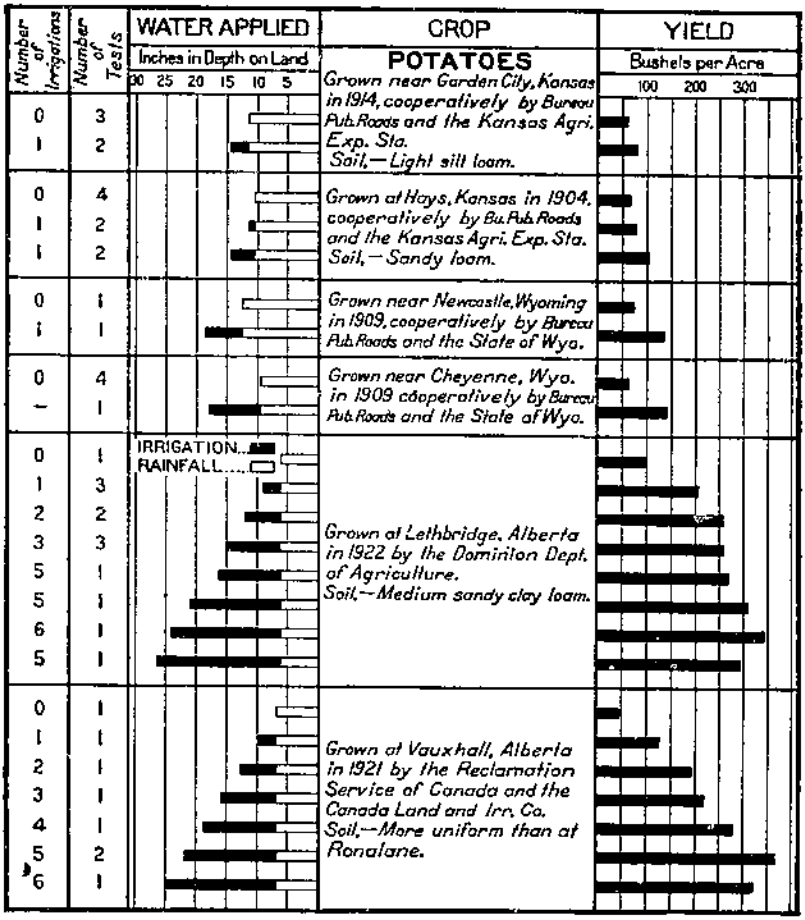

FIG. 16.—Relationship between the quantity of water applied and the crop yield of potatoes at various places between 1904 and 1922

The water requirements of these do not differ widely. Fall-sown wheat requires much less irrigation water than spring-sown. On account of the large acreage in wheat, more experiments have been made with this crop than with any other. The data collected in widely separated localities of this basin and in the adjacent Province of Alberta have established with some exceptions the following conclusions: (1) When only 6 to 10 acre-inches of water are available regardless of the source from which it is derived, whether ditch supplies, rain or soil moisture, or combinations of these, no marketable grain is produced, the growth being confined to straw alone or

straw and shriveled grain; (2) it requires from 10 to 14 acre-inches to produce a crop that will pay expenses; (3) the most profitable yields under irrigation are produced with a moderate quantity of water; and (4) overirrigation at certain stages of growth lessens the yield and impairs the quality of the grain.

The results of plot experiments at Newcastle, Wyo. (Table 18), for 1910 to 1913, inclusive, show that little or no grain was produced with the use of less than 6 inches of rainfall. At the experiment station near Cheyenne, Wyo., practically no crop was produced in 1910 with the use of nearly 7 inches of rain and no crop was produced on four plots which received over 8 inches of rain in 1912. In 1914 three plots which received less than 7 inches produced an average of 1

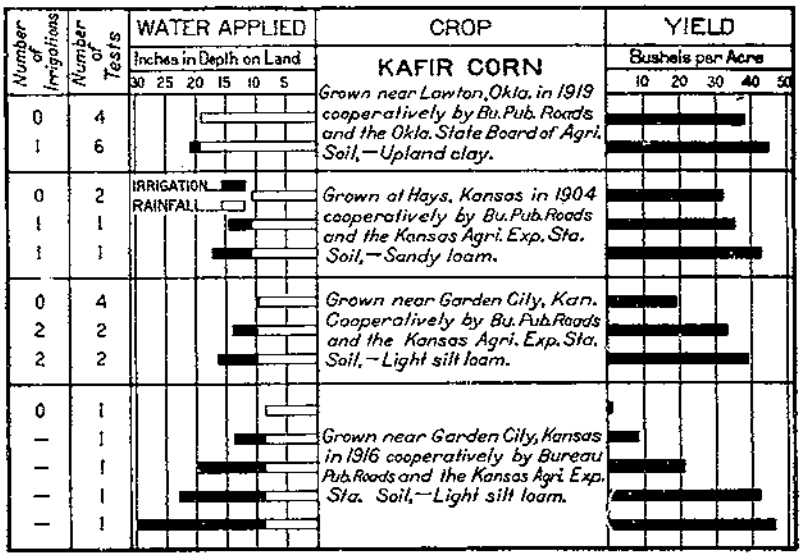

FIG. 17.—Relationship between the quantity of water applied and the crop yield of Kafir corn as determined at various places

bushel per acre. In southern Alberta the evaporation is less, and less water is needed. During the dry years, however, the results are somewhat similar to those of Wyoming and other States. Thus in the dry year of 1918 at Brooks, Alberta, less than 2½ inches of rainfall produced 1 bushel per acre, and at Ronalane, Alberta, in the same year, about 4 inches of rain produced 2.6 bushels per acre. The Bureau of Plant Industry has conducted experiments for years to determine the possibilities and best methods of crop production in the Great Plains. Part of these studies have dealt with precipitation and soil water and their relation to crop yield. Table 4 gives a few of the crop failures and smallest yields of spring wheat and the corresponding quantity of water used at a number of localities in the Missouri and Arkansas River Basins (*11*).

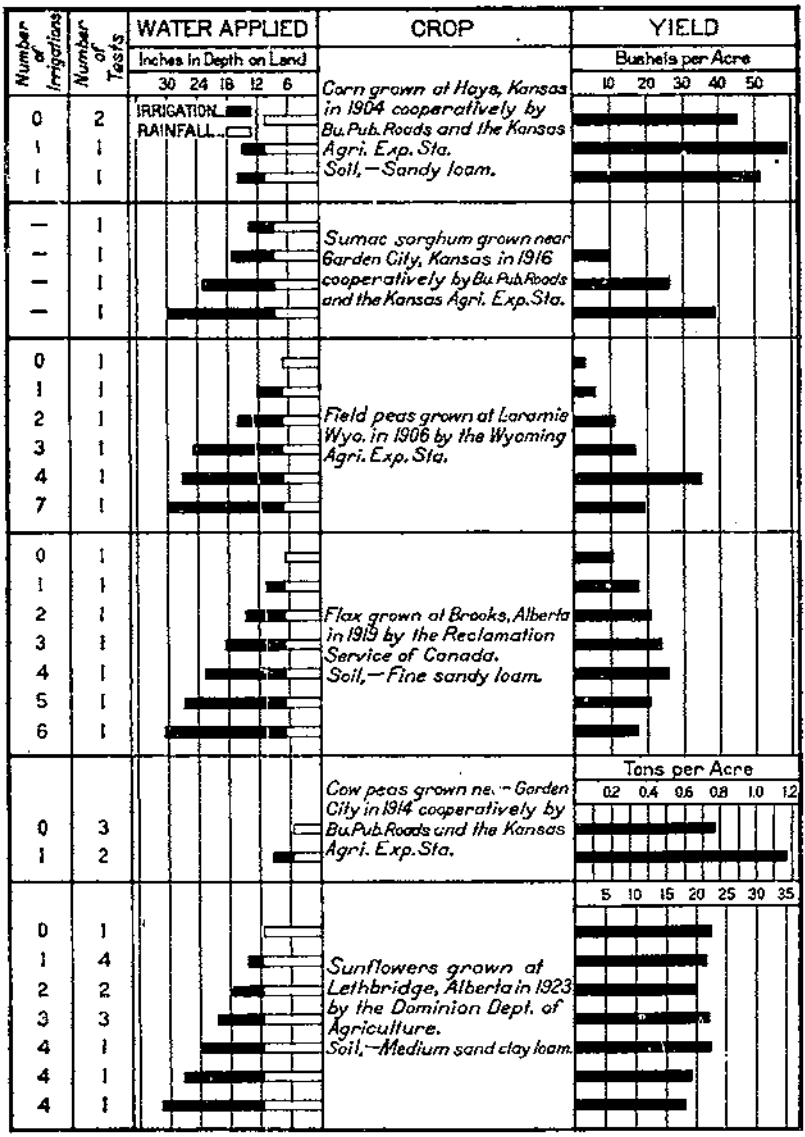

FIG. 18.—Relationship between the quantity of water applied and the crop yield of corn, Sumac sorghum, field peas, flax, cowpeas, and sunflowers, as determined at various places between 1904 and 1923

TABLE 4.—*Crop failures and low yields of spring wheat, and corresponding quantity of water used*

Year	Locality	Water used			Yield		
		From the soil	Precipitation	Total	Grain	Straw	Total
		Inches	*Inches*	*Inches*	*Bushels*	*Pounds*	*Pounds*
1911	Garden City, Kans.	0.90	5.35	6.25	0.0	0	0
1914	do.	5.15	4.12	9.27	1.5	1,290	1,380
1916	do.	2.44	2.24	4.68	.0	0	0
1911	North Platte, Nebr.	—.08	1.55	1.47	.0	0	0
1917	do.	3.35	3.35	6.70	4.2	1,290	1,510
1911	Scotts Bluff, Nebr.	3.57	3.85	7.42	.5	670	700
1918	do.	1.83	6.31	8.14	3.7	600	820
1910	Belle Fourche, S. Dak.	3.23	3.03	6.26	2.8	660	830
1912	do.	2.09	4.31	6.40	.0	1,300	1,300
1910	Williston, N. Dak.	1.09	4.22	5.31	1.7	1,040	1,140
1911	do.	.62	5.09	5.71	2.7	380	510

The quantity of water required to produce a yield of wheat large enough to pay expenses—say 10 to 14 bushels per acre—varies from 9 to 12 acre-inches according to United States Department of Agriculture Bulletin 1004 (*11*).

In producing larger yields more water is required. The proper quantity for most economical yield depends largely on the season, the quantity of water stored in the soil, and other variables. At Brooks, Alberta, in 1918, the largest yields of barley were grown on the plots that received from 1.7 to 2.2 acre-feet of water per acre, and at Ronalane, Alberta, in the years 1918 and 1920 inclusive, from 1.83 to 2.86 acre-feet gave the best results.

Results of a large number of plot experiments carried on at Brooks, and Ronalane, Alberta, from 1915 to 1921 indicate that from 1.5 to 2.5 acre-feet per acre will provide sufficient moisture for the largest yields of oats, for that climate and soil. Making allowance for the larger waste of water in irrigating fields, the above data obtained from plot experiments are confirmed by field experiments in northern Colorado as reported by Hemphill (*25*). Of 15 fields of oats investigated, the water applied to the 8 fields which produced the largest yields, ranging from 61 to 77.8 bushels per acre, was found to average 2.67 acre-feet per acre, including rainfall.

Measurements of water used on 9 fields of wheat in Yellowstone County, Mont., in 1914, showed that the 3 fields which produced the largest yields of over 44 bushels per acre used an average of 1.59 acre-feet of water per acre including rainfall. The field which gave the highest return in 1915 used 1.34 acre-feet. On two 1-acre plots in Gallatin Valley, Mont., the highest yield was produced on a plot which received 1.2 acre-feet. Of the 25 fields of wheat investigated in northern Colorado in 1916 and 1917, 8 of the most productive yielded an average of 44.35 bushels per acre with an average use of water, including rainfall, of 1.94 acre-feet per acre. The wheat plots in southern Alberta which yielded the best crops from 1913 to 1923 required less than 1.5 acre-feet per acre in the wet years and from 1.5 acre-feet to 2.25 acre-feet per acre in the dry years.

A consideration of the available data obtained in different parts of the Missouri and Arkansas River Basins and southern Alberta, point to the conclusion that under similar physical and climatic conditions all the small grains require about the same quantity of moisture; that variations in the quantity of soil moisture required are due mainly to differences in soils, topography, and altitude, and that an average quantity of 1.67 acre-feet of water per acre including effective rainfall, is sufficient to produce profitable yields.

EXPERIMENTS WITH POTATOES

The largest yield of potatoes on four fields tested in 1914 in Yellowstone County, Mont., resulted from the use of 1 acre-foot of irrigation and 0.71 acre-foot of rainfall. The following year was wet, which resulted in the use of only 0.36 acre-foot of irrigation and 1.03 acre-feet of rain to produce the largest crop on three fields. In growing potatoes on plots in southern Alberta the highest yields were obtained with a combined irrigation and rainfall supply of about 1.5 to 2 acre-feet per acre.

It appears from the data herein presented that the water requirement of potatoes does not differ materially from that of small grain, and that an average of 1.65 acre-feet per acre including rainfall, is sufficient to produce profitable yields.

EXPERIMENTS WITH SUGAR BEETS

Of the nine fields of sugar beets investigated in Yellowstone County, Mont., in 1913, four of the largest yields averaged 15.9 tons per acre with an average use of water of 2.23 acre-feet. At Newcastle, Wyo., the use of 1.53 acre-feet produced 13.2 tons, whereas 1.02 acre-feet produced 11.02 tons. The largest yield from 12 plots tested at Rocky Ford, Colo., in 1905 was obtained on one which received 2.13 acre-feet of water. At Loveland, Colo., in 1906, 20.28 tons were grown with the use of 2.15 acre-feet. Of 61 fields of sugar beets studied in northern Colorado in 1916 and 1917, 11 produced more than 15 tons per acre with the use of 2.66 acre-feet of irrigation water and rainfall per acre. In the plot experiments in southern Alberta, those plots which received 1.55 to 2.2 acre-feet of water produced the greatest tonnage. From the foregoing and other data the water requirement of sugar beets seems to vary from 1.6 to 2.5 acre-feet per acre.

Much of the data on water requirements for each main crop, given in the tables of the appendix, are grouped in Table 5 by the name of each crop, or group of crops, the number of tests, the lowest general average and highest general average of the water requirement, including effective rainfall. The figure giving the highest general average in Table 5 for certain crops, especially potatoes, is low compared with what is used in northern Colorado, but there is reliable evidence to show that too much water is applied to this crop in that locality.

TABLE 5.—*Average range of water requirement of crops including rainfall*

Name of crop	Number of tests	Water requirement (acre-feet per acre)		Name of crop	Number of tests	Water requirement (acre-feet per acre)	
		Average low	Average high			Average low	Average high
Alfalfa and other forage crops	648	1.94	2.62	Barley	335	1.33	1.82
Potatoes	350	1.38	1.70	Peas	168	1.48	1.94
Cantaloupes	10	1.50	2.30	Buckwheat	3	1.05	1.30
Tomatoes	6	2.10	2.80	Corn	70	1.23	1.83
Sugar beets	128	1.60	2.50	Kafir corn	15	1.43	1.57
Sunflowers	16	1.20	1.40	Millet	14	.81	.94
Apples	4	2.10	2.60	Milo maize	27	1.09	1.70
Wheat	542	1.36	1.80	Sorghum	20	1.06	1.47
Oats	509	1.35	1.81	Beans	4	1.30	1.60
				Flax	59	1.47	1.86

TIME AND FREQUENCY OF IRRIGATION

The time and frequency of irrigation depend primarily on the kind of crop grown and its need for water at particular stages of growth, and, secondarily, on varying conditions of soil, root system, climate, water supply, water delivery, and canal regulations. Some crops require much more water than others. Although alfalfa usually matures in less time than wheat, it requires nearly double the quantity of water to produce a unit weight of dry matter. Furthermore, alfalfa requires an increasing quantity of water until it is harvested, whereas wheat requires the largest quantity of water during its intermediate stages of growth.

Of the secondary factors which influence the time and frequency of irrigation the character of the soil is usually the most important. The irrigator uses that part of the soil in which plant roots function, as a reservoir in which to store water temporarily for the use of crops. Soils that do not retain much water have to be replenished oftener but with a smaller quantity; hence the necessity of applying light and frequent irrigations to porous soils. The capacity of this soil reservoir likewise depends on the depth of the root system. Timothy, pasture grasses, and wild hay are shallow rooted, and thrive best when watered often. Alfalfa and orchard trees with their deeper-rooted systems have a larger storage of soil moisture from which to draw and do not need to be irrigated so frequently. The effect of climate on the frequency of irrigation is seen in comparing the yields of crops from fields in southern Alberta during the wet year of 1915 with the dry year of 1918. Of nine fields in alfalfa at Coaldale, Alberta, in 1915, the largest seasonal yield of 4.84 tons per acre was produced on a field which received but one irrigation on July 19, of 1.03 acre-feet per acre. The rainfall, however, during the period of growth was, in addition to soil moisture, 1.32 acre-feet per acre. In 1918 at the same place and on chiefly the same fields the highest seasonal yield of 4.37 tons per acre was produced on a field which was irrigated on May 15 and also on July 9, the total quantity of irrigation water used being 2.81 acre-feet and the rainfall 0.34 acre-foot per acre.

Some light has been shed on the underlying principles which control the time and frequency of irrigation by growing crops in tanks.

In 1914 and 1915 wheat was grown in tanks at Bozeman, Mont., by the Bureau of Public Roads in cooperation with the Montana Agricultural Experiment Station. The tanks were divided into four sets with different treatments for each. Set No. 1 was uncropped and the soil moisture maintained reasonably constant at about 18 per cent. In set No. 2, the moisture content was kept slightly above the wilting point, or at about 10 per cent. In set No. 3, it was about 14.5 per cent; and in set No. 4 it was maintained at a trifle over 18 per cent, which was considered the content most favorable for plant growth. Averages of the yields of the two years for each of the sets are given in Table 6.

TABLE 6.—*Average yields of wheat grown in tanks, Bozeman, Mont., 1914 and 1915*

Set	Moisture content of soil	Yield		
		Grain	Straw	Total
	Per cent	*Grams*	*Grams*	*Grams*
1	18	(1)	(1)	(1)
2	10	90.7	166.2	256.9
3	14.5	114.2	214.4	328.6
4	18+	122.4	229.6	352.0

[1] Uncropped.

These results show the desirability of maintaining the soil moisture content somewhere near the optimum by frequent irrigations if necessary.

The first crop of alfalfa after seeding, grown in tanks in several parts of the Missouri River Basin, required much more water than the subsequent crops in the same season, chiefly because of the amount of water required to establish a root system and the longer time required for the plants to mature. Many growers consider it desirable to water young alfalfa sparingly in order to induce deep rooting. There seems to be little justification for such practice. The growth of the plant is certain to be checked, if no worse effects result, by withholding water at a time when the plant has the double duty of building up a root system and producing stems and foliage for flowers and seed. If the first crop requires, as it often does, 50 per cent more water than the second or third, the necessary quantity should be provided and stored in the soil. Nature will take care of the root system and its penetration if the soil and subsoil are of the right character and contain the proper amount of moisture.

CONDITIONS AFFECTING USE OF WATER IN IRRIGATION

Some of the principal influences affecting the quantity of water used in irrigating land in the Missouri and Arkansas River Basins are discussed in the following paragraphs.

CLIMATE

Much of the scanty annual precipitation occurs in the spring and early summer months. Lower temperature because of altitude and a northerly location keeps the evaporation low so that much of this precipitation is available for vegetation. The first artificial watering in the colder and more elevated valleys frequently is postponed

until after June 30, which lessens the seasonal application. On the other hand, there are conditions which tend to increase the quantity of water required. Plants after a long period of dormancy are very active in their growth, the sun in northern latitudes shines early and late with intense brightness; and if the soil is fertile, cultural conditions good, and the water supply adequate, large yields may be produced in a short season. The writer has grown in the Gallatin Valley, Mont., 74 bushels of wheat, 68 bushels of barley, and 107 bushels of oats per acre in a season of 105 days between killing frosts of late May and early September. In the Yellowstone Valley of the same State, at a lower elevation, a seasonal yield of alfalfa of 6 tons per acre in three cuttings is not uncommon.

CROPS

The crops adapted to the climate and other agricultural conditions of the basins of the Missouri and Arkansas Rivers, may be grouped under three classes as regards their water requirement. Alfalfa leads that class which requires the most water, followed by other forage crops such as clover, mixed timothy and clover, pasture grasses, and native hay. The class requiring a medium quantity of water may well be headed by sugar beets, followed by potatoes, vegetables, small grain, and fruit. In a third class, which requires the least water, are corn, Kafir corn, millet, milo, sorghum, sunflowers for silage, and beans.

SOILS

Theoretically a crop grown on a light sandy soil should not require more water than if it were grown on a heavy clay soil. More water is applied to porous soils mainly because of the greater percentage wasted. The lighter soils retain little water per unit of volume as compared with the heavier soils, and when too much is applied the excess is soon drawn downward by capillarity and gravity beyond the root zone of plants. Light and frequent irrigations, use of short runs, and a rapid wetting of the surface by large heads of water skillfully applied, have done much to lessen the waste of water, but there is an economic limit to such preventive measures beyond which the ordinary farmer should not go.

Some of the heavier soils absorb too little water for profitable production. Their particles are so fine and so densely packed that under ordinary methods little water penetrates far into their mass. Special methods of irrigation are needed for such soils and due consideration must be given to their drainage.

Regardless of the type of soil, its fertility and humus content affect the quantity of water needed by crops. The soil solution furnishes water and food to plants, and if it be weak a larger volume is required.

WATER SUPPLY

In 1920 there were 1,220 reservoirs with a combined capacity of 4,860,616 acre-feet in the watershed of the Missouri River. This is a large quantity of water but it is probably less than one-fourth the entire amount used annually for irrigation in this basin. In other words, about 75 per cent of the water supply is uncontrolled by storage. This portion is diverted directly from streams which fluctuate widely. In irrigating from a stream which carries 20 times more water in May than in August, it is difficult to meet the needs

of crops for moisture without considerable waste. The common practice is to overirrigate when there is an abundance of water and to underirrigate when there is a scarcity.

The quantity of water used also depends on how it is delivered and paid for. As a rule, continuous delivery of small streams is more wasteful of water than a rotated delivery and there is little incentive to economize in the use of water when it is paid for on an acreage basis rather than as a measured quantity.

TYPE OF CHANNEL USED

The quantity of water to be taken from a stream or other source depends to a considerable extent on the channel used for its conveyance. If it is a canal in earth, the transmission losses will vary with its size and the absorptive properties of the soil. In average material the loss per mile when expressed in percentage of the flow usually is about 1 per cent in the larger canals, 6 per cent in those of medium size, and 15 to 20 per cent in the smaller canals. Lining channels with concrete, when efficiently done, prevents the greater part of the loss and there is no considerable loss in conveying water through water-tight flumes and pipes.

SOIL MOISTURE DISTRIBUTION

The main purpose of irrigation is to supply the needed moisture to the soil around the roots of plants. If the root zone is not uniformly moistened or if either too much or too little water is added, the result will be a diminished harvest. To safeguard the crop by a proper control of the soil moisture, care is exercised to provide large enough supply ditches and to grade the surface of each field in such a way that it can be readily and uniformly watered. When this important feature is badly planned there is certain to be not only waste of water, but lowered profits from farming.

COST OF WATER

It has been repeatedly shown that the cost of water has a direct bearing on its economical use. The cost of delivered water per acre-foot of a system having its source in the Colorado River in southern California is $8.14 and the average duty is 4.3 acre-feet per acre (*3*). On another system in southern California the cost of water is $218.98 per acre-foot and the duty is 1.37 acre-feet per acre. While these are not wholly comparable cases, alfalfa being the main crop of the first system and citrus orchards that of the second, it is generally true that the higher the cost of water, the better are the facilities provided for its conveyance and use and the smaller is the quantity used.

DIVERSIFIED FARMING

Crops differ not only in their water requirements but also in the time and frequency of their irrigation. The farmer who grows only small grain under irrigation may require a large quantity of water for a short period, but when the grain is mature he has no further use for water until the following season. By growing leguminous crops in rotation with grain, root crops, vegetables, and fruit he not only improves the soil but makes a more beneficial use of the water supply. By following this course, the short irrigation season for grain of 30

days or less may be lengthened to 150 or more days for diversified crops, provided the climate is favorable, and much more profitable returns are obtained without any actual increase in the water supply.

PERMISSIBLE WASTE

Fully one-half of the quantity of water annually diverted for irrigation purposes within the Missouri River Basin is wasted in transmission, unequal distribution over fields, deep percolation, and run-off, but such losses are gradually being reduced. Every porous earthen canal that is lined, flumed, or piped, and every effort made to improve irrigation practice tends to lessen the waste of water, which is much less to-day than it was 20 years ago. Manifestly there is a limit to such improvements. Many of the means employed in water conservation are costly and farmers with small or even medium returns can not afford to make their irrigation systems 100 per cent efficient. In the territory considered in this bulletin there will always be what is here termed permissible waste in the use of irrigation water.

DUTY OF WATER AS AFFECTED BY STATE, COMMUNITY, AND CORPORATE REGULATIONS

It was stated in the first bulletin of this series (*20*) that statutes, court decisions, public regulations, and water-right contracts, had tended to bring about a more economical use of water in the Great Basin area than would probably have resulted without them. The same statement holds true for the Missouri and Arkansas River Basins generally, where under a greater variety of natural conditions ranging from arid to semiarid the two opposing doctrines of appropriation and riparian rights are in force, in some cases within the same State.

STATE LAWS AND REGULATIONS

REGULATION OF APPROPRIATIONS

In all the States of this area except Montana there are officials or administrative bodies to whom applications for licenses to appropriate water must be made and who are generally vested with authority to disapprove the applications if there is no unappropriated water in the proposed source of supply, or if the contemplated use conflicts with existing rights or threatens to prove detrimental to the public interest, appeal to the courts being provided where the decision is adverse to the applicant. These State officials necessarily make rules and regulations which must be followed by applicants for permits, as well as rules governing their own procedure in issuing permits, making adjudications, and supervising the distribution of water. In Colorado an applicant can go directly to the district court.

Certain States authorize the cancellation of certificates of appropriation under which the water has not been put to beneficial use for a term of years.

STATE ADJUDICATIONS

Adjudication of water rights by a State board, of which the State engineer is a member, is provided by the statutes of Wyoming and Nebraska, with an appeal to the courts in each State.

In North Dakota and South Dakota the State engineer is authorized to make hydrographic surveys for use in court adjudications of each source of water supply. In North Dakota the attorney general is charged with the duty of beginning suit for an adjudication upon completion of the preliminary investigations, while in South Dakota original suit is entered by the attorney general only when in the judgment of the State engineer the public interests require it. In Colorado adjudications are made entirely by the courts.

ADMINISTRATION OF PRIORITIES

Most States in the basins of the Missouri and Arkansas Rivers require the State engineer or water board to supervise the apportionment of water in accordance with licenses issued or adjudication decrees rendered. For the purpose of such control, water divisions comprising drainage areas commonly are created. For example, Wyoming is divided into four water divisions, each presided over by a water superintendent under the general supervision of the State engineer. Each division contains water districts, created as necessary, under water commissioners who are controlled by the respective superintendents. The State engineer as ex officio president and the four water superintendents constitute the board of control charged with the duty of making determinations of priorities. South Dakota and Kansas have not provided for State control over water distribution. Montana has authorized a measure of supervision by commissioners appointed by the courts.

LIMIT OF BENEFICIAL USE

Certain States have placed a maximum limit upon the quantity of water which may be considered to constitute beneficial use. For example, North Dakota limits appropriated and adjudicated water rights to 1 second-foot for 80 acres, and Wyoming, South Dakota, and Nebraska 1 second-foot for 70 acres; Nebraska further providing that the use shall not exceed 3 acre-feet per acre in the aggregate each year. Three other States require the use to be for a specified time each year.

A common provision of all the statutes governing water rights in the basins is that the quantities allowed shall be no more than can be used beneficially, whether limiting the total use or not, leaving the actual determination of what is beneficial use to the State administrative officials and the courts. The Nebraska law states that no allotment of water shall "exceed the least amount of water that experience may hereafter indicate as necessary for the production of crops in the exercise of good husbandry" (*36, sec. 3404*). In Kansas grants of water are made subject to the principle of beneficial use, not in excess of the reasonable needs of appropriators.

ROTATION IN USE

The rotation among a group of users of a head or stream of water, made up in the aggregate of a number of smaller streams allotted severally to these users, is authorized by the laws of several States for the purpose of increasing the efficiency of the water allotments and to reduce waste. This procedure is always conditional upon non-

interference with the rights of others. Wyoming, for example, allows several water users to rotate among themselves, or a single water user entitled to different priorities, to rotate in use. Kansas authorizes consumers under a lateral to agree among themselves upon rotation. In Nebraska, where an allotment at the rate of 1 second-foot for 70 acres continuous flow proves too small for proper distribution and application to tracts of 40 acres or less, an applicant is permitted to use, for a limited time, as much water as can be applied without waste.

EXCHANGE OF WATER IN COLORADO

Northeastern Colorado, notably Cache la Poudre Valley, has developed a complicated but highly efficient system of exchange of water, described in another bulletin (*25*), which virtually effects the storage of water in reservoirs located at lower levels than the land on which the equivalent of this stored water is used. This system of exchange is authorized by statute, which places it under the control of the State engineer, the division engineer, and the local water commissioner.

INFLUENCE UPON USE OF WATER

The several State statutes governing water rights and the use of water have without doubt exercised a restraining influence upon its improper use, for a showing must be made in every case that the water is to be applied to a beneficial purpose. The virtue of centralized State control, even though the amount of discretion allowed the State engineer is limited, lies in an orderly procedure for appropriating water and in the check provided against unwarranted appropriations. The old idea of measuring the appropriation by the carrying capacity of the ditch is not countenanced by these statutes.

There is still room, however, for a more scientific determination as to just what is beneficial use, which must be based upon broad studies of actual uses of water and their effect upon crop returns, including experiments wherever possible. In other words, the highest economical use, rather than simply beneficial use, should be the goal of those responsible for the utilization of a State's water supply.

As stated in the first bulletin of this series (*20*), a statutory limit upon the maximum use of water, while commendable for its effort to prevent excessive use and waste, does not seem to be altogether wise, owing to the great variety of conditions that may be encountered even within a single drainage area. It is entirely possible under some circumstances that the use of a greater amount of water than that allowed by statute would be a truly economical use. In certain extreme cases of this kind the letter of the law has not been strictly followed. It would make for better practice to modify such a rule by authorizing the State officials or the courts to grant an increased allowance upon clear proof of its necessity.

COURT DECISIONS

RIPARIAN RIGHTS

Opposing views with regard to the doctrine of riparian rights are held by different States of the Missouri and Arkansas River Basins. These views are voiced by the courts of Wyoming and Kansas. In

the case of Moyer *v.* Preston the Supreme Court of Wyoming stated "The common-law doctrine of the rights of riparian owners to the waters of natural streams, being inapplicable to the requirement of the landowners of Wyoming, is not in force in that State." [3] In the Kansas case of Clark *v.* Allaman,[4] on the other hand, it was stated that this rule was adapted to the conditions of the early settlers of the Territory and became a part of the settled jurisprudence of the State. It was stated in the same case that "The doctrine of prior appropriation may exist in the same State with the common-law doctrine of riparian rights."

Riparian rights in Nebraska are held to have been abrogated by the irrigation acts of 1889 and 1895.[5] These acts in providing an appropriation law in place of the law of riparian rights of course affected only the future acquirement of rights and did not attempt to interfere with vested riparian rights.

REGULATION OF APPROPRIATIONS

The courts have upheld the power of the State to regulate the appropriation of water. The Supreme Court of Nebraska, for example, has declared: "It is the policy of the law to regulate the diversion and use of the waters flowing in the streams of the State, for the irrigation of lands by a uniform system * * * and the law of appropriation, as defined by the statute and administered by the State board of irrigation, is deemed an effective means to accomplish the desired results." [6] Again, regarding the exercise of discretion by State officials: "The State board of irrigation, highways, and drainage, in acting upon an application for the appropriation of the waters of the State, is given a reasonable discretion to so limit the grant that it will not be detrimental to the public welfare." [7] The Colorado court stated: "The irrigation act of 1887, in requiring superintendents of irrigation to enforce the rights of the owners of ditches in accordance with their priorities of appropriation, as established by decrees of the courts in their respective districts * * * is a proper exercise of the police power of the State to prevent personal conflicts by treating the decrees rendered in the several districts as prima facie correct, and regulating the distribution of water accordingly, until the rights of parties can be adjudicated." [8]

INTERPRETATION OF BENEFICIAL USE

It is the general rule of the courts at the present time that a water user shall not be allowed more water than he can apply beneficially. This rule has been stated in many different forms. Some definitions make the term "beneficial" synonymous with "useful," others with "reasonable," others with "proper," and still others contrast it with "future speculative profit or advantage." [9] The Supreme Court of Nebraska has stated: "What is a reasonable use of water for irrigation is largely a question of fact * * *, but waste, needless diminution, or total consumption, of a stream, to the injury of others, is clearly

[3] Moyer *v.* Preston (Wyo.), 44 Pac. 845.
[4] Clark *v.* Allaman (Kans.), 80 Pac. 571.
[5] Crawford *v.* Hathaway, 67 Nebr. 325; 93 N. W. 781.
[6] McCook Irrigation & Water Power Co. *v.* Crews (Nebr.), 102 N. W. 249.
[7] Kirk *v.* State Board of Irrigation (Nebr.), 134 N. W. 167.
[8] Farmers' Independent Ditch Co. *v.* Agricultural Ditch Co. (Colo.), 45 Pac. 444.
[9] Toohey *v.* Campbell (Mont.), 60 Pac. 330; Redwater Land & Canal Co. *v.* Jones (S. Dak.), 130 N. W. 85.

unreasonable."[10] To quote the Colorado court: "An excessive diversion of water can not be regarded as a diversion to beneficial use."[11] A departure from the early rule of ditch capacity is noted in a Montana case: "The extent of the right of the first appropriation is limited by the capacity of the original ditch, but if its capacity exceeds the amount required for reasonable use, the necessity of the use, and not the size of the ditch, measures the extent of the right."[12] That water granted by an overgenerous decree may nevertheless not be used wastefully is indicated by a Colorado case: "an appropriator * * * can not take more [water] than is reasonably necessary to irrigate his land," even though decreed more.[13] Another Colorado decision makes the appropriator responsible for the exercise of reasonable care in preventing unnecessary transmission losses in conveying the water to his land.[14]

While wasteful practices are not tolerated, and the courts are coming more and more to insist upon a reasonable use of water, yet it is often difficult to translate this rule in a given case into a definite number of acre-feet per acre that will serve the public interest as well as the needs of the individual. As a general rule an adjudication based upon actual findings of fact by State administrative officials, reinforced by experimental data, should have a broader foundation and be more representative of the general welfare of the State than an isolated decree rendered with sole regard to the interests of the claimants in the case.

COMMUNITY REGULATIONS AND CONTRACTS

IRRIGATION ENTERPRISES

Where a maximum allowance of water for a tract of land has been fixed by State statute, irrigation enterprises of course can not provide for a greater quantity by contract or otherwise, but in some cases can effect a more economical use than if they were to deliver the statutory limit. In those States in which water is not allotted to definite subdivisions of land, an enterprise by careful distribution of the water may greatly increase its efficiency, consequently serving a larger area and materially raising the duty. The method of water delivery may be an important factor in accomplishing a more economical use. Furthermore, the detection and prevention of waste on farms offer opportunities for an enterprise to improve the use of the water.

WATER-RIGHT CONTRACTS

Contracts for the sale of water-rights often specify a quantity of water or a rate of flow per acre which will be delivered to contract lands, and have an important influence in fixing, within limits, the duty over large areas. Unless the duty so fixed is arrived at only after thorough and careful investigation, it may be the source of later trouble, for on the one hand the quantities of water may prove to be inadequate for the soils and the crops adapted to the territory, or on the other hand may prove more than abundant and may cause drainage troubles. This situation, unfortunately, is not un-

[10] Meng v. Coffey (Nebr.), 93 N. W. 713.
[11] Combs v. Agricultural Ditch Co. (Colo.), 28 Pac. 966.
[12] Conrow v. Huffine, (Mont.), 138 Pac. 1094.
[13] Larimer County Canal No. 2 Irrigating Co. v. Poudre Valley Reservoir Co. (Colo.), 129. Pac. 348.
[14] Town of Sterling v. Pawnee Ditch Extension Co. (Colo.), 94 Pac. 339.

common in new districts. In the early stages of an irrigation project's existence the farmers are usually given all the water they want, irrespective of the contract allowance, which is possible because the lands are then only sparsely settled and may not have had time to develop drainage difficulties. Again, certain lands need more water to begin with, yet may yield equally good results with smaller quantities later. The real test comes in later years with closer settlement of lands, by which time any wasteful practices that may have been encouraged are likely to be yielding their harvest in the waterlogging of lands. Experience, not only in the Missouri River Basin, but in all parts of the West, indicates that best results can be expected if a contract duty is fixed only with the greatest care and foresight and then adhered to, within reason, pending the time when all of the water-right lands will be demanding their full allowances of water.

An interesting development in connection with water-right contracts has taken place in the valley of the Cache la Poudre River in Colorado, where the holders of water rights formed several cooperative companies and deeded their rights to the companies, receiving in return shares of stock not attached to any land. This induced owners of tracts of land, which formerly had water rights, to acquire additional lands theretofore without water rights and to apply to a larger area the water formerly confined to the original tracts, all of which is thought to have resulted in a considerably higher duty of water in the community than probably would have resulted otherwise.

THE RECLAMATION OF ARABLE LANDS

The reclamation of additional lands in the Missouri and Arkansas River Basins will depend mainly on (1) the water supply and how it is controlled and used; (2) the cost of a water right and the labor and equipment necessary to make irrigated holdings remunerative; and (3) the profits to be derived from irrigated farms. Considering the water supply only, it is estimated that there is enough water available to irrigate 17,000,000 acres. Deducting the area under irrigation in 1919 leaves a balance of about 12,000,000 acres susceptible of reclamation. However, it should be borne in mind that water may be available for certain lands and yet prove too costly for economical diversion. These or other lands which the water might serve may be so rough, steep, and uneven or otherwise inferior as to make it doubtful whether costly water should be applied to them. Finally, the irrigation development of the future will always be confronted with the pertinent query, Will reclamation pay?

SEASONAL NET IRRIGATION REQUIREMENTS OF EACH SUBDIVISION OF THE MISSOURI AND ARKANSAS RIVER BASINS

From the data upon which this bulletin is based, supplemented by a consideration of agricultural conditions and anticipated improvements in irrigation practice, an estimate by way of conclusion has been made of the seasonal net irrigation requirements of the irrigable lands of the Missouri and Arkansas River Basins. In so large a territory, conditions of climate, soils, products, and types of farming differ, and because they affect the quantity of water required for irrigation, the basins have been separated into 18 divisions by placing in each division as far as practicable, all irrigable lands of nearly sim-

ilar irrigation requirement. Anticipated improvements in irrigation practice embrace a more general control of water supplies by storage, a better preparation of land surfaces to receive water, and a more economical use of water than is evidenced in some of the experiments herein recorded. By seasonal net irrigation requirements is meant the average quantity of irrigation water, expressed in acre-feet per acre, which is needed for any farm or other tract in each subdivision in any one crop-growing season. This quantity is exclusive of rainfall and all transmission and other losses which may occur between the source of supply and the farm.

As an additional aid in making the estimates, the water requirements of each field or plot irrigated, as given in the tables of the appendix, have been evaluated. By this process a small number have been eliminated, some have been reduced, others increased. Quite generally the quantities of water applied to plots have been increased, since it is not possible to irrigate fields or other subdivisions of a farm with as little water per unit of surface as is applied generally to plots. In other words, compared with plots, there is a larger percentage of water wasted in irrigating fields. On the other hand, it is obvious that an excess of water was applied to some of the plot and field experiments and the results of these have been reduced.

The appraised averages of seasonal net water requirements for each of the principal crops grown are given in Table 7.

TABLE 7.—*Principal crops, number of experiments made on each, and evaluated results of the average seasonal net water requirement, including rainfall*

Crop	Number of experiments	Average evaluated seasonal net water requirement per acre	Crop	Number of experiments	Average evaluated seasonal net water requirement per acre
		Acre-feet			*Acre-feet*
Wheat	435	1.78	Oats	372	1.72
Barley	282	1.70	Potatoes	291	1.70
Alfalfa	486	2.48	Peas	42	1.67
Sugar beets	153	2.17			

Estimates of the seasonal net irrigation requirements of the irrigable lands of each subdivision are given in Table 8. These figures have been arrived at, in part, by separating the crops grown and to be grown into a number of groups according to the quantity of water needed for each, and considering the percentage of each crop that is likely to be grown in each subdivision. The results are further modified by a consideration of the climate, soil, use of water, and types of farming followed in each subdivision.

TABLE 8.—*Monthly and seasonal net irrigation requirements of the various subdivisions of the Missouri and Arkansas River Basins*

Number of division	Description of division	Monthly percentage of total seasonal net irrigation requirements							Seasonal net irrigation requirement, in acre-feet per acre
		Apr.	May	June	July	Aug.	Sept.	Oct.	
1	Northeastern Montana	-------	6	37	36	20	-------	[1]	1.40
2	North central Montana	-------	6	41	31	21	-------	[1]	1.50
3	Central Montana	-------	3	32	44	20	-------	[1]	1.70
4	Upper Missouri River Basin in Montana	-------	3	31	47	15	-------	[1]	1.60
5	Upper Yellowstone River Basin in Montana	-------	4	33	45	17	-------	[1]	1.90
6	Southeastern Montana	-------	5	31	39	20	4	[1]	1.95
7	Big Horn River Basin in Wyoming	-------	4	33	43	16	3	[1]	1.65
8	Yellowstone and Missouri River Basin in Wyoming	-------	6	32	41	18	2	[1]	1.70
9	Upper Platte River Basin in Wyoming	-------	3	35	44	15	2	[1]	1.60
10	Northeastern Colorado	4	14	27	28	19	7	[1]	2.05
11	North central Colorado	2	11	29	30	20	7	[1]	2.20
12	South central Colorado	6	15	28	29	18	3	[1]	2.10
13	Southeastern Colorado	8	20	23	21	19	4	[2]	2.30
14	Western Kansas	4	14	25	26	20	7	[2]	1.75
15	Central Nebraska	3	10	21	32	20	8	[3]	1.25
16	Western Nebraska	2	8	23	28	25	12	[2]	2.00
17	Western South Dakota	1	4	27	31	23	10	[1]	1.50
18	Western North Dakota	-------	3	35	38	22	1	[1]	1.35

[1] Winter irrigation. [2] Mainly winter irrigation.

One of the principal influences affecting the seasonal irrigation requirements of this area is the shortness of the period in which water is applied to crops. In general, the use of water on alfalfa covers the longest period, but even this is short when compared with its duration on other main river basins of the West. In irrigating 275 plots of alfalfa located in several localities of southern Alberta over a number of years, 15 per cent of the total seasonal application was made in May, 29 per cent in June, 33 per cent in July, 22 per cent in August, and only 1 per cent in September. In irrigating small grain the season is shorter. In a total of 758 plots of wheat, oats, and barley grown in southern Alberta 2 per cent of the water application was made in May, 44 per cent in June, 46 per cent in July, 8 per cent in August, and none in September. In irrigating 62 fields of alfalfa in the Yellowstone Valley, Mont., 11 per cent of the total application was made in May, 25 per cent in June, 35 per cent in July, 26 per cent in August, and 3 per cent in September. In irrigating 48 fields of wheat and oats in the same valley, 49 per cent of the application was made in June, 50 per cent in July, and 1 per cent in August. In the Arkansas Valley of Colorado the growing season is longer, water occasionally being applied in March and as late as October, with correspondingly smaller quantities in June and July. In a total of 132 field experiments on diversified crops in the Arkansas Valley, 2 per cent of the water application was made near the end of March, 8 per cent in April, 20 per cent in May, 23 per cent in June, 22 per cent in July, 19 per cent in August, 4 per cent in September, and 2 per cent in October.

The duration of the irrigation season and the quantities of water needed for each monthly period in each subdivision are also given in Table 8. Quite generally throughout the basins, a small percentage of the net seasonal quantity of water used is applied late in the fall, as winter irrigation, to provide soil moisture for the following season. Accordingly, in estimating the monthly irrigation requirements, a small percentage is allowed for winter irrigation and is placed in the column headed October, although part of such allowance may be used in November or later.

The subdivisions referred to in Table 8 are outlined on the map of Missouri and Arkansas River Basin. (Fig. 19.)

APPENDIX

USE OF WATER ON CROPS IN MISSOURI AND ARKANSAS RIVER BASINS, IRRIGATION WATER APPLIED, RAINFALL, AND CROP YIELDS IN COLORADO, KANSAS, NEBRASKA, WYOMING, AND IN ALBERTA, CANADA

TABLE 9.—*Use of water on crops in the Missouri River Basins, irrigation water applied, rainfall, and crop yields in Yellowstone Valley, Mont.*[1]

ALFALFA

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			May	June	July	August	September	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1900	53.40	1			1.30			1.30	0.44	1.74	[2] 5.17
1901	53.41							1.14	.59	1.73	(3)
1913	8.30	2		0.61	0.70			1.31	.67	1.98	[4] 2.65
1913	7.60	2		.81	1.09			1.90	.67	2.57	2.75
1913	10.00	2		.80	.58			1.38	.67	2.05	4.70
1913	6.70	2		.98		1.86		2.84	.67	3.51	4.50
1913	4.40	2		1.11		1.06		2.17	.67	2.84	5.50
1913	2.90	3		.49	.62	.35		1.46	.67	2.13	4.90
1913	3.40	3	0.42		.50	.46		1.38	.67	2.05	4.80
1913	3.55	3	.48		.82	.39		1.49	.67	2.16	5.30
1913	6.12	2	.83		.80			1.63	.67	2.30	4.50
1913	2.66	3	.23		.58	1.22		2.03	.67	2.70	4.50
1913	3.43	3	.34		.62	.91		1.87	.67	2.54	4.50
1913	3.50	3	.36		.32	.58		1.26	.67	1.93	5.20
1913	5.45	3		.76	.28		0.28	1.32	.67	1.99	5.20
1913	8.50	3		.21	.33		.46	1.00	.67	1.67	4.50
1913	2.93	3		.48	.38		.14	1.00	.67	1.67	4.50
1914	10.00	2		.57		.33		.90	.82	1.72	[5] 3.89
1914	7.80	2			.66	.87		1.53	.82	2.35	2.87
1914	35.10	3	.49	.70		.81		2.00	.82	2.82	3.83
1914	11.10	3		.55	.37	.50		1.42	.82	2.24	5.45
1914	1.46	2			1.08	1.32		2.40	.82	3.22	5.24
1914	11.50	3	.61		.94	1.21		2.76	.82	3.58	4.01
1914	5.65	3	.49		1.17	.73		2.39	.82	3.21	4.01
1914	7.13	3	.36		.57	.46		1.39	.82	2.21	4.88
1914	8.08	3	.84		1.06			1.90	.82	2.72	4.21
1914	5.71	3	.44		.53			.97	.82	1.79	3.56
1914	4.80	2	1.70		1.53			3.23	.82	4.05	4.26
1914	6.27	2	.43		.54			.97	.82	1.79	4.27
1914	5.62	2	.58		.89			1.47	.82	2.29	4.52
1914	10.50	4		.37	.36	1.15		1.88	.82	2.70	3.16
1914	3.90	4		.39	.26	1.03		1.08	.82	2.50	2.82
1914	4.10	4		.38	.40	.71		1.49	.82	2.31	2.82
1914	3.70	4		.30	.27	.84		1.41	.82	2.23	3.45
1914	3.10	4		.30	.79	.48		1.57	.82	2.39	3.45
1914	3.10	3		1.39		1.79		3.18	.82	4.00	4.50
1914	4.00	3		.41	.62	1.12		2.15	.82	2.97	4.50
1914	3.30	3		.61	.51	1.32		2.44	.82	3.26	5.00
1914	3.95	3		.59	.36	1.44		2.39	.82	3.21	3.00
1914	3.70	3		.28	.86	1.56		2.70	.82	3.52	2.30
1914	3.50	3		.80	.29	.87		1.96	.82	2.78	3.70
1914	3.00	3		1.18	.29	.87		2.34	.82	3.16	3.70
1914	20.20	3		.27	.45	.36		1.08	.82	1.90	[6] 2.97
1914	10.10	3		.28	.29	.74		1.31	.82	2.13	[6] 2.97
1914	2.30	2		.38	.44			.82	.82	1.64	4.00
1914	3.70	3		.99	.79		1.19	2.97	.82	3.79	4.00

See footnotes at end of table.

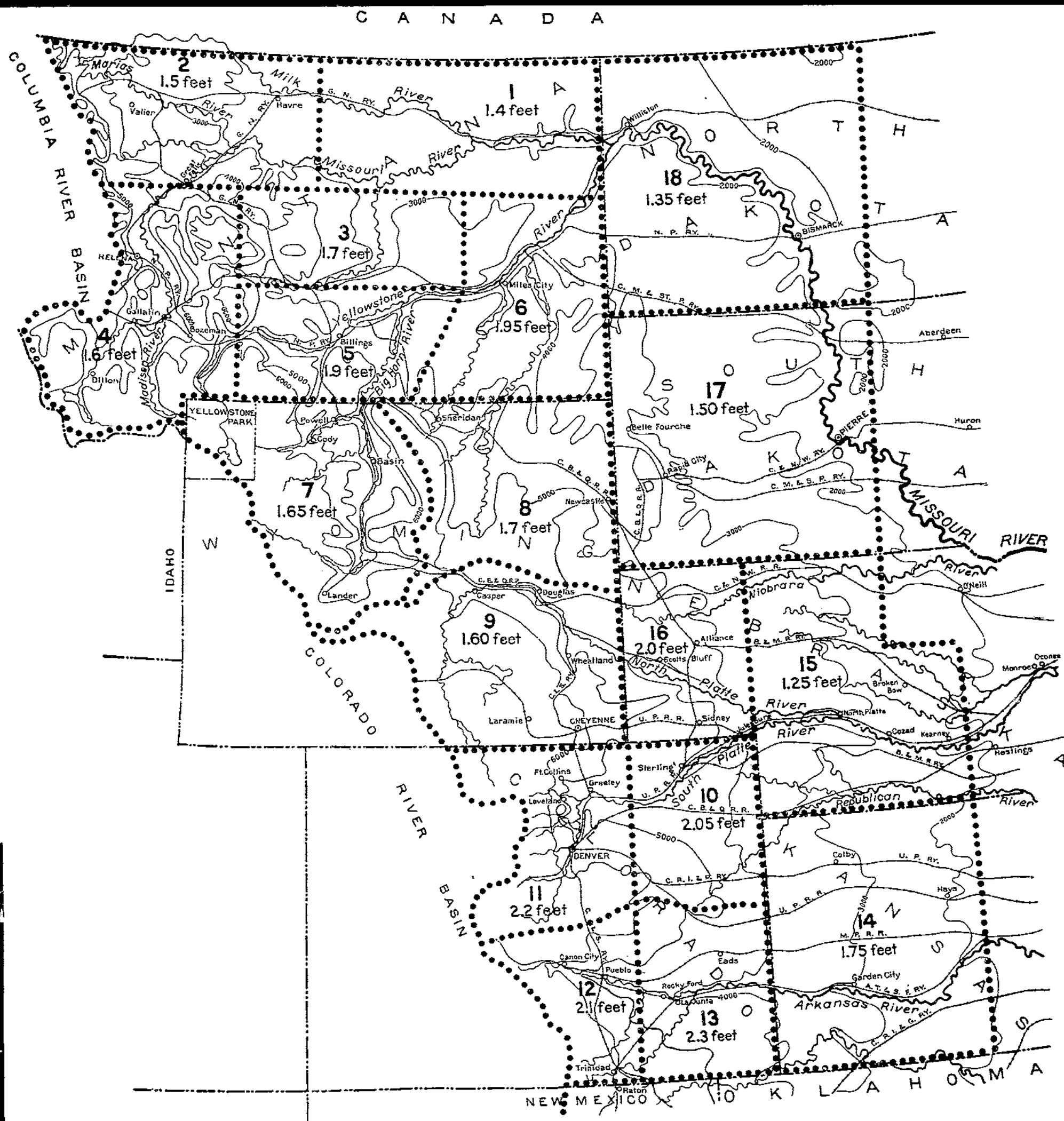

FIG. 19.—Missouri River and Arkansas River Basins and the various duty of water divisions (bounded by dotted lines), with net irrigation requirements of each

TABLE 9.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields in Yellowstone Valley, Mont.*—Continued

ALFALFA—Continued

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			May	June	July	August	September	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1914	4.90	3		0.65	0.57	0.32		1.54	0.82	2.36	3.10
1914	9.00	2		.65	.57			1.22	.82	2.04	5.00
1914	12.60	3		.78	.69			1.47	.82	2.29	4.60
1914	5.30	2		.94	.77			1.71	.82	2.53	5.50
1914	3.90	3		.72	.72	1.08		3.42	.82	4.24	3.70
1914	2.40	3		.55	.60	1.23		2.44	.82	3.26	3.70
1914	3.50	4		.56	1.24	.47		2.27	.82	3.09	5.33
1914	4.75	4		.43	.71	.32		1.46	.82	2.28	5.17
1914	3.20	3			.95	.39		1.34	.82	2.16	2.02
1914	6.80	2		1.56		.50		2.06	.82	2.90	3.10
1914	25.90	2			.70	.44		.94	.82	1.76	3.10
1915	8.20	3	1.03		.55	.85		2.43	1.23	3.66	4.97
1915	8.40	2	1.00		.58			1.58	1.23	2.81	4.97
1915	8.60	2	.67		.57			1.24	1.23	2.47	4.97
1915	6.27	2		.34	.28			.62	1.23	1.85	4.30
1915	5.02	2		.22	.62			.84	1.23	2.07	4.60
1915	5.68	1		1.32				1.32	1.23	2.55	[7] 5.20
1915	5.02	1		.82				.82	1.23	2.05	[7] 5.80

BARLEY

											Bushels
1914	4.05	2			1.25	0.64		1.89	0.69	2.58	30.10

CORN

1914	0.50	1			0.02			0.02	0.71	1.33	02.30
1915	0.50	0							1.03	1.03	30.00

OATS

1913	5.25	2		0.33	1.33			1.66	0.55	2.21	[8] 87.60
1913	5.03	2		1.93	.98			2.91	.55	3.46	58.50
1913	7.20	2		1.09	.72			1.81	.55	2.36	68.60
1913	3.20	2		.46	.33			.79	.55	1.34	73.50
1913	3.26	2		.46	.50			.96	.55	1.51	73.50
1913	3.10	2		.45	.50			.95	.55	1.50	73.50
1913	2.82	2		.46	.50			.96	.55	1.45	73.50
1914	5.00	2		1.16				1.16	.69	1.85	[8] 92.00
1914	4.30	2		2.18				2.18	.69	2.87	74.00
1914	4.20	2		.71	.21			.92	.69	1.61	87.00
1914	3.90	1		1.00				1.00	.69	1.78	102.00
1914	3.80	1		1.02				1.02	.69	1.71	77.00
1914	3.70	1		.80				.80	.69	1.49	84.00
1914	8.30	1		.49				.49	.69	1.18	50.00
1914	1.68	1			.60			.60	.69	1.29	73.00
1914	1.11	1			.51			.51	.69	1.20	73.00
1914	1.51	1			.38			.38	.69	1.07	73.00
1914	2.60	2		.40	.42			.91	.69	1.60	58.00
1914	3.55	2		.20	.30			.68	.69	1.37	70.00
1914	8.05	2		.39	.31			.70	.69	1.39	61.00
1914	5.60	2		.36	.40			.76	.64	1.40	47.00
1914	2.80	1			.62			.62	.64	1.26	29.00
1914	7.23	1			.43			.43	.69	1.12	65.00
1915	7.81	1				0.61		.61	.92	1.53	74.00

POTATOES

1914	3.50	4			0.36	0.64		1.00	0.71	1.71	254.00
1914	2.80	2			.52			.52	.71	1.23	[10] 97.00
1914	5.70	2			.53	.54		1.07	.71	1.78	
1914	2.25	1			.60			.60	.71	1.31	111.00
1914	6.10	2			.39	.43		.82	.71	1.53	214.00
1915	3.50	2				.36		.36	1.03	1.39	250.00

See footnotes at end of table

TABLE 9.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields in Yellowstone Valley, Mont.*—Continued

SUGAR BEETS

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			May	June	July	August	September	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1912	7.25	2			1.11	0.74		1.85	0.67	2.52	[1] 15.90
1913	4.90	2			.99	.63		1.62	.67	2.29	15.90
1913	4.65	2			.77	.62		1.39	.67	2.06	15.90
1914	7.65	2			.85	.53		1.41	.67	2.08	15.90
1913	5.20	2			.72	.66		1.38	.67	2.05	12.70
1913	4.25	2			.95	.71		1.46	.67	2.13	12.70
1913	6.15	2			.49	.57		1.06	.67	1.73	12.70
1913	1.70	2			.67	.58		1.25	.67	1.92	12.70
1913	1.80	2			.70	.47		1.06	.67	1.73	12.70
1914	5.80	2			.56	.45		1.06	.71	1.77	[2] 15.97
1914	6.40	2			.53	.37		.89	.71	1.61	15.18
1914	3.50	2			.62	.63		1.33	.71	2.06	13.40
1914	6.80	2			.52	.61		.93	.71	1.64	12.28
1915	14.70	2		0.17	.17			.62	1.03	1.65	.....
1915	6.45	2				.62	0.25	.84	1.03	1.91	17.90
1915	2.80	1				.58		.58	1.03	1.61	16.10
1915	5.55	2				.51		.51	1.05	1.57	5.00
1915	7.65	2				.65	.31	1.00	1.03	2.03	14.30
1915	5.41	1				.73		.73	1.03	1.76	15.00
1915	1.74	2				.62		.62	1.03	1.65	9.70
1915	3.57	2				.68		.68	1.03	1.71	.....
1915	3.55	3			.98	.88	.41	2.27	1.03	3.30	15.40
1915	8.79	2			.97	.65		1.62	1.03	2.65	15.40

WHEAT

											Bush.
1913	5.62	2		0.21	0.72			1.03	0.55	1.58	[3] 42.90
1913	5.08	2		.26	.34			.62	.55	1.17	43.90
1913	5.61	2		.21	.26			.47	.55	1.02	44.70
1913	3.87	2		.51	.38			.92	.55	1.47	43.90
1915	3.12	2		.76	.69			1.45	.55	1.90	43.90
1913	3.07	2		.21	.29			.50	.55	1.05	43.90
1914	7.60	1		.61				.61	.69	1.30	[4] 31.70
1914	11.50	1		.63				.63	.69	1.32	41.70
1914	4.05	1		.87				.87	.69	1.56	44.70
1914	7.35	1			1.21			1.21	.64	1.85	44.50
1914	4.60	1			.80			.80	.61	1.41	18.60
1914	13.70	1			.85			.85	.64	1.49	19.00
1914	17.40	2		.35	.31			.66	.64	1.30	21.90
1914	7.30	2		.50	.25			.75	.64	1.39	20.20
1914	5.20	1			.81			.81	.64	1.45	21.00
1915	4.11	1			.57			.57	.92	1.49	54.20
1915	3.65	1		.55				.55	.92	1.47	.....
1915	11.28	1			.12			.12	.92	1.31	57.60
1915	4.11	1		1.02				1.02	.92	1.94	46.00
1915	4.76	1		1.20				1.20	.92	2.12	46.00
1915	7.80	1			1.12			1.12	.92	2.04	46.60
1915	5.22	1			.54			.54	.92	1.46	46.00
1915	7.22	1			.48			.48	.92	1.40	.....
1915	10.15	1			.89			.89	.92	1.81	35.20

[1] These studies were made on fields near Billings by the Bureau of Public Roads, United States Department of Agriculture, and the Montana Agricultural Experiment Station. The soils of these fields are loams, sandy loams, and fine sandy loams.
[2] O. E. S. Bul. 31 (17).
[3] O. E. S. Bul. 172 (2), p. 69.
[4] This and following experiments, up to footnote 5, from Mont. Expt. Agr. Sta. Bul. 103, (24, p. 353).
[5] This and following experiments, up to footnote 8, from unpublished report of Bureau of Public Roads.
[6] Damaged by hail.
[7] Approximate.
[8] This and following experiments, up to footnote 9, from Mont. Agr. Expt. Sta. Bul. 103, (24, p. 356).
[9] This and following experiments, up to footnote 11, from unpublished report of Bureau of Public Roads.
[10] Average of marketable potatoes from irrigated and unirrigated plots.
[11] This and following experiments, up to footnote 12, from Mont. Agr. Expt. Sta. Bul. 103, (24, p. 357).
[12] This and following experiments, up to footnote 13, from unpublished report of Bureau of Public Roads.
[13] This and following experiments, up to footnote 14, from Mont. Agr. Expt. Sta. Bul 103, (24, p. 366).
[14] This and following experiments, from unpublished report of Bureau of Public Roads.

TABLE 10.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields in Gallatin Valley, Mont.*[1]

SUGAR BEETS

Year	Area irrigated	Number of irrigations	Monthly application of water				Total quantity of water received by crop			Yield per acre
			June	July	August	September	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1901	3.00	3	.....	0.96	0.50	.....	1.46	0.59	2.05	[2] 10.60

WHEAT

										Bushels
1899	6.02	2	1.27	0.71	.....	.....	1.98	0.42	2.40	[3] 37.89

CLOVER

										Tons
1899	21.00	2	0.49	0.53	.....	.....	1.02	0.44	1.46	3.00
1900	66.29	2	1.51	.67	.....	.....	1.98	.44	2.42	(4)
1900	7.26	4	.56	1.54	0.70	.....	2.70	.44	3.14	7.02
1900	1.00	3	.83	.14	.....	.....	.97	.30	1.27	1.58
1900	73.00	3	.61	1.17	.....	.....	1.78	.44	2.22	.....
1901	20.86	2	.54	.58	.....	.....	.92	.65	1.57	[5] 3.26
1901	1.38	3	.97	1.51	.....	.....	1.81	.67	2.48	3.36
1901	7.13	2	.59	.63	.....	.....	1.21	.62	1.86	3.36
1901	6.85	3	.79	1.37	.....	.....	1.53	.62	2.17	3.36
1901	1.00	2	.79	.71	.....	.....	.77	.43	1.20	1.59
1901	27.84	1	.85	.....	.....	.....	.85	.62	1.57	3.00
1902	9.72	2	.63	1.62	.....	.....	1.65	.78	2.43	(4)
1902	27.84	1	1.00	.....	.....	.....	1.00	.78	1.78	.....
1902	81.30	1	3.33	.....	.....	.....	3.33	.78	3.91	.....
1903	27.84	1	.....	.....	.....	.....	.94	1.03	1.97	(4)
1901	81.30	1	.....	.....	.....	.....	1.69	1.03	2.72	.....

TIMOTHY AND CLOVER

1901	37.34	1	.....	.....	.....	.....	0.66	1.03	1.69	.....

ALFALFA

1902	1.02	2	0.39	0.62	.....	.....	1.01	0.78	1.79	(4)

BARLEY

										Bush.
1899	3.25	2	1.27	0.71	.....	.....	1.98	0.42	2.40	[3] 45.00
1899	66.39	1	.....	.98	.....	.....	.98	.41	1.39	73.00
1900	4.11	2	1.50	.....	.....	.....	1.50	.28	1.78	[10] 48.50
1900	1.66	2	.66	.51	.....	.....	1.17	.28	1.45	87.29
1900	4.52	2	.98	.98	.....	.....	1.96	.42	2.38	68.58
1901	1.60	2	.96	.81	.....	.....	.77	.43	1.20	[11] 61.50
1901	12.47	1	.....	.85	.....	.....	.85	.46	1.31	50.00
1902	10.89	2	.55	.42	.....	.....	.97	.64	1.61	(4)

OATS

1899	23.11	1	.....	1.53	.....	.....	1.53	0.38	1.91	[12] 51.00
1899	7.26	2	.....	1.31	.....	.....	1.31	.39	1.70	72.75
1899	2.18	2	.....	2.16	.....	.....	2.16	.36	2.52	72.75
1899	25.69	1	.....	1.28	.....	.....	1.28	.41	1.72	.....
1900	25.69	2	0.62	.22	.....	.....	.84	.39	1.23	(4)
1900	1.00	2	.29	.29	.....	.....	.58	.39	.95	75.58
1900	8.51	2	.70	.81	.....	.....	1.27	.40	1.67	74.67
1901	15.35	2	.70	.82	.....	.....	1.62	.43	2.05	[11] 73.00
1901	37.30	1	.....	1.23	.....	.....	1.27	.45	1.72	.....
1902	3.38	2	.74	.74	.....	.....	1.98	.54	1.82	(4)
1902	8.93	2	.95	.82	.....	.....	1.77	.54	2.31	.....

See footnotes at end of table.

TABLE 10.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall and crop yields in Gallatin Valley, Mont.*—Continued

WHEAT

Year	Area irrigated	Number of irrigations	Monthly application of water				Total quantity of water received by crop			Yield per acre
			June	July	August	September	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1900	1.00	2	0.33	0.44			0.77	0.30	1.07	38.33
1901	5.34	2	.33	.87			1.20	.45	1.65	[16] 43.20
1901	1.00	2	.26	.51			.77	.43	1.20	[17] 42.00
1902	5.62	2	1.29	1.15			2.44	.72	3.16	(*)

PEAS

1899	4.23	2	0.69	0.41			1.10	0.41	1.51	[18] 31.25
1900	1.00	2	.28	.28			.56	.30	.95	[19] 22.17
1901	8.40	1		.35			.35	.77	1.12	[7] 37.50

[1] These measurements were made by the United States Office of Experiment Stations, with the Montana Agricultural Experiment Station cooperating. The soils of these fields are loams and clay loams. In a few cases the data on monthly application are incomplete.
[2] O. E. S. Bul. 119 (*18*).
[3] This and following item to footnote 4 from O. E. S. Bul. 86 (*16*).
[4] This and following items to footnote 5 from O. E. S. Bul. 104 (*17*).
[5] This and following items to footnote 6 from O. E. S. Bul. 119 (*18*).
[6] This and following items to footnote 7 from O. E. S. Bul. 133 (*19*).
[7] This and following items to footnote 8 from O. E. S. Bul. 172 (*21*).
[8] O. E. S. Bul. 133 (*19*).
[9] This and following items to footnote 10 from O. E. S. Bul. 86 (*16*).
[10] This and following items to footnote 11 from O. E. S. Bul. 104 (*17*).
[11] This and following items to footnote 12 from O. E. S. Bul. 119 (*18*).
[12] This and following items to footnote 13 from O. E. S. Bul. 86 (*16*).
[13] This and following items to footnote 14 from O. E. S. Bul. 104 (*17*).
[14] This and following item to footnote 15 from O. E. S. Bul. 119 (*18*).
[15] This and following item to footnote 16 from O. E. S. Bul. 133 (*19*).
[16] O. E. S. Bul. 104 (*17*).
[17] This and following item to footnote 18 from O. E. S. Bul. 119 (*18*).
[18] O. E. S. Bul. 86 (*16*).
[19] O. E. S. Bul. 104 (*17*).

TABLE 11.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields in Gallatin Valley, Mont.*[1]

ALFALFA

Year	Number of irrigations	Monthly application of water			Total quantity of water received by crop			Yield per acre
		June	July	August	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1903	1	0.50			0.50	0.70	1.20	[2] 4.62
1903	0				.00	.70	.70	1.00
1903	3	.66	0.17	0.17	1.00	.70	1.70	4.42
1903	4	.67	.25	.58	1.50	.70	2.20	3.75
1903	5	.84	.50	.66	2.00	.70	2.70	6.35
1903	7	.83	.68	1.00	2.50	.70	3.20	7.20
1903	8	.83	.75	1.42	3.00	.70	3.70	7.69

OATS

								Bushels
1900	0					0.39	0.39	[2] 46.12
1900	1	0.17			0.17	.39	.56	61.73
1900	2	.33	0.34		.67	.39	1.06	68.16
1900	2	.42	.33		.75	.39	1.14	73.54
1900	3	.33	.67		1.00	.39	1.39	74.82
1900	4	.33	1.00		1.33	.39	1.72	78.15
1900	5	.33	1.00	0.34	1.67	.39	2.06	77.04
1900	6	.33	1.00	.67	2.00	.39	2.39	83.53

POTATOES

								Pounds
1903	0					0.59	0.59	[4] 18,750
1903	2			0.50	0.50	.59	1.09	18,000
1903	3			1.00	1.00	.59	1.59	10,500
1903	5		0.25	1.25	1.50	.59	2.09	19,050
1903	5		.50	1.50	2.00	.59	2.59	16,500
1903	6		.67	1.83	2.50	.59	3.09	14,550

WHEAT

1903	0					0.59	0.59	1,920
1903	2			0.50	0.50	.59	1.09	2,505
1903	3			1.00	1.00	.59	1.59	2,655
1903	5	0.25		1.25	1.50	.59	2.09	[5] 2,070
1903	5	.50		1.50	2.00	.59	2.59	[5] 2,715
1903	6	.75		1.75	2.50	.59	3.09	[5] 2,430

[1] These experiments were conducted at the experimental farm of the Montana Agricultural Experiment Station at Bozeman under cooperative agreement between the station and this bureau. Three of the alfalfa plots contained about one-seventeenth acre and all other plots one-fifteenth acre. The soil type on which the plots were located is a heavy silty loam of compact structure.

[2] This and following items to footnote 3 from 16th Ann. Rpt. Mont. Agr. Expt. Sta. (*1*).

[3] This and following items to footnote 4 from U. S. Bul. 104 (*17*).

[4] This and following items to end of table from 16th Ann. Rpt. Mont. Agr. Expt. Sta. (*1*).

[5] Wheat frost bitten and shrunken.

TABLE 12.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields in Valier project, Montana*[1]

ALFALFA

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			May	June	July	August	September	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1921	13.10	3	.....	1.71	1.86	.....	.....	3.57	0.26	3.83	(2)
1922	39.33	2	.....	.10	.....	0.42	.....	.52	.55	1.07	2.10
1922	59.26	1	.....	.....	.....	.07	.....	.07	.55	1.22	1.91
1922	26.30	1	.....	.....	.53	.....	.....	.53	.55	1.08	2.38
1922	11.75	1	.....	.89	.....	.....	.....	.89	.55	1.44	2.59
1923	8.84	3	0.84	.31	.32	.....	.....	1.49	1.01	2.50	2.44
1923	6.77	2	.61	.....	.....	.40	.....	1.01	1.01	2.02	2.61
1923	5.35	1	.....	.....	.....	.47	.....	.47	1.01	1.48	1.52
1923	3.24	2	.....	.12	.....	.52	.....	1.11	1.01	2.15	2.13
1923	3.67	1	.....	.51	.....	.....	.....	.71	1.01	1.82	1.65

BARLEY

											Bushels
1920	2.00	0	.....	.....	.....	.....	.....	0	.....	.....	[3] 47.50
1921	12.40	1	.....	.....	.....	.....	.....	0.51	0.20	0.71	20.00
1921	9.00	3	.....	1.71	1.86	.....	.....	3.57	.20	3.77	[3] 20.00
1922	9.46	1	.....	.....	.41	.....	.....	.41	.55	.96	25.00

OATS

1921	9.69	1	.....	0.84	.....	.....	.....	0.84	0.26	1.10	40.00

POTATOES

1920	10.08	1	.....	.....	.....	.....	.....	0.28	.....	.....	91.00

SPELTZ

1921	5.62	1	.....	0.84	.....	.....	.....	0.84	0.26	1.10	30.00

WHEAT

1920	3.00	1	.....	.....	.....	0.60	.....	0.60	.....	.....	35.00
1921	.....	3	.....	0.81	0.30	.....	.....	1.11	0.20	1.31	16.20
1921	7.54	2	.....	.79	.90	.....	.....	1.69	.20	1.89	17.00
1922	5.73	1	.....	1.15	.....	.....	.....	1.15	.55	1.70	19.20
1922	9.35	1	.....	.....	.74	.....	.....	.74	.55	1.29	31.80
1922	8.92	1	.....	.65	.....	.....	.....	.65	.55	1.20	35.90
1922	9.49	2	.....	.32	.....	.49	.....	.81	.55	1.36	40.50
1923	8.08	1	.....	.49	.....	.....	.....	.49	.55	1.04	38.90
1923	.67	0	.....	.....	.....	.....	.....	.....	.55	.55	20.00
1923	14.19	1	.....	.50	.....	.....	.....	.50	.55	1.05	30.00
1923	9.45	0	.....	.....	.....	.....	.....	.....	1.01	1.01	13.30
1923	8.92	1	.....	.56	.....	.....	.....	.56	1.01	1.57	14.00
1923	9.69	1	.....	.....	.39	.....	.....	.39	1.01	1.40	15.50
1923	8.08	1	.....	.....	.....	.56	.....	.56	1.01	1.57	16.60
1923	.67	0	.....	.....	.....	.....	.....	.....	1.01	1.01	12.00
1923	3.67	1	.....	.....	.....	.....	.....	.76	1.01	1.77	12.00

[1] These determinations were made by the Montana Agricultural Experiment Station, the data being furnished by H. E. Murdock. The soils of these fields were mainly heavy, stiff clays, though a few sandy loams were included.

[2] First year. All items from unpublished report to Montana station.

[3] Nurse crop for alfalfa.

TABLE 13.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields in Williston, N. Dak.*[1]

ALFALFA

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1909	3	...	...	0.33	0.33	0.34	1.00	0.77	1.77	(2)
1909	3	...	...	.50	.50	.50	1.50	.77	2.27	(3)
1909	3	...	...	.17	.17	.16	.50	.77	1.27	(3)
1909	3	...	...	.33	.33	.34	1.00	.77	1.77	(3)
1909	3	...	...	.50	.50	.50	1.50	.77	2.27	(3)
1909	3	...	...	.42	.42	.41	1.25	.77	2.02	(3)
1910	4	...	1.25	.47	.43	...	2.05	.61	2.66	3.07
1910	4	...	1.91	.42	.67	...	3.03	.61	3.64	4.37
1910	4	0.31	.28	.28	.38	...	1.28	.61	1.89	4.55
1910	4	.72	.51	.37	.43	...	2.03	.61	2.65	4.15
1910	4	.98	.72	.41	.69	...	2.82	.61	3.43	5.02
1910	4	...	1.44	.47	.77	...	2.39	.61	3.10	3.46

[1] These experiments were conducted by the Williston subexperiment station of the North Dakota Agricultural Experiment Station. Plots contained 0.319 and 0.325 acre each. The soils of the station farm are described in the 1st Ann. Rpt. (46) as follows: "About 50 acres lying in the Little Muddy Creek bottom consists of heavy gumbo soil. Many of the hills on the high land are full of gravel that reaches the surface in places. The balance of the land varies from a black loam to a sandy loam, from a few inches to 18 inches in depth. The subsoil consists of yellow clay, sand and gravel."

[2] This and following items from the 3d Ann. Rpt. Williston Sub. Expt. Sta. (47).

[3] First year; two clippings.

TABLE 14. *Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Cheyenne, Wyo.*[1]

ALFALFA

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1909		...	...	...	...	...	0.90	0.80	1.70	[2] [3] 2.50
1909	0	...	...	...	...	...	...	.80	.80	[3] [4] 1.05
1909	2	...	...	...	...	...	4.00	.80	...	[3] [5] [6] 2.06
1909	0	...	...	...	...	...	...	.80	.80	[4] 1.50
1910	4	0.25	...	0.25	0.36	0.25	1.12	.52	1.64	[7] [8] 2.40
1910	0	...	...	...	...	...	...	.52	.52	[4] [8] .28
1910	1	...	...	...	...	...	2.50	.52	...	[8] [9] .60
1911	6	...	...	...	...	...	1.73	.53	2.26	4.90
1911	0	...	...	...	...	...	...	.53	.53	[4] .50
1912	3	...	0.51	...	.25	.39	.95	.59	1.54	[9] [10] 3.96
1912	0	...	...	...	...	...	...	.59	.59	[4] .74
1913	1	...	.37	.25	.27	.29	1.18	.60	1.78	4.26
1914	0	...	...	...	...	...	...	.60	.60	[4] .90
1913	0	...	...	...	...	...	...	.60	.60	0.58
1914	3	...	...	.66	...	.43	1.09	.50	1.59	4.60
1914	...	...	...	...	...	...	1.81	.50	...	[11] 1.95

See footnotes at end of table.

TABLE 14.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Cheyenne, Wyo.*[1]—Continued

BARLEY

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1907	1						(13)	0.73		[13] 10.50
1907	0							.73	0.73	[4] 4.75
1907	0							.73	.73	[13] 5.18
1907	0							.73	.73	[13] 4.53
1907	1						4.00	.73		[14] 16.75
1908	1				0.34		.34	1.32	1.66	15.20
1908	0							1.32	1.32	[4] 13.14
1908	0							1.32	1.32	[13] 21.85
1908	0							1.32	1.32	[13] 17.89
1908	2						4.25	1.32		[3 14] 10.81
1909	0						.25	.69	1.24	[13] 42.50
1909	0							.69	.69	[4] 16.50
1909	0							.69	.69	[13] 10.00
1909	0							.69	.69	[13] 18.80
1909	2						4.00	.69		[5 6] 34.5
1910	3	0.30		0.34	.17		.81	.41	1.22	[16] 38.00
1910	3	.30		.34	.17		.81	.41	1.22	24.00
1910	0							.41	.41	[4] 2.50
1910	0							.41	.41	[13] 2.50
1910	0							.41	.41	[13] 2.00
1910	1						2.50	.41		[3 17] 11.50
1912	0							.59	.59	[18 4] 16.50
1912	0							.59	.59	[4] 33.00
1913	2		0.34		.25		.59	.60	1.19	23.00
1913	0							.60	.60	[13] 10.00
1913	0							.60	.60	[13] 8.00
1913	0							.60	.60	[13] 6.50
1914	2			.29	.33		.62	.50	1.12	[19] 11.50

BROME GRASS

										Tons
1908	0							1.06	1.06	[4 20 21] 1.20
1909										
1913	0							.60	.60	[22] .48

CORN

1914							1.25	0.50		[11] 2.60

MILLET

1909	1						0.35	0.80	1.15	[23] 1.47
1909	0							.80	.80	[4] .37
1909	0							.80	.80	[13] 1.02
1913	0							.60	.60	[4 24] 1.56
1914	2			0.37		0.35	.72	.50	1.22	(25)
1914							1.29	.50		[11] 1.27

OATS

										Bushels
1909	2						4.00	0.80		[3 5 26] 37.00
1910	3	0.33		0.29	0.33		1.00	.54	1.54	[27] 54.00
1910	0							.54	.54	[4] 1.00
1910	1						2.50	.54		[3] 18.00
1910	1						2.50	.54		[3] 24.00
1912	2			.37	.31		.68	.59	1.27	38.00
1912	0							.59	.59	[13] 28.80
1912	0							.59	.59	[13] 30.59
1912	0							.59	.59	[4] 33.00
1913	2			.41	.32		.73	.60	1.33	63.00
1913	0							.60	.60	[4] 12.00
1913	0							.00	.60	[13 28 29]
1913	0							.60	.60	[13 29]
1913	1						2.00	.60		[3] 34.25
1913	1						2.00	.60		[3] 38.00
1913	1						2.00	.60		[3] 34.00
1913	1						2.00	.60		[3] 36.00
1914	1			.40			.40	.50	.90	39.00
1914							1.29	.50		[11] 38.60
1914							1.29	.50		[11] 34.38
1914							1.29	.50		[11] 40.74

See footnotes at end of table.

TABLE 14.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Cheyenne, Wyo.*[1]—Continued

PEAS

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1900	0							0.77	0.77	[4 30] 7.00
1906	0							.77	.77	[13] 15.83
1906	1						1.50	.77		[14] 17.63
1906	2						3.00	.77		[14] 17.03
1906	2						3.09	.77		[15 31] 15.13
1907	1				0.25		.25	.73	.98	[3] 10.80
1907	0							.73	.73	[3 4] 6.08
1907	0							.73	.73	[3 13] 9.03
1907	0							.73	.73	[3 13] 7.08
1908	1				.27		.27	1.32	1.59	[3] 12.00
1908	0							1.32	1.32	[3 4] 4.00
1908	0							1.32	1.32	[3 13] 7.00
1908	0							1.32	1.32	[3 13] 6.00

POTATOES

1906	0							0.77	0.77	[4] 77.00
1906	0							.77	.77	[13] 89.80
1906	0							.77	.77	[13] 53.20
1906	1						1.50	.77		[14] 82.50
1906	2						3.00	.77		[14] 82.50
1907	2				0.24	0.29	.53	.73	1.26	101.50
1907	0							.73	.73	[4] 51.50
1907	0							.73	.73	[13] 91.00
1907	0							.73	.73	[13] 86.20
1907	1						4.00	.73		[14 3] 69.30
1908	3			0.29	.18	.31	.78	1.32	2.10	[3] 120.00
1908	0							1.32	1.32	[3 4] 94.30
1908	0							1.32	1.32	[3 13] 109.60
1908	0							1.32	1.32	[3 13] 84.70
1908	2						5.00	1.32		[3 14] 86.30
1909							.71	.80	1.51	[33] 140.00
1909	0							.80	.80	[4] 63.00
1909	0							.80	.80	[13] 51.00
1909	0							.80	.80	[13] 75.00
1909	2						4.00	.80		[14 6] 42.00
1909	0							.80	.80	[13] 61.00
1910	5	0.34			.23	.26	.88	.60	1.48	[33 34] 72.00
1910	0							.60	.60	[4 34] 7.00
1910	0							.60	.60	[13] 96.00
1910	0							.60	.60	[13] 105.00
1910	1						2.50	.60		[4 34] 72.00
1912	3				.31	.38	.69	.59	1.28	[35]
1912	0							.59	.59	[4 35]
1912	0							.59	.59	[4 35]
1913	4						1.04	.60	1.64	30.00
1913	0							.60	.60	[4] 25.00
1913	0							.60	.60	[13 35 13]
1913	0							.60	.60	[13 35 13]
1913							2.60	.60		[31] 30.00
1914	0							.80	.80	[4] 20.00
1914							1.29	.50		[33] 43.30

RYE

1906	0							0.77	0.77	[4 37 38] 9.71
1906	0							.77	.77	[4] 25.07
1906	0							.77	.77	[13 38] 8.77
1906	0							.77	.77	[13] 22.25
1906	0							.77	.77	[13] 14.32
1906	0							.77	.77	[13] 16.85
1906	1						1.50	.77		[14] 14.11
1908	1						1.50	.77		[3 14] 8.97
1913	0							.60	.60	[4 39 40]
1914	1			0.26			.26	.50	.76	19.10
1914	0							.50	.50	[4] 10.40
1914	0							.50	.50	[4 41]

See footnotes at end of table.

TABLE 14.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Cheyenne, Wyo.*[1]—Continued

SLENDER WHEATGRASS

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1909	0							0.80	0.80	[4 42] 1.22
1910	0							.60	.60	[4 43] .50

WHEAT

										Bushels
1906	2				0.50		0.50	0.77	1.27	[41] 30.00
1907	2				.50		.50	.77	1.27	[30] 22.57
1908	2				.50		.50	.77	1.27	25.33
1901	0							.77	.77	[13] 27.42
1906	0							.77	.77	[13] 23.09
1906	0							.77	.77	[13] 22.19
1905	0							.77	.77	[13] 23.27
1905	0							.77	.77	[13] 21.60
1906	0							.77	.77	[13] 22.40
1906	0							.77	.77	[13] 22.40
1906	1						1.50	.77		[14] 22.53
1906	1						1.50	.90		[14 43 45] 19.83
1909	1						1.50	.77		[14] 20.83
1906	2						3.00	.77		[14] 23.20
1909	2						3.00	.77		[14] 18.10
1906	2						3.00	.77		[14] 16.77
1906	2						3.00	.77		[14] 20.37
1907	1							.73		[47 45] 16.00
1907	0							.73	.73	[4 45] 3.00
1907	0							.77	.77	[13 45 46 47] 7.00
1907	0						(14)	[44] .77	.77	[45 46] 7.50
1907	1						4.00	.73		[14 45] 10.41
1908	2			0.27			.77	1.33		[45 49] 32.23
1908	0						.00	1.33	1.33	[13 46] 6.40
1908	0						.00	1.33	1.33	[13 46] 13.12
1908	2						4.25	1.32		[14] 14.00
1908	2						4.25	1.32		[14] 10.40
1909	2						.69	1.07	1.69	[46 50] 38.50
1909	0							1.07	1.07	[46 52]
1909	2						4.00	.80		[5 6] 8.00
1909	2						4.00	.80		[6 6] 16.80
1909	0							.80	.80	[13] 11.50
1910	3			0.53			.80	.58	1.28	[11 49 61] 23.00
1910	0							.58	.58	[1 49]
1910	0							.58	.58	[13 46] 6.50
1910	0							.58	.58	[13 46] 5.50
1910	0							.41	.41	[13] 2.50
1910	0							.41	.41	[13] 2.00
1910	1						2.50	.41		[5] 13.50
1910	1						2.50	.41		[5] 18.00
1911							1.14	.53	1.67	48.00
1911	0							.53	.53	[4] 5.00
1912	3			.33	.32		.87	.70		[11 46 53] 46.50
1912	0							.70	.70	[1 45 54]
1912	0							.70	.70	[1 45 54]
1912	0							.70	.70	[1 46 55]
1912	0							.70	.70	[1 46 55]
1912	0							.59	.59	[13] 11.30
1912	0							.59	.59	[13] 14.13
1912	0							.59	.59	[4] 21.00
1912	0							.59	.59	[4] 13.00
1913	3			.45			.91	.65		[11 46] 35.00
1913	4			.54	.51	0.21	.06	.60	1.36	[58] 40.00
1913	0							.60	.60	[13 57] 13.00
1913	0							.60	.60	[4 46] 7.00
1913	0							.60	.60	[13 58] 4.00
1913	0							.60	.60	[13 46] 3.50
1913							2.54	.60		[11] 33.50
1913	1						2.00	.60		[5] 14.50
1913	1						2.00	.66		[5 46] 11.20
1913	1						2.00	.60		[5] 22.00
1913	1						2.00	.60		[5] 17.00
1913	1						2.00	.60		[5] 29.00
1913	1						2.00	.60		[5] 14.50
1911	3			.57	.43		1.00	.56	1.56	[46] 39.00
1914	0							.50	.50	[4] 3.00
1914	0							.58	.58	[13 46 59]

See footnotes at end of table.

TABLE 14.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Cheyenne, Wyo.*[1]—Continued

WHEAT—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1914	0							0.56	0.56	[13] [16] [24]
1914							1.99	.50		[11] 19.70
1911							1.29	.50		[11] 21.00
1911							1.29	.50		[11] 18.60
1911	1						1.00	.50		[4] 17.00
1911	1						1.00	.50		[4] 20.50

[1] The Cheyenne Experimental Farm was operated by the Bureau of Public Roads in cooperation with the State of Wyoming, for the purpose of making experiments in supplemental irrigation with small water supplies, in conjunction with the farms at Newcastle, Wyo., and Eads, Colo., at representative points on the cropland plains east of the Rockies. The farm was located about 15½ miles east of Cheyenne, and consisted of two separate tracts. There was no uniformity in size of plots, many containing fractions of an acre and some being 4 to 5 acres in size. The soil is not uniform and contains much gravel. The north farm contains some clay, but sandy loam predominates. The subsoil of both tracts is open, and does not hold moisture well, the water draining through to the creek below. In all cases where the total irrigation water applied is more than the sum of the monthly amounts indicated the difference is due to winter irrigation.

[2] This and following items to footnote 7 from O. E. S. Circ. 95 (22).
[3] Damaged by hail.
[4] Continuously cropped, dry farmed.
[5] Fall irrigation.
[6] Spring irrigation.
[7] This and following items to footnote 9 from unpublished report Cheyenne Experimental Farm.
[8] Damaged by hail and frost.
[9] This and following items to footnote 12 from unpublished report, Cheyenne Experimental Farm.
[10] Inclement weather prevented cutting third crop.
[11] Includes one fall irrigation.
[12] This and following items to footnote 15 from O. E. S. Circ. 92 (5).
[13] Summer fallowed.
[14] Winter irrigation.
[15] This and following items to footnote 16 from O. E. S. Circ. 95 (22).
[16] This and following items to footnote 18 from unpublished report Cheyenne Experimental Farm.
[17] Injured by frost.
[18] This and following items to footnote 20 from unpublished report Cheyenne Experimental Farm.
[19] Damaged by gophers.
[20] This and following item to footnote 22 from O. E. S. Circ. 95 (22).
[21] Average of two seasons.
[22] This and following items to footnote 23 from unpublished report, Cheyenne Experimental Farm.
[23] This and following items to footnote 24 from O. E. S. Circ. 96 (23).
[24] This and following items to footnote 26 from unpublished report Cheyenne Experimental Farm.
[25] Growth retarded by Russian thistle.
[26] This and following items to footnote 27 from O. E. S. Circ. 95 (22).
[27] This and following items to footnote 30 from unpublished report, Cheyenne Experimental Farm.
[28] Rodents destroyed grain.
[29] Crop failure.
[30] O. E. S. Circ. 92 (6) is source of information of this and following items to footnote 32.
[31] Slightly damaged by intertillage implement.
[32] This and following items to footnote 33 from O. E. S. Circ. 95 (22).
[33] This and following items to footnote 37 from unpublished report Cheyenne Experimental Farm.
[34] Injured by bugs, etc.
[35] Injured by disease, rodents, etc.
[36] Crop hardly worth harvesting.
[37] This and following items to footnote 39 from O. E. S. Circ. 92 (6).
[38] Damaged by wind and hail.
[39] This and following items to footnote 42 from unpublished report Cheyenne Experimental Farm.
[40] 0.85 ton hay.
[41] 0.46 ton hay.
[42] This item from O. E. S. Circ. 95 (22).
[43] This item from unpublished report Cheyenne Experimental Farm.
[44] This and following items to footnote 50 from O. E. S. Circ. 92 (5).
[45] Partially winter killed.
[46] Winter wheat; March rainfall added.
[47] Partially irrigated.
[48] Partially damaged by hail.
[49] One winter irrigation.
[50] This and following items to footnote 51 from O. E. S. Circ. 95 (22).
[51] This and following items to footnote 53 from unpublished report, Cheyenne Experimental Farm.
[52] Completely winter killed, lack of moisture.
[53] This and following items to end from unpublished report Cheyenne Experimental Farm.
[54] Yield too small to record.
[55] Practically all winter killed on account of lack of moisture.
[56] Including appreciable loss.
[57] Received some run-off from adjacent plot.
[58] Unfavorable field conditions.
[59] Plants dried up.

TABLE 15.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Laramie, Wyo.*[1]

ALFALFA

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1896	2	.....	0.67	0.52	.....	.....	1.09	0.40	1.49	2.33	6
1898	4	.....	1.16	.85	0.40	0.56	2.97	.38	3.35	[2] 1.11	6
1898	5	.....	1.57	.81	.....	.22	2.60	.38	2.98	4.33	6
1899	.....	.....	.....	.....	.....	.....	2.14	.42	2.56	2.76	15
1900	.....	.....	.....	.....	.....	.....	2.38	.42	2.80	3.11	15
1901	.....	.....	.....	.....	.....	.....	1.25	.52	1.77	2.85	15
1901	.....	.....	.....	.....	.....	.....	1.37	.52	1.89	4.63	15
1901	.....	.....	.....	.....	.....	.....	1.76	.52	2.28	2.80	15
1901	.....	.....	.....	.....	.....	.....	2.06	.52	2.58	4.36	15
1901	.....	.....	.....	.....	.....	.....	1.77	.52	2.29	4.74	15
1901	.....	.....	.....	.....	.....	.....	1.87	.52	2.39	5.77	15
1901	.....	.....	.....	.....	.....	.....	1.21	.52	1.73	4.23	15
1902	.....	.....	.....	.....	.....	.....	2.20	.36	2.56	3.75	15
1902	.....	.....	.....	.....	.....	.....	1.76	.36	2.12	2.42	15
1902	.....	.....	.....	.....	.....	.....	1.52	.36	1.88	3.85	15
1902	.....	.....	.....	.....	.....	.....	1.63	.36	1.99	3.21	15
1902	.....	.....	.....	.....	.....	.....	3.22	.36	3.58	2.20	15
1902	.....	.....	.....	.....	.....	.....	2.69	.36	3.05	2.74	15
1902	.....	.....	.....	.....	.....	.....	3.12	.36	3.48	3.22	15
1903	.....	.....	.....	.....	.....	.....	2.04	.60	2.64	2.22	15
1903	.....	.....	.....	.....	.....	.....	1.36	.60	1.96	3.64	15
1903	.....	.....	.....	.....	.....	.....	2.13	.60	2.73	4.79	15
1903	.....	.....	.....	.....	.....	.....	1.67	.60	2.27	2.52	15
1903	.....	.....	.....	.....	.....	.....	1.45	.60	2.05	3.82	15
1903	.....	.....	.....	.....	.....	.....	2.06	.60	2.66	4.74	15
1903	.....	.....	.....	.....	.....	.....	1.86	.60	2.46	2.27	15
1903	.....	.....	.....	.....	.....	.....	1.41	.60	2.01	1.99	15
1903	.....	.....	.....	.....	.....	.....	.61	.60	1.21	2.94	15

BARLEY

										Pounds	
1895	2	.....	0.45	0.76	.....	.....	1.21	0.67	1.88	896	6
1896	2	.....	.....	1.45	.....	.....	1.45	.42	1.87	[3] 1,222	6
1896	2	.....	.....	1.45	.....	.....	1.45	.42	1.87	[4] 1,325	6
1897	2	.....	.95	.64	.....	.....	1.59	.41	2.00	1,927	6
1898	2	.....	.96	.76	.....	.....	1.72	.38	2.10	[3] 751	6
1898	2	.....	.96	.76	.....	.....	1.72	.38	2.10	[4] 627	6
1898	2	.....	1.88	.82	.....	.....	2.70	.38	3.08	1,392	6
1899	.....	.....	.....	.....	.....	.....	1.90	.42	2.32	241	15

BROME GRASS

1898	3	.....	1.75	0.81	.....	0.42	2.98	0.38	3.36	(5)	6

CANE, DURRA

1892	1	.....	.....	0.72	.....	.....	0.72	0.58	1.30	.....	6

CORN

1892	1	.....	.....	0.33	.....	.....	0.33	0.58	0.91	(5)	6

FLAX

1897	2	.....	0.95	0.64	.....	.....	1.59	0.41	2.00	2,104	6

See footnotes at end of table.

TABLE 15.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Laramie, Wyo.*[1]—Continued

NATIVE HAY

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds*	*Reference No.*
1898							4.00	0.38	4.38		6

OATS

1896	2			1.45			1.45	0.42	1.87	[3] 1,345	6
1896	2			1.45			1.45	.42	1.87	[4] 1,520	6
1896	1			.96			.96	.40	1.36	542	6
1898	3		0.83	.83	0.24		1.90	.38	2.28	1,688	6
1898	3		1.18	1.40			2.58	.38	2.96	698	6
1898	2		2.57	1.12			3.69	.38	4.07	1,034	6
1898	2		.76	.48			1.24	.40	1.64	1,555	6
1897	2		.95	.64			1.59	.41	2.00	1,182	6
1897	2		1.62	.84			2.46	.41	2.87	[4] 1,662	6
1897	2		1.62	.84			2.46	.41	2.87	[7] 1,456	6
1898	2		.90	.78			1.72	.38	2.10	[3] 1,578	6
1898	2		.90	.78			1.72	.38	2.10	[4] 1,303	6
1898	2		.81	.93			1.74	.38	2.12	[6] 992	6
1898	2		.81	.93			1.74	.38	2.12	[7] 530	6
1899							2.27	.42	2.69	560	15
1900							.57	.60	1.17	[1] 732	15
1899							.84	.42	1.26	491	15
1899							1.38	.42	1.80	446	15
1899							2.14	.42	2.56	567	15
1903							.00	.60	.60	560	15
1903							.25	.60	.85	890	15
1903							.50	.60	1.10	950	15
1903							.75	.60	1.35	1,500	15
1903							1.00	.60	1.60	1,470	15
1903							.50	.60	1.10	1,110	15
1903							1.50	.60	2.10	1,550	15
1903							2.00	.60	2.60	1,840	15
1903							3.00	.60	3.60	1,910	15
1903							1.50	.00	2.10	1,760	15

OATS AND VETCH

1898	3		0.92	0.39	0.27		1.58	0.38	1.96	5,563	6

PEAS

1898	3		1.66	1.20			2.86	0.38	3.24	828	6

PEAS AND BEANS

1892	1		0.41				0.41	0.58	0.99	*Bushels* 7	6

POTATOES

										Pounds	
1895	1	0.27					0.27	0.68	0.95	9,000	6
1896	1				0.32		.32	.40	.72		6
1897	2			0.45	.15		.60	.41	1.01		6
1898	3			1.02	.12		1.14	.40	1.54	[3] 8,759	6
1898	3			1.02	.12		1.14	.40	1.54	[4] 5,591	6
1898	2			.17	.13		.30	.38	.68	[3] 4,972	6
1898	2			.17	.13		.30	.38	.68	[4] 5,290	6
1899							1.07	.42	1.49	3,070	15

See footnotes at end of table.

TABLE 15.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Laramie, Wyo.*[1]—Continued

POTATOES—Continued

Year	Number of irrigations	Monthly application of water: May	June	July	Aug.	Sept.	Total quantity of water received by crop: Irrigation	Rainfall	Total	Yield per acre	Literature cited (see p. 130)
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds*	*Reference No.*
1899							0.12	0.30	0.42	588	15
1900							.30	.30	.49	1,302	15
1900							.54	.30	.84	2,321	15
1903							1.01	.60	1.61	4,347	15
1903							.56	.60	1.06	5,521	15
1900							.12	.30	.42	1,176	15
1900							.30	.30	.60	2,330	15
1901							.53	.30	.83	3,059	15
1901							1.12	.52	1.91	3,582	15
1901							.69	.52	1.21	6,056	15
1901							4.01	.52	4.50	5,432	15
1902							.25	.36	.61	4,220	15
1902							.50	.36	.86	7,110	15
1902							.77	.36	1.11	11,550	15
1902							1.00	.36	1.36	5,110	15
1902							1.25	.36	1.61	1,020	15
1902							1.50	.36	1.86	4,700	15
1902							2.00	.36	2.36	4,730	15
1902							2.50	.36	2.86	4,510	15
1902							3.00	.36	3.36	4,540	15
1902							3.50	.36	3.86	3,780	15
1902								.36	.36	2,825	15
1902							.25	.36	.61	3,790	15
1902							.50	.36	.86	4,175	15
1902							.77	.36	1.11	4,310	15
1902							1.00	.36	1.36	4,420	15
1902							1.25	.36	1.61	4,090	15
1902							1.50	.36	1.86	3,350	15
1902							2.00	.36	2.36	2,170	15
1902							2.50	.36	2.86	2,310	15
1903							.25	.60	.85	1,840	15
1903							.50	.60	1.10	9,640	15
1903							1.01	.60	1.61	7,270	15
1903							.70	.60	1.10	6,960	15

RUTABAGAS

1892	3						0.82	0.58	1.40	*Tons* 18.00	6

RYE

1897	2		0.95	0.44			1.52	0.48	2.00	*Pounds* 1,518	6
1898	2		.63	.04			1.03	.58	1.71	556	6

SUGAR BEETS

1892	3						0.82	0.58	1.40	*Tons* 8.60	6

SUGAR BEETS AND RUTABAGAS

1898	2			1.46	0.44		1.00	0.38	1.98	*Pounds* 7,622	6

TURNIPS AND RUTABAGAS

1895	4	0.26	0.61	0.10	1.29		2.59	0.68	3.27	18,000	6
1903							1.09	.60	1.69	25,810	15

[1] See footnotes at end of table.

TABLE 15. *Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Laramie, Wyo.*[1]—Continued

WHEAT

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds*	*Reference No.*
1906	2		0.76	0.48			1.24	0.30	1.54	1,868	6
1907	2			1.45			1.45	.42	1.87	1,967	6
1908	2			1.45			1.45	.42	1.87	1,917	6
1909	1			.86			.86	.49	1.35	628	6
1910	2		1.62	.84			2.46	.41	2.87	[2] 638	6
1911	2		1.62	.84			2.46	.41	2.87	[2] 965	6
1912	2		.96	.76			1.72	.38	2.10	[2] 857	6
1913	2		.96	.76			1.72	.38	2.10	1,527	6
1914	2		.84	.93			1.77	.38	2.12	[2] 841	6
1915	2		.84	.93			1.77	.38	2.12	[2] 930	6
1916	2		1.73	.80	1.32		3.85	.38	4.01	1,573	6
							.92	.72	1.44	965	15
							1.35	.36	1.71	1,486	15
							.78	.66	1.44	839	15

These determinations were made under cooperative agreement between the Bureau of Public Roads and the Wyoming Agricultural Experiment Station, at the experimental farm located about 2 miles west of Laramie. The measurements were made on areas varying from a fraction of 1 acre to 50 acres. The soil of the experimental farm is a sandy loam from 15 inches to over 5 feet deep, largely underlaid with gypsum, carbonate of lime, and sandstone, and is sticky when wet. In many cases no data were available as to the monthly application of water.

[1] Dry year.
[2] Not irrigated.
[3] Subsoiled.
[4] Cut for fodder.
[5] Cultivated.
[6] Good culture.

TABLE 16. *Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Laramie, Wyo.*[1]

BARLEY

Year	Number of irrigations	Monthly application of water			Total quantity of water received by crop			Yield per acre
		June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds*
1902	0				0.00	0.59	0.59	[2] 91.70
1903	1		0.70		.70	.59	1.29	393.00
1905	2		.90		.90	.59	1.49	918.00
1907	3		1.04	0.59	1.63	.59	2.22	1,695.00
1902	4		1.29	1.09	2.20	.59	2.79	1,007.00
1907	6		1.79	1.10	2.89	.59	3.48	1,468.00

FIELD PEAS

								Bushels
1906	7		0.91	0.48	1.91	0.59	2.50	[2] 19.21
1908	1		.64	1.03	1.67	.59	2.26	31.75
1906	4		.97	.51	1.48	.59	2.07	16.56
1908	2		.76		.76	.59	1.35	11.17
1905	1		.43		.43	.59	1.02	6.04
1900	0				.00	.59	.59	3.09

[1] These experiments were conducted by the Wyoming Agricultural Experiment Station. The plots contained from 1.27 to 2.36 acres each. The soil of the experiment farm is a sandy loam from 15 inches to over 5 feet deep, largely underlaid with gypsum, carbonate of lime, and sandstone, and is sticky when wet.
[2] This and following items to footnote 5 from the Wyo. Agr. Expt. Sta. Bul. 77 (38).
[3] This and following items to end from the Wyo. Agr. Expt. Sta. Bul. 72 (37).

TABLE 17.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Laramie, Wyo.*[1]

BARLEY

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds*
1899	10.83	2			1.32	0.58		1.90	0.42	2.32	[2] 240
					OATS						
1890	13.47	2				1.47	0.17	1.64	0.42	2.06	[1] 558
					MIXED GRAINS						
1891	[4] 24.00							2.55	0.51	3.06	(3)
1892	[4] 24.20							1.12	.58	1.70	(3)

[1] These determinations were made cooperatively by the Bureau of Public Roads and the Wyoming Agricultural Experiment Station.
[2] From O. E. S. Bull. 104 (*15*).
[3] From O. E. S. Bull. 81 (*6*). Monthly application of water not recorded.
[4] Approximate.

TABLE 18.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Newcastle, Wyo.*[1]

ALFALFA

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1909	2			0.29	0.96		1.25	0.74	1.99	1.93
1909	0							.74	.74	[2] .35
1910	1			.49			.49	.58	1.07	[2] .75
1910	0							.58	.58	(2 3 4)
1912	5						.61	.66	1.27	1.63
1913	10		0.54	.46	.41	0.95	2.36	.46	2.82	3.10
					BARLEY					
										Bushels
1909	2				0.75		0.75	0.91	[5] .66	10.00
1909	0							.91	.91	[2] 12.00
1910	1			0.53			.53	.51	1.04	[2] 12.00
1910	0							.51	.51	(2 3 4)
1911	5			.67	.65	0.33	1.65	.33	1.98	[6] 8.35
1911	0							.33	.33	(2 3 6)
1911	0							.33	.33	(4 6 7)
1911	3				.28	.20	.48	.31	.79	(8)
1912	4						1.30	.56	1.86	13.60
1912	0							.48	.48	[7] 4.50
1912	0							.48	.48	[7] 2.20
1912	0							.68	.58	[2] 3.50
1913	5		0.29	.59	.54		1.42	.46	1.88	12.10
1913	0							.41	.41	[7] 3.10
1913	0							.41	.41	2.90
1913	5			.53	.88		1.41	.46	1.87	20.00

See footnotes at end of table.

TABLE 18.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Newcastle, Wyo.*[1]—Continued

BEANS

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1909	1			0.51			0.51	1.02	1.53	3.87
1909	0							1.02	1.02	[7] 2.50

CORN

1909	1				0.51		0.51	0.91	1.42	45.06
1909	1				.51		.51	.66	1.17	29.72
1909	0							.91	.91	[7] 21.61
1909	0							.66	.66	[7] 18.72
1909	0							.80	.80	([7] [9])
										Pounds
1911	3			0.15	.17	0.18	.50	.53	1.03	[10] 1,262
1911	0							.53	.53	[7] [10] 750
1912	2						.13	.63	.76	
1912	0							.76	.70	(?)
1912	0							.63	.03	
										Bushels
1913	1	0.02					.02	.44	1.00	9
										Tons
1913	0							.44	.44	[7] [11] 2.87
										Pounds
1913	4		0.09		.41	.43	.93	.44	1.37	[7] [10] 1,224

FIELD PEAS

										Bushels
1909	1				0.30		0.30	0.74	1.04	[12] 3.00
1909	0							.74	.74	[7] [12] 1.00
1909	0							.74	.74	[7] 3.50
1913	0							.41	.41	[7] 4.20

KAFIR CORN

										Tons
1909	1				0.51		0.51	0.66	1.17	[13] 4.05
1909	0							.66	.66	[7] 3.47

MANGEL WURTZEL

1909	1				0.51		0.51	1.02	1.53	14.55
1909	0							1.02	1.02	[7] 9.72

MILLET

										Bushels
1909	0							0.89	0.89	[7] 13.00
										Tons
1911	1					0.30	0.30	.31	.61	[14] 1.11
1911	0							.33	.33	([7] [14])
1913	0							.46	.46	[14] [7] 1.23

See footnotes at end of table.

TABLE 18.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Newcastle, Wyo.*[1]—Continued

OATS

Year	Number of irrigations	Monthly application of water					Total (growing season) received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1909	2			0.72	0.57		0.89	0.91	1.80	37.00
1910	0							.99	.99	[2] 17.00
1911	0							.99	.99	[2] 31.00
1912	1			.43			.11	.74	.85	[2] 19.00
1913	0							.74	.74	(3)
1914	3			.71	.97		1.68	.66	2.34	[4] 16.32
1915	0							.55	.55	[4] 0
1916	0							.53	.53	(3)
1917	1						1.22	.56	1.78	31.90
1918	0							.58	.58	[2] 21.10
1919	0							.78	.78	[2] 7.00
1920	0							.76	.76	24.80
1921	3		0.52	.51	.53		1.56	.46	1.92	31.90
1922	0							.41	.41	[2] 11.20
1923	0							.41	.41	28.80
1924	0							.41	.41	[2] 5.40
1925	0							.41	.41	40.90
1926	2			.80	.71	.79	2.30	.46	2.76	40.90

POTATOES

1914	3				0.51		0.74	0.65	1.39	333.60
1915	0							1.07	1.07	[2] 72.22
1916	0						.19	.76	.95	
1917	0						.00	.76	.76	
1918	3			.55	.73	0.44	1.72	.51	2.23	40.00

PUMPKINS

										Tons
1909	1				0.51		0.51	1.02	1.53	5.35
1910	0						.00	1.02	1.02	[2] 6.01

RYE

										Bushels
1909	0							0.76	0.76	[2] 15.00
1910	0							.18	.18	[2] 5.00
1911	0							.11	.11	[2] 1.10
1912	0							.19	.19	[2] 1.36

SUGAR BEETS

										Tons
1909	1				0.51		0.71	1.02	1.53	13.20
1910	0							1.02	1.02	[2] 11.02

WHEAT

										Bushels
1909	2			0.72	0.57		1.09	0.91	2.00	24.00
1910	2			.02	.50		1.52	.91	2.23	27.00
1911	0							.91	.91	[2] 7.00
1912	0							.91	.91	[2] 10.00
1913	0							.93	.93	[2] [5] 17.00
1914	0							.93	.93	[2] [5] 13.50
1915	0							.93	.93	[2] [5] 21.00
1916	1			.37			.37	.51	.88	[2] 10.00
1917	0							.51	.51	(3) [6]

See footnotes at end of table.

TABLE 18.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Newcastle, Wyo.*[1]—Continued

WHEAT—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
[illegible]	3			[illegible]	[illegible]	0.30	1.18	0.73	[illegible]	[2] 23.46
[illegible]	0							.33	.33	(4)
1912	1						1.22	.56	1.78	21.67
[illegible]	1						[illegible]	.58	1.16	[2] 26.33
1912	0							.48	.48	[7] 3.33
1912	0							.83	.83	[2,17] 9.80
1912	0							.73	.73	[2,17] 11.28
1912	0							.78	.78	[7] 3.70
1912	0							.78	.78	1.87
1912	0							.78	.58	[2] 3.73
[illegible]	0							.58	.58	[2] 15.03
[illegible]	1		[illegible]				[illegible]	.41	[illegible]	3.20
1913	0							.56	.56	[7] 5.70
[illegible]	0							.56	.56	[7] 2.80
1913	2						[illegible]	.50	[illegible]	37.30
[illegible]	0							.41	.41	[2] 4.60

[1] These experiments were conducted by the Bureau of Public Roads in cooperation with the State of Wyoming. The farm was located 5 miles northeast of Newcastle, Wyo. The plots were of varying sizes, most of them containing 1 acre or less. This farm and those at Cheyenne, Wyo., and Akron, Colo., were located at representative points on the Great Plains for the purpose of experimenting with the use of small water supplies. The soil of the experiment farm is of a clayey alluvial character, containing sufficient sand to pulverize readily when dry. The data are from an unpublished report of the Bureau of Public Roads.
[2] Continuously cropped, dry farmed.
[3] Damaged by frost.
[4] No harvest.
[5] 270 pounds.
[6] Injured by hail.
[7] Summer fallowed.
[8] 1,976 pounds hay.
[9] 2.47 tons.
[10] Corn on cob.
[11] Fodder only.
[12] Yield damaged by wind after harvesting and before threshing.
[13] Did not ripen; cut for fodder.
[14] Hay.
[15] Fall rye; March rainfall included.
[16] Grain lost by wind and birds.
[17] Winter wheat; March rainfall included.
[18] Partially winterkilled.
[19] Damaged by smut.

TABLE 19.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Wheatland, Wyo.*[1]

ALFALFA

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1898		6	0.71		0.44	0.84	0.41	0.20	2.60	0.15	2.75	7.88	6

BARLEY

Year	Area irrigated	Number of irrigations	Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	Yield per acre	Literature cited (see p. 110)
												Pounds	
1898		3			0.68	0.23			0.91	0.15	1.06	864	6

See footnotes at end of table.

TABLE 19.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Wheatland, Wyo.*—Continued

CORN

Year	Area irrigated	Number of irrigations	Monthly application of water: Apr.	May	June	July	Aug.	Sept.	Total quantity of water received by crop: Irrigation	Rainfall	Total	Yield per acre	Literature cited (see p. 110)
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds*	*Reference No.*
1883		3				0.60	0.40		1.00	0.15	1.24	3,189	6

FLAX

1893		3			1.31	0.87			2.18	0.15	2.33	701	6
1893		3			1.31	.87			2.18	.15	2.33	480	6

OATS

												Bushels	
1889	123.7	3			0.60	1.83	0.18		2.61	0.84	3.45	[1] 40	6
1891	150.0	1							1.45	.29	1.74	[1] 40	6
												Pounds	
1893		4			1.40	.37			1.77	.15	1.92	1,603	6
1893		4			.90	.67			1.57	.15	1.72	1,324	6
												Bushels	
1900	25.0	2				1.73			1.73	.24	1.97	30	26

POTATOES

1889	7.0					1.00			1.00	0.84	1.90	150	6
												Pounds	
1893		6			0.20	.72	0.50		1.42	.15	1.57	7,344	6
												Bushels	
1900	10.0	3					3.63		3.63	.24	3.87	80	26

RYE

												Pounds	
1893		3			1.29				1.29	0.15	1.44	974	6
1893		2			.88				.88	.15	1.03	739	6

SUGAR BEETS

												Tons	
1893		5			1.22	1.24			2.46	0.15	2.61	6.40	6

TIMOTHY

1893		5		1.00	1.35				2.35	0.15	2.50	1.11	6

WHEAT

												Pounds	
1893		4			1.34	0.27			1.61	0.15	1.76	1,982	6
1893		2			.94				.94	.15	1.09	486	6

[1] These determinations were made under cooperative agreement between the Bureau of Public Roads and the Wyoming Agricultural Experiment Station, at the Wheatland substation. The measurements were made on areas varying from a fraction of 1 acre to 50 acres. The soil of the substation experimental farm is a sandy loam, deep, underlaid with gypsum, carbonate of lime, and sandstone.

[2] Part damaged by hail.

[3] Approximate.

TABLE 20.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Cache La Poudre Valley, Colo.*[1]

ALFALFA

Year	Area irrigated	Number of irrigations	Total quantity of water received by crop			Yield per acre	Year	Area irrigated	Number of irrigations	Total quantity of water received by crop			Yield per acre
			Irrigation	Rainfall	Total					Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Tons*		*Acres*		*Feet*	*Feet*	*Feet*	*Tons*
1916	5.94	2	0.74	0.61	1.35	1.40	1916	16.30	4	3.48	0.61	4.09	2.07
1916	42.82	2	.69	.61	1.30	1.40	1916	22.00	4	2.82	.61	3.43	3.18
1916	20.28	2	2.10	.61	2.71	3.20	1916	18.52	3	1.24	.61	1.85	2.11
1916	38.81	3	1.51	.61	2.12	4.10	1916	12.02	4	1.68	.61	2.29	2.12
1916	15.00	3	2.40	.61	3.10	3.76	1916	42.08	4	2.54	.61	3.15	2.21
1916	22.04	1	.02	.61	1.23	3.07	1916	8.25	2	1.60	.61	2.21	2.15
1916	23.00	2	1.41	.61	2.02	2.72	1916	26.68	3	1.50	.61	2.11	3.26
1916	8.35	2	1.56	.61	2.27	2.72	1917	43.00	2	1.00	.83	1.83	2.50
1916	50.58	3	1.52	.61	2.13	3.04	1917	27.00	3	2.08	.83	2.91	3.63
1916	27.54	2	1.14	.61	1.75	2.53	1917	29.50	2	2.04	.83	2.87	3.85
1916	11.58	3	1.95	.61	2.56	2.14	1917	17.15	5	1.46	.83	2.29	4.01
1916	5.87	2	1.16	.61	1.77	2.23	1917	43.50	3	2.20	.83	3.03	1.80
1916	8.78	2	.85	.61	1.46	1.68	1917	11.90	3	2.25	.83	3.08	3.80
1916	8.16	2	.78	.61	1.39	3.97	1917	5.21	2	1.60	.83	2.43	2.50
1916	11.62	3	1.42	.61	2.03	3.21	1917	9.20	3	3.65	.83	4.48	2.07
1916	8.67	2	2.05	.61	2.66	3.91	1917	48.30	5	3.57	.83	4.40	2.70
1916	19.74	3	1.72	.61	2.33	1.52	1917	18.00	4	4.11	.83	4.94	5.60
1916	33.85	3	1.53	.61	2.14	3.56	1917	25.00	7	13.59	.83	14.42	2.40
1916	7.46	2	1.36	.61	1.97	3.06	1917	22.30	3	7.09	.83	7.92	2.40
1916	35.70	3	1.07	.61	1.68	1.30	1917	14.52	2	2.40	.83	3.23	3.35
1916	11.72	1	1.43	.61	2.04	2.29	1917	5.11	2	3.50	.83	4.33	2.84
1916	11.80	1	1.31	.61	1.92	2.20	1917	64.10	5	4.94	.83	5.77	2.40
1916	9.18	3	2.57	.61	3.46	1.20	1917	30.60	4	3.42	.83	4.25	4.40
1916	51.61	2	2.12	.61	2.73	2.70	1917	10.10	2	3.81	.83	4.64	2.97
1916	18.58	1	3.49	.61	4.10	5.90	1917	40.00	2	1.13	.83	1.96	3.35
1916	28.40	3	8.72	.61	9.33	3.60	1917	15.00	3	2.07	.83	2.90	2.10
1916	7.92	3	1.37	.61	1.98	3.20	1917	32.15	3	4.24	.83	5.07	1.78
1916	14.31	3	1.88	.61	2.49	2.50	1917	20.55	3	1.04	.83	1.87	3.49
1916	68.38	6	6.73	.61	7.34	2.40	1917	16.22	3	1.26	.83	2.09	2.26
1916	30.60	4	3.18	.61	3.79	3.82	1917	11.03	5	2.81	.83	3.64	1.92
1916	10.10	3	4.13	.61	4.74	1.90	1917	12.02	2	.91	.83	1.74	1.57
1916	5.22	3	1.42	.61	2.03	2.00	1917	17.05	4	.81	.83	1.64	0.96
1916	5.48	3	1.33	.61	1.94	2.00	1917	36.26	3	2.73	.83	3.56	2.60
1916	33.00	1	.54	.61	1.15	3.70	1917	32.55	3	1.58	.83	2.41	2.84
1916	20.10	1	.56	.61	1.17	2.45	1917	6.25	3	2.42	.83	3.25	2.85
1916	33.00	2	1.37	.61	1.98	3.24	1917	1.61	1	.87	.83	1.70	5.15
1916	20.55	4	3.99	.61	4.60	2.59	1917	16.80	1	.52	.83	1.35	2.10

WHEAT

						Bush.							*Bush.*
1916	40.79	1	0.80	0.61	1.41	43.70	1916	20.39	2	2.81	0.61	3.42	33.00
1916	29.88	1	1.79	.61	2.40	13.70	1916	15.36	1	.17	.61	.78	51.39
1916	7.68	2	2.32	.61	2.93	26.20	1916	7.39	1	1.30	.61	1.91	50.30
1916	8.22	2	1.55	.61	2.16	23.80	1917	11.93	1	1.00	.83	1.83	34.00
1916	13.00	2	2.09	.61	2.70	9.40	1917	58.60	1	.82	.83	1.65	22.00
1916	15.12	2	.95	.61	1.56	15.70	1917	50.00	1	.98	.83	1.81	33.30
1916	58.60	1	.60	.61	1.21	26.40	1917	5.00	1	1.07	.83	1.90	40.00
1916	42.00	1	.44	.61	1.05	27.00	1917	11.61	1	1.03	.83	1.86	43.60
1916	20.30	1	.72	.61	1.33	27.20	1917	9.56	1	.84	.83	1.67	29.30
1916	10.55	1	.77	.51	1.38	33.20	1917	4.60	1	1.63	.83	2.46	37.00
1916	3.00	1	.60	.61	1.21	33.30	1917	12.45	1	2.71	.83	3.54	42.40
1916	9.59	1	.74	.61	1.35	33.40	1917	15.36	1	.83	.83	1.66	46.70
1916	14.05	2	.89	.61	1.50	31.00							

OATS

1916	17.10	2	1.33	0.61	1.94	70.00	1917	12.50	1	0.60	0.83	1.43	28.00
1916	9.51	1	.80	.61	1.41	20.80	1917	14.60	2	1.10	.83	1.93	29.70
1916	10.56	1	1.41	.61	2.02	72.90	1917	8.90	2	2.44	.83	3.27	77.80
1916	16.10	4	3.09	.61	3.67	65.20	1917	8.54	1	1.07	.83	1.90	76.50
1916	12.50	1	1.39	.61	2.00	53.30	1917	11.60	2	2.37	.83	3.20	62.60
1916	6.76	1	.50	.61	1.21	42.90	1917	5.20	2	1.67	.83	2.50	70.40
1917	10.10	2	2.01	.83	2.84	61.00	1917	9.61	2	.66	.83	1.49	56.70
1917	33.30	1	.70	.83	1.53	23.20							

See footnote at end of table.

TABLE 20.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Cache La Poudre Valley, Colo.*[1]—Continued

BARLEY

Year	Area irrigated	Number of irrigations	Total quantity of water received by crop: Irrigation	Total quantity of water received by crop: Rainfall	Total quantity of water received by crop: Total	Yield per acre	Year	Area irrigated	Number of irrigations	Total quantity of water received by crop: Irrigation	Total quantity of water received by crop: Rainfall	Total quantity of water received by crop: Total	Yield per acre
	Acres		*Feet*	*Feet*	*Feet*	*Bush.*		*Acres*		*Feet*	*Feet*	*Feet*	*Bush.*
1916	15.20	1	0.36	0.61	0.97	39.80	1917	9.20	1	0.65	0.83	1.51	62.20
1916	17.40	1	1.18	.61	1.79	38.10	1917	5.40	1	1.20	.83	1.83	56.50
1916	10.70	1	.70	.61	1.31	36.80	1917	5.20	1	.95	.83	1.80	49.00
1916	13.50	1	.54	.61	1.15	46.10	1917	7.80	2	3.13	.83	3.96	39.70
1916	11.60	1	3.21	.61	3.82	18.50	1917	2.60	1	1.63	.83	2.46	33.30
1916	16.80	2	2.73	.61	3.34	11.30	1917	4.20	1	2.20	.83	3.03	18.20
1916	9.10	1	3.96	.61	4.57	54.50	1917	5.60	1	1.98	.83	2.81	46.60
1916	7.10	1	1.82	.61	2.43	17.20	1917	14.30	1	.85	.83	1.68	63.00
1916	19.30	1	.51	.61	.77	13.30	1917	21.10	2	1.15	.83	1.98	60.00
1916	20.50	1	1.61	.61	1.61	17.00	1917	9.20	1	1.02	.83	1.85	36.30
1916	11.60	1	1.12	.61	1.73	9.50	1917	7.20	1	.87	.83	1.70	16.30
1916	9.80	1	1.33	.61	1.94	33.30	1917	9.60	1	1.08	.83	1.91	46.40
1916	8.10	1	.56	.61	1.17	47.80	1917	7.00	2	1.42	.83	2.25	46.40
1916	10.50	1	1.13	.61	2.04	11.45	1917	4.50	2	.95	.83	1.78	61.40
1916	2.50	1	.78	.61	1.61	16.60	1917	10.20	5	1.00	.83	1.83	52.80

SUGAR BEETS

Year	Area irrigated	Number of irrigations	Total quantity of water received by crop: Irrigation	Total quantity of water received by crop: Rainfall	Total quantity of water received by crop: Total	Yield per acre	Year	Area irrigated	Number of irrigations	Total quantity of water received by crop: Irrigation	Total quantity of water received by crop: Rainfall	Total quantity of water received by crop: Total	Yield per acre
						Tons							*Tons*
1916	15.30	3	1.67	0.61	2.28	12.30	1916	6.09	3	2.87	0.61	3.48	17.10
1916	17.10	3	1.30	.61	1.91	10.30	1916	5.88	3	1.25	.61	1.86	17.10
1916	32.50	3	1.30	.61	1.91	10.50	1916	10.40	3	1.20	.61	2.81	13.00
1916	7.60	3	2.76	.61	3.37	14.85	1916	14.10	3	.70	.61	1.31	13.90
1916	21.80	3	3.12	.61	3.73	17.14	1916	7.30	3	1.91	.61	2.52	13.80
1916	43.00	3	2.33	.61	2.94	17.84	1916	16.20	3	1.11	.83	2.21	14.65
1916	31.74	2	1.85	.61	2.46	9.45	1917	21.50	2	2.30	.83	3.23	18.92
1916	36.20	2	1.11	.61	1.72	9.85	1917	31.20	2	1.02	.83	1.85	11.73
1916	2.30	2	3.43	.61	4.04	9.85	1917	13.12	4	1.17	.83	2.00	11.73
1916	6.12	2	1.10	.61	1.71	9.85	1917	10.37	3	1.09	.83	1.92	4.82
1916	2.60	1	.32	.61	.93	9.85	1917	12.65	4	5.03	.83	5.86	14.80
1916	20.80	4	2.18	.61	2.79	8.10	1917	15.15	5	1.33	.83	2.16	17.20
1916	21.10	4	1.25	.61	1.86	9.30	1917	12.50	5	2.09	.83	2.92	14.80
1916	11.80	3	1.55	.61	2.27	7.70	1917	10.50	5	6.29	.83	7.12	15.00
1916	9.60	4	.62	.61	1.23	15.04	1917	22.60	5	1.71	.83	2.34	15.83
1916	17.20	4	1.87	.61	2.48	15.80	1917	11.40	5	1.65	.83	1.98	15.83
1916	9.20	4	.97	.61	1.58	14.80	1917	7.01	2	.74	.83	1.57	8.15
1916	12.02	4	.71	.61	1.32	9.80	1917	10.00	2	1.43	.83	2.26	14.20
1916	23.60	4	1.58	.61	2.19	11.10	1917	9.27	3	1.35	.83	2.18	12.31
1916	9.90	4	2.15	.61	2.76	11.10	1917	4.02	3	1.15	.83	1.98	8.95
1916	17.50	3	2.73	.61	3.34	6.70	1917	9.30	3	1.26	.83	2.09	10.00
1916	15.30	3	2.22	.61	2.83	11.70	1917	36.56	3	2.07	.83	2.90	12.62
1916	17.60	3	1.38	.61	1.99	11.78	1917	3.71	3	1.38	.83	2.21	10.85
1916	14.74	3	.88	.61	1.49	12.47	1917	10.15	3	1.78	.83	2.61	10.85
1916	11.60	3	2.57	.61	3.18	13.23	1917	6.09	3	2.10	.83	2.93	12.41
1916	11.24	3	1.09	.61	2.26	12.99	1917	5.88	4	2.60	.83	3.43	14.89
1916	1.62	3	1.72	.61	2.33	11.70	1917	19.25	2	.93	.83	1.76	15.42
1916	12.30	3	3.65	.61	4.26	9.91	1917	14.70	3	1.88	.83	2.71	14.80
1916	5.85	3	4.96	.61	5.57	11.24	1917	6.52	2	.70	.83	1.53	9.96
1916	5.41	3	3.79	.61	4.39	11.24	1917	8.81	3	3.69	.83	4.52	9.96
1916	31.74	3	3.40	.61	4.01	11.24							

POTATOES

Year	Area irrigated	Number of irrigations	Total quantity of water received by crop: Irrigation	Total quantity of water received by crop: Rainfall	Total quantity of water received by crop: Total	Yield per acre	Year	Area irrigated	Number of irrigations	Total quantity of water received by crop: Irrigation	Total quantity of water received by crop: Rainfall	Total quantity of water received by crop: Total	Yield per acre
						Bush.							*Bush.*
1916	16.20	3	1.13	0.61	2.01	250.00	1917	11.80	5	2.33	0.83	3.16	204.00
1916	11.60	3	.70	.61	1.37	311.00	1917	11.7	3	1.50	.83	2.33	171.00
1916	5.75	4	1.15	.61	2.05	291.00	1917	17.60	3	1.13	.83	1.96	284.00
1916	31.50	5	2.01	.61	2.62	264.00	1917	3.60	3	3.28	.83	4.11	8.30
1916	4.72	3	1.71	.61	2.12	48.00	1917	7.95	3	1.92	.83	2.75	352.00
1916	9.48	4	1.41	.61	2.02	222.40	1917	3.90	5	.85	.83	1.68	201.60
1916	10.60	5	2.35	.61	2.96	214.00	1917	9.60	5	1.30	.83	2.13	278.00
1916	11.00	5	2.10	.61	2.71	230.00	1917	17.00	6	2.41	.83	3.27	300.00
1916	4.12	5	1.85	.61	2.46	181.00	1917	6.35	5	2.20	.83	3.03	300.00
1916	5.95	5	1.24	.61	1.85	195.00	1917	8.25	5	2.61	.83	3.44	29.00
1916	17.20	5	2.05	.61	2.66	250.00	1917	8.85	6	16.01	.83	17.17	226.00
1916	9.30	4	1.15	.61	1.76	147.00	1917	9.90	5	2.80	.83	3.63	374.00
1916	8.61	4	1.20	.61	1.81	216.00	1917	4.10	5	3.90	.83	4.73	320.00
1917	15.30	3	1.04	.83	1.87	271.00	1917	13.21	3	2.41	.83	3.21	302.00
1917	15.20	4	1.79	.83	2.62	309.00	1917	9.70	2	1.13	.83	1.96	250.00
1917	11.54	4	1.81	.83	2.64	335.00	1917	1.42	2	1.19	.83	2.02	246.00
1917	68.15	3	1.69	.83	2.52	325.00	1917	1.47	2	1.43	.83	2.26	274.00
1917	12.40	3	1.71	.83	2.57	173.00	1917	15.89	3	2.09	.83	2.92	340.00
1917	3.60	3	1.08	.83	1.91	151.00	1917	3.12	2	.74	.83	1.57	93.00

See footnote at end of table.

TABLE 20.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Cache La Poudre Valley, Colo.*[1]—Continued

BEANS

Year	Area irrigated	Number of irrigations	Total quantity of water received by crop			Yield per acre	Year	Area irrigated	Number of irrigations	Total quantity of water received by crop			Yield per acre
			Irrigation	Rainfall	Total					Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Bush.*		*Acres*		*Feet*	*Feet*	*Feet*	*Bush.*
1916	11.70	3	0.85	0.61	1.46	23.80	1917	11.60	2	0.37	0.83	1.20	34.20
1916	33.30	2	.44	.61	1.05	15.80	1917	11.40	3	.81	.83	1.64	27.70
1916	7.28	2	.72	.61	1.33	10.40	1917	20.60	2	.81	.83	1.64	17.20
1916	8.78	4	1.05	.61	1.66	29.30	1917	9.51	4	.51	.83	1.34	29.00
1916	8.10	3	.57	.61	1.18	24.50	1917	17.40	4	.48	.83	1.31	33.30
1916	6.65	2	1.20	.61	1.81	20.00	1917	8.35	5	.96	.83	1.79	30.20
1917	20.30	2	.52	.83	1.35	13.60	1917	8.35	3	.42	.83	1.25	30.20
1917	9.71	2	1.01	.83	1.84	24.40	1917	1.00	3	.34	.83	1.17	27.60
1917	13.01	2	.97	.83	1.80	6.90	1917	8.36	4	.63	.83	1.46	36.20

[1] Measurements on these fields were made under cooperative agreement between the Bureau of Public Roads and the Colorado Agricultural Experiment Station. The soils of these fields are largely fine sandy loams, but include some silt, clay, and gravelly loams. Data from Dept. Bull. 1026 (*25*). All measurements made at Fort Collins.

TABLE 21—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Loveland, Colo.*[1]

SUGAR BEETS

Year	Area irrigated	Number of irrigations	Monthly application of water			Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
			July	Aug.	Sept.	Irrigation	Rainfall	Total		
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1905		1	0.45			0.45	1.12	1.57	[2] 13.92	
1905		2	.76	0.49		1.25	1.12	2.37	[2] 16.87	
1905		3	.58	.38	0.40	1.36	1.12	2.48	[2] 16.78	
1905		4	.79	.85	.48	2.12	1.12	3.24	[2] 17.88	
1905	9	3	1.61	.77	0.51	2.89	1.12	4.01	[2] 13.98	
1906	9	2				2.82	1.21	4.03	[2] 21.13	45
1906		1				.46	1.21	1.67	[2] 17.41	45
1906		2				.94	1.21	2.15	[2] 20.38	45
1906		3				1.35	1.21	2.56	[2] 17.45	45
1906		4				1.69	1.21	2.90	[2] 17.20	45
1905 to 1907		1				.51			[3] 9.67	45
		2				.83			[3] 10.79	45
		3				1.40			[3] 11.78	45
		4				1.62			[3] 12.82	45

[1] These experiments were made cooperatively by the Bureau of Public Roads and the Great Western Sugar Co. The plots each had an area of 0.5 to 1 acre. The soils of these plots are a mixture of clay and silt.

[2] From unpublished report, Bureau of Public Roads.

[3] No data available as to monthly application.

[4] Summary of three years' experiments at Loveland and Rocky Ford. No data available as to monthly application.

TABLE 22.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Greeley, Colo.*[1]

POTATOES

Year	Area irrigated	Number of irrigations	Monthly application of water			Total quantity of water received by crop			Yield per acre [2]
			July	Aug.	Sept.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Sacks*
1906	17.88	4	0.32	0.83	-------	1.15	0.73	1.88	[3] [4] 150
1900	19.70	4	.39	.39	-------	.78	.73	1.51	[4] 130

[1] Measurements made by the Colorado Agricultural Experiment Station. Soil is clay loam about 2½ feet deep, underlaid with gravel.
[2] Data from Colo. Expt. Sta. Bul. 117 (*z*).
[3] Old alfalfa land.
[4] Approximate.

TABLE 23.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Platte Valley, Nebr.*[1]

ALFALFA

Year	Area irrigated	Number of irrigations	Monthly application of water			Total quantity of water received by crop			Yield per acre [2]
			June	July	Aug.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1914	8.0	1	-------	0.55	-------	0.55	1.22	1.77	3.5

CORN

									Bushels
1914	60.0	3	0.42	-------	0.34	0.76	0.98	1.74	53
1914	25.0	2	-------	0.28	.30	.58	1.22	1.80	54
1914	20.0	2	-------	.52	.23	.75	1.22	1.97	40
1914	10.0	2	-------	.33	.61	.94	1.22	2.16	55
1914	35.0	1	-------	.38	-------	.38	.98	1.36	45
1914	3.0	3	-------	-------	-------	.58	1.22	1.80	75
1914	30.0	1	-------	-------	.47	.47	.98	1.45	35

POTATOES

1914	8.0	1	0.57	-------	-------	0.57	1.22	1.79	120
1914	.5	2	-------	0.26	-------	.26	.98	1.24	160
1914	4.0	1	-------	.89	-------	.89	.98	1.87	125
1914	1.0	3	-------	-------	-------	1.77	1.22	2.99	200

SUGAR BEETS

									Tons
1914	37.3	2	-------	0.44	0.44	0.88	0.98	1.86	12.98

[1] These measurements were made by the Bureau of Public Roads on farms irrigated from pumping plants in Platte Valley between Cozad and Kearney. Soils: The soils of these fields are principally silt loams, but include some loams and fine sandy loams. In some cases no data were available as to monthly application of water.
[2] All data from unpublished report of Bureau of Public Roads.

TABLE 24.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crop yields, Monroe, Nebr.*[1]

CUCUMBERS FOR SEED

Year	Area irrigated	Number of irrigations	Monthly application of water		Total quantity of water received by crop			Yield per acre[2]
			July	Aug.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds*
1900	8.46	1	----------	0.56	0.56	0.60	1.16	190
1900	5.65	1	----------	.32	.32	.60	.92	132
1900	5.84	1	----------	.82	.82	.60	1.42	137

ONIONS

								Bushels
1900	3	2	0.71	1.04	1.75	0.60	2.35	42

SQUASH FOR SEED

								Pounds
1900	4.50	2	0.63	----------	0.63	0.60	1.23	270
1900	4.28	2	.32	0.63	.95	.60	1.55	208
1900	4.66	2	.58	.61	1.19	.60	1.79	62
1900	3.83	2	.70	.83	1.53	.60	2.13	261
1900	3.00	2	.53	1.04	1.57	.60	2.17	256

[1] These determinations were made in cooperation with the Western Seed & Irrigation Co. The soil is a rich loam.
[2] All data from O. E. S. Bul. 104 (*49*).

TABLE 25.—*Use of water on crops in the Missouri River Basin, irrigation water applied, rainfall, and crops yields, Oconee, Nebr.*[1]

POTATOES

Year	Area irrigated	Number of irrigations	Total quantity of water received by crop			Yield per acre[2]
			Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Bushels*
1900	5.82	2	2.19	0.91	3.10	82.5
1900	15.97	3	2.11	.91	3.02	84.0

SQUASH FOR SEED

						Pounds
1900	5.00	0	----------	0.91	0.91	56
1900	4.88	----------	2.88	.91	3.77	113

SWEET CORN

						Bushels
1900	30.82	0	----------	0.91	0.91	6.0
1900	48.69	----------	1.76	.91	2.67	15.2

[1] The soil is of a very light, sandy character.
[2] All data from O. E. S. Bul. 104 (*49*).

TABLE 26.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Fort Hays, Kans.*[1]

ALFALFA

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre[2]
		Apr.	May	June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1904	1	1.41					1.41	0.88	2.29	3.40
1904	0							.88	.88	2.60
1904	1				1.13		1.13	.88	2.01	3.04
1904	0						.00	.88	.88	2.76

CORN

										Bushels
1904	1	0.45					0.45	0.88	1.33	51.42
1904	0							.88	.88	47.28
1904	1				0.38		.38	.88	1.26	59.14
1904	0							.88	.88	43.12

KAFIR CORN

1904	1	0.55					0.55	0.88	1.43	42.86
1904	0							.88	.88	44.64
1904	1				0.34		.34	.88	1.22	35.36
1904	0							.88	.88	19.64

PENCILLARIA

1904	1				0.20		0.20	0.88	1.08	14.08
1904	0							.88	.88	7.78

POTATOES

1904	1	0.32					0.32	0.88	1.20	96.84
1904	0							.88	.88	73.76
1904	1			0.08			.08	.88	.96	79.44
1904	0						.00	.88	.88	58.06
1904	1	.32					.32	.88	1.20	106.46
1904	0							.88	.88	65.58
1904	1			.08			.08	.88	.96	74.28
1904	0						.00	.88	.88	62.72

SORGHUM

1904	1	0.25					0.25	0.88	1.13	35.36
1904	0							.88	.88	32.86
1904	1				0.46		.46	.88	1.34	40.00
1904	0							.88	.88	35.70

SUGAR BEETS

										Tons
1904	1	0.48					0.48	0.88	1.36	16.52
1904	0							.88	.88	14.14
1904	1				0.44		.44	.88	1.32	19.57
1904	0							.88	.88	14.36

[1] These studies were carried on cooperatively by this bureau and the Kansas Agricultural Experiment Station at the Fort Hays Branch Experiment Station. The plots contained 2 acres each. The soil is a dark loam with enough sand to make it friable, and quite deep.

[2] All data from O. E. S. Bulletin 158 (*25*).

TABLE 27.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Arkansas Valley, Colo.*[1]

ALFALFA

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1922	24.01	6	———	0.58	0.53	0.40	0.15	0.33	1.99	0.60	2.59	[2] 3.38
1924	20.24	4	0.52	———	.98	.67	———	.43	2.60	.18	2.78	[3] 2.23
1922	36.16	5	.26	———	.46	1.04	.63	———	2.39	.27	2.66	[4] 3.73
1923	50.20	5	———	.11	.33	.32	———	1.50	[17] 2.74	1.86	4.60	[5] 2.27
1924	44.94	5	———	1.18	1.73	———	.17	.90	[17] 4.27	.25	4.52	[3] 4.05
1922	58.98	3	———	.48	.11	.13	1.10	———	1.82	.26	2.08	[4] 3.76
1921	60.98	5	.05	.56	———	———	.01	———	[17] 1.50	1.35	2.85	[4] 1.27
1922	23.40	3	1.08	1.05	———	.28	———	———	2.41	.18	2.59	[3] 2.85
1922	44.76	5	———	.07	.32	.29	.11	———	[17] .84	.45	1.29	[6] 5.09
1923	30.46	5	.06	———	.34	.09	.21	1.24	1.94	1.62	3.56	[3] 3.35
1924	2.58	2	———	———	.16	.67	———	———	.82	.46	1.28	[7] 5.8
1922	4.44	2	———	———	1.11	———	.98	———	2.09	.15	2.24	[8] 1.12
1923	4.50	1	1.74	———	———	———	———	———	1.74	1.37	3.11	[8] 3.49
1924	4.58	4	———	.35	.24	3.06	.26	———	3.91	.33	4.24	[8] 3.64
1922	50.80	6	———	.50	.75	.52	1.50	.63	3.90	.19	4.18	[8] 4.60
1923	66.65	3	1.12	.89	———	———	———	.33	2.34	1.40	3.74	[9] 4.04
1924	89.18	6	.70	.28	.24	.59	.15	———	1.96	.33	2.29	[9] 1.24
1923	32.00	5	1.08	.85	1.47	.05	———	2.20	[16] 5.55	1.10	7.65	[10] 2.25
1924	35.91	6	1.83	———	.93	.77	.25	.91	4.69	.27	4.96	[10 11] 2.68
1922	17.07	3	———	———	.41	.96	———	———	1.37	.39	1.76	[12] 2.06
1924	20.10	4	———	.20	1.63	———	.01	.79	3.12	.04	3.16	[12] 2.29
1922	39.31	5	.31	.41	.34	.13	.16	———	1.35	.52	1.87	[13] 3.34
1923	33.40	6	.19	.82	.78	.96	.64	———	3.39	1.25	4.64	[13] 3.09
1924	24.00	3	———	2.13	.58	———	———	———	2.66	.28	2.94	[13] 4.42
1922	22.76	4	———	.01	1.27	.18	.30	———	1.76	.57	2.33	[14] 5.05
1921	30.15	6	.31	———	1.16	.01	———	.07	[12] 2.60	1.66	4.26	[14] 2.84
1924	30.45	3	———	1.73	.86	———	———	———	[12] 2.97	.21	3.18	[14] 3.06

WHEAT

												Bushels
1924	4.01	3	1.80	———	1.87	———	———	———	3.76	0.27	4.03	[10 15] 36.00
1922	18.29	2	———	1.77	———	———	———	———	1.77	.27	2.04	[3 15] 48.50
1922	32.02	3	———	1.21	.63	———	———	———	1.84	.27	2.11	[3 16] 19.40
1923	38.40	2	———	1.07	1.56	———	———	———	2.63	1.86	4.49	[3 15] 41.05
1924	17.95	2	———	2.11	1.16	———	———	———	3.27	.25	3.52	[3 15] 54.70
1922	20.07	3	———	.62	.24	———	———	———	.86	.26	1.12	[4 15] 43.10
1923	18.53	3	.22	———	.79	———	———	———	[17] 1.39	1.36	2.74	[4 16] 19.70
1922	31.10	3	———	.15	.76	———	———	———	.91	.18	1.09	[5 15] 51.00
1922	15.81	1	———	.49	———	———	———	———	.49	.45	.94	[6 15] 50.20
1923	22.70	2	———	———	.25	———	———	———	[17] .51	1.62	2.13	[6 15] 41.90
1922	40.40	1	———	.79	———	———	———	———	.79	.19	.98	[9 15] 40.00
1923	35.90	3	———	.65	———	———	———	———	[17] 1.62	1.40	3.02	[9 16] 21.50
1924	10.05	2	———	2.20	———	———	———	———	2.20	.33	2.53	[9 15] 40.00
1922	38.62	2	———	.69	.36	———	———	———	1.05	.39	1.44	[12 15] 32.60
1923	12.74	2	———	———	.43	———	———	———	[17] .96	.82	1.78	[12 15] 31.24
1924	13.80	3	———	.51	.51	———	———	———	1.02	.04	1.06	[12 15] 31.20
1922	9.58	2	———	———	1.04	———	———	———	1.64	.52	2.16	[13 16] 26.50
1922	7.55	2	———	.55	.95	———	———	———	1.50	.57	2.07	[14 16] 23.20

BEETS

												Tons
1922	5.72	4	———	0.60	———	0.36	0.78	———	1.85	0.60	2.45	[3] 10.84
1922	22.21	4	———	1.08	0.41	———	.73	———	2.22	.27	2.49	[3] 9.75
1923	18.98	5	0.30	.10	———	———	.62	1.71	2.79	1.86	4.65	[3] 12.16
1924	38.18	5	———	.98	———	1.53	.87	———	3.38	.25	3.63	[3] 12.70
1922	13.48	2	———	.28	.27	———	———	———	.55	.26	.81	[4] 13.12
1922	30.49	5	———	.24	———	.59	.30	———	1.13	.18	1.31	[5] 11.20
1922	13.97	4	———	———	.21	1.15	.82	———	[13] 3.34	.45	3.79	[6] 8.95
1923	7.29	4	———	———	———	.28	.30	.94	1.52	1.62	3.14	[6] 13.50
1924	6.20	6	———	.87	1.63	———	.35	———	2.85	.46	3.31	[7] 12.90
1922	88.60	5	———	———	.51	.14	.40	.94	2.05	.19	2.24	[6] 13.00
1923	112.60	4	.47	———	———	.43	———	.38	[17] 1.52	1.40	2.92	(?)
1924	90.00	6	.43	.14	.83	1.24	1.14	1.91	4.79	.33	5.12	[9] 13.00
1922	19.30	4	———	.76	———	.56	.39	.44	2.15	.39	2.54	[12] 9.38
1924	26.32	6	.34	.11	.45	.30	1.22	———	2.42	.04	2.46	[13] 13.40
1922	22.10	6	.20	.56	.28	.78	.59	.64	3.05	.52	3.57	[13] 13.60
1923	23.24	4	.24	.18	.86	.77	———	———	2.05	1.25	3.30	[13] 14.45
1924	25.18	5	.66	———	1.37	.46	1.03	———	3.52	.28	3.80	[13] 15.75
1922	5.88	6	———	.29	———	.40	.38	.12	1.19	.57	1.76	[14] 16.48
1923	6.42	6	.28	.34	———	.43	.61	———	1.66	1.60	3.26	[14] 11.78
1924	5.31	6	———	———	.74	.83	1.09	1.28	3.94	.21	4.15	[11] 21.19

See footnotes at end of table.

TABLE 27.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Arkansas Valley, Colo.*[1]—Continued

BARLEY

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1922	8.36	2		0.22	0.53				0.75	0.60	1.35	[2] 47.90

CORN

1924	41.28	3			0.38	0.38	0.11		0.87	0.18	1.05	[3] 35.00
1922	15.19	3				.42	.11	0.09	.62	.60	1.22	(4)
1922	25.85	2				.57	.16		.73	.27	1.00	(5)
1923	37.12	3		0.38		.55			[11]1.12	1.86	2.98	(5)
1924	39.86	3				.84	.52		1.36	.25	1.61	[3] 42.80
1923	27.05	3		.21		.72		.01	1.84	1.35	3.19	[6] 30.00
1922	7.09	2			.77	.52			1.29	.45	1.74	[6] 30.00
1923	7.07	2				.14	.65		.79	1.62	2.41	(6)
1924	6.63	5			.66	.54	.11		1.31	.46	1.77	[7] 38.00
1922	8.35	3			1.00	.04	.40		2.04	.15	2.19	(6)
1923	23.90	1					.32		.32	1.37	1.69	[8] 81.60
1924	23.10	4			.25	.95	.40		1.60	.33	1.93	[9] 52.00
1922	38.80	5			.37	1.07	1.28		2.72	.19	2.91	[6] 32.00
1923	31.30	1		.72					.72	1.40	2.12	[9] 40.10
1923	15.08	3		1.00		1.81			2.81	1.10	3.91	[10] 30.00
1924	4.88	2				1.12	.65		1.77	.27	2.04	[10] 25.60
1922	35.91	4			.74		1.50		2.24	.39	2.63	[12] 43.60
1923	50.12	4	0.51			.19	.23	.90	1.83	.82	2.65	[12] 60.00
1924	58.75	4			.33	.28	.55		1.16	.04	1.20	[12] 40.00
1922	14.66	2			.81	.36			1.17	.52	1.69	(12)
1923	15.58	3		.05	.16	.81			1.02	1.25	2.27	[13] 66.00
1924	19.73	4		1.04	1.02		1.06	.06	3.18	.28	3.46	[13] 50.00
1922	2.15	6		.07	.06	.50	.19		.82	.57	1.39	(14)
1923	2.25	6		.78		1.33			2.11	1.60	3.71	[14] 74.60
1924	2.04	4			1.08	.38	.65		2.11	.21	2.32	[14] 62.50

RYE

1924	4.12	1		1.27					1.27	0.18	1.45	[3] 28.70

BEANS

												Pounds
1922	6.28	2				0.56	0.18		0.74	0.60	1.34	[2] 700
1923	5.91	3		0.58		.62			1.20	1.25	2.45	(13)
1924	9.82	6		.45	0.25	.53	.29		1.52	.21	1.73	[14] 1,691

TOMATOES

												Tons
1922	7.09	5		0.11	0.02	0.23	0.42		1.38	0.60	1.98	[2] 1.77
1924	1.79	5		.18	.77		.94		1.89	.46	2.35	[7] 10.05
1922	4.85	10		.28	.07	.30	.42	0.13	1.20	.57	1.77	[14] 12.70
1923	5.91	8		.35	.04	1.10	.18		1.67	1.60	3.27	[14] 8.12
1924	5.86	10		1.17	.71	.75	.54	.35	3.52	.21	3.73	[14] 15.00

OATS

												Bushels
1922	6.67	1			0.74				0.74	0.27	1.01	[3] 53.70
1922	7.07	2	0.38		.15				.53	.45	.98	[6] 52.00
1923	6.34	3	.27		.40	0.16			.83	1.62	2.45	[6] 35.60
1924	12.43	2		0.39	.43				.82	.46	1.28	[7] 73.50
1922	34.65	2		.78	.61				1.39	.19	1.58	[9] 43.00
1923	33.05	1		.68					.68	1.40	2.08	[9] 53.00
1924	70.10	2		.89	.65				1.54	.33	1.87	[9] 40.00
1924	9.65	3		.66	.55				1.21	.27	1.48	[10] 64.00
1922	7.11	1			1.04				1.04	.52	1.56	[15] 49.10
1923	10.45	4	.21	.52	.52				1.25	1.25	2.50	[13] 43.70
1924	8.32	2		1.08	.75				2.43	.28	2.71	(12)

See footnotes at end of table.

TABLE 27.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Arkansas Valley, Colo.*[1]—Continued

CUCUMBERS

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds seed*
1922	15.05	4	.....	.....	0.88	0.92	0.33	.....	2.13	0.26	2.39	[2] 217
1924	8.90	5	.....	.....	.60	.39	.22	.....	1.27	.48	1.75	[3] 232
1922	5.39	6	.....	0.34	.84	.71	.83	.....	2.72	.15	2.87	[4] 175
1924	14.90	5	.....	1.34	.95	.72	.47	.....	3.48	.27	3.75	[5] 435
1924	11.07	5	.....	.10	.78	.58	.97	.....	2.43	.28	2.71	[6] 445
1922	5.90	8	.....	.09	.35	.29	1.04	.....	[7] 2.14	.57	2.71	[8] 170
												Pounds of cucumbers
1923	3.50	7	.....	.03	.08	.39	.22	.....	.72	1.60	2.32	[9] 661

WATERMELONS

												Dollars
1922	1.61	10	.....	0.28	0.08	0.08	0.11	.....	0.55	0.57	1.12	[10] 186
1923	1.95	8	0.46	.03	.27	.45	.08	.....	1.29	1.60	2.89	[10]
												Tons
1924	1.72	9	.....	1.24	.46	.31	.54	.....	2.55	.21	2.76	[11] 10

ONIONS

1922	11.13	6	.....	0.22	0.62	0.91	0.51	.....	2.26	0.15	2.41	[6] 1.44
1922	2.24	6	.....	.34	.37	.46	.12	.....	1.29	.57	1.86	[12] 10.18
1923	4.00	9	0.15	.20	.....	.57	.....	.....	[13] 1.11	1.60	2.71	[11] 4.38
1924	.74	4	.....	.99	.47	.....	.53	.....	1.99	.21	2.20	[14] 6.05

[1] These experiments were carried on under a cooperative agreement between the Colorado Agricultural Experiment Station, the United States Department of Agriculture, and the American Beet Sugar Co. Except for the farm of the sugar company, all the tracts chosen were privately owned. These farms are located at various points along the Arkansas Valley from Avondale to Lamar. The areas given for the fields were determined from a plane table survey made each year. The irrigation water was first measured through the farmer's short box flume, but it was found that the results could not be depended upon, due to the large amount of silt carried by the water. When necessary, improved Venturi flumes were installed later. Recording instruments were used at every farm. The rainfall given was determined from small rain gauges located at the farms and looked after by the farmers. This record is for the period of irrigation only, usually from the first of March to the last of September. The soil types given are taken from the Bureau of Soils maps for 1902. Source of information is unpublished data, Colorado Experiment Station.

[2] C. W. Mills farm.
[3] A. Mitchell farm, Maricopa sandy adobe.
[4] Haines Bros. Fresno fine sandy loam with gravelly areas.
[5] Gus Stjernhom farm.
[6] Herbert Heath, Fresno fine sandy loam.
[7] Ray Baker farm.
[8] Clem Ryan farm, Fresno fine sandy loam.
[9] American Beet Sugar Co. east farm, Maricopa sandy loam.
[10] Kouns farm.
[11] 62.8 pounds seed.
[12] G. Bryant farm, Maricopa sandy loam.
[13] Henry Nesslage farm.
[14] Wm. Bauserman farm.
[15] Winter wheat.
[16] Spring wheat.
[17] Winter irrigation. Some totals include small application after September.

TABLE 28.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Canon City, Colo.*[1]

APPLES

Year	Number of irrigations	Total quantity of water received by crop			Yield per acre[2]	Year	Number of irrigations	Total quantity of water received by crop			Yield per acre[2]
		Irrigation	Rainfall	Total				Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Boxes*			*Feet*	*Feet*	*Feet*	*Boxes*
1906	2	0.67	0.75	1.42		1909	5	2.12	0.80	2.92	[3] 380.00
1906	5	1.20	.75	1.95		1910	3	1.56	.37	1.93	
1907	2	.97	.44	1.41		1910	6	2.11	.37	2.48	(4)
1907	2	1.58	.44	2.02		1911	5	1.93	.50	2.43	[4] 508.11
1908	3	1.18	.72	1.90		1911	8	3.13	.50	3.63	[3] [4] 368.70
1908	6	1.80	.72	2.52	(4)	1912	3	1.27	.88	2.15	
1909	2	1.14	.80	1.94	349.73	1912	6	3.33	.88	4.21	(4)

[1] These studies were made by the Bureau of Public Roads in cooperation with a local orchardist. The soil of the orchard ranges from a rather heavy loam to a light sandy loam containing gravel pockets, underlaid with a clay subsoil.
[2] All data taken from unpublished report, Bureau of Public Roads.
[3] Corn and alfalfa grown between rows account for heavy use of water.
[4] Plus 4,541 pounds bulk and 541 pounds culls.
[5] Plus 4,081 pounds bulk and 1,388 pounds culls.

TABLE 29.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Rocky Ford, Colo.*[1]

SUGAR BEETS

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1905	17.7	5	0.11	0.00	0.47	0.30		1.00	0.48	1.48	8.82
1905	13.5	6		.35	.34	.50		1.91	.48	2.39	8.52
1905		2		.41	.47			.88	.48	1.36	10.04
1905		2		.41	.47			.88	.48	1.36	0.59
1905		2		.41	.47			.88	.48	1.36	6.23
1905		2		.40	.56			.96	.48	1.44	9.56
1905		2		.40	.56			.96	.48	1.44	11.64
1905		2		.40	.56			.96	.48	1.44	7.91
1905		3		.42	.65	.41		1.48	.48	1.96	10.98
1905		3		.42	.65	.41		1.48	.48	1.96	11.03
1905		3		.42	.65	.41		1.48	.48	1.96	9.68
1905		4		.42	.57	.38	.28	1.65	.48	2.13	10.65
1905		4		.42	.57	.38	.28	1.65	.48	2.13	12.52
1905		4		.42	.57	.39	.28	1.65	.48	2.13	11.68

[1] These experiments were made cooperatively by the Bureau of Public Roads and the American Beet Sugar Co. The plots included from 0.5 to 1 acre each. The soils of these plots are a mixture of clay and silt quite common in Arkansas Valley. From unpublished report, Bureau of Public Roads.

TABLE 30.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Ends, Colo.*[1]

ALFALFA

Year	Number of irrigations	Total quantity of water received by crop			Yield per acre[2]	Year	Number of irrigations	Total quantity of water received by crop			Yield per acre[2]
		Irrigation	Rainfall	Total				Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Tons*			*Feet*	*Feet*	*Feet*	*Tons*
1910	0	1.38	1.05	2.43	3.84	1911	6	1.00	0.37	1.37	2.29
1910	0	.00	1.05	1.05	(3)	1911	0	.00	.37	.37	(3)

[1] These experiments were conducted by the Bureau of Public Roads at its demonstration farm at Ends, Colo. This farm and the demonstration farms at Cheyenne and Newcastle, Wyo., were established to experiment with water pumped from wells as a supplement to dry farming. Plots contained 0.75 acre each. The soil is a sandy loam, underlaid with a heavier clay stratum which in places carries a large per cent of gypsum.
[2] Data from unpublished report, Bureau of Public Roads.
[3] Crop failure.

TABLE 31.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Garden City, Kans.*[1]

ALFALFA

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1913	15	3	0.33	0.26	------	------	0.20	------	0.78	0.74	1.52	2.00	------
1913	140	3	1.05	1.05	------	1.05	------	------	3.15	1.18	4.33	1.50	------
1914	------	4	------	------	0.46	.06	.49	0.41	1.42	0.97	2.39	[2] 2.77	------
1915	------	3	------	------	.53	.44	------	.43	1.40	1.71	3.11	[2] 3.22	------

BARLEY

												Bushels	
1914	------	0	------	------	------	------	------	------	0.00	0.72	0.72	[2] [3] 32.60	------
1914	------	0	------	------	------	------	------	------	.00	.72	.72	[2] [3] 31.70	------
1914	------	0	------	------	------	------	------	------	.00	.72	.72	[2] 25.40	------
1914	------	0	------	------	------	------	------	------	.00	.72	.72	[2] 30.40	------
1914	------	1	------	------	0.12	------	------	------	.12	.72	.84	[2] 27.90	------
1914	------	1	------	------	.11	------	------	------	.11	.72	.83	[2] 30.40	------
1914	------	2	------	------	.58	------	------	------	.58	.72	1.30	[2] 25.40	------
1914	------	2	------	------	.55	------	------	------	.55	.72	1.27	[2] 27.10	------
1915	------	1	------	------	------	------	------	------	.34	.93	------	[2] 55.00	------
1915	------	1	------	------	------	------	------	------	.34	.93	------	[2] 31.70	------
1915	------	2	------	------	.34	------	------	------	.68	.93	------	[2] 29.60	------
1915	------	2	------	------	.34	------	------	------	.68	.93	------	[2] 49.60	------
1915	------	3	------	------	.50	------	------	------	.84	.93	------	[2] 56.40	------
1915	------	3	------	------	.50	------	------	------	.84	.93	------	[2] 50.00	------
1915	------	3	------	------	.88	------	------	------	1.22	.93	------	[2] 64.20	------
1915	------	3	------	------	.88	------	------	------	1.22	.93	------	[2] 62.10	------
1915	------	0	------	------	------	------	------	------	.00	.93	.93	[2] 24.30	------
1916	------	0	------	------	------	------	------	------	.00	.62	.62	1.70	29, 30
1916	------	------	------	------	------	------	------	------	.51	.62	1.13	14.50	29, 30
1916	------	------	------	------	------	------	------	------	1.07	.62	1.69	18.10	29, 30
1916	------	------	------	------	------	------	------	------	1.45	.62	2.07	27.30	29, 30
1916	------	------	------	------	------	------	------	------	2.82	.62	3.44	20.60	29, 30
1917	------	0	------	------	------	------	------	------	.00	.60	.60	0.00	29, 30
1917	------	------	------	------	------	------	------	------	.60	.60	1.20	.40	29, 30
1917	------	------	------	------	------	------	------	------	.60	.60	1.20	.60	29, 30
1917	------	------	------	------	------	------	------	------	.77	.60	1.37	3.00	29, 30
1917	------	------	------	------	------	------	------	------	.85	.60	1.45	2.70	29, 30
1918	------	0	------	------	------	------	------	------	.00	.43	.43	0.00	29, 30
1918	------	------	------	------	------	------	------	------	.69	.43	1.12	3.40	29, 30
1918	------	------	------	------	------	------	------	------	1.44	.43	1.87	6.20	29, 30
1918	------	------	------	------	------	------	------	------	1.44	.43	1.87	8.30	29, 30
1918	------	------	------	------	------	------	------	------	2.26	.43	2.69	10.60	29, 30
1919	------	0	------	------	------	------	------	------	.00	.31	.31	14.60	29, 30
1919	------	------	------	------	------	------	------	------	.58	.31	.89	20.30	29, 30
1919	------	------	------	------	------	------	------	------	.58	.31	.89	22.00	29, 30
1919	------	------	------	------	------	------	------	------	1.22	.31	1.53	28.90	29, 30
1919	------	------	------	------	------	------	------	------	1.86	.31	2.17	26.30	29, 30

CORN

1916	------	1	------	------	------	------	------	------	1.17	0.72	------	58.00	28
1917	------	1	------	------	------	------	------	------	1.17	.87	------	30.00	28
1918	------	1	------	------	------	------	------	------	1.50	.72	------	20.40	28
1918	------	0	------	------	------	------	------	------	.00	.72	0.72	0.00	28
1918	------	1	------	------	------	------	------	------	1.50	1.72	------	34.60	28
1918	------	0	------	------	------	------	------	------	.00	.72	.72	0.00	28
1918	------	1	------	------	------	------	------	------	1.50	.72	------	41.70	28

See footnotes at end of table.

TABLE 31.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Garden City, Kans.*[1]—Continued

COWPEAS

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1914		1					0.31		0.31	0.46	0.77	[3] 1.10	
1914		1					.32		.32	.46	.78	[3] 1.24	
1914		0							.00	.46	.46	[3] .70	
1914		0							.00	.46	.46	[3] .76	
1914		0							.00	.46	.46	[3] .85	
1915		1							.34	1.14		[3] 2.90	
1915		1							.34	1.14		[3] 1.40	
1915		1							.34	1.14		[3] 3.20	
1915		1							.34	1.14		[3] 1.40	

KAFIR

												Bushels	
1913	8	3		0.50		0.25			0.75	0.65	1.40	[3] 4.38	
1914		2				.27	0.26		.53	.82	1.35	[3] 38.60	
1914		2				.30	.26		.56	.82	1.38	[3] 40.00	
1914		2				.17	.16		.33	.82	1.15	[3] 35.40	
1914		2				.17	.17		.34	.82	1.16	[3] 31.40	
1914		0							.00	.82	.82	[3] 23.30	
1914		0							.00	.82	.82	[3] 14.10	
1914		0							.00	.82	.82	[3] 21.40	
1914		0							.00	.82	.82	[3] 18.20	
1915		4				.42	.25	0.13	1.76	1.12		[3] 42.50	
1915		4				.42	.25	.13	1.76	1.12		[3] 38.20	
1915		3					.16	.12	1.24	1.12		[3] 46.40	
1915		3					.16	.12	1.24	1.12		[3] 39.00	
1915		1							.96	1.12		[3] 37.90	
1915		1							.96	1.12		[3] 42.20	
1915		1							.96	1.12		[3] 32.50	
1915		1							.96	1.12		[3] 42.50	
1915		0							.00	1.12	1.12	[3] 30.90	
1916		1							1.17	.72		30.30	28
1917		1							1.17	.87		46.40	28
1918		1							1.58	.72		47.80	28
1918		0							.00	.72	.72	5.60	28
1916		0							.00	.72	.72	1.10	29, 30
1916									.43	.72	1.15	8.50	29, 30
1916									.92	.72	1.60	21.10	29, 30
1916									1.19	.72	1.91	42.40	29, 30
1916									1.78	.72	2.50	46.20	29, 30
1917		0							.00	.87	.87	0.00	29, 30
1917									.68	.87	1.55	0.00	29, 30
1917									1.15	.87	2.02	23.10	29, 30
1917									1.80	.87	2.67	22.90	29, 30
1917									2.48	.87	3.35	29.10	29, 30
1918		0							.00	.72	.72	2.00	29, 30
1918									1.06	.72	1.78	2.10	29, 30
1918									1.06	.72	1.78	3.00	29, 30
1918									1.62	.72	2.34	9.80	29, 30
1918									1.92	.72	2.64	18.20	29, 30
1919		0							.00	.49	.49	31.50	29
1919									.21	.49	.70	30.10	29
1919									.61	.49	1.10	34.50	29

MILLET

1914		0							0.00	0.46	0.46	[3] 9.00	
1914		1					0.32		.32	.46	.78	[3] 11.80	
1914		1					.35		.35	.46	.81	[3] 10.60	
1914		2			0.48		.24		.72	.46	1.18	[3] 18.00	
1914		2			.40		.32		.72	.46	1.18	[3] 20.80	
1915		2				0.50			.84	.78		[3] 122.00	
1915		2				.50			.84	.78		[3] 102.00	
1915		2				1.00			1.34	.78		[3] 128.00	
1915		2				1.00			1.34	.78		[3] 128.00	

See footnotes at end of table.

TABLE 31.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Garden City, Kans.*[1]—Continued

MILO

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1914		2				0.21	0.27		0.48	0.82	1.30	[2] 44.60	
1914		2				.26	.29		.55	.82	1.37	[2] 38.00	
1914		2				.18	.18		.36	.82	1.18	[2] 34.60	
1914		2				.18	.17		.35	.82	1.17	[2] 32.50	
1914		0				.00			.00	.82	.82	[2] 33.90	
1914		0							.00	.82	.82	[2] 24.50	
1914		0							.00	.82	.82	[2] 20.70	
1914		0							.00	.82	.82	[2] 23.30	
1915		4				.42	.25	0.13	1.76	1.12		[2] 56.40	
1915		4				.42	.25	.13	1.76	1.12		[2] 58.80	
1915		3					.16	.12	1.24	1.12		[2] 54.20	
1915		3					.16	.12	1.24	1.12		[2] 52.10	
1915		1							.96	1.12		[2] 43.50	
1915		1							.96	1.12		[2] 52.40	
1915		1							.96	1.12		[2] 33.90	
1915		1							.96	1.12		[2] 33.50	
1915		0							.00	1.12	1.12	[2] 37.90	
1916		1							1.17	.72		35.30	28
1917		1							1.17	.87		33.40	28
1918		1							1.50	.72		53.00	28
1918		0							.00	.72	.72	4.00	28
1918		1							1.50	.72		72.20	28
1916									.43	.72	1.15	7.50	29, 30
1916									.94	.72	1.66	16.30	29, 30
1916									1.19	.72	1.91	41.50	29, 30
1916									1.78	.72	2.50	58.60	29, 30
1916		0							.00	.72	.72	1.50	29, 30
1917		0							.00	.87	.87	.00	29, 30
1917									.68	.87	1.55	.00	29, 30
1917									1.15	.87	2.02	28.80	29, 30
1917									1.80	.87	2.67	41.80	29, 30
1917									2.48	.87	3.35	43.70	29, 30
1918		0							.00	.72	.72	2.10	29, 30
1918									1.06	.72	1.78	20.10	29, 30
1918									1.55	.72	2.27	57.80	29, 30
1918									1.79	.72	2.51	55.40	29, 30
1918									2.21	.72	2.93	59.10	29, 30
1919		0							.00	.49	.49	52.90	29
1919									.22	.49	.71	44.10	29
1919									.61	.49	1.10	49.70	29

OATS

1914		0							0.00	0.72	0.72	[2] 45.60	
1914		0							.00	.72	.72	[2] 45.00	
1914		0							.00	.72	.72	[2] 48.10	
1914		0							.00	.72	.72	[2] 46.50	
1914		1			0.12				.12	.72	.84	[2] 47.80	
1914		1			.15				.15	.72	.87	[2] 45.20	
1914		2			.48				.48	.72	1.20	[2] 48.70	
1914		2			.38				.38	.72	1.10	[2] 48.10	
1914		1			.21				.21	.72	.93	[2] 34.60	
1915		1							.34	.88		[2] 48.70	
1915		1							.34	.88		[2] 54.90	
1915		2			.42				.70	.88		[2] 49.30	
1915		2			.42				.76	.88		[2] 48.70	
1915		2			.63				.97	.88		[2] 48.70	
1915		2			.63				.97	.88		[2] 49.30	
1915		3			1.01				1.35	.88		[2] 51.20	
1915		3			1.01				1.35	.88		[2] 50.00	
1915		2			.43				.58	.88		[3] 56.30	
1915		0							.00	.88	.88	[2] 31.90	
1916									.63	.62	1.25	15.00	29
1916									1.02	.62	1.64	33.90	29
1916									1.52	.62	2.14	40.30	29
1916									2.64	.62	3.26	40.60	29
1917									.59	.60	1.19	.00	29
1917									.59	.60	1.19	.70	29
1917									1.18	.60	1.78	6.70	29

See footnotes at end of table.

TABLE 31.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Garden City, Kans.*[1]—Continued

BARLEY

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1917									1.47	0.60	2.07	5.90	29
1918									.68	.43	1.11	9.00	29
1918									.68	.43	1.11	15.60	29
1918									1.40	.43	1.83	24.90	29
1918									1.40	.43	1.83	20.30	29
1919									.63	.31	.94	38.10	29
1919									.63	.31	.94	38.40	29
1919									1.28	.31	1.59	42.20	29
1919									1.92	.31	2.23	36.60	29

POTATOES

1914		0							0.00	0.96	0.96	[2] 48.00	
1914		0							.00	.96	.96	[2] 63.90	
1914		0							.00	.96	.96	[2] 66.60	
1914		1				0.25			.25	.96	1.21	[2] 72.20	
1914		1				.25			.25	.96	1.21	[2] 86.30	
1915		1							.34	1.71		[2] 115.50	
1915		1							.34	1.71		[2] 98.20	
1915		1							.34	1.71		[2] 82.60	
1915		1							.34	1.71		[2] 83.60	

SUDAN GRASS

1914		3				0.49	0.33		0.82	0.82	1.64	[2] 10.25	
1914		3				.46	.31		.77	.82	1.59	[2] 12.50	
1914		2				.18	.18		.36	.82	1.18	[2] 10.00	
1914		2				.17	.16		.33	.82	1.15	[2] 10.50	
1914		0							.00	.82	.82	[2] 9.50	
1914		0							.00	.82	.82	[2] 10.50	
1914		0							.00	.82	.82	[2] 8.75	
1914		0							.00	.82	.82	[2] 11.00	
1915		4				.42	.25	0.13	1.76	1.12		[2] 6.00	
1915		4				.42	.25	.13	1.76	1.12		[2] 11.00	
1915		3					.16	.12	1.24	1.12		[2] 8.00	
1915		3					.16	.12	1.24	1.12		[2] 10.50	
1915		1							.96	1.12		[2] 9.00	
1915		1							.96	1.12		[2] 13.00	
1915		1							.96	1.12		[2] 10.50	
1915		1							.96	1.12		[2] 13.00	
1915		1							.25	.80		[2] 3.40	
1915		2				.48		.38	.86	.99	1.85	(3)	
1916									.43	.72	1.15	1.50	29
1916									.72	.72	1.44	2.00	29
1916									1.19	.72	1.91	1.00	29
1916									1.78	.72	2.50	1.00	29
1917									.68	.87	1.55	4.70	29
1917									1.15	.87	2.02	2.20	29
1917									1.80	.87	2.67	3.50	29
1917									2.48	.87	3.35	4.20	29
1918									1.06	.72	1.78	4.20	29
1918									1.06	.72	1.78	8.20	29
1918									1.80	.72	2.52	6.70	29
1918									2.18	.72	2.90	6.20	29

SUGAR BEETS

												Tons	
1914		0							0.00	0.82	0.82	[2] 13.42	
1914		0							.00	.82	.82	[2] 3.84	
1914		0							.00	.82	.82	[2] 9.55	
1914		1					0.12		.12	.82	.94	[2] 9.10	
1914		1					.15		.15	.82	.97	[2] 11.12	

See footnotes at end of table.

TABLE 31.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Garden City, Kans.*[1]—Continued

SUMAC SORGHUM

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1914	------	2	------	------	------	0.24	0.28	------	0.52	0.82	1.34	[2] 2.60	------
1914	------	2	------	------	------	.25	.28	------	.53	.82	1.35	[2] 5.40	------
1914	------	2	------	------	------	.18	.17	------	.35	.82	1.17	[2] 1.20	------
1914	------	2	------	------	------	.16	.16	------	.32	.82	1.14	[2] .30	------
1914	------	0	------	------	------	------	------	------	.00	.82	.82	[2] .10	------
1914	------	0	------	------	------	------	------	------	.00	.82	.82	[2] .30	------
1914	------	0	------	------	------	------	------	------	.00	.82	.82	[2] .40	------
1914	------	0	------	------	------	------	------	------	.00	.82	.82	[2] .20	------
1915	------	4	------	------	------	.42	.25	0.13	1.76	1.12	------	[2] 16.80	------
1915	------	4	------	------	------	.42	.25	.13	1.76	1.12	------	[2] 18.00	------
1915	------	3	------	------	------	------	.16	.12	1.24	1.12	------	[2] 18.80	------
1915	------	3	------	------	------	------	.16	.12	1.24	1.12	------	[2 5] 7.60	------
1915	------	1	------	------	------	------	------	------	.96	1.12	------	[2] 11.20	------
1915	------	1	------	------	------	------	------	------	.00	1.12	------	[2] 14.40	------
1915	------	1	------	------	------	------	------	------	.90	1.12	------	[2] 16.80	------
1915	------	1	------	------	------	------	------	------	.96	1.12	------	[2] 13.20	------
1916	------	1	------	------	------	------	------	------	1.17	.72	------	(3)	------
1917	------	1	------	------	------	------	------	------	1.17	.87	------	(3)	------
1918	------	1	------	------	------	------	------	------	1.50	.72	------	(3)	------
1916	------	------	------	------	------	------	------	------	.43	.72	1.15	0.00	29
1916	------	------	------	------	------	------	------	------	.72	.72	1.44	9.90	29
1916	------	------	------	------	------	------	------	------	1.19	.72	1.91	26.20	29
1916	------	------	------	------	------	------	------	------	1.78	.72	2.50	39.20	29
1917	------	------	------	------	------	------	------	------	.68	.87	1.55	0.00	29
1917	------	------	------	------	------	------	------	------	1.15	.87	2.02	4.50	29
1917	------	------	------	------	------	------	------	------	1.80	.87	2.67	12.60	29
1917	------	------	------	------	------	------	------	------	2.48	.87	3.35	9.80	29
1918	------	------	------	------	------	------	------	------	1.06	.72	1.78	17.00	29
1918	------	------	------	------	------	------	------	------	1.62	.72	2.34	24.80	29
1918	------	------	------	------	------	------	------	------	1.88	.72	2.60	26.80	29
1919	------	0	------	------	------	------	------	------	.00	.49	.49	27.60	29
1919	------	------	------	------	------	------	------	------	.21	.49	.70	31.60	29
1919	------	------	------	------	------	------	------	------	.61	.49	1.10	36.70	29

WHEAT

1913	37	2	0.34	0.12	------	------	------	------	0.46	0.78	1.24	[2 9] 1.22	------
1914	------	0	------	------	------	------	------	------	.00	.72	.72	[2] 10.60	------
1914	------	0	------	------	------	------	------	------	.00	.72	.72	[2] 17.10	------
1914	------	0	------	------	------	------	------	------	.00	.72	.72	[2] 18.50	------
1914	------	0	------	------	------	------	------	------	.00	.72	.72	[2] 17.00	------
1914	------	1	------	------	0.25	------	------	------	.25	.72	.97	[2] 23.80	------
1914	------	1	------	------	.39	------	------	------	.39	.72	1.11	[2] 21.80	------
1914	------	2	------	------	.52	------	------	------	.52	.72	1.24	[2] 27.00	------
1914	------	2	------	------	.54	------	------	------	.54	.72	1.26	[2] 23.60	------
1914	------	1	------	------	.48	------	------	------	.48	.72	1.20	[2 9] 25.00	------
1915	------	1	------	------	------	------	------	------	.34	1.00	------	[2 10] 24.60	------
1915	------	1	------	------	------	------	------	------	.34	1.00	------	[2 10] 26.00	------
1915	------	2	------	------	.42	------	------	------	.76	1.00	------	[2 10] 31.90	------
1915	------	2	------	------	.42	------	------	------	.76	1.00	------	[2 10] 32.30	------
1915	------	2	------	------	.58	------	------	------	.92	1.00	------	[2 10] 28.30	------
1915	------	2	------	------	.58	------	------	------	.92	1.00	------	[2 10] 23.70	------
1915	------	3	------	------	.85	------	------	------	1.19	1.00	------	[2 10] 26.70	------
1915	------	3	------	------	.85	------	------	------	1.19	1.00	------	[2 10] 31.00	------
1915	------	2	------	------	.46	------	------	------	.71	.96	------	[2 10] 28.37	------
1915	------	0	------	------	------	------	------	------	.00	.88	.88	[2 10] 10.70	------
1916	------	0	------	------	------	------	------	------	.00	.67	.67	[2] .00	29, 30
1916	------	------	------	------	------	------	------	------	.74	.67	1.41	[10] 15.60	29, 30
1916	------	------	------	------	------	------	------	------	1.12	.67	1.79	[10] 20.30	29, 30
1916	------	------	------	------	------	------	------	------	1.72	.67	2.39	[10] 26.90	29, 30
1916	------	------	------	------	------	------	------	------	2.88	.67	3.55	[10] 29.10	29, 30
1917	------	0	------	------	------	------	------	------	.00	.60	.60	.00	29, 30
1917	------	------	------	------	------	------	------	------	.73	.60	1.33	.00	29, 30

See footnotes at end of table.

TABLE 31.—*Use of water on crops in the Arkansas River Basin, irrigation water applied, rainfall, and crop yields, Garden City, Kans.*[1]—Continued

WHEAT—Continued

Year	Area irrigated	Number of irrigations	Monthly application of water						Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
			Apr.	May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1917									0.73	0.60	1.33	.10	29, 30
1917									1.32	.60	1.92	1.40	29, 30
1917									1.61	.60	2.21	1.20	29, 30
1918		0							.00	.43	.43	.00	29, 30
1918									.67	.43	1.10	3.30	29, 30
1918									.67	.43	1.10	11.00	29, 30
1918									1.38	.43	1.81	12.20	29, 30
1919		0							1.85	.43	2.28	16.80	29, 30
1919									.00	.31	.31	20.10	29, 30
1919									.98	.31	1.29	23.00	29, 30
1919									.98	.31	1.29	33.00	29, 30
1919									1.21	.31	1.52	29.00	29, 30
1919									1.54	.31	1.85	34.50	29, 30
BEETS													
1913	6	4		0.39		0.22	0.22		0.83	1.11	1.94	*Tons* [2] 3.33	
1913	23	4		.74		.34	.38		1.46	1.11	2.57	[3] 4.74	
MAIZE													
1913	6	4		0.39		0.22	0.22		0.83	1.09	1.92	*Bushels* [4] 30	

[1] These experiments were conducted at the Garden City Branch Experiment Station under cooperative agreement between the Bureau of Public Roads and the Kansas Agricultural Experiment Station from 1914 to 1918, and by the station alone after that time. In most cases plots were 0.05 acre in area. A few ranged as high as 7 to 15 acres. The station farm is located on high upland. The soil is a light silt loam and, with the exception of accumulated humus near the surface, is practically uniform to a depth of at least 15 feet. In all cases where the total irrigation water applied is greater than the total for the months indicated the difference is due to winter irrigation.

[2] From unpublished report of the experiments.

[3] Better stand than on irrigated plots.

[4] Injured by pests and weather.

[5] Seed contained nearly 20 per cent barley.

[6] 4.40 tons hay.

[7] Dry stover.

[8] Injured by hot wind.

[9] Winter wheat; March rainfall only 0.03 inch.

[10] Winter wheat; March rainfall included.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]

ALFALFA

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 116)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1920	0						0.00	0.41	0.41	0.30	32
1920	1		0.33				.33	.41	.74	4.33	32
1920	2		.33	0.34			.67	.41	1.08	3.82	32
1920	3		.66	.34			1.00	.41	1.41	3.96	32
1920	4		.67	.33	0.33		1.33	.41	1.74	6.00	32
1920	5		.66	.67	.34		1.67	.41	2.08	6.48	32
1920	6		.66	.67	.67		2.00	.41	2.41	6.08	32
1920	5		1.00	1.00	.50		2.50	.41	2.91	5.40	32
1920	6		1.00	1.00	1.00		3.00	.41	3.41	5.96	32
1920	7		1.00	1.50	1.00		3.50	.41	3.91	6.48	32
1921	0						.00	.23	.23	.05	33
1921	1		.33				.33	.23	.56	9.78	33
1921	2		.33	.34			.67	.42	1.09	1.02	33
1921	3		.67	.33			1.00	.42	1.42	1.43	33
1921	4		.66	.34	.33		1.33	.42	1.75	2.71	33
1921	5		.67	.33	.67		1.67	.42	2.09	4.60	33
1921	6		.66	.67	.67		2.00	.42	2.42	5.24	33
1921	5		1.00	.50	1.00		2.50	.42	2.92	4.44	33
1921	6		1.00	1.00	1.00		3.00	.42	3.42	5.55	33
1921	7		1.00	1.50	1.00		3.50	.42	3.92	5.57	33
1921	0						.00	.23	.23	.417	33
1921	1		.33				.33	.23	.56	.80	33
1921	2		.33	.34			.67	.42	1.09	2.25	33
1921	3		.33	.67			1.00	.42	1.42	3.77	33
1921	4		.66	.33	.34		1.33	.42	1.75	4.17	33
1921	5		.66	.33	.68		1.67	.42	2.09	4.49	33
1921	6		.66	.66	.68		2.00	.42	2.42	5.73	33
1921	5		1.00	.50	1.00		2.50	.42	2.92	5.22	33
1921	6		1.00	1.00	1.00		3.00	.42	3.42	5.72	33
1921	7		1.00	1.50	1.00		3.50	.42	3.92	5.12	33
1921	0						.00	.23	.23	.10	33
1921	1		.33				.33	.23	.56	.80	33
1921	2		.33	.34			.67	.42	1.09	1.075	33
1921	3		.33	.67			1.00	.42	1.42	1.735	33
1921	4		.66	.33	.34		1.33	.42	1.75	2.80	33
1921	5		.66	.33	.68		1.67	.42	2.09	5.16	33
1921	6		.66	.66	.68		2.00	.42	2.42	5.165	33
1921	5		1.00	.50	1.00		2.50	.42	2.92	4.515	33
1921	6		1.00	1.00	1.00		3.00	.42	3.42	5.50	33
1921	7		1.00	1.50	1.00		3.50	.42	3.92	5.30	33
1922	0						.00	.61	.61	4.45	34
1922	1		.50				.50	.61	1.11	4.52	34
1922	2		.50	.50			1.00	.61	1.61	6.13	34
1922	3		.50	1.00			1.50	.61	2.11	7.43	34
1922	3		1.00	.50			1.50	.61	2.11	7.52	34
1922	5		1.00	1.00	.50		2.50	.61	3.11	6.79	34
1922	6		1.00	1.00	1.00		3.00	.61	3.61	6.88	34
1922	3		.67	.33			1.00	.61	1.61	6.67	34
1922	5		.67	.66	.34		1.67	.61	2.28	6.95	34
1922	6		.67	.66	.67		2.00	.61	2.61	7.56	34
1922	0						.00	.61	.61	.00	34
1922	1		.50				.50	.61	1.11	3.10	34
1922	2		.50	.50			1.00	.61	1.61	3.78	34
1922	3		.50	1.00			1.50	.61	2.11	4.93	34
1922	4		1.00	.50	.50		2.00	.61	2.61	5.92	34
1922	5		1.00	1.00	.50		2.50	.61	3.11	6.08	34
1922	6		1.00	1.00	1.00		3.00	.61	3.61	5.46	34
1922	3		.67	.33			1.00	.61	1.61	4.70	34
1922	5		.67	.67	.33		1.67	.61	2.28	5.91	34
1922	6		.67	.67	.66		2.00	.61	2.61	6.04	34
1922	0						.00	.61	.61	.00	34
1922	1		.50				.50	.61	1.11	1.48	34
1922	2		.50	.50			1.00	.61	1.61	2.05	34
1922	3		.50	1.00			1.50	.61	2.11	3.54	34
1922	4		1.00	.50	.50		2.00	.61	2.61	4.91	34
1922	5		1.00	1.00	.50		2.50	.61	3.11	7.10	34
1922	6		1.00	1.00	1.00		3.00	.61	3.61	7.05	34
1922	3		.67	.33			1.00	.61	1.61	5.95	34
1922	5		.67	.67	.33		1.67	.61	2.28	6.70	34
1922	6		.67	.67	.66		2.00	.61	2.61	6.71	34
1922	0						.00	.61	.61	.00	34
1922	1		.50				.50	.61	1.11	3.07	34

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

ALFALFA—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1922	2		0.50	0.50			1.00	0.61	1.61	3.72	34
1922	3		.50	1.00			1.50	.61	2.11	4.04	34
1922	4		1.00	.50	0.50		2.00	.61	2.61	5.00	34
1922	5		1.00	1.00	.50		2.50	.61	3.11	5.22	34
1922	6		1.00	1.00	1.00		3.00	.61	3.61	5.25	34
1922	3		.67	.33			1.00	.61	1.61	4.80	34
1922	5		.67	.67	.33		1.67	.61	2.28	5.30	34
1922	6		.67	.67	.66		2.00	.61	2.61	5.01	34
1923	0						.00	.79	.79	.951	8
1923	1		.50				.50	.79	1.29	1.390	8
1923	2		.50	.50			1.00	.79	1.79	3.210	8
1923	2		.50	.50			1.00	.79	1.79	4.080	8
1923	3	0.50	.50	.50			1.50	.79	2.29	5.618	8
1923	3	.50	.50		.50		1.50	.79	2.29	5.916	8
1923	4	.50	.50		1.00		2.00	.79	2.79	5.760	8
1923	2	.33	.34				.67	.79	1.46	4.731	8
1923	3	.33	.34		.33		1.00	.79	1.79	5.820	8
1923	4	.33	.34		.66		1.33	.79	2.12	5.158	8
1923	0						.00	.79	.79	.537	8
1923	1		.50				.50	.79	1.29	3.071	8
1923	3	.50	.50	.50			1.50	.79	2.29	4.750	8
1923	2	.50		.50			1.00	.79	1.79	4.029	8
1923	3	.50	.50	.50			1.50	.79	2.29	5.867	8
1923	3	.50	.50		.50		1.50	.79	2.29	5.400	8
1923	4	.50	.50		1.00		2.00	.79	2.79	5.040	8
1923	2	.33	.34				.67	.79	1.46	3.953	8
1923	3	.33	.34		.33		1.00	.79	1.79	4.010	8
1923	4	.33	.34		.66		1.33	.79	2.12	5.454	8
1923	2		.25	.25			.50	.79	1.29	3.080	8
1923	2	.50		.50			1.00	.79	1.79	3.770	8
1923	3	.33	.50	.50			1.33	.79	2.12	4.415	8
1923	3	.33	.33		.50		1.16	.79	1.95	4.447	8
1923	4	.50	.50		1.00		2.00	.79	2.79	4.477	8
1923	0						.00	.79	.79		8
1923	1		.50				.50	.79	1.29	2.050	8
1923	2	.33	.34				.67	.79	1.46	2.405	8
1923	3	.33	.34		.33		1.00	.79	1.79	3.949	8
1923	4	.33	.34		.66		1.33	.79	2.12	3.983	8

ALFALFA SEED

										Bushels	
1919	0						0.00	0.55	0.55	[2] 4.80	44
1919	1	0.25					.25	.55	.80	[2] 9.20	44
1919	2	.25	0.25				.50	.55	1.05	[2] 11.80	44
1919	3	.50	.25				.75	.55	1.30	[2] 12.50	44
1919	4	.50	.50				1.00	.55	1.55	[2] 11.80	44
1919	0						.00	.55	.55	[3] .70	44
1919	1	.25					.25	.55	.80	[3] 2.10	44
1919	2	.25	.25				.50	.55	1.05	[3] 3.50	44
1919	3	.50	.25				.75	.55	1.30	[3] 7.00	44
1919	4	.50	.50				1.00	.55	1.55	[3] 9.70	44
1919	0						.00	.55	.55	[4] 2.50	44
1919	1	.25					.25	.55	.80	[4] 3.90	44
1919	2	.25	.25				.50	.55	1.05	[4] 7.70	44
1919	3	.50	.25				.75	.55	1.30	[4] 8.30	44
1919	4	.50	50				1.00	.55	1.55	[4] 11.50	44
1920	0						.00	.41	.41	[2] 5.80	32
1920	1	.25					.25	.41	.66	[2] 2.00	32
1920	2	.25	.25				.50	.41	.91	[2] 3.00	32
1920	3	.25	.50				.75	.41	1.16	[2] 4.78	32
1920	4	.25	.50	0.25			1.00	.41	1.41	[2] 3.12	32
1920	0						.00	.41	.41	[3] 5.40	32
1920	1	.25					.25	.41	.66	[3] 1.40	32
1920	2	.25	.25				.50	.41	.91	[3] 5.00	32
1920	3	.25	.50				.75	.41	1.16	[3] 8.33	32
1920	4	.25	.50	.25			1.00	.41	1.41	[3] 4.87	32
1920	0						.00	.41	.41	[4] 5.00	32
1920	1	.25					.25	.41	.66	[4] [5] 1.00	32
1920	2	.25	.25				.50	.41	.91	[4] [5] 5.00	32

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada*—Continued

ALFALFA SEED—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1920	3		0.25	0.50			0.75	0.41	1.16	[4] 8.90	32
1920	4		.25	.50	0.25		1.00	.41	1.41	[4] 6.28	32
1921	0						.00	.57	.57	[4] .00	33
1921	1		.25				.25	.57	.82	[4] .00	33
1921	2		.25	.25			.50	.57	1.07	[4] .88	33
1921	3		.25	.25	.25		.75	.57	1.32	[4] 1.85	33
1921	4		.50	.25	.25		1.00	.57	1.57	[4] 3.20	33
1921	0						.00	.57	.57	[3] .00	33
1921	1		.25				.25	.57	.82	[3] .00	33
1921	2		.25	.25			.50	.57	1.07	[3] 1.87	33
1921	3		.25	.25	.25		.75	.57	1.32	[3] 1.54	33
1921	4		.50	.25	.25		1.00	.57	1.57	[3] 2.38	33
1921	0						.00	.57	.57	[2] .00	33
1921	1		.25				.25	.57	.82	[2] .00	33
1921	2		.25	.25			.50	.57	1.07	[2] 1.40	33
1921	3		.25	.25	.25		.75	.57	1.32	[2] 1.12	33
1921	4		.50	.25	.25		1.00	.57	1.57	[2] 3.70	33
1922	1		.33				.33	.59	.92	3.50	34
1922	1		.33				.33	.59	.92	.90	34
1922	2		.33	.25			.58	.59	1.17	4.40	34
1922	3		.33	.50			.83	.70	1.53	7.20	34
1922	4		.33	.50	.25		1.08	.70	1.78	8.70	34
1922	5		.33	.50	.50		1.33	.70	2.03	11.90	34
1922	0						.00	.59	.59	.00	34
1922	1		.25				.25	.59	.84	.80	34
1922	2		.25	.25			.50	.59	1.09	1.21	34
1922	3		.25	.50			.75	.70	1.45	2.98	34
1922	4		.25	.50	.25		1.00	.70	1.70	6.47	34
1922	5		.25	.50	.50		1.25	.70	1.95	1.92	34
										Pounds	
1923	0						.00	.78	.78	23.04	8
1923	1		.25				.25	.79	1.04	28.40	8
1923	1		.25				.25	.79	1.04	32.58	8
1923	2		.25	.25			.50	.79	1.29	54.74	8
1923	3		.25	.50			.75	.79	1.54	4.83	8
1923	4		.25	.50	.25		1.00	.79	1.79	55.92	8
1923	1		.25				.25	.79	1.04	117.70	8
1923	1		.25				.25	.79	1.04		8
1923	1		.25				.25	.79	1.04	54.20	8
1923	2		.26	.25			.50	.79	1.29	156.10	8
1923	3		.25	.50			.75	.81	1.56	111.50	8
1923	4		.25	.50	.25		1.00	.81	1.81	107.90	8
1923	0						.00	.78	.78	32.46	8
1923	2	0.25	.25				.50	.78	1.28	24.20	8
1923	2	.25	.25				.50	.78	1.28	23.23	8
1923	2	.25	.25				.50	.78	1.28	11.84	8
1923	3	.25	.25	.25			.75	.78	1.53	18.27	8
1923	1		.25				.25	.79	1.04	66.36	8
1923	1		.25				.25	.79	1.04		8
1923	1		.25				.25	.79	1.04	32.70	8
1923	2		.25	.25			.50	.79	1.29	70.40	8
1923	3		.25	.50			.75	.81	1.56	71.50	8
1923	4		.25	.50	.25		1.00	.81	1.81	32.20	8
1923	2		.33	.25			.58	.79	1.37	63.88	8
1923	1		.33				.33	.79	1.12	33.14	8
1923	2		.33	.25			.58	.79	1.37		8
1923	0						.00	.78	.78	169.30	8
1923	2		.33	.25			.58	.79	1.37	90.60	8
1923	2		.33	.25			.58	.79	1.37	12.33	8
1923	2		.33	.25			.58	.79	1.37		8
1923	3		.33	.50			.83	.79	1.62	59.00	8
1923	3		.33	.50			.83	.79	1.62	33.00	8
1923	3		.33	.50			.83	.79	1.62		8
1923	1			.33			.33	.79	1.12	13.79	8
1923	2		.50		.25		.75	.79	1.54		8
1923	2		.50	.25			.75	.79	1.54	19.00	8
1923	4		.33	.50	.25		1.08	.79	1.87	52 50	8
1923	2		.33		.25		.58	.79	1.37		8
1923	1				.25		.25	.79	1.04	36.40	8
1923	2			.25	.25		.50	.79	1.29		8
1923	1		.50				.50	.79	1.29	10.70	8
1923	1		.50				.50	.78	1.28		8
1923	0						.00	.79	.79	20.20	8

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada*[1]—Continued

BARLEY

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1918	0						0.00	0.20	0.20	6.80	43
1918	1		0.33				.33	.20	.53	20.70	43
1918	2		.33	0.34			.67	.20	.87	23.40	43
1918	3		.33	.67			1.00	.20	1.20	45.40	43
1918	4		.66	.67			1.33	.20	1.53	56.60	43
1918	5		.66	.67	0.34		1.67	.20	1.87	67.20	43
1918	6		.66	1.00	.34		2.00	.20	2.20	72.10	43
1918	2		.50	.50			1.00	.20	1.20	49.10	43
1918	3		.50	1.00			1.50	.20	1.70	63.50	43
1918	4		1.00	1.00			2.00	.20	2.20	78.80	43
1918	0						.00	.20	.20	5.00	43
1918	1		.33				.33	.20	.53	25.30	43
1918	2		.33	.34			.67	.20	.87	28.00	43
1918	3		.33	.67			1.00	.20	1.20	35.40	43
1918	4		.66	.67			1.33	.20	1.53	64.30	43
1918	5		.66	.67	.34		1.67	.20	1.87	66.40	43
1918	6		.66	1.00	.34		2.00	.20	2.20	64.40	43
1918	3		.50	1.00			1.50	.20	1.70	68.50	43
1918	4		1.00	1.00			2.00	.20	2.20	57.20	43
1918	0						.00	.20	.20	2.90	43
1918	1		.33				.33	.20	.53	8.90	43
1918	2		.33	.34			.67	.20	.87	19.00	43
1918	3		.33	.67			1.00	.20	1.20	32.10	43
1918	4		.66	.67			1.33	.20	1.53	23.70	43
1918	5		.66	.67	.34		1.67	.20	1.87	55.30	43
1918	6		.66	1.00	.34		2.00	.20	2.20	65.50	43
1918	2		.50	.50			1.00	.20	1.20	32.10	43
1918	3		.50	1.00			1.50	.20	1.70	42.30	43
1918	4		1.00	1.00			2.00	.20	2.20	48.70	43
1919	1		.33				.33	.26	.59	17.00	44
1919	2		.33	.34			.67	.38	1.05	29.70	44
1919	3		.66	.34			1.00	.43	1.43	37.00	44
1919	4		.66	.67			1.33	.43	1.76	37.40	44
1919	5	0.33	.33	1.01			1.67	.43	2.10	39.20	44
1919	6	.33	.67	1.00			2.00	.43	2.43	33.80	44
1919	2		.50	.50			1.00	.43	1.43	34.60	44
1919	3		1.00	.50			1.50	.43	1.93	32.10	44
1919	4		1.00	1.00			2.00	.43	2.43	38.40	44
1919	0						.00	.37	.37	9.60	44
1919	1		.33				.33	.37	.70	25.10	44
1919	2		.33	.34			.67	.43	1.10	26.40	44
1919	3		.66	.34			1.00	.43	1.43	29.40	44
1919	4		.66	.67			1.33	.43	1.76	29.40	44
1919	5	.33	.33	1.01			1.67	.43	2.10	30.70	44
1919	6	.33	.67	1.01			2.00	.43	2.43	29.40	44
1919	2		.50	.50			1.00	.43	1.43	24.40	44
1919	3		1.00	.50			1.50	.43	1.93	32.80	44
1919	4		1.00	1.00			2.00	.43	2.43	36.70	44
1919	0						.00	.37	.37	11.10	44
1919	1		.33				.33	.37	.70	20.20	44
1919	2		.33	.34			.67	.37	1.04	30.96	44
1919	3		.66	.34			1.00	.43	1.43	35.50	44
1919	4		.66	.67			1.33	.43	1.76	24.50	44
1919	5	.33	.33	1.01			1.67	.43	2.10	34.30	44
1919	6	.33	.67	1.01			2.00	.43	2.43	32.50	44
1919	2		.50	.50			1.00	.43	1.43	30.00	44
1919	3		1.00	.50			1.50	.43	1.93	35.50	44
1919	4		1.00	1.00			2.00	.43	2.43	33.10	44
1920	0						.00	.41	.41	4.00	32
1920	1			.33			.33	.41	.74	24.00	32
1920	2		.33	.34			.67	.41	1.08	41.00	32
1920	3		.33	.67			1.00	.41	1.41	45.00	32
1920	4		.33	.67	.33		1.33	.41	1.74	51.00	32
1920	5		.66	.67	.34		1.67	.41	2.08	58.00	32
1920	6		.66	.67	.67		2.00	.41	2.41	54.00	32
1920	2		.50	.50			1.00	.41	1.41	47.00	32
1920	3		.50	1.00			1.50	.41	1.91	53.00	32
1920	4		.50	1.00	.50		2.00	.41	2.41	49.00	32
1920	0						.00	.41	.41	3.00	32
1920	1		.33				.33	.41	.74	38.00	32

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

BARLEY—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 116)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1920	2		0.33	0.34			0.67	0.41	1.08	46.00	32
1920	3		.33	.67			1.00	.41	1.41	60.00	32
1920	4		.33	1.00			1.33	.41	1.74	55.00	32
1920	5		.66	.67	0.34		1.67	.41	2.08	60.00	32
1920	6		.66	1.00	.34		2.00	.41	2.41	63.00	32
1920	2		.50	.50			1.00	.41	1.41	53.00	32
1920	3		.50	1.00			1.50	.41	1.91	58.00	32
1920	4		.50	1.50			2.00	.41	2.41	69.00	32
1921	0						.00	.35	.35	12.10	33
1921	1		.33				.33	.35	.68	24.00	33
1921	2		.33	.34			.67	.35	1.02	18.80	33
1921	3		.33	.67			1.00	.35	1.35	37.40	33
1921	4		.33	1.01			1.34	.35	1.69	42.66	33
1921	5		.67	1.00			1.67	.35	2.02	39.20	33
1921	2		.50	.50			1.00	.35	1.35	21.40	33
1921	3		.50	1.00			1.50	.35	1.85	40.10	33
1921	4		.50	1.50			2.00	.35	2.35	44.20	33
1921	0						.00	.35	.35	.00	33
1921	1		.33				.33	.35	.68	34.70	33
1921	2		.33	.34			.67	.35	1.02	42.10	33
1921	3		.33	.67			1.00	.35	1.35	58.60	33
1921	4		.33	1.01			1.34	.35	1.69	47.80	33
1921	4		.66	.68			1.34	.35	1.69	60.50	33
1921	5		.67	1.00			1.67	.35	2.02	60.50	33
1921	2		.50	.50			1.00	.35	1.35	51.20	33
1921	4		.67	.67			1.34	.35	1.69	49.20	33
1921	3		.50	1.00			1.50	.35	1.85	52.00	33
1921	4		.50	1.50			2.00	.35	2.35	52.50	33
1921	0						.00	.35	.35	.00	33
1921	1		.33				.33	.35	.68	10.00	33
1921	2		.33	.34			.67	.35	1.02	23.70	33
1921	3		.33	.67			1.00	.35	1.35	47.00	33
1921	4		.67	.67			1.34	.35	1.69	52.00	33
1921	4		.67	.67			1.34	.35	1.69	52.00	33
1921	5		1.00	.67			1.67	.35	2.02	44.50	33
1921	2		.50	.50			1.00	.35	1.35	38.50	33
1921	3		.50	1.00			1.50	.35	1.35	27.50	33
1921	4		1.00	1.00			2.00	.35	2.35	21.60	33
1922	0						.00	.55	.55	3.90	34
1922	1		.33				.33	.57	.90	49.20	34
1922	2		.33	.34			.67	.57	1.24	55.00	34
1922	3		.67	.33			1.00	.57	1.57	62.00	34
1922	4		.67	.33	.33		1.33	.57	1.90	61.50	34
1922	5		.67	.66	.34		1.67	.57	2.24	59.00	34
1922	6		1.00	.67	.33		2.00	.57	2.57	56.00	34
1922	2		.50	.50			1.00	.57	1.57	63.00	34
1922	3		1.00	.50			1.50	.57	2.07	62.00	34
1922	4		1.00	.50	.50		2.00	.57	2.57	58.40	34
1922	0						.00	.55	.55	19.60	34
1922	1		.33				.33	.55	.88	26.20	34
1922	2		.33	.34			.67	.55	1.22	36.80	34
1922	3		.67	.33			1.00	.55	1.55	41.00	34
1922	4		.67	.66			1.33	.55	1.88	49.50	34
1922	5		.67	.66	.34		1.67	.55	2.22	50.20	34
1922	6		1.00	.66	.34		2.00	.55	2.55	37.30	34
1922	2		.50	.50			1.00	.55	1.55	32.20	34
1922	3		1.00	.50			1.50	.55	2.05	41.70	34
1922	4		1.00	1.00			2.00	.55	2.55	46.30	34
1922	0						.00	.55	.55	6.85	34
1922	1		.33				.33	.55	.88	24.80	34
1922	2		.33	.34			.67	.55	1.22	40.40	34
1922	3		.67	.33			1.00	.55	1.55	43.60	34
1922	4		.67	.33	.33		1.33	.55	1.88	44.00	34
1922	5		.67	.66	.34		1.67	.55	2.22	43.30	34
1922	6		.67	1.00	.33		2.00	.55	2.55	39.50	34
1922	2		.50	.50			1.00	.55	1.55	42.00	34
1922	3		1.00	.50			1.50	.55	2.05	43.50	34
1922	4		1.00	.50	.50		2.00	.57	2.57	44.00	34
1922	5		.67	.33	.34		1.67	.57	2.24	42.30	34
1923	0						.00	.72	.72	.00	8

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

BARLEY—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1923	1		0.33				0.33	0.72	1.05	44.50	8
1923	2		.33	0.34			.67	.72	1.39	44.10	8
1923	3		.67	.33			1.00	.72	1.72	40.20	8
1923	4		.67	.66			1.33	.72	2.05	46.00	8
1923	3		.67		0.33		1.00	.72	1.72	50.70	8
1923	4		.67	.33	.33		1.33	.72	2.05	50.80	8
1923	2		.50	.50			1.00	.72	1.72	49.20	8
1923	3		1.00	.50			1.50	.72	2.22	49.10	8
1923	4		1.00	1.00			2.00	.72	2.72	50.20	8
1923	0						.00	.65	.65	15.20	8
1923	1		.33				.33	.65	.98	22.90	8
1923	2		.33	.34			.67	.69	1.36	29.10	8
1923	2		.33	.34			.67	.69	1.36	33.50	8
1923	3		.33	.67			1.00	.69	1.69	38.10	8
1923	3		.37		.34		.71	.69	1.40	38.20	8
1923	3		.41		.34		.75	.69	1.44	35.50	8
1923	4		.50	.34	.33		1.17	.69	1.86	36.80	8
1923	2		.50	.50			1.00	.69	1.69	32.40	8
1923	2		.50	.50			1.00	.69	1.69	35.00	8
1923	3		.50	1.00			1.50	.69	2.19	35.40	8
1923	0						.00	.72	.72	10.80	8
1923	1		.33				.33	.72	1.05	27.00	8
1923	2		.67				.67	.72	1.39	46.60	8
1923	2		.33	.34			.67	.72	1.39	30.80	8
1923	3		.33	.67			1.00	.72	1.72	51.10	8
1923	4		.67	.33	.33		1.33	.72	2.05		8
1923	3		.83	.33			1.16	.72	1.88	45.20	8
1923	2		.50	.50			1.00	.72	1.72	48.40	8
1923	3		.50	1.00			1.50	.72	2.22	43.40	8

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										Tons	
1920	1		0.33				0.33	0.41	0.74	1.23	32
1920	2		.33	0.34			.67	.41	1.08	2.07	32
1920	3		.33	.33	0.34		1.00	.41	1.41	2.22	32
1920	4		.33	.33	.67		1.33	.41	1.74	2.90	32
1920	5		.33	.33	1.01		1.67	.41	2.08	2.05	32
1921	0						.00	.57	.57	7.95	33
										Bushels	
1921	1		.17				.17	.57	.74	12.00	33
1921	2		.17	.16			.33	.57	.90	16.30	33
1921	3		.17	.33			.50	.57	1.07	21.50	33
1921	4		.17	.50			.67	.57	1.24	20.03	33
1921	5		.33	.34	.17		.84	.57	1.41	20.00	33
1921	6		.33	.50	.17		1.00	.57	1.57	16.77	33
1922	0						.00	.70	.70	9.05	34
1922	1		.17				.17	.70	.87	8.83	34
1922	2		.17	.16			.33	.70	1.03	11.86	34
1922	3		.17	.33			.50	.70	1.20	12.78	34
1922	4		.17	.33	.16		.66	.70	1.36	13.63	34
1922	5		.17	.33	.33		.83	.70	1.53	13.65	34
1922	2		.25	.25			.50	.70	1.20	13.25	34
1922	3		.25	.50			.75	.70	1.45	14.50	34
1922	4		.25	.50	.25		1.00	.70	1.70	17.71	34
1923	0						.00	.79	.79	4.44	8
1923	1			.17			.17	.79	.96	6.05	8
1923	2			.34			.34	.79	1.13	7.60	8
1923	2			.17	.17		.34	.79	1.13	6.67	8
1923	3			.17	.33		.50	.79	1.29	6.95	8
1923	4			.33	.34		.67	.79	1.46		8
1923	5			.58	.34		.92	.79	1.71	5.74	8
1923	2			.50			.50	.79	1.29	6.72	8
1923	2			.25	.25		.50	.79	1.29	7.77	8
1923	3			.25	.50		.75	.79	1.54	6.58	8

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada*[1]—Continued

FLAX

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1918	0						0.00	0.20	0.20	5.70	43
1918	1		0.33				.33	.20	.53	10.80	43
1918	2		.33	0.34			.67	.20	.87	11.40	43
1918	3		.33	.67			1.00	.20	1.20	22.20	43
1918	4		.66	.67			1.33	.23	1.56	23.30	43
1918	5		.66	1.01			1.67	.23	1.90	26.70	43
1918	6		.66	1.02	0.34		2.00	.23	2.23	30.10	43
1918	2		.50	.50			1.00	.23	1.23	10.20	43
1918	3		.50	1.00			1.50	.23	1.73	15.30	43
1918	4		1.00	1.00			2.00	.23	2.23	23.30	43
1919	0						.00	.56	.56	10.40	44
1919	1		.33				.33	.56	.89	17.30	44
1919	2		.33	.34			.67	.56	1.23	20.60	44
1919	3		.66	.34			1.00	.56	1.56	23.40	44
1919	4		.66	.67			1.33	.56	1.89	25.70	44
1919	5	0.33	.33	1.01			1.67	.56	2.23	20.60	44
1919	6	.33	.67	1.00			2.00	.56	2.56	17.30	44
1919	2		.50	.50			1.00	.56	1.56	16.20	44
1919	3		1.00	.50			1.50	.56	2.06	20.60	44
1919	4		1.00	1.00			2.00	.56	2.56	20.60	44
1920	0						.00	.41	.41	4.90	32
1920	1		.33				.33	.41	.74	7.70	32
1920	2		.33	.34			.67	.41	1.08	11.10	32
1920	3		.33	.67			1.00	.41	1.41	13.60	32
1920	4		.33	1.00			1.33	.41	1.74	17.30	32
1920	5		.66	.67	.34		1.67	.41	2.08	15.40	32
1920	6		.66	1.00	.34		2.00	.41	2.41	13.10	32
1920	2		.50	.50			1.00	.41	1.41	14.90	32
1920	3		.50	1.00			1.50	.41	1.91	16.60	32
1920	4		.50	1.50			2.00	.41	2.41	14.50	32
1922	0						.00	.55	.55	1.01	34
1922	1		.33				.33	.55	.88	3.35	34
1922	2		.33	.34			.67	.55	1.22	5.33	34
1922	3		.67	.33			1.00	.57	1.57	18.20	34
1922	4		.67	.33	.33		1.33	.58	1.91	20.70	34
1922	5		.67	.67	.33		1.67	.58	2.25	31.10	34
1922	6		1.00	.67	.33		2.00	.58	2.58	27.90	34
1922	2		.50	.50			1.00	.57	1.57	17.40	34
1922	3		1.00	.50			1.50	.58	2.08	30.90	34
1922	4		1.00	.50	.50		2.00	.58	2.58	27.70	34
1923	0						.00	.78	.78	7.05	8
1923	1		.33				.33	.79	1.12	17.10	8
1923	2		.33	.34			.67	.79	1.46	16.30	8
1923	2		.33	.34			.67	.79	1.46	20.80	8
1923	3		.33	.67			1.00	.79	1.79	24.10	8
1923	3		.67		.33		1.00	.79	1.79	20.00	8
1923	4		.67	.33	.33		1.33	.79	2.12	20.40	8
1923	2		.50	.50			1.00	.79	1.79	11.30	8
1923	2		.50	.33			.83	.79	1.62	18.40	8
1923	3		.50	.83			1.33	.79	2.12	15.99	8

GRASSES

										Tons	
1920	1		0.33				0.33	0.41	0.74	0.80	32
1920	2		.67				.67	.41	1.08	1.23	32
1920	3		1.00				1.00	.41	1.41	1.01	32
1920	4		1.00	0.33			1.33	.41	1.74	1.75	32
1920	5		1.33	.34			1.67	.41	2.08	1.72	32
1920	6		1.33	.67			2.00	.41	2.41	1.75	32
1920	1		.33				.33	.41	.74	1.33	32
1920	2		1.00				1.00	.41	1.41	1.40	32
1920	3		1.50				1.50	.41	1.91	1.58	32
1920	4		1.50	.50			2.00	.41	2.41	1.74	32
1921	0						.00	.32	.32	1.00	33
1921	1		.33				.33	.32	.65	1.48	33
1921	2		.67				.67	.32	.99	1.46	33
1921	3		.67	.33			1.00	.32	1.32	1.30	33
1921	3		.67	.33			1.00	.32	1.32	1.23	33

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

GRASSES—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1921	4		1.00	0.33			1.33	0.32	1.65	1.42	33
1921	4		1.00	.33			1.33	.32	1.65	1.48	33
1921	2		1.00				1.00	.32	1.32	1.64	33
1921	3		1.00	.50			1.50	.32	1.82	1.81	33
1921	3		1.00	.50			1.50	.32	1.82	1.88	33
1922	0						.00	.46	.46	1.48	34
1922	1		.33				.33	.46	.79	2.08	34
1922	2		.67				.67	.46	1.13	1.92	34
1922	3		1.00				1.00	.46	1.46	2.53	34
1922	3		1.00				1.00	.46	1.46	2.45	34
1922	4		1.33				1.33	.46	1.79	2.28	34
1922	5		1.67				1.67	.46	2.13	2.62	34
1922	2		1.00				1.00	.46	1.46	2.22	34
1922	3		1.50				1.50	.46	1.96	2.84	34
1922	4		2.00				2.00	.46	2.46	1.72	34
1923	0						.00	.49	.49	.725	8
1923	1	0.33					.33	.49	.82	.762	8
1923	2	.33	.34				.67	.49	1.16	1.216	8
1923	3	.33	.67				1.00	.49	1.49	1.720	8
1923	3	.33	.67				1.00	.49	1.49	1.515	8
1923	3	.67	.33				1.00	.49	1.49	1.362	8
1923	4	.33	1.00				1.33	.49	1.82	.740	8
1923	2	.50	.50				1.00	.49	1.49	.713	8
1923	3	.50	1.00				1.50	.49	1.99	1.010	8
1923	3	.50	1.00				1.50	.49	1.99	.550	8
1923	0						.00	.49	.49	.595	8
1923	1	.33					.33	.49	.82		8
1923	2	.33	.34				.67	.49	1.16	1.65	8
1923	3	.33	.67				1.00	.49	1.49	1.26	8
1923	3	.33	.67				1.00	.49	1.49		8
1923	3	.67	.33				1.00	.49	1.49	1.26	8
1923	4	.67	.66				1.33	.49	1.82	.95	8
1923	2	.50	.50				1.00	.49	1.49	1.60	8
1923	3	.50	1.00				1.50	.49	1.99	1.28	8
1923	3	.50	1.00				1.50	.49	1.99	1.20	8

OATS

1918	0									*Bushels*	
1918	1		0.33				0.00	0.20	0.20	10.10	43
1918	2		.33	0.34			.33	.20	.53	38.00	43
1918	3		.33	.67			.67	.29	.96	47.10	43
1918	4		.66	.67			1.00	.26	1.26	83.30	43
1918	5		.66	.67	0.34		1.33	.26	1.59	100.10	43
1918	6		.66	1.00	.34		1.67	.26	1.93	113.00	43
1918	2		.50	.50			2.00	.26	2.26	108.70	43
1918	3		.50	1.00			1.00	.29	1.29	66.10	43
1918	4		1.00	1.00			1.50	.29	1.79	60.80	43
1918	2		.33	.34			2.00	.26	2.26	53.00	43
1918	3		.33	.67			.67	.20	.87	58.70	43
1918	4		.66	.67			1.00	.20	1.20	81.10	43
1918	5		.66	.67	.34		1.33	.23	1.56	73.10	43
1918	6		.66	1.00	.34		1.67	.23	1.90	95.00	43
1918	2		.50	.50			2.00	.26	2.26	94.10	43
1918	3		.50	1.00			1.00	.29	1.29	57.40	43
1918	4		1.00	1.00			1.50	.26	1.76	68.70	43
1919	0						2.00	.23	2.23	94.10	43
1919	1		.33				.00	.26	.26	2.90	44
1919	2		.33	.34			.33	.26	.59	30.20	44
1919	3		.66	.34			.67	.38	1.05	56.30	44
1919	4		.66	.67			1.00	.43	1.43	72.10	44
1919	5	0.33	.33	1.01			1.33	.43	1.76	71.80	44
1919	6	.33	.67	1.00			1.67	.43	2.10	71.80	44
1919	2		.50	.50			2.00	.43	2.43	66.80	44
1919	3		1.00	.50			1.00	.43	1.43	77.00	44
1919	4		1.00	1.00			1.50	.43	1.93	65.60	44
1919	0						2.00	.43	2.43	69.30	44
1919	1		.33				.00	.38	.38	1.50	44
							.33	.38	.71	41.70	44

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

OATS—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1919	2		0.33	0.34			0.67	0.38	1.05	56.90	44
1919	3		.66	.34			1.00	.43	1.43	69.00	44
1919	4		.66	.67			1.33	.43	1.76	69.00	44
1919	5	0.33	.33	1.01			1.67	.43	2.10	68.90	44
1919	6	.33	.67	1.00			2.00	.43	2.43	52.30	44
1919	2		.50	.50			1.00	.43	1.43	57.80	44
1919	3		1.00	.50			1.50	.43	1.93	52.30	44
1919	4		1.00	1.00			2.00	.43	2.43	55.80	44
1919	0						.00	.43	.43	2.00	44
1919	1		.33				.33	.43	.76	69.50	44
1919	2		.33	.34			.67	.43	1.10	71.80	44
1919	3		.66	.34			1.00	.43	1.43	80.60	44
1919	4		.66	.67			1.33	.43	1.76	79.00	44
1919	5	.33	.33	1.01			1.67	.43	2.10	73.50	44
1919	6	.33	.66	1.01			2.00	.43	2.43	62.10	44
1919	2		.50	.50			1.00	.43	1.43	47.40	44
1919	3		1.00	.50			1.50	.43	1.93	56.20	44
1919	4		1.00	1.00			2.00	.43	2.43	51.20	44
1919	0						.00	.38	.38	12.60	44
1919	1		.33				.33	.38	.71	35.00	44
1919	2		.33	.34			.67	.38	1.05	41.10	44
1919	3		.66	.34			1.00	.43	1.43	46.70	44
1919	4		.66	.67			1.33	.43	1.76	49.80	44
1919	5	.33	.33	1.01			1.67	.43	2.10	64.00	44
1919	6	.33	.67	1.00			2.00	.43	2.43	55.00	44
1919	2		.50	.50			1.00	.43	1.43	50.20	44
1919	3		1.00	.50			1.50	.43	1.93	49.70	44
1919	4		1.00	1.00			2.00	.43	2.43	64.00	44
1920	0						.00	.41	.41	60.00	32
1920	1			.33			.33	.41	.74	103.00	32
1920	2		.33	.34			.67	.41	1.08	131.00	32
1920	3		.33	.67			1.00	.41	1.41	132.00	32
1920	4		.33	1.00			1.33	.41	1.74	132.00	32
1920	5		.66	.67	0.34		1.67	.41	2.08	124.00	32
1920	6		.66	1.00	.34		2.00	.41	2.41	119.00	32
1920	2		.50	.50			1.00	.41	1.41	133.00	32
1920	3		.50	1.00			1.50	.41	1.91	132.00	32
1920	4		.50	1.50			2.00	.41	2.41	106.00	32
1920	0						.00	.41	.41	30.00	32
1920	1			.33			.33	.41	.74	59.00	32
1920	2		.33	.34			.67	.41	1.08	75.00	32
1920	3		.33	.67			1.00	.41	1.41	91.00	32
1920	4		.33	1.00			1.33	.41	1.74	105.00	32
1920	5		.66	.67	.34		1.67	.41	2.08	108.00	32
1920	6		.66	1.00	.34		2.00	.41	2.41	100.00	32
1920	2		.50	.50			1.00	.41	1.41	96.00	32
1920	3		.50	1.00			1.50	.41	1.91	87.00	32
1920	4		.50	1.50			2.00	.41	2.41	98.00	32
1920	0						.00	.41	.41	22.00	32
1920	1			.33			.33	.41	.74	62.00	32
1920	2		.33	.34			.67	.41	1.08	71.00	32
1920	3		.33	.67			1.00	.41	1.41	84.00	32
1920	4		.33	.67	.33		1.33	.41	1.74	92.00	32
1920	5		.66	.67	.34		1.67	.41	2.08	97.00	32
1920	6		.66	.67	.67		2.00	.41	2.41	94.00	32
1920	2		.50	.50			1.00	.41	1.41	70.00	32
1920	3		.50	1.00			1.50	.41	1.91	91.00	32
1920	4		.50	1.00	.50		2.00	.41	2.41	108.00	32
1920	0						.00	.41	.41	8.00	32
1920	1		.33				.33	.41	.74	52.00	32
1920	2		.33	.34			.67	.41	1.08	70.00	32
1920	3		.33	.67			1.00	.41	1.41	77.00	32
1920	4		.33	1.00			1.33	.41	1.74	81.00	32
1920	5		.66	.67	.34		1.67	.41	2.08	87.00	32
1920	6		.66	1.00	.34		2.00	.41	2.41	80.00	32
1920	2		.50	.50			1.00	.41	1.41	73.00	32
1920	3		.50	1.00			1.50	.41	1.91	87.00	32
1920	4		.50	1.50			2.00	.41	2.41	85.00	32
1921	0						.00	.42	.42	0.00	33
1921	1		.33				.33	.42	.75	112.00	33
1921	2		.33	.34			.67	.42	1.09	113.00	33

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

OATS—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1921	3		0.33	0.67			1.00	0.42	1.42	131.50	33
1921	4		.67	.66			1.33	.42	1.75	135.00	33
1921	5		.67	.67	0.33		1.67	.42	2.09	143.00	33
1921	6		1.00	.67	.32		2.00	.42	2.42	131.00	33
1921	2		.50	.50			1.00	.42	1.42	118.10	33
1921	3		.50	1.00			1.50	.42	1.92	113.00	33
1921	4		1.00	1.00			2.00	.42	2.42	117.00	33
1921	0						.00	.42	.42	0.00	33
1921	1		.33				.33	.42	.75	39.40	33
1921	2		.33	.34			.67	.42	1.09	112.00	33
1921	3		.33	.67			1.00	.42	1.42	133.40	33
1921	4		.67	.66			1.33	.42	1.75	128.00	33
1921	5		.67	.67	.33		1.67	.42	2.09	116.00	33
1921	6		1.00	.67	.33		2.00	.42	2.42	127.00	33
1921	2		.50	.50			1.00	.42	1.42	134.00	33
1921	3		.50	1.00			1.50	.42	1.92	138.10	33
1921	4		1.00	1.00			2.00	.42	2.42	135.80	33
1921	0						.00	.39	.39	0.00	33
1921	2		.33				.33	.39	.72	38.40	33
1921	2		.33	.34			.67	.39	1.06	67.00	33
1921	3		.33	.67			1.00	.39	1.39	68.10	33
1921	4		.33	1.00			1.33	.39	1.72	62.40	33
1921	5		.67	.67	.33		1.67	.39	2.06	80.00	33
1921	6		.67	1.00	.33		2.00	.39	2.39	91.20	33
1921	2		.50	.50			1.00	.39	1.39	63.00	33
1921	3		.50	1.00			1.50	.39	1.89	66.90	33
1921	4		.50	1.50			2.00	.39	2.39	66.80	33
1921	0						.00	.39	.39	0.00	33
1921	1		.33				.33	.39	.72	43.40	33
1921	2		.33	.34			.67	.39	1.06	54.00	33
1921	3		.33	.67			1.00	.39	1.39	62.10	33
1921	4		.33	1.00			1.33	.39	1.72	73.20	33
1921	5		.67	.67	.33		1.67	.39	2.06	84.70	33
1921	6		.67	1.00	.33		2.00	.39	2.39	74.00	33
1921	2		.50	.50			1.00	.39	1.39	60.00	33
1921	3		.50	1.00			1.50	.39	1.89	59.00	33
1921	4		.50	1.50			2.00	.39	2.39	70.00	33
1922	0						.00	.57	.57	15.10	34
1922	1		.33				.33	.57	.90	101.50	34
1922	2		.33	.34			.67	.57	1.24	82.40	34
1922	3		.67	.33			1.00	.57	1.57	94.40	34
1922	4		.67	.33	.33		1.33	.57	1.90	131.20	34
1922	5		.67	.66	.34		1.67	.57	2.24	112.00	34
1922	6		1.00	.66	.34		2.00	.57	2.57	118.00	34
1922	2		.50	.50			1.00	.57	1.57	116.50	34
1922	3		1.00	.50			1.50	.57	2.07	116.20	34
1922	4		1.00	.50	.50		2.00	.57	2.57	112.80	34
1922	0						.00	.57	.57	194.40	34
1922	1		.33				.33	.61	.94	91.00	34
1922	2		.33	.34			.67	.61	1.28	115.50	34
1922	3		.67	.33			1.00	.62	1.62	104.50	34
1922	4		.67	.33	.33		1.33	.62	1.95	112.80	34
1922	5		.67	.67	.33		1.67	.61	2.28	108.50	34
1922	6		1.00	.67	.33		2.00	.62	2.62	134.00	34
1922	2		.50	.50			1.00	.62	1.62	111.50	34
1922	3		1.00	.50			1.50	.62	2.12	123.20	34
1922	4		1.00	.50	.50		2.00	.62	2.62	128.00	34
1923	0						.00	.55	.55	21.90	34
1922	1		.33				.33	.55	.88	42.00	34
1922	2		.33	.34			.67	.57	1.24	90.30	34
1922	3		.67	.33			1.00	.57	1.57	91.10	34
1922	4		.67	.33	.33		1.33	.57	1.90	100.40	34
1922	5		.67	.66	.34		1.67	.57	2.24	88.50	34
1922	6		1.00	.67	.33		2.00	.57	2.57	80.50	34
1922	2		.50	.50			1.00	.57	1.57	91.50	34
1922	3		1.00	.50			1.50	.57	2.07	88.70	34
1922	4		1.00	.50	.50		2.00	.57	2.57	87.70	34
1922	5		.67	.66	.34		1.67	.57	2.24	99.50	34
1922	0						.00	.55	.55	10.30	34
1922	1		.33				.33	.55	.88	53.50	34
1922	2		.33	.34			.67	.56	1.22	83.80	34

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

OATS—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1922	3		0.67	0.33			1.00	0.57	1.57	109.50	34
1922	4		.67	.33	0.33		1.33	.57	1.90	101.00	34
1922	5		.67	.67	.33		1.67	.57	2.24	93.60	34
1922	6		1.00	.67	.33		2.00	.57	2.57	85.50	34
1922	2		.50	.50			1.00	.55	1.55	69.50	34
1922	3		1.00	.50			1.50	.57	2.07	87.00	34
1922	4		1.00	.50	.50		2.00	.57	2.57	80.00	34
1923	0						.00	.65	.65	26.80	8
1923	1		.33				.33	.65	.98	90.00	8
1923	2		.33	.34			.67	.65	1.32		8
1923	2		.67				.67	.72	1.39	110.50	8
1923	3		.33	.67			1.00	.72	1.72	130.20	8
1923	3		.67		.33		1.00	.72	1.72	134.20	8
1923	4		.67	.33	.33		1.33	.72	2.05	128.50	8
1923	2		.50	.50			1.00	.72	1.72	135.00	8
1923	2		.50	.50			1.00	.72	1.72	126.50	8
1923	3		.50	1.00			1.50	.72	2.22	108.00	8
1923	0						.00	.72	.72	97.00	8
1923	2		.33	.34			.67	.72	1.39	96.60	8
1923	2		.33	.34			.67	.72	1.39	111.50	8
1923	2		.33	.34			.67	.72	1.39	116.50	8
1923	3		.33	.67			1.00	.78	1.78	112.60	8
1923	3		.67		.33		1.00	.78	1.78	116.20	8
1923	4		.67	.33	.33		1.33	.78	2.11	122.20	8
1923	2		.50	.50			1.00	.78	1.78	119.30	8
1923	2		.50	.50			1.00	.78	1.78	123.50	8
1923	3		.50	1.00			1.50	.78	2.28	118.50	8
1923	0						.00	.65	.65	21.30	8
1923	1		.33				.33	.65	.98	49.40	8
1923	2		.33	.34			.67	.72	1.39	62.20	8
1923	2		.33	.34			.67	.72	1.39	70.40	8
1923	3		.33	.67			1.00	.72	1.72	74.40	8
1923	3		.67		.33		1.00	.72	1.72	79.00	8
1923	3		.67		.33		1.00	.72	1.72	73.70	8
1923	4		.67	.33	.33		1.33	.72	2.05	81.20	8
1923	2		.42	.50			.92	.72	1.64	77.00	8
1923	2		.50	.50			1.00	.72	1.72	79.00	8
1923	3		.50	1.00			1.50	.72	2.22	90.50	8
1924	0						.00	.65	.65	20.30	8
1923	1		.33				.33	.65	.98	42.60	8
1923	2		.33	.34			.67	.78	1.45	96.50	8
1923	2		.67				.67	.78	1.45	99.30	8
1923	3		.67	.33			1.00	.78	1.78	107.00	8
1923	3		.67		.33		1.00	.57	1.57	69.00	8
1923	4		.67	.33	.33		1.33	.78	2.11	91.00	8
1923	2		.50	.50			1.00	.78	1.78	98.50	8
1923	2		1.00				1.00	.78	1.78	95.00	8
1923	3		1.00	.50			1.50	.78	2.28	124.00	8

PEAS

1918	0						0.00	0.20	0.20	6.20	43
1918	1		0.33				.33	.20	.53	16.90	43
1918	2		.33	0.34			.67	.26	.93	29.50	43
1918	3		.33	.67			1.00	.23	1.23	38.00	43
1918	4		.66	.67			1.33	.23	1.56	[6] 33.90	43
1918	5		.66	.67	0.34		1.67	.26	1.93	50.80	43
1918	6		.66	1.00	.34		2.00	.26	2.26	44.50	43
1918	2		.50	.50			1.00	.23	1.23	33.20	43
1918	3		.50	1.00			1.50	.26	1.76	[6] 32.40	43
1918	4		1.00	1.00			2.00	.26	2.26	37.00	43
1918	0						.00	.20	.20	8.70	43
1918	2		.33	.34			.67	.20	.87	28.70	43
1918	3		.33	.67			1.00	.26	1.26	36.20	43
1918	4		.66	.67			1.33	.26	1.59	37.70	43
1918	5		.66	.67	.34		1.67	.20	1.87	14.00	43
1918	6		.66	1.00	.34		2.00	.26	2.26	45.50	43
1918	2		.50	.50			1.00	.26	1.26	33.20	43

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

PEAS—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1918	3		0.50	1.00			1.50	0.26	1.76	38.20	43
1918	4		1.00	1.00			2.00	.20	2.20	[6] 25.30	43
1919	0						.00	.26	.26	4.00	44
1919	1		.33				.33	.43	.76	15.80	44
1919	2		.33	.34			.67	.49	1.16	21.50	44
1919	3		.66	.34			1.00	.52	1.52	32.20	44
1919	4		.66	.67			1.33	.52	1.85	38.40	44
1919	5	0.33	.33	1.01			1.67	.56	2.23	46.50	44
1919	6	.33	.67	1.00			2.00	.56	2.56	56.20	44
1919	2		.50	.50			1.00	.43	1.43	25.70	44
1919	3		1.00	.50			1.50	.56	2.06	53.50	44
1919	4		1.00	1.00			2.00	.56	2.56	56.88	44
1920	0						.00	.41	.41	4.30	32
1920	1			.33			.33	.41	.74	24.00	32
1920	2		.33	.34			.67	.41	1.08	47.50	32
1920	3		.33	.67			1.00	.41	1.41	49.20	32
1920	4		.33	.67	0.33		1.33	.41	1.74	52.70	32
1920	5		.66	.67	.34		1.67	.41	2.08	55.00	32
1920	6		.66	.67	.67		2.00	.41	2.41	60.70	32
1920	7		1.00	1.00	.33		2.33	.41	2.74	50.00	32
1920	8		1.00	1.00	.67		2.67	.41	3.08	53.80	32
1920	2		.50	.50			1.00	.41	1.41	43.80	32
1920	3		.50	1.00			1.50	.41	1.91	58.00	32
1920	4		.50	1.00	.50		2.00	.41	2.41	68.00	32
1920	0						.00	.44	.44	11.50	32
1920	1		.33				.33	.44	.77	18.80	32
1920	2		.33	.34			.67	.44	1.11	23.80	32
1920	3		.66	.34			1.00	.44	1.44	23.20	32
1920	4		.66	.67			1.33	.44	1.77	25.20	32
1920	5		1.00	.67			1.67	.44	2.11	28.50	32
1920	0		1.00	1.00			2.00	.44	2.44	34.50	32
1921	0						.00	.47	.47	0.00	33
1921	1		.33				.33	.47	.80	8.25	33
1921	2		.33	.34			.67	.47	1.14	28.30	33
1921	3		.33	.67			1.00	.47	1.47	52.50	33
1921	4		.33	1.01			1.34	.47	1.81	52.00	33
1921	5		.67	.67	.33		1.67	.47	2.14	51.10	33
1921	6		.67	1.00	.33		2.00	.47	2.47	60.30	33
1921	2		.50	.50			1.00	.47	1.47	44.30	33
1921	3		.50	1.00			1.50	.47	1.97	56.70	33
1921	4		.50	1.50			2.00	.47	2.47	56.00	33
1921	7		1.00	1.00	.34		2.34	.47	2.81	58.40	33
1921	8		1.00	1.00	.67		2.67	.47	3.14	57.20	33
1922	0						.00	.55	.55	9.70	34
1922	1		.33				.33	.55	.88	18.10	34
1922	2		.33	.34			.67	.59	1.26	38.00	34
1922	3		.67	.33			1.00	.63	1.63	47.30	34
1922	4		.67	.33	.33		1.33	.70	2.03	50.70	34
1922	5		.67	.66	.34		1.67	.70	2.37	56.80	34
1922	6		.67	1.00	.33		2.00	.70	2.70	52.50	34
1922	7		1.00	.67	.66		2.33	.70	3.03	48.50	34
1922	8		1.00	.67	1.00		2.67	.70	3.37	43.30	34
1922	2		.50	.50			1.00	.59	1.59	39.90	34
1922	3		1.00	.50			1.50	.63	2.13	53.50	34
1922	4		1.00	.50	.50		2.00	.70	2.70	55.70	34
1922	5		.67	.66	.34		1.67	.63	2.30	54.40	34
1923	0						.00	.65	.65	10.30	8
1923	1		.33				.33	.72	1.05	14.60	8
1923	2		.33	.50			.83	.78	1.61	24.80	8
1923	2		.33	.34			.67	.78	1.45	29.70	8
1923	3		.33	.67			1.00	.78	1.78	32.00	8
1923	3		.67		.33		1.00	.78	1.78	34.80	8
1923	4		.67	.33	.33		1.33	.78	2.11	34.20	8
1923	5		1.00	.34	.33		1.67	.78	2.45	34.80	8
1923	6		1.00	.34	.66		2.00	.78	2.78	24.70	8
1923	2		.50	.50			1.00	.72	1.72	29.60	8
1923	2		.50	.50			1.00	.78	1.78	33.40	8
1923	3		.50	1.00			1.50	.78	2.28	23.00	8

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

POTATOES

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1918	0						0.00	0.29	0.29	44.00	43
1918	1		0.33				.33	.29	.62	76.10	43
1918	2		.33	0.34			.67	.29	.96	103.80	43
1918	3		.33	.67			1.00	.29	1.29	163.60	43
1918	4		.66	.67			1.33	.29	1.62	177.30	43
1918	5		.66	.67	0.34		1.67	.29	1.96	231.30	43
1918	6		.66	1.00	.34		2.00	.29	2.29	346.20	43
1918	2		.50	.50			1.00	.29	1.29	166.60	43
1918	3		.50	1.00			1.50	.29	1.79	195.90	43
1918	4		1.00	1.00			2.00	.29	2.29	199.60	43
1918	0						.00	.29	.29	81.20	43
1918	1		.33				.33	.29	.62	137.90	43
1918	2		.33	.34			.67	.29	.96	164.40	43
1918	3		.33	.67			1.00	.29	1.29	173.40	43
1918	4		.66	.67			1.33	.29	1.62	165.40	43
1918	5		.66	.67	.34		1.67	.29	1.96	263.10	43
1918	6		.66	1.00	.34		2.00	.29	2.29	277.30	43
1918	2		.50	.50			1.00	.29	1.29	118.10	43
1918	3		.50	1.00			1.50	.29	1.79	140.90	43
1918	4		1.00	1.00			2.00	.29	2.29	147.20	43
1919	0						.00	.71	.71	102.00	44
1919	1			.16			.16	.71	.87	208.00	44
1919	2		.16	.17			.33	.71	1.04	205.00	44
1919	3		.16	.34			.50	.71	1.21	224.00	44
1919	4		.16	.34	.17		.67	.71	1.38	283.00	44
1919	5		.32	.34	.17		.83	.71	1.54	259.00	44
1919	6		.32	.34	.17	0.17	1.00	.71	1.71	306.00	44
1919	2		.25	.25			.50	.71	1.21	220.00	44
1919	3		.25	.25	.25		.75	.71	1.46	309.00	44
1919	4		.25	.50	.25		1.00	.71	1.71	360.00	44
1919	0						.00	.71	.71	258.00	44
1919	1			.16			.16	.71	.87	268.00	44
1919	2		.16	.17			.33	.71	1.04	284.00	44
1919	3		.16	.34			.50	.71	1.21	297.00	44
1919	4		.16	.34	.17		.67	.71	1.38	345.00	44
1919	5		.32	.34	.17		.83	.71	1.54	406.00	44
1919	6		.32	.34	.17	.17	1.00	.71	1.71	347.00	44
1919	2		.25	.25			.50	.71	1.21	309.00	44
1919	3		.25	.25	.25		.75	.71	1.46	349.00	44
1919	4		.25	.50	.25		1.00	.71	1.71	381.00	44
1920	0						.00	.41	.41	24.00	44
1920	1			.17			.17	.41	.58	72.00	32
1920	2			.17	.16		.33	.41	.74	116.00	32
1920	3			.34	.16		.50	.41	.91	159.00	32
1920	4		.17	.17	.33		.67	.41	1.08	189.00	32
1920	5		.17	.33	.17	.16	.83	.41	1.24	217.00	32
1920	6		.34	.16	.34	.16	1.00	.41	1.41	167.00	32
1920	2		.25		.25		.50	.41	.91	94.00	32
1920	3		.25	.25	.25		.75	.41	1.16	151.00	32
1920	4		.25	.25	.25	.25	1.00	.41	1.41	202.00	32
1920	0						.00	.41	.41	20.00	32
1920	1			.17			.17	.41	.58	65.00	32
1920	2			.17	.16		.33	.41	.74	100.00	32
1920	3			.34	.16		.50	.41	.91	158.00	32
1920	4		.17	.17	.33		.67	.41	1.08	175.00	32
1920	5		.17	.33	.17	.16	.83	.41	1.24	185.00	32
1920	6		.34	.16	.34	.16	1.00	.41	1.41	147.00	32
1920	2		.25		.25		.50	.41	.91	171.00	32
1920	3		.25	.25	.25		.75	.41	1.16	167.00	32
1920	4		.25	.25	.25	.25	1.00	.41	1.41	158.00	32
1921	0						.00	.69	.69	120.00	33
1921	1		.17				.17	.69	.86	166.00	33
1921	2		.17	.16			.33	.69	1.02	211.00	33
1921	3		.17	.17	.16		.50	.69	1.19	245.00	33
1921	4		.17	.17	.33		.67	.69	1.36	301.00	33
1921	5		.17	.33	.33		.83	.69	1.52	340.00	33
1921	6		.17	.33	.50		1.00	.69	1.69	388.00	33
1921	2		.25	.25			.50	.69	1.19	298.00	33
1921	3		.25	.25	.25		.75	.69	1.44	379.00	33
1921	4		.25	.25	.50		1.00	.69	1.69	421.00	33
1921	1		.17				.17	.61	.78	141.00	33
1921	1		.17				.17	.61	.78	135.00	33
1921	2		.17	.16			.33	.61	.94	170.00	33
1921	3		.17	.16	.17		.50	.61	1.11	214.00	33

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada*[1]—Continued

POTATOES—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1921	4		0.17	0.16	0.34		0.67	0.61	1.28	203.00	33
1921	5		.17	.33	.33		.83	.61	1.44	202.00	33
1921	6		.17	.33	.50		1.00	.61	1.61	227.00	33
1921	2		.25	.25			.50	.61	1.11	221.60	33
1921	3		.25	.25	.25		.75	.61	1.36	252.00	33
1921	4		.25	.25	.50		1.00	.61	1.61	283.00	33
1922	0						.00	.77	.77	100.40	34
1922	1			.17			.17	.77	.94	147.80	34
1922	2			.17	.16		.33	.77	1.10	205.80	34
1922	3		.17	.16	.17		.50	.77	1.27	297.70	34
1922	4		.17	.16	.33		.66	.77	1.43	364.50	34
1922	5		.17	.16	.50		.83	.77	1.60	429.40	34
1922	6		.17	.33	.50		1.00	.77	1.77	425.20	34
1922	2			.25	.25		.50	.77	1.27	328.10	34
1922	3		.25	.25	.25		.75	.77	1.52	394.60	34
1922	4		.25	.25	.50		1.00	.77	1.77	408.20	34
1922	0						.00	.77	.77	165.60	34
1922	1			.17			.17	.77	.94	170.90	34
1922	2			.17	.16		.33	.77	1.10	194.60	34
1922	3		.17	.16	.17		.50	.77	1.27	258.20	34
1922	4		.17	.16	.33		.66	.77	1.43	269.10	34
1922	5		.17	.33	.33		.83	.77	1.60	297.00	34
1922	6		.17	.33	.50		1.00	.77	1.77	295.80	34
1922	2			.25	.25		.50	.77	1.27	175.00	34
1922	3		.25	.25	.25		.75	.77	1.52	258.50	34
1922	4		.25	.25	.50		1.00	.77	1.77	256.30	34
1923	0						.00	.79	.79	163.70	8
1923	1			.17			.17	.79	.96	181.50	8
1923	1				.17		.17	.79	.96	151.50	8
1923	2			.17	.17		.34	.79	1.13	208.00	8
1923	3			.17	.16	0.17	.50	.79	1.29	216.80	8
1923	4			.33	.17	.17	.67	.79	1.46	441.10	8
1923	5			.34	.34	.17	.85	.79	1.64	470.40	8
1923	2			.25	.25		.50	.79	1.29	258.40	8
1923	2			.25	.25		.50	.79	1.29	227.10	8
1923	3			.25	.25	.25	.75	.79	1.54	231.00	8
1923	0						.00	.79	.79	171.90	8
1923	1			.17			.17	.79	.96	192.10	8
1923	1				.17		.17	.79	.96	198.70	8
1923	2			.17	.17		.34	.79	1.13	253.50	8
1923	3			.17	.16	.17	.50	.79	1.29	357.60	8
1923	4			.33	.17	.17	.67	.79	1.46	372.10	8
1923	5			.34	.34	.17	.85	.79	1.64	366.40	8
1923	1				.25		.25	.79	1.04	197.50	8
1923	2			.25	.25		.50	.79	1.29	183.30	8
1923	3			.25	.25	.25	.75	.79	1.54	337.30	8

SUGAR BEETS

										Tons	
1920	1		0.33				0.33	0.41	0.74	1.50	32
1920	2		.33	0.34			.67	.41	1.08	8.90	32
1920	3		.33	.33	0.34		1.00	.41	1.41	12.50	32
1920	4		.33	.33	.67		1.33	.41	1.74	15.70	32
1920	5		.33	.33	.67	0.34	1.67	.41	2.08	16.00	32

WHEAT

										Bushels	
1918	0						0.00	0.20	0.20	1.00	43
1918	1		0.33				.33	.20	.53	13.80	43
1918	2		.33	0.34			.67	.26	.93	21.10	43
1918	3		.33	.67			1.00	.26	1.26	34.80	43
1918	4		.66	.67			1.33	.26	1.59	23.50	43
1918	5		.66	.67	0.34		1.67	.26	1.93	35.60	43
1918	6		.66	1.00	.34		2.00	.26	2.26	39.30	43
1918	2		.50	.50			1.00	.26	1.26	30.10	43
1918	3		.50	1.00			1.50	.26	1.76	40.70	43
1918	4		1.00	1.00			2.00	.26	2.26	27.30	43
1918	2		.33	.34			.67	.24	.91	31.30	43

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada*[1]—Continued

WHEAT—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1918	3		0.33	0.67			1.00	0.26	1.26	38.90	43
1918	4		.33	.67			1.33	.26	1.59	[2] 30.70	43
1918	5		.66	.67	0.34		1.67	.26	1.93	[2] 36.00	43
1918	6		.66	1.00	.34		2.00	.26	2.26	49.40	43
1918	2		1.00				1.00	.24	1.24	33.70	43
1918	3		.50	1.00			1.50	.26	1.76	38.50	43
1918	4		1.00	1.00			2.00	.26	2.26	30.40	43
1919	0						.00	.34	.34	5.00	44
1919	1		.33				.33	.36	.69	20.80	44
1919	2		.33	.34			.67	.49	1.16	36.80	44
1919	3		.66	.34			1.00	.49	1.49	47.50	44
1919	4		.66	.67			1.33	.49	1.82	50.30	44
1919	5	0.33	.33	1.01			1.67	.49	2.16	51.20	44
1919	6	.33	.67	1.00			2.00	.49	2.49	42.30	44
1919	2		.50	.50			1.00	.49	1.49	42.70	44
1919	3		1.00	.50			1.50	.49	1.99	38.70	44
1919	4		1.00	1.00			2.00	.49	2.49	40.70	44
1919	0						.00	.34	.34	4.80	44
1919	1		.33				.33	.43	.76	21.10	44
1919	2		.33	.34			.67	.43	1.10	36.60	44
1919	3		.66	.34			1.00	.43	1.43	43.90	44
1919	4		.66	.67			1.33	.43	1.76	45.80	44
1919	5	.33	.33	1.01			1.67	.43	2.10	42.30	44
1919	6	.33	.67	1.00			2.00	.43	2.43	43.40	44
1919	2		.50	.50			1.00	.43	1.43	44.00	44
1919	3		1.00	.50			1.50	.43	1.93	45.80	44
1919	4		1.00	1.00			2.00	.43	2.43	36.00	44
1919	0						.00	.38	.38	4.10	44
1919	1		.33				.33	.38	.71	17.10	44
1919	2		.33	.34			.67	.43	1.10	29.80	44
1919	3		.66	.34			1.00	.43	1.43	37.50	44
1919	4		.66	.67			1.33	.43	1.76	41.80	44
1919	5	.33	.33	1.01			1.67	.43	2.10	45.80	44
1919	6	.33	.67	1.00			2.00	.43	2.43	44.10	44
1919	2		.50	.50			1.00	.43	1.43	34.90	44
1919	3		1.00	.50			1.50	.43	1.93	48.30	44
1919	4		1.00	1.00			2.00	.43	2.43	44.30	44
1919	0						.00	.26	.26	4.80	44
1919	1		.33				.33	.26	.59	17.50	44
1919	2		.33	.34			.67	.36	1.03	21.40	44
1919	3		.66	.34			1.00	.43	1.43	39.70	44
1919	4		.66	.67			1.33	.43	1.76	42.00	44
1919	5	.33	.33	1.01			1.67	.43	2.10	53.00	44
1919	6	.33	.67	1.00			2.00	.43	2.43	52.70	44
1919	2		.50	.50			1.00	.43	1.43	42.20	44
1919	3		1.00	.50			1.50	.43	1.93	46.70	44
1919	4		1.00	1.00			2.00	.43	2.43	51.20	44
1919	0						.00	.34	.34	6.80	44
1919	1		.33				.33	.38	.71	21.20	44
1919	2		.33	.34			.67	.43	1.10	33.20	44
1919	3		.66	.34			1.00	.43	1.43	35.90	44
1919	4		.66	.67			1.33	.43	1.76	40.80	44
1919	5	.33	.34	1.00			1.67	.43	2.10	44.10	44
1919	6	.33	.67	1.00			2.00	.43	2.43	47.50	44
1919	2		.50	.50			1.00	.43	1.43	44.10	44
1919	3		1.00	.50			1.50	.43	1.93	44.10	44
1919	4		1.00	1.00			2.00	.43	2.43	34.90	44
1920	0						.00	.41	.41	10.00	32
1920	1		.33				.33	.41	.74	30.90	32
1920	2		.33	.34			.67	.41	1.08	41.90	32
1920	3		.33	.67			1.00	.41	1.41	47.60	32
1920	4		.33	.67	.33		1.33	.41	1.74	50.00	32
1920	5		.66	.67	.34		1.67	.41	2.08	51.00	32
1920	6		.66	.67	.67		2.00	.41	2.41	48.30	32
1920	2		.50	.50			1.00	.41	1.41	41.80	32
1920	3		.50	1.00			1.50	.41	1.91	44.70	32
1920	4		.50	1.00	.50		2.00	.41	2.41	43.60	32
1920	0						.00	.41	.41	15.00	32
1920	1		.33				.33	.41	.74	25.00	32
1920	2		.33	.34			.67	.41	1.08	35.70	32
1920	3		.33	.67			1.00	.41	1.41	40.00	32
1920	4		.33	1.00			1.33	.41	1.74	44.30	32
1920	5		.66	.67	.34		1.67	.41	2.08	47.40	32
1920	6		.66	1.00	.34		2.00	.41	2.41	46.00	32
1920	2		.50	.50			1.00	.41	1.41	31.00	32

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada*—Continued

WHEAT—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1920	3		0.50	1.00			1.50	0.41	1.91	42.70	32
1920	4		.50	1.50			2.00	.41	2.41	42.50	32
1920	0						.00	.41	.41	12.00	32
1920	1		.33				.33	.41	.74	23.60	32
1920	2		.33	.34			.67	.41	1.08	32.20	32
1920	3		.33	.67			1.00	.41	1.41	39.80	32
1920	4		.33	1.00			1.33	.41	1.74	43.60	32
1920	5		.66	.67	0.34		1.67	.41	2.08	37.80	32
1920	6		.66	1.00	.34		2.00	.41	2.41	36.00	32
1920	2		.50	.50			1.00	.41	1.41	29.50	32
1920	3		.50	1.00			1.50	.41	1.91	36.40	32
1920	4		.50	1.50			2.00	.41	2.41	30.80	32
1920	0						.00	.41	.41	9.40	32
1920	1		.33				.33	.41	.74	19.30	32
1920	2		.33	.34			.67	.41	1.08	29.00	32
1920	3		.33	.67			1.00	.41	1.41	30.30	32
1920	4		.33	1.00			1.33	.41	1.74	32.30	32
1920	5		.66	.67	.34		1.67	.41	2.08	33.80	32
1920	6		.66	1.00	.34		2.00	.41	2.41	30.30	32
1920	2		.50	.50			1.00	.41	1.41	23.20	32
1920	3		.50	1.00			1.50	.41	1.91	30.10	32
1920	4		.50	1.50			2.00	.41	2.41	24.70	32
1920	0						.00	.44	.44	6.00	32
1920	1		.33				.33	.44	.77	26.40	32
1920	2		.33	.34			.67	.44	1.11	33.20	32
1920	3		.66	.34			1.00	.44	1.44	39.20	32
1920	4		.66	.67			1.33	.44	1.77	42.70	32
1920	5		1.00	.67			1.67	.44	2.11	50.30	32
1920	6		1.00	1.00			2.00	.44	2.44	40.30	32
1921	0						.00	.42	.42	.00	33
1921	1		.33				.33	.42	.75	12.30	33
1921	2		.33	.34			.67	.42	1.09	21.20	33
1921	3		.33	.67			1.00	.42	1.42	29.60	33
1921	4		.33	.67	.33		1.33	.42	1.75	33.30	33
1921	5		.67	.67	.33		1.67	.42	2.09	35.60	33
1921	6		.67	1.00	.33		2.00	.42	2.42	35.00	33
1921	2		.50	.50			1.00	.42	1.42	29.10	33
1921	3		.50	1.00			1.50	.42	1.92	42.50	33
1921	4		.50	1.00	.50		2.00	.42	2.42	38.50	33
1921	0						.00	.42	.42	.00	33
1921	1		.33				.33	.42	.75	23.80	33
1921	2		.33	.34			.67	.42	1.09	18.10	33
1921	3		.33	.67			1.00	.42	1.42	25.60	33
1921	4		.33	1.00			1.33	.42	1.75	32.40	33
1921	5		.67	.67	.33		1.67	.42	2.09	38.40	33
1921	6		.67	1.00	.33		2.00	.42	2.42	38.70	33
1921	2		.50	.50			1.00	.42	1.42	29.40	33
1921	3		.50	1.00			1.50	.42	1.92	30.40	33
1921	4		.50	1.50			2.00	.42	2.42	30.00	33
1921	0						.00	.42	.42	.00	33
1921	1		.33				.33	.42	.75	3.38	33
1921	2		.33	.34			.67	.42	1.09	13.40	33
1921	3		.33	.67			1.00	.42	1.42	23.82	33
1921	4		.67	.66			1.33	.42	1.75	29.00	33
1921	5		.67	.67	.33		1.67	.42	2.09	34.90	33
1921	6		1.00	.67	.33		2.00	.42	2.42	33.60	33
1921	2		.50	.50			1.00	.42	1.42	29.20	33
1921	3		.50	1.00			1.50	.42	1.92	34.00	33
1921	4		1.00	1.00			2.00	.42	2.42	31.50	33
1922	0						.00	.55	.55	30.60	34
1922	1		.33				.33	.55	.88	44.80	34
1922	2		.33	.34			.67	.57	1.24	56.80	34
1922	3		.67	.33			1.00	.57	1.57	62.30	34
1922	4		.67	.33	.33		1.33	.57	1.90	65.60	34
1922	5		.67	.67	.33		1.67	.57	2.24	63.50	34
1922	6		1.00	.67	.33		2.00	.57	2.57	62.30	34
1922	2		.50	.50			1.00	.57	1.57	49.00	34
1922	3		1.00	.50			1.50	.57	2.07	56.50	34
1922	4		1.00	.50	.50		2.00	.57	2.57	61.20	34
1922	0						.00	.55	.55	7.45	34
1922	1		.33				.33	.57	.90	42.50	34
1922	2		.33	.34			.67	.57	1.24	58.60	34
1922	3		.66	.34			1.00	.57	1.57	55.70	34
1922	4		.67	.33	.34		1.34	.57	1.91	55.10	34

See footnotes at end of table.

TABLE 32.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Brooks, southern Alberta, Canada* [1]—Continued

WHEAT—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1922	5		0.67	0.67	0.33		1.67	0.57	2.24	47.40	34
1922	6		1.00	.67	.33		2.00	.57	2.57	55.50	34
1922	2		.50	.50			1.00	.57	1.57	51.90	34
1922	3		1.00	.50			1.50	.57	2.07	45.60	34
1922	4		1.00	.50	.50		2.00	.57	2.57	42.40	34
1922	0						.00	.55	.55	3.90	34
1922	1		.33				.33	.55	.88	19.70	34
1922	2		.33	.34			.67	.55	1.22	39.40	34
1922	3		.67	.33			1.00	.55	1.55	47.00	34
1922	4		.67	.33	.33		1.33	.55	1.88	40.00	34
1922	5		.67	.67	.33		1.67	.55	2.22	56.50	34
1922	6		.67	1.00	.33		2.00	.55	2.55	55.50	34
1922	2		.50	.50			1.00	.57	1.57	46.70	34
1922	3		1.00	.50			1.50	.57	2.07	48.90	34
1922	4		1.00	.50	.50		2.00	.57	2.57	51.50	34
1922	5		.67	.67	.33		1.67	.55	2.22	55.00	34
1922	0						.00	.55	.55	28.30	34
1922	1		.33				.33	.55	.88	28.80	34
1922	2		.33	.34			.67	.57	1.24	37.30	34
1922	3		.67	.33			1.00	.57	1.57	38.40	34
1922	4		.67	.67			1.34	.57	1.91	38.90	34
1922	5		.67	.67	.33		1.67	.57	2.24	42.50	34
1922	6		1.00	.67	.33		2.00	.57	2.57	36.90	34
1922	2		.50	.50			1.00	.57	1.57	38.80	34
1922	3		1.00	.50			1.50	.57	2.07	36.90	34
1922	4		1.00	1.00			2.00	.57	2.57	43.50	34
1923	0						.00	.72	.72	11.95	8
1923	1		.33				.33	.72	1.05	16.85	8
1923	2		.33	.34			.67	.72	1.39	28.95	8
1923	2	0.33	.34				.67	.72	1.39	38.60	8
1923	3	.33		.67			1.00	.72	1.72	40.10	8
1923	3	.33	.34	.33			1.00	.78	1.78	45.99	8
1923	4	.33	.34	.33	.33		1.33	.78	2.11	51.10	8
1923	2		.33	.50			.83	.78	1.61	38.35	8
1923	2	.50		.50			1.00	.78	1.78	56.50	8
1923	3	.50		1.00			1.50	.78	2.28	57.50	8
1923	0						.00	.72	.72	22.70	8
1923	1		.33				.33	.78	1.11	41.30	8
1923	2		.33	.34			.67	.78	1.45	50.33	8
1923	2		.67				.67	.78	1.45	50.70	8
1923	3		.67	.33			1.00	.78	1.78	51.34	8
1923	4		1.00		.33		1.33	.78	2.11	47.70	8
1923	4		1.00		.33		1.33	.78	2.11	47.30	8
1923	2		.50	.50			1.00	.78	1.78	44.15	8
1923	2		.50	.50			1.00	.78	1.78	45.34	8
1923	3		.50	1.00			1.50	.78	2.28	45.30	8
1923	0						.00	.72	.72	10.00	8
1923	1		.33				.33	.72	1.05	19.25	8
1923	1		.33				.33	.72	1.05	17.60	8
1923	2	.15	.33				.53	.72	1.30	25.70	8
1923	3	.25	.33	.33			.91	.72	1.63	36.33	8
1923	3	.25	.33		.33		.91	.72	1.63	35.18	8
1923	4	.25	.33	.34	.33		1.25	.72	1.97	32.64	8
1923	2		.50	.50			1.00	.72	1.72	19.54	8
1923	2	.50	.50				1.00	.72	1.72	28.10	8
1923	3	.50	.50	.50			1.50	.72	2.22	31.00	8
1923	0						.00	.72	.72	9.92	8
1923	1		.33				.33	.72	1.05	32.60	8
1923	2		.33	.34			.67	.78	1.45	37.80	8
1923	2		.33	.34			.67	.78	1.45	41.60	8
1923	3		.33	.67			1.00	.78	1.78	40.20	8
1923	3		.67		.33		1.00	.78	1.78	50.15	8
1923	3		.67		.33		1.00	.78	1.78	46.00	8
1923	5		.67	.67	.33		1.67	.78	2.45	47.70	8
1923	2		.50	.50			1.00	.72	1.72	47.70	8
1923	2		.50	.50			1.00	.78	1.78	46.80	8
1923	3		.50	1.00			1.50	.78	2.28	49.70	8

[1] The Reclamation Service, Department of the Interior, of Canada, has conducted these experiments at the station near Brooks since 1917. The plots have usually contained less than 0.25 acre; a few have been larger, and a few as small as 0.005 acre. The soil is a fine sandy loam, very uniform, underlaid by very fine sand and silt and with light gravel at 12 to 14 feet in depth. Prior to 1918 the precipitation figures are for the period Apr. 1 to Sept. 30, inclusive. For 1918 and following years, unless otherwise noted, figures are from Apr. 1 to harvest.

[2] Sown in hills.
[3] Sown in rows.
[4] Sown in drills.
[5] Estimated.
[6] Shattered by wind.
[7] Plot very patchy due to burn outs.

TABLE 33.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Coaldale, southern Alberta, Canada* [1]

ALFALFA

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1913	35.00	2		0.93	0.77			1.70	0.98	2.68	[2] 4.41
1913	30.00	3		.64	.71	0.36		1.71	.98	2.69	[2] 4.70
1914	30.00	3	0.48		.51	.40		1.39	.57	1.96	[3] 4.21
1914	34.00	2	.78		.02			1.70	.57	2.27	4.67
1914	13.30	2			.06	.85		1.81	.57	2.38	([4])
1914	50.00	2			1.27	1.34		2.61	.57	3.18	([4])
1914	50.00	2			.63	.08		1.61	.57	2.18	([4])
1914	50.00	2			1.15	.76		1.91	.57	2.48	([4])
1914	50.00	2			.98	1.15		2.13	.57	2.70	([4])
1915	30.00	1			.45			.45	1.32	1.77	[5] 3.96
1915	34.00	1					1.03	1.03	1.32	2.35	4.84
1915	50.00	1	.20					.20	1.32	1.52	2.04
1915	8.50	1	.35					.35	1.32	1.67	3.21
1915	35.10	1	.59					.59	1.32	1.91	2.60
1915	7.30	2	.48			.23		.71	1.32	2.03	3.14
1915	50.00	2	.46			.38		.84	1.32	2.16	1.91
1915	19.70	3	.52	.99		.69		2.20	1.32	3.52	1.64
1915	43.20	1		.39				.39	1.32	1.71	3.09
1916	30.00	2	.81		1.02			1.83	1.56	3.39	[6] 2.91
1916	34.00	0						.00	1.56	1.56	3.18
1916	50.00	0						.00	1.56	1.56	2.69
1916	50.00	0						.00	1.56	1.56	2.60
1916	50.00	0						.00	1.56	1.56	2.46
1916	50.00	0						.00	1.56	1.56	1.51
1916	19.70	0						.00	1.56	1.56	2.48
1916	43.20	1			.76			.76	1.56	2.32	3.19
1917	42.00	1				.79		.79	.70	1.49	[7] 2.46
1917	14.00	1			1.68			1.68	.70	2.38	2.65
1917	50.00	1			1.79			1.79	.66	2.45	2.24
1917	50.00	2		.63		.40		1.03	.66	1.69	4.13
1917	50.00	1			1.03			1.03	.66	1.69	2.38
1918	30.00	2	.97		1.08			2.05	.31	2.36	[8] 2.73
1918	42.00	2	1.07			.68		1.75	.30	2.05	2.03
1918	14.00	3	.48		.74		.67	1.89	.27	2.16	3.26
1918	19.70	2	.72		.63			1.35	.30	1.65	3.99
1918	50.00	2	.53		.69			1.22	.33	1.55	2.10
1918	50.00	2		1.16		1.12		2.28	.33	2.61	3.46
1918	35.09	2		.71	1.60			2.31	.33	2.64	4.32
1918	50.00	2	1.63		1.18			2.81	.34	3.15	4.37
1918	32.73	2	.99			1.07		2.06	.30	2.36	3.31
1919	30.00	2	.85		.03			1.78	.64	2.42	[9] 4.11
1919	42.00	2	.69		.77			1.46	.46	1.92	4.05
1919	22.50	2		.77	.69			1.46	.46	1.92	5.17
1919	14.00	2	.54		.62			1.16	.46	1.62	4.24
1919	19.70	2	.64		1.22			1.86	.46	2.32	4.92
1919	50.00	2	.74		.83			1.57	.46	2.03	4.37
1919	50.00	2		.89	.76			1.65	.46	2.11	4.88
1919	35.09	2	1.32		1.16			2.48	.46	2.94	3.99
1919	50.00	2	.91		1.15			2.06	.43	2.49	3.83
1919	32.73	2	1.20			.54		1.74	.46	2.20	4.82
1919	11.00	2		.92	.48			1.40	.46	1.86	2.49
1919	16.40	2	.52		.73			1.25	.46	1.71	2.71
1920	30.00	2			.36	.48		.84	.81	1.65	[10] 2.46
1920	42.00	2		.55		.52		1.07	.79	1.86	4.39
1920	23.50	2		.84		1.02		1.86	.81	2.67	4.66
1920	14.00	2		.87		.39		1.26	.81	2.07	4.00
1920	19.70	2		.64		.57		1.21	.83	2.04	2.92
1920	50.00	2		.67		.71		1.38	.81	2.19	3.42
1920	50.00	2		.45		.70		1.15	.83	1.98	4.55
1920	35.09	2		.59		1.62		2.21	.83	3.04	4.96
1920	50.00	2		.32		1.32		1.64	.81	2.45	3.73
1920	32.73	2		1.01		.72		1.73	.81	2.54	5.07
1920	11.00	1				.64		.64	.81	1.45	2.97
1920	16.40	2		.42	.29			.71	.79	1.50	2.79
1921	30.00	1		.97				.97	.44	1.41	[11] 2.13
1921	42.00	2		.65	.79			1.44	.45	1.89	3.94
1921	22.50	2		.80	.94			1.74	.45	2.19	4.22
1921	14.00	2		.51		.95		1.46	.45	1.91	4.00
1921	19.70	2		.60	.68			1.28	.45	1.73	2.63
1921	50.00	2		.49	.95			1.44	.45	1.89	2.98
1921	50.00	2		.54	1.29			1.83	.53	2.36	
1921	35.09	2		.42	.79			1.21	.45	1.66	3.68
1921	50.00	2		.94	1.21			2.15	.45	2.60	3.38

See footnotes on p. 99.

TABLE 33.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Coaldale, southern Alberta, Canada* [1]—Continued

ALFALFA—Continued

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1921	32.73	2	0.40			1.11		1.51	0.45	1.96	3.93
1921	11.00	2		1.05	0.98			2.03	.45	2.48	2.72
1921	16.40	2		.72		1.24		1.96	.53	2.49	3.29
1922	30.00	3		1.48	.65			2.13	.69	2.82	[11] 1.85
1922	42.00	2	.49		.65			1.14	.67	1.81	2.39
1922	23.50	1			.69			.69	.67	1.36	3.25
1922	14.00	2		.10	.09			1.09	.69	1.78	2.58
1922	50.00	1			.67			.67	.69	1.36	3.55
1922	35.09	1			1.71			1.71	.67	2.38	4.31
1922	50.00	2		.51	.29			.80	.67	1.47	4.26
1922	32.73	2		.50		.85		1.35	.67	2.02	4.39
1922	11.00	1			.99			.99	.69	1.68	4.23

ALFALFA AND TIMOTHY

1914	32.00	2	1.20			0.73		1.93	0.57	2.50	[13] 2.66
1914	9.16	3	.99	1.57	1.20			3.75	.57	4.33	[13] 3.48
1914	14.40	2	.99		1.21			2.20	.57	2.77	[13 24] 2.09
1917	23.50	1				1.56		1.56	.70	2.26	[14] 3.53
1918	23.56	3	.74		.77		0.81	2.32	.30	2.62	[16] 4.94

BARLEY

											Bushels
1914	23.20	1		0.61				0.61	0.57	1.18	[13 25] 30.00
1914	19.00	2	1.00	.65				1.65	.57	2.22	[13] 25.50
1915	23.20	0						.00	1.32	1.32	[17] 40.00
1916	78.30	0						.00	1.56	1.56	[18] 36.00
1916	26.00	0						.00	1.56	1.56	[18] 57.00
1916	33.00	0						.00	1.56	1.56	[18] 30.00
1922	13.00	1			0.91			.91	.67	1.58	[19] 11.90

BARLEY AND ALFALFA

1914	20.90	2		0.45	1.05			1.50	0.57	2.07	[13 26] 21.00

WHEAT

1918	72.00	1		0.78				0.78	0.28	1.06	[16] 38.50
1918	8.65	1		.89				.89	.30	1.19	[16] 25.80
1918	85.60	2	0.75	1.05				1.80	.30	2.10	[16] 19.90

OATS

1914	78.30	1		0.33				0.33	0.57	0.90	[13] 24.80
1914	4.60	2		1.18	0.67			1.85	.57	2.42	[13 27] 1.52
1915	78.30	0						.00	1.32	1.32	[17] 45.40
1918	.21	1			.50			.50	1.56	2.06	[18] 108.00
1916	.76	0						.00	1.56	1.56	[18] 112.30
1918	13.30	1		1.04				1.04	.28	1.32	[16] 17.30
1919	23.50	1		1.15				1.15	.46	1.61	[20 21] 20.00
1919	27.20	1		1.19				1.19	.40	1.65	[20] 30.50
1919	8.86	1		1.12				1.12	.40	1.58	[20] 43.80
1920	13.30	1		.62				.62	.79	1.41	[22] 55.60
1920	5.86	1		.47				.47	.81	1.28	[22] 30.00
1920	8.60	1			.54			.54	.81	1.35	[22] 33.00
1921	43.00	1		.21				.21	.45	.66	[23] 39.56
1921	6.20	1		1.20				1.20	.40	1.60	[23] 57.26

See footnotes on p. 99.

TABLE 33.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Coaldale, southern Alberta, Canada* [1]—Continued

OATS AND TIMOTHY

Year	Area irrigated	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
			May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels.*
1914	22.50	2	0.95			1.33		2.28	0.57	2.85	[13] 22.00

POTATOES

1914	2.50	2		1.12	0.86			1.98	0.57	2.55	[13] 120.00
1919	13.30	1			.22			.22	.65	.87	[20 21] 216.60
1919	9.70	2			.32	0.14		.46	.65	1.11	[20 21] 233.30
1920	3.20	1				1.41		1.41	.83	2.24	[21] 110.60

TIMOTHY

											Tons
1913	160.00	1		0.85				0.85	0.98	1.83	[3] 1.07
1915	22.50	2	0.74				0.66	1.40	1.32	2.72	[17] 1.50
1915	117.00	2	.71			0.46		1.17	1.32	2.49	[17] 1.99
1916	22.50	1	.37					.37	1.56	1.93	[19] 1.00
1916	100.00	1	.29					.29	1.56	1.85	[19] .55
1917	78.00	1		.96				.96	.70	1.66	[15] 1.17
1917	22.50	1		1.99				1.99	.72	2.71	[15] 1.33
1918	65.00	1	1.01					1.04	.27	1.31	[18] .30
1918	22.50	2	1.11	.45				1.56	.33	1.89	[18] .38
1919	22.50	2	.69	.56				1.25	.25	1.50	[20] .42
1920	22.50	1		.80				.80	.78	1.58	[21] 1.74
1921	22.50	1	.35					.35	.36	.71	[22] 1.03
1922	22.50	2	.34	.22				.56	.65	1.21	[19] 1.38
1922	50.00	1		.38				.38	.65	1.03	[19] .94

WHEAT

											Bushels
1913	45.00	1		0.76				0.76	0.98	1.74	[3] 26.40
1913	80.00	1		.72				.72	.98	1.70	[3] 19.40
1913		0						.00	.98	.98	[3] 15.00
1915	50.00	0						.00	1.32	1.32	[17] 45.00
1915	14.00	1		.86				.86	1.32	2.18	[17] 31.90
1915	25.00	0						.00	1.32	1.32	[17] 51.60
1915	15.40	0						.00	1.32	1.32	[17] 26.90
1918	.22	1			0.50			.50	1.56	2.06	[18] 49.80
1916	.76	0						.00	1.56	1.56	[18] 54.00
1917	8.50	1			.66			.66	.41	1.07	[15] 23.50
1917	13.30	1			.89			.89	.41	1.30	[15] 32.30
1919	25.00	1		.77				.77	.43	1.20	[20] 19.40
1919	62.10	2		1.31	.54			1.85	.46	2.31	21.00
1919	8.65	1	1.12					1.12	.46	1.58	23.00
1919	30.50	2		.53	.60			1.13	.43	1.56	24.80
1919	6.20	1		.86				.86	.43	1.29	34.70
1919	39.90	1		.82				.82	.43	1.25	14.50
1919	3.20	2		.99	.77			1.76	.46	2.22	[25] 17.10
1919	4.40	2		.81	.30			1.11	.46	1.57	[25] 17.00
1920	12.70	1			.47			.47	.81	1.28	[22] 40.00
1921	50.00	2		.48	.55			1.03	.53	1.56	[23] 20.40
1921	32.14	1		.74				.74	.44	1.18	[23] 20.10
1921	3.20	1		.82				.82	.45	1.27	[23] 31.56
1922	83.50	1			.23			.23	.67	.90	[19] 22.40
1922	43.94	1		.36				.36	.67	1.03	[19] 16.40
1922	40.56	1			.42			.42	.67	1.09	[19] 33.30

See footnotes on p. 99.

TABLE 34.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Lethbridge, southern Alberta, Canada* [1]

ALFALFA

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1923	0						0.00	0.99	0.99	[2] 2.10
1923	1						.50	.99		[3] 2.71
1923	1	0.50					.50	.99	1.49	2.86
1923	1	.50					.50	.99	1.49	2.77
1923	1	.50					.50	.99	1.49	2.99
1923	1		0.50				.50	.99	1.49	3.32
1923	1			0.50			.50	.99	1.49	2.84
1923	2	.50					1.00	.99		[4] 3.22
1923	2	1.00					1.00	.99	1.99	2.85
1923	2		.50				1.00	.99		[4] 2.81
1923	2			.50			1.00	.99		[4] 2.90
1923	2	.50	.50				1.00	.99	1.99	2.96
1923	2	.50		.50			1.00	.99	1.99	3.05
1923	2	.33		.33			.66	.99	1.65	2.75
1923	2	.66		.66			1.32	.99	2.31	3.07
1923	3	.50		.50			1.50	.99		[4] 2.92
1923	3		.50		0.50		1.50	.99		[4] 3.37
1923	3	1.00		.50			1.50	.99	2.49	2.90
1923	3	.50	.50		.50		1.50	.99	2.49	4.15
1923	4	1.00		1.00			2.00	.99	2.99	3.47
1923	5	1.00		1.00			2.50	.99		[4] 3.66

PASTURE GRASS

1923	11	0.50	0.50	0.50	0.75	1.00	3.25	1.00	4.25	[5] 14.68
1923	7	1.00	.50	.50	1.00	.50	3.50	1.00	4.50	[6] 11.30
1923	6	.50	.50	.50	1.00	.50	3.00	1.00	4.00	[7] 11.49

See footnotes at end of table.

(FOOTNOTES FOR TABLE 33)

[1] These measurements were made under the direction of the commissioner of irrigation, reclamation service, Department of the Interior of Canada. The upper soil for a few inches is a clay loam, underlaid by a light clay loam very uniform in character and containing no impervious strata.
[2] From Ann. Rpt., Dept. Int., Canada 1914 (*53*).
[3] To footnote 5 from Bul. 4, Irrig. Ser., Dept. Int., Canada (*48*).
[4] New alfalfa, none cut.
[5] To footnote 6 from Rpt. Irrig. Surys., 1915–16, Dept. Int., Canada (*40*).
[6] This and following items to footnote 7 from Rpt. Irrig. Surys., 1916–17, Dept. Int., Canada (*41*).
[7] This and following items to footnote 8 from Rpt. Irrig. Surys., 1917–18, Dept. Int., Canada (*42*).
[8] This and following items to footnote 9 from Rpt. Irrig. Surys., 1918–19, Dept. Int., Canada (*43*).
[9] This and following items to footnote 10 from Ann. Rpt. Reclam. Serv., Canada., 1919–20 (*44*).
[10] This and following items to footnote 11 from Ann. Rpt. Reclam. Serv., Canada, 1920–21 (*52*).
[11] This and following items to footnote 12 from Ann. Rpt. Reclam. Serv., Canada, 1921–22 (*55*).
[12] This and following items to footnote 13 from Ann. Rpt. Reclam. Serv., Canada, 1922–23 (*54*).
[13] From Bul. 4, Irrig. Ser., Dept. Int., Canada (*48*)
[14] New planting.
[15] Rept Irrig. Surveys 1917–18, Dept. Int., Canada (*42*)
[16] Rpt. Irrig. Surveys 1918–19, Dept. Int., Canada (*43*).
[17] Rpt. Irrig. Surveys 1915–16, Dept. Int., Canada (*40*).
[18] Rpt. Irrig. Surveys 1916–17, Dept. Int., Canada (*41*)
[19] Ann. Rpt. Reclam. Serv., Canada, 1922–23 (*54*).
[20] Ann. Rpt. Reclam. Serv., Canada, 1919–20 (*44*).
[21] Part green feed.
[22] Ann. Rpt. Reclam. Serv., Canada, 1920–21 (*52*).
[23] Ann. Rpt. Reclam. Serv., Canada, 1921–22 (*55*).
[24] Crop frozen before digging; heavy loss.
[25] Fall irrigated 1913.
[26] Yield of grain; barley was sown as nurse crop.
[27] Green feed (tons).
[28] Damaged by hail.
[29] This and following items to footnote 22 from Ann. Rpt. Reclam. Serv., 1919–1920 (*44*).

TABLE 34.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Lethbridge, southern Alberta, Canada* [1]—Continued

POTATOES

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Pounds*
1922	0						0.00	0.51	0.51	[6] 5,755
1922	1			0.25			.25	.51	.76	12,762
1922	1				0.25		.25	.51	.76	12,754
1922	2			.25	.25		.50	.51	1.01	15,678
1922	3			.25	.50		.75	.51	1.26	16,302
1922	1			.25			.25	.51	.76	11,412
1922	2			.50			.50	.51	1.01	15,085
1922	3			.50	.25		.75	.51	1.26	14,473
1922	3			.25	.50		.75	.51	1.26	15,520
1922	5			.34	.51		.85	.51	1.36	16,158
1922	5			.68	1.02		1.70	.51	2.21	17,589
1922	5			.50	.75		1.25	.51	1.76	18,448
1922	6			.50	.75	0.25	1.50	.51	2.01	20,586
1922	1						.40	.51		[5] 14,474
1922	2			.25			.65	.51		[4] 18,596
1922	2						.65	.51		[4] 19,667
1923	0						.00	.84	.84	[7] 10,280
1923	1						.25	.84		[3] 20,280
1923	1			.33			.33	.84	1.17	15,940
1923	1			.33			.33	.84	1.17	20,640
1923	1			.25			.25	.84	1.09	17,140
1923					.25		.25	.84	1.09	20,300
1923	2			.25			.50	.84		[4] 20,260
1923	2			.25			.50	.84		[4] 19,220
1923	2			.50			.50	.84	1.34	18,320
1923	2			.25	.25		.50	.84	1.34	21,580
1923	3			.50	.25		.75	.84	1.59	19,240
1923	3			.25	.50		.75	.84	1.59	17,160
1923	3			.25	.50		.75	.84	1.59	19,680
1923	4			.50	.50		1.00	.84	1.84	18,080
1923	4			.50	.50		1.00	.84	1.84	18,080
1923	4			.34	.34		.98	.84	1.52	18,360
1923	4			.66	.66		1.32	.84	2.16	18,780
1923	5			.50	.75		1.25	.84	2.09	19,300
1923	6			.50	.75	.25	1.50	.84	2.34	20,220

SUNFLOWERS

										Tons
1923	0						0.00	0.96	0.96	[4] 22.35
1923	1						.25	.96		[4] [5] 27.40
1923	1		0.25				.25	.96	1.21	[3] 24.15
1923	1		.25				.25	.96	1.21	[3] 21.50
1923	1		.25				.25	.96	1.21	[3] 20.50
1923	1				0.25		.25	.96	1.21	[3] 20.45
1923	2			0.25			.50	.96		[3] [4] 30.10
1923	2		.25	.25			.50	.96	1.46	[4] 20.45
1923	2			.25	.25		.50	.96	1.46	[3] 19.08
1923	3		.25	.50			.75	.96	1.71	[4] 23.33
1923	3		.25	.25	.25		.75	.96	1.71	[3] 23.45
1923	3		.25	.25	.25		.75	.96	1.71	[3] 19.28
1923	4		.17	.34	.17		.68	.96	1.64	[3] 22.38
1923	4		.25	.50	.25		1.00	.96	1.96	[3] 22.43
1923	4		.33	.66	.33		1.32	.96	2.28	[4] 19.18
1923	4		.42	.84	.42		1.68	.96	2.64	[4] 18.25
1923	5		.50	.25	.50		1.25	.96	2.21	[4] 15.43
1923	10		.75	1.00	.75		2.50	.96	3.46	[4] 10.45

See footnotes at end of table.

TABLE 34.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Lethbridge, southern Alberta, Canada* [1]—Continued

WHEAT

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1922	0						0.00	0.56	0.56	[2] 44.90
1922	1			0.50			.50	.56	1.06	47.20
1922	1			.50			.50	.56	1.06	58.80
1922	1		0.50				.50	.56	1.06	69.20
1922	1		.50				.50	.56	1.06	55.00
1922	1		.50				.50	.56	1.06	59.20
1922	2			1.00			1.00	.56	1.56	59.80
1922	2		.33	.33			.66	.56	1.22	63.30
1922	2		.50	.38			.88	.56	1.44	65.60
1922	2		.50	.50			1.00	.56	1.56	62.90
1922	2		.66	.50			1.16	.56	1.72	63.10
1922	2		.66	.66			1.32	.56	1.88	64.20
1922	3		.50	.50	0.50		1.50	.56	2.06	56.20
1922	4		.50	1.00	.38		1.88	.56	2.44	51.60
1923	0						.00	.99	.99	[3] 39.80
1923	1						.50	.99		[3] 36.90
1923	1	0.50					.50	.99	1.49	54.50
1923	1		.50				.50	.99	1.49	47.30
1923	1		.50				.50	.99	1.49	43.90
1923	1		.50				.50	.99	1.49	53.60
1923	1			.50			.50	.99	1.49	45.00
1923	1			.50			.50	.99	1.49	41.20
1923	2		.50				1.00	.99		[4] 38.50
1923	2			.50			1.00	.99		[4] 40.10
1923	2		.50	.50			1.00	.99	1.99	49.80
1923	2		.33	.33			.66	.99	1.65	53.30
1923	2		.66	.66			1.32	.99	2.31	49.10
1923	2		.50	.50			1.00	.99	1.99	41.20
1923	3		.50	.50			1.50	.99		[4] 35.70
1923	3		1.00	.50			1.50	.99	2.49	52.90
1923	4		1.00	.50			2.00	.99		[4] 29.30
1923	4		1.00	.50	.50		2.00	.99	2.99	38.50
1924	0						.00	.96	.96	28.60
1923	1						.50	.96		[3] 39.60
1923	1	.50					.50	.96	1.46	31.00
1923	1		.50				.50	.96	1.46	32.20
1923	1		.50				.50	.96	1.46	34.00
1923	1		.50				.50	.96	1.46	36.30
1923	1			.50			.50	.96	1.46	34.70
1923	1			.50			.50	.96	1.46	33.10
1923	2		.50				1.00	.96		[4] 36.50
1923	2			.50			1.00	.96		[4] 38.50
1923	2		.33	.33			.66	.96	1.62	31.80
1923	2		.50	.50			1.00	.96	1.96	33.30
1923	2		.66	.66			1.32	.96	2.28	36.70
1923	2		.50	.50			1.00	.96	1.96	33.10
1923	3		.50	.50			1.50	.96		[4] 39.20
1923	3		1.00	.50			1.50	.96	2.46	38.20
1923	4		1.00	.50			2.00	.96		[4] 38.10
1923	4		1.00	.50	.50		2.00	.96	2.96	38.00

[1] This investigation was initiated in 1922 by the Dominion Department of Agriculture at the experimental station at Lethbridge, for the primary purpose of determining the stage of plant development when water can most advantageously be used, with minor emphasis upon quantities of water. Duplicate 0.05-acre plots are used. The soil is a uniform medium sandy clay loam, with a subsoil of similar texture.

[2] This and following items to footnote 6 from report Lethbridge experiments, 1923 (*14*).

[3] Fall irrigation.

[4] Includes fall irrigation.

[5] Green weight.

[6] This and following items to footnote 7 report Lethbridge experiments, 1922 (*13*).

[7] This and following items to footnote 8 from report Lethbridge experiments, 1923 (*14*).

[8] This and following items to footnote 9 from report Lethbridge experiments, 1922 (*13*).

[9] This and following items to end from report Lethbridge experiments, 1923 (*14*).

TABLE 35.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Ronalane, southern Alberta, Canada* [1]

ALFALFA

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*	*Reference No.*
1915	1	0.51					0.51	0.93	1.44	1.66	40
1915	2	.49			0.52		1.01	.93	1.94	4.04	40
1915	2	.69			.58		1.27	.93	2.20	3.97	40
1915	2	.72			.62		1.34	.93	2.27	3.60	40
1915	2	.70			.65		1.35	.93	2.28	3.85	40
1915	3	.49		0.55	.45		1.49	.93	2.42	2.36	40
1915	3	.62		.40	.58		1.60	.93	2.53	2.20	40
1915	3	.73		.48	.58		1.70	.93	2.72	3.40	40
1915	3	.73	0.42		.67		1.82	.93	2.75	3.37	40
1916	0						.00	1.32	1.32	1.52	41
1916	1				.77		.77	1.32	2.09	2.90	41
1916	1				.54		.54	1.32	1.86	3.24	41
1916	1				.50		.50	1.32	1.82	2.94	41
1916	1				.52		.52	1.32	1.84	3.16	41
1916	1	.47					.47	1.32	1.79	2.32	41
1916	2	.51		.40			.91	1.32	2.23	2.30	41
1916	3	.53		.48	.50		1.51	1.32	2.83	3.10	41
1916	4	.47		.54	.94		1.95	1.32	3.27	3.82	41
1917	0						.00	.30	.36	.420	42
1917	1		.33				.33	.36	.69	1.316	42
1917	2		.33	.33			.66	.36	1.02	1.680	42
1917	3		.33	.66			.99	.36	1.35	2.668	42
1917	3	.33	.33	.33			.99	.36	1.35	2.548	42
1917	4	.33		.66	.33		1.32	.36	1.68	3.128	42
1917	5	.33	.33	.66	.33		1.65	.36	2.01	2.860	42
1917	2		.50	.50			1.00	.36	1.36	1.668	42
1917	3	.50	.50	.50			1.50	.36	1.86	2.428	42
1917	5	.50	.50	1.50			2.50	.36	2.86	2.860	42
1918	0						.00	.34	.34	.00	43
1918	1		.33				.33	.34	.67	.348	43
1918	2	.33		.33			.66	.34	1.00	1.028	43
1918	4	.33		.33	.33	0.33	1.32	.34	1.66	2.208	43
1918	4	.33	.33	.33		.33	1.32	.34	1.66	2.460	43
1918	5	.33	.33	.66		.33	1.65	.34	1.99	2.360	43
1918	9	.66	.66	.99	.33	.33	2.97	.34	3.31	3.396	43
1918	3	.50	.50	.50			1.50	.34	1.84	1.788	43
1918	5	.50	.50	.50	.50	.50	2.50	.34	2.84	2.288	43
1918	8	.50	1.00	1.50	.50	.50	4.00	.34	4.34	2.508	43
1919	2		.33	.34			.67	.50	1.17	1.08	44
1919	3		.33	.33	.34		1.00	.50	1.50	1.66	44
1919	4		.33	.67	.33		1.33	.50	1.83	2.62	44
1919	5		.33	.67	.67		1.67	.50	2.17	3.11	44
1919	6	.33	.33	.67	.67		2.00	.50	2.50	3.09	44
1919	8	.33	.33	1.34	.67		2.67	.50	3.17	2.44	44
1919	4		.50	.50	1.00		2.00	.50	2.50	2.14	44
1919	4		.50	.50	1.00		2.00	.50	2.50	2.69	44
1919	6		.50	1.50	1.00		3.00	.50	3.50	2.44	44
1920	0						.00	.44	.44	.20	32
1920	1		.33				.33	.44	.77	.70	32
1920	2	.33	.34				.67	.44	1.11	1.74	32
1920	3	.33	.33	.34			1.00	.44	1.44	2.87	32
1920	4	.33	.33	.67			1.33	.44	1.77	2.65	32
1920	5	.33	.67	.33	.34		1.67	.44	2.11	3.44	32
1920	6	.33	.67	.66	.34		2.00	.44	2.44	2.97	32
1920	5	.50	1.00	.50	.50		2.50	.44	2.94	3.39	32
1920	6	.50	1.00	1.00	.50		3.00	.44	3.44	2.98	32
1920	7	.50	1.50	1.00	.50		3.50	.44	3.94	3.03	32
1921	0						.00	.39	.39	.400	33
1921	1			.33			.33	.39	.72	.740	33
1921	3		.33	.33	.33		.99	.39	1.38	1.760	33
1921	4		.33	.66	.33		1.32	.39	1.71	2.664	33
1921	5		.33	.66	.66		1.65	.39	2.04	2.788	33
1921	6	.33	.33	.66	.66		1.98	.39	2.37	3.000	33
1921	8	.33	.33	1.32	.66		2.64	.39	3.03	3.220	33
1921	4		.50	.50	1.00		2.00	.39	2.39	3.280	33
1921	4		.50	.50	1.00		2.00	.39	2.39	3.272	33
1921	6		.50	1.50	1.00		3.00	.39	3.39	3.104	33

See footnotes at end of table.

TABLE 35.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Ronalane, southern Alberta, Canada* [1]—Continued

BARLEY

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1915	1			0.48			0.48	0.93	1.41	48.00	40
1915	1			1.00			1.00	.93	1.93	43.50	40
1915	2			1.53			1.53	.93	2.46	40.00	40
1915	3		0.67	1.20			1.96	.93	2.89	48.60	40
1915	0						.00	.93	.93	[1] 60.00	40
1916	1	0.45					.45	1.32	1.77	55.00	41
1916	3	.45			1.00		1.45	1.32	2.77	45.00	41
1916	2	.45			.48		.93	1.32	2.25	47.40	41
1916	3	.45			1.00		1.45	1.32	2.77	40.80	41
1916	0						.00	1.32	1.32	52.50	41
1917	0						.00	.36	.36	12.42	42
1917	1			.33			.33	.36	.69	27.02	42
1917	2			.66			.66	.36	1.02	38.13	42
1917	2			.66			.66	.36	1.02	49.62	42
1917	3		.33	.66			.99	.36	1.35	54.98	42
1917	4		.33	.99			1.32	.36	1.68	51.87	42
1917	2			1.00			1.00	.36	1.36	42.55	42
1917	3			1.50			1.50	.36	1.86	44.76	42
1918	0						.00	.36	.36	21.00	43
1918	1			.33			.33	.36	.69	47.00	43
1918	2			.66			.66	.36	1.02	51.50	43
1918	3			.66	.33		.99	.36	1.35	55.00	43
1918	4		.33	.66	.33		1.32	.36	1.68	52.50	43
1918	4			.99	.33		1.32	.36	1.68	22.90	43
1918	4			.99	.33		1.32	.36	1.68	60.00	43
1918	5			.99	.66		1.65	.36	2.01	84.50	43
1918	4			1.50	.50		2.00	.36	2.36	76.50	43
1918	5			1.50	1.00		2.50	.36	2.86	75.50	43
1919	0						.00	.48	.48	0.10	44
1919	1		.33				.33	.50	.83	42.20	44
1919	2		.33	.34			.67	.50	1.17	53.90	44
1919	3		.33	.67			1.00	.50	1.50	54.70	44
1919	4		.33	.67	.33		1.33	.50	1.83	56.00	44
1919	5		.66	.67	.34		1.67	.50	2.17	52.90	44
1919	6		.66	.67	.67		2.00	.50	2.50	51.80	44
1920	0						.00	.44	.44	9.20	32
1920	1		.33				.33	.44	.77	32.80	32
1920	2		.33	.34			.67	.44	1.11	38.40	32
1920	3		.66	.34			1.00	.44	1.44	40.40	32
1920	4		.66	.67			1.33	.44	1.77	47.60	32
1920	5		1.00	.67			1.67	.44	2.11	50.80	32
1920	6		1.00	1.00			2.00	.44	2.44	47.60	32

OATS

1915	1		0.52				0.52	0.93	1.45	76.25	40
1915	1		.91				.91	.93	1.84	88.50	40
1915	2		.76	0.75			1.51	.93	2.44	95.00	40
1915	3		.67	1.40			2.07	.93	3.00	108.33	40
1916	0						.00	1.32	1.32	71.80	41
1916	1				0.50		.50	1.32	1.82	75.00	41
1916	1				.50		.50	1.32	1.82	79.20	41
1916	2			.42	.50		.92	1.32	2.24	77.60	41
1917	0						.00	.36	.36	44.18	42
1917	1			.33			.33	.36	.69	59.57	42
1917	2			.66			.66	.36	1.02	63.23	42
1917	3			.99			.99	.36	1.35	84.47	42
1917	3		.33	.66			.99	.36	1.35	95.74	42
1917	4		.33	.99			1.32	.36	1.68	100.58	42
1917	2		.50	.50			1.00	.36	1.36	106.62	42
1917	2			1.25			1.25	.36	1.61	70.39	42
1918	0						.00	.32	.32	20.50	43
1918	1		.33				.33	.32	.65	52.00	43
1918	2		.33	.33			.66	.32	.98	69.00	43
1918	3		.33	.66			.99	.32	1.31	55.50	43
1918	4		.33	.99			1.32	.32	1.64	52.20	43

See footnotes at end of table.

TABLE 35.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Ronalane, southern Alberta, Canada* [1]—Continued

OATS—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 119)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1918	4		0.33	0.99			1.32	0.32	1.64	48.00	43
1918	5		.33	.99	0.33		1.65	.32	1.97	65.00	43
1918	6		.66	.99	.33		1.98	.32	2.30	82.50	43
1918	5		.50	1.50	.50		2.50	.32	2.82	91.00	43
1918	6		1.00	1.50	.50		3.00	.32	3.33	101.50	43
1919	0						.00	.47	.47	10.90	44
1919	1		.33				.33	.50	.83	40.80	44
1919	2		.33	.34			.67	.50	1.17	65.10	44
1919	3		.33	.67			1.00	.50	1.50	77.20	44
1919	4		.33	.67	.33		1.33	.50	1.83	73.70	44
1919	5		.66	.67	.34		1.67	.50	2.17	70.10	44
1919	6		.66	.67	.67		2.00	.50	2.50	67.40	44
1920	0						.00	.44	.44	10.50	32
1920	1		.33				.33	.44	.77	44.00	32
1920	2		.33	.34			.67	.44	1.11	50.60	32
1920	3		.66	.34			1.00	.44	1.44	56.40	32
1920	4		.66	.67			1.33	.44	1.77	59.60	32
1920	5		1.00	.67			1.67	.44	2.11	75.30	32
1920	6		1.00	1.00			2.00	.44	2.44	71.00	32

FIELD PEAS

1915	1		0.55				0.55	0.93	1.48	21.72	40
1915	1		.85				.85	.93	1.78	24.67	40
1915	1		.80				.80	.93	1.73	21.26	40
1915	3		.67	0.66	0.57		1.90	.93	2.83	23.32	40
1915	0						.00	.93	.93	23.33	40
1916	1				.50		.50	1.32	1.82	45.60	41
1916	1				.50		.50	1.32	1.82	43.40	41
1916	2				1.00		1.00	1.32	2.32	42.60	41
1916	3			.58	1.00		1.58	1.32	2.90	53.00	41
1916	0						.00	1.32	1.32	40.80	41
1917	0						.00	.36	.36	10.40	42
1917	1			.33			.33	.36	.69	24.47	42
1917	2			.66			.66	.36	1.02	49.62	42
1917	3			.99			.99	.36	1.35	60.25	42
1917	3		.33	.66			.99	.36	1.35	60.64	42
1917	5		.33	.99	.33		1.65	.36	2.01	58.13	42
1917	2			1.00			1.00	.36	1.36	33.66	42
1917	3		.50	1.00			1.50	.36	1.86	52.13	42
1918	0						.00	.36	.36	16.65	43
1918	1		.33				.33	.36	.69	37.15	43
1918	2		.33	.33			.66	.36	1.02	38.30	43
1918	3		.33	.66			.99	.36	1.35	20.55	43
1918	4		.33	.99			1.32	.36	1.68	31.65	43
1918	4		.33	.99			1.32	.36	1.68	30.40	43
1918	5		.33	.99	.33		1.65	.36	2.01	31.65	43
1918	6		.66	.99	.33		1.98	.36	2.34	47.00	43
1918	5		.50	1.50	.50		2.50	.36	2.86	57.25	43
1918	6		1.00	1.50	.50		3.00	.36	3.36	50.00	43
1919	0						.00	.41	.41	12.70	44
1919	1		.33				.33	.50	.83	16.90	44
1919	2		.33	.34			.67	.50	1.17	22.50	44
1919	3		.33	.67			1.00	.50	1.50	22.70	44
1919	4		.33	.67	.33		1.33	.50	1.83	23.80	44
1919	5		.66	.67	.34		1.67	.50	2.17	25.60	44
1919	6		.66	.67	.67		2.00	.50	2.50	33.60	44

POTATOES

1914	4	0.67		1.20	0.63		2.50	0.38	2.88	86.80	55
1914	4	.67		1.64	.61		2.92	.38	3.30	65.03	55
1914	4	.67		1.24	.61		2.52	.38	2.90	102.20	55
1914	4	.67		1.20	.63		2.50	.38	2.88	113.25	55
1914	4	.67		1.64	.61		2.92	.38	3.30	183.15	55

See footnotes at end of table.

TABLE 35.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Ronalane, southern Alberta, Canada*—Continued

POTATOES—Continued

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1914	4	0.67		1.24	0.61		2.52	0.38	2.90	176.92	55
1914	4	.67		1.20	.63		2.50	.38	2.88	127.50	55
1914	4	.67		1.64	.61		2.92	.38	3.30	127.16	55
1914	4	.67		1.24	.61		2.52	.38	2.90	158.84	55
1915	0						.00	.93	.93	290.00	40
1915	1				.60		.00	.93	1.53	393.20	40
1915	2			.50	.60		1.10	.93	2.03	408.00	40
1915	3			.50	1.25		1.75	.93	2.68	404.10	40
1916	0						.00	1.32	1.32	189.50	41
1916	1				.51		.51	1.32	1.83	281.50	41
1916	1				.49		.49	1.32	1.81	271.40	41
1916	1				.50		.50	1.32	1.82	283.00	41
1916	1				.50		.50	1.32	1.82	204.00	41
1916	1				.50		.50	1.32	1.82	288.00	41
1916	2				.97		.97	1.32	2.29	287.10	41
1916	2				1.00		1.00	1.32	2.32	254.00	41
1918	0						.00	.38	.38	79.15	43
1918	1			.33			.33	.38	.71	137.50	43
1918	2			.66			.66	.38	1.04	329.15	43
1918	3			.66	.33		.99	.38	1.37	418.75	43
1918	4			.99	.33		1.32	.38	1.70	325.00	43
1918	5		0.33	.99	.33		1.65	.38	2.03	347.99	43
1918	6		.33	1.32	.33		1.98	.38	2.36	470.85	43
1918	7		.66	1.32	.33		2.31	.38	2.69	437.55	43
1918	5		.50	1.50	.50		2.50	.38	2.88	393.75	43
1918	7		1.00	2.00	.50		3.50	.38	3.88	362.10	43
1919	0						.00	.50	.50	57.50	44
1919	1		.33				.33	.59	.92	148.70	44
1919	2		.33	.34			.67	.59	1.26	218.40	44
1919	3		.33	.33	.34		1.00	.59	1.59	255.60	44
1919	4		.66	.67			1.33	.59	1.92	303.40	44
1919	5		.33	.67	.67		1.67	.59	2.26	368.50	44
1919	6		.33	.67	1.00		2.00	.59	2.59	314.10	44
1920	0						.00	.45	.45	10.00	32
1920	1			.25			.25	.45	.70	104.00	32
1920	2		.25	.25			.50	.45	.95	108.00	32
1920	3		.25	.25	.25		.75	.45	1.20	146.00	32
1920	4		.25	.50	.25		1.00	.45	1.45	217.20	32
1920	5		.50	.25	.50		1.25	.45	1.70	315.40	32
1920	6		.50	.50	.25	0.25	1.50	.45	1.95	280.20	32

SUGAR BEETS

										Tons	
1914	5	0.67		0.86	1.00		2.62	0.38	3.00	10.116	55
1914	5	.67		.86	1.00		2.62	.38	3.00	10.152	55
1914	4	.67		.79	1.00		2.55	.38	2.93	11.820	55
1915	0						.00	.93	.93	9.050	40
1915	1				.62		.62	.93	1.55	16.000	40
1915	2			.67	.62		1.29	.93	2.22	13.800	40
1915	3			.67	1.27		1.94	.93	2.87	14.400	40
1916	0						.00	1.32	1.32	4.530	41
1916	2	.42			.50		.92	1.32	2.24	10.440	41
1916	2	.42			.50		.92	1.32	2.24	11.120	41
1916	3	.42			.97		1.39	1.32	2.71	10.800	41
1917	0						.00	.50	.50	9.010	42
1917	2			.33	.33		.66	.50	1.16	17.180	42
1917	3			.66	.33		.99	.50	1.49	15.040	42
1917	4			.66	.66		1.32	.50	1.82	16.070	42
1920	0						.00	.45	.45	4.100	32
1920	1			.25			.25	.45	.70	8.000	32
1920	2		0.25	.25			.50	.45	.95	10.200	32
1920	3		.25	.25	.25		.75	.45	1.20	9.400	32
1920	4		.25	.50	.25		1.00	.45	1.45	12.200	32
1920	5		.50	.25	.50		1.25	.45	1.70	15.400	32
1920	6		.50	.50	.25	0.25	1.50	.45	1.95	12.100	32

See footnotes at end of table.

TABLE 35.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Ronalane, southern Alberta, Canada* [1]—Continued

WHEAT

Year	Number of irrigations	Monthly application of water					Total quantity of water received by crop			Yield per acre	Literature cited (see p. 110)
		May	June	July	Aug.	Sept.	Irrigation	Rainfall	Total		
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*	*Reference No.*
1915	1			0.34			0.34	0.93	1.27	46.16	40
1915	1			.67			.67	.93	1.60	43.50	40
1915	1		0.55				.55	.93	1.48	42.67	40
1915	1		.70				.70	.93	1.63	43.00	40
1915	2		.50	.75			1.25	.93	2.18	44.50	40
1915	1		.78				.78	.93	1.71	44.00	40
1915	1		.62				.62	.93	1.55	47.67	40
1915	2		.66	.68			1.34	.93	2.27	40.33	40
1915	0						.00	.93	.93	42.00	40
1916	0						.00	1.32	1.32	47.00	41
1916	1				0.50		.50	1.32	1.82	47.80	41
1916	1				.48		.48	1.32	1.80	44.40	41
1916	2			.50	.42		.92	1.32	2.24	44.20	41
1917	0						.00	.36	.36	17.62	42
1917	1			.33			.33	.36	.69	25.66	42
1917	2			.66			.66	.36	1.02	34.34	42
1917	3			.99			.99	.36	1.35	42.04	42
1917	3		.33	.66			.99	.36	1.35	39.36	42
1917	4		.33	.99			1.32	.36	1.68	46.81	42
1917	2			1.00			1.00	.36	1.36	44.36	42
1917	3		.50	1.00			1.50	.36	1.86	50.00	42
1918	0						.00	.34	.34	2.55	43
1918	1		.33				.33	.34	.67	31.25	43
1918	2		.33	.33			.66	.34	1.00	34.55	43
1918	3		.33	.66			.99	.34	1.33	27.90	43
1918	4		.33	.99			1.32	.34	1.66	25.00	43
1918	4		.33	.99			1.32	.34	1.66	27.50	43
1918	5		.33	.99	.33		1.65	.34	1.99	31.65	43
1918	6		.66	.99	.33		1.98	.34	2.32	37.90	43
1918	5		.50	1.50	.50		2.50	.34	2.84	36.65	43
1918	6		1.00	1.50	.50		3.00	.34	3.34	35.85	43
1919	0						.00	.47	.47	10.50	44
1919	1		.33				.33	.47	.80	25.60	44
1919	2		.33	.34			.67	.47	1.14	25.90	44
1919	3		.33	.67			1.00	.47	1.47	37.00	44
1919	4		.33	.67	.33		1.33	.47	1.80	39.50	44
1919	5		.66	.68	.33		1.67	.47	2.14	39.50	44
1919	6		.66	.67	.67		2.00	.47	2.47	36.40	44

[1] These experiments were conducted cooperatively by the reclamation service, Department of the Interior of Canada, and the Southern Alberta Land Co. and its successor, the Canada Land & Irrigation Co. The plots ranged in size from a fraction of 1 acre to 1.067 acres. In 1921 this station was abandoned in favor of a more advantageous location at Vauxhall. Precipitation figures prior to 1917 are for period April 1 to September 30, inclusive. For 1917 and following period, April 1, to harvest. Soils: Fine sandy loam soil for several inches, then a sandy loam to a depth of 3 to 4 feet, underlaid with sand and gravel.

[2] Summer fallowed.

TABLE 36.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Strathmore, southern Alberta, Canada* [1]

ALFALFA

Year	Number of irrigations	Monthly application of water			Total quantity of water received by crop			Yield per acre
		June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1915	1			0.25	0.25	1.44	1.69	[2] 3.23
1915	1			.50	.50	1.44	1.94	[2] 3.70
1915	0				.00	1.44	1.44	[2] 3.88
1915	1			1.00	1.00	1.44	2.44	[2] 3.36
1915	0				.00	1.44	1.44	[2] 2.92
1915	1			.25	.25	1.44	1.69	[2] 3.29
1915	1			.50	.50	1.44	1.94	[2] 2.96
1915	1			1.00	1.00	1.44	2.44	[2] 3.12

FODDER CORN

1915	0				0.00	1.44	1.44	[2] 3.55
1915	1			0.25	.25	1.44	1.69	[2] 4.11
1915	1			.50	.50	1.44	1.94	[2] 3.06
1915	1			1.00	1.00	1.44	2.44	[2] 3.20

PEAS

								Bushels
1914	0				0.00	0.71	0.71	[3] 27.80
1914	1	0.30			.30	.71	1.01	[3] 29.30
1914	1	.40			.40	.71	1.11	[3] 40.30
1914	0				.00	.71	.71	[3] 21.20
1914	1	.39			.39	.71	1.10	[3] 21.50
1914	1	.21			.21	.71	.92	[3] 34.50
1914	1	.49			.49	.71	1.20	[3] 18.90
1914	1	.40			.40	.71	1.11	[3] 29.60

POTATOES

1914	0				0.00	0.71	0.71	[3] [5] 248.00
1914	0				.00	.71	.71	[3] [5] 254.00
1914	1		0.13		.13	.71	.84	[3] 276.00
1914	2		.40		.40	.71	1.11	[3] 353.00
1914	0				.00	.71	.71	[3] 209.00
1914	1		.13		.13	.71	.84	[3] 216.00
1914	2		.40		.40	.71	1.11	[3] 251.00

TURNIPS

1915	0				0.00	1.44	1.44	[4] 144.70
1915	1			0.25	.25	1.44	1.69	[4] 198.20
1915	1			.50	.50	1.44	1.94	[4] 323.30
1915	1			1.00	1.00	1.44	2.44	[4] 271.30

WHEAT

1914	0				0.00	0.71	0.71	[3] 10.00
1914	1	0.17			.17	.71	.88	[3] 26.80
1914	1	.23			.23	.71	.94	[3] 25.60
1914	2	.23			.23	.71	.94	[3] 36.10
1914	1	.31			.31	.71	1.02	[3] 42.80
1914	0				.00	.71	.71	[3] 16.80
1914	1	.28			.28	.71	.99	[3] 39.50
1914	1	.32			.32	.71	1.03	[3] 45.10
1914	1	.21			.21	.71	.92	[3] 46.10
1914	1	.33			.33	.71	1.04	[3] 50.10

[1] These investigations were carried on by the irrigation branch (later the reclamation service), Department of the Interior of Canada, in cooperation with the department of natural resources of the Canadian Pacific Railway. The plots varied in size from 0.08 to 0.78 acre. Owing to the wet season, no irrigation was applied in 1916. In 1917 this station was abandoned as a result of a rise in the ground-water level. Precipitation for period Apr. 1 to Sept. 30, inclusive. Soils: Sandy for a few inches in depth, then a fine sandy soil to a depth varying from 3 to 7 feet, underlaid by a very impervious subsoil of heavy clay and gumbo.

[2] From Rpt. Irrig. Surveys, 1915–16, Dept. Int., Canada (*40*).

[3] From Bull. 4, Irrig. Ser., Dept. Int., Canada (*54*).

[4] From Rpt. Irrig. Surveys, 1915–16, Dept. Int., Canada (*40*).

[5] From Bull. 4, Irrig. Ser., Dept. Int., Canada (*54*).

[6] Summer fallowed.

TABLE 37.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Strathmore, southern Alberta, Canada* [1]

ALFALFA

Year	Area irrigated	Number of irrigations	Monthly application of water			Total quantity of water received by crop			Yield per acre [1]
			May	June	July	Irrigation	Rainfall	Total	
	Acres		*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Tons*
1914	1.49	0				0.00	0.71	0.71	0.74
1914	1.55	2	0.18		0.20	.38	.71	1.09	3.09
1914	1.37	2	.31		.27	.58	.71	1.29	[3] 4.30
1914	3.43	2		0.79	.33	1.12	.71	1.83	3.26
1914	3.69	2	1.59		.31	1.90	.71	2.61	3.10
1914	2.01	2		.82	.38	1.20	.71	1.91	2.02
1914	10.00	2	.01		1.08	2.02	.71	2.73	4.18
1914	5.00	3	.04		1.25	2.19	.71	2.90	4.87

FLAX

1914		0				0.00	0.71	0.71	*Bushels* 2.00
1914	6.25	1	1.04			1.04	.71	1.75	15.00

WHEAT

1914	18.00					0.00	0.71	0.71	11.30
1914	3.60	1		0.21		.21	.71	.92	15.50
1914	2.25	1		.39		.39	.71	1.10	22.10

[1] Investigations were carried on by the irrigation branch, Department of the Interior of Canada, in cooperation with the department of natural resources of the Canadian Pacific Railway and with individual farmers. Soils: Sandy loams, some of uniform texture for some depth, and some underlaid with hardpan at about 6 inches. Precipitation for period Apr. 1 to Sept. 30, inclusive.
[2] Data from Bul. 4, Irrig. Ser., Dept. Int., Canada (*54*).
[3] Fall irrigated, 1913.

TABLE 38.—*Use of water on crops, irrigation water applied, rainfall and crop yields at Gleichen, southern Alberta, Canada* [1]

OATS

Year	Number of irrigations	Total quantity of water received by crop			Yield per acre [2]
		Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Bushels*
1915	0	0.00	1.24	1.24	[3] 80
1915	0	.00	1.24	1.24	[3] 79
1915	1	.19	1.24	1.43	75

[1] These were part of a series of field demonstration plots on which a program of irrigation was conducted by the irrigation division (later the reclamation service), Department of the Interior of Canada. The plots contained 1 to 3 acres. Practically all the soils were of the same general structure and texture as at Strathmore. The precipitation was for period Apr. 1 to Sept. 30, inclusive.
[2] Data from the Rpt. Irrig. Surveys, Dept. Int., Canada, 1915–16 (*40*).
[3] Summer fallowed.

TABLE 39.—*Use of water on crops, irrigation water applied, rainfall, and crop yields at Vauxhall, southern Alberta, Canada* [1]

BARLEY

Year	Number of irrigations	Monthly application of water			Total quantity of water received by crop			Yield per acre
		June	July	Aug.	Irrigation	Rainfall	Total	
		Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Bushels*
1921	0				0.00	0.39	0.39	3.2
1921	4	0.66	0.33	0.33	1.32	.39	1.71	43.2
1921	1	.33			.33	.39	.72	16.4
1921	2	.33	.33		.66	.39	1.05	25.2
1921	3	.33	.66		.99	.39	1.38	32.8
1921	4	.33	.66	.33	1.32	.39	1.71	40.0
1921	4	.66	.33	.33	1.32	.39	1.71	44.4
1921	4	.66	.33	.33	1.32	.39	1.71	47.6

OATS

1921	0				0.00	0.40	0.40	12.4
1921	1	0.33			.33	.40	.73	66.4
1921	2	.33	0.33		.66	.40	1.06	80.4
1921	3	.33	.66		.99	.40	1.39	102.6
1921	4	.33	.66	0.33	1.32	.40	1.72	112.8
1921	4	.66	.33	.33	1.32	.40	1.72	116.4
1921	4	.66	.33	.33	1.32	.40	1.72	115.6
1921	3	.66	.33		.99	.40	1.39	112.0

PEAS

1921	0				0.00	0.40	0.40	6.8
1921	1	0.33			.33	.40	.73	12.4
1921	2	.33		0.33	.66	.40	1.06	15.6
1921	2	.33	0.33		.66	.40	1.06	23.2
1921	2	.33	.33		.66	.40	1.06	20.8
1921	3	.33	.33	.33	.99	.40	1.39	24.4
1921	3	.33	.33	.33	.99	.40	1.39	21.6
1921	3	.33	.66		.99	.40	1.39	24.0

POTATOES

1921	0				0.00	0.567	0.567	46.5
1921	1	0.25			.25	.567	.817	124.8
1921	2	.25	0.25		.50	.567	1.067	191.2
1921	3	.25	.25	0.25	.75	.567	1.317	217.2
1921	4	.50	.50		1.00	.567	1.567	280.0
1921	5	.25	.50	.50	1.25	.567	1.817	352.0
1921	5	.25	.50	.50	1.25	.567	1.817	376.0
1921	6	.25	.50	.75	1.50	.567	2.067	320.4

WHEAT

1921	0				0.00	0.39	0.39	[2] 8.4
1921	1	0.33			.33	.39	.72	24.8
1921	2	.33	0.33		.66	.39	1.05	33.2
1921	3	.33	.66		.99	.39	1.38	37.6
1921	4	.33	.66	0.33	1.32	.39	1.71	40.0
1921	4	.66	.33	.33	1.32	.39	1.71	43.2
1921	4	.66	.33	.33	1.32	.39	1.71	40.4
1921	4	.66	.33	.33	1.32	.39	1.71	39.2

[1] These studies have been made by the reclamation service, Department of the Interior, of Canada, and the Canada Land & Irrigation Co. The plots are 0.25 acre in size. Precipitation for period, April 1 to harvest. Soils: More uniform than at Ronalane. Data taken from Ann. Rpt. Reclam. Serv., Canada, 1921-22 (*88*).

[2] Estimated.

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