UNIVERSITY OF NOTTINGHAM

Department of Agriculture and Horticulture

# DRY BULB ONIONS

H. W. T. Kerr

Agricultural Enterprise Studies
in England and Wales
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DEPARTMENT OF AGRICULTURE AND HORTICULTURE

# DRY BULB ONIONS

A study of the production economics of the 1971
Dry Bulb Onion Crop in the East Midland Region
including the Holland Division of Lincolnshire

H. W. T. KERR

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# AGRICULTURAL ENTERPRISE STUDIES IN ENGLAND AND WALES

University departments of Agricultural Economics in England and Wales have for many years undertaken economic studies of crop and livestock enterprises. In this work the departments receive financial and technical support from the Ministry of Agriculture, Fisheries and Food.

A recent development is that departments in different regions of the country are now conducting joint studies into those enterprises in which they have a particular interest. This community of interest is being recognised by issuing enterprise reports in a common series entitled "Agricultural Enterprise Studies in England and Wales", although the publications will continue to be prepared and published by individual departments.

Titles of recent publications in this series and the addresses of the University departments are given at the end of this report.

## ACKNOWLEDGEMENTS

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# FOREWORD

This study of the 1971 dry bulb onion crop was carried out as part of the programme to gain further knowledge of crops which might be of value as break crops in the rotation of general arable farms in the East Midland Region. The Holland Division of Lincolnshire was also included by agreement with the University of Cambridge within whose province this county is located. Reports have already been published by this Department on oil seed rape, field beans, vining peas, threshed peas and red beet.

This report is presented in the same way as the others in the series, the primary purpose being to examine the potential for introducing dry bulb onions into the rotation of general arable farms. Since this crop makes a considerable demand upon fixed resources, an assessment was also made of their cost so that the output and gross margin needed to provide a satisfactory net margin could be suggested. The physical data is shown in detail so that adjustments can be readily made for changes in prices which have taken place since 1971.

Owing to limited resources, the sample was small, but it is hoped that the study, besides providing useful data in its own right, may act as a pilot for wider investigations in the future.

# 1. INTRODUCTION

## 1.1 The Dry Bulb Onion Crop in 1971

The acreage of dry bulb onions grown in England and Wales has risen dramatically during the last decade from as little as 2,000 acres in 1961 to a peak of over 13,500 acres in 1971. The 1971 acreage represented an increase of 46% over that of 1970. Eighty-nine per cent of the crop was grown in the Eastern and East Midland Regions, the main locations being in the counties Lincolnshire (Holland), 3,780 acres; Cambridgeshire and the Isle of Ely, 2,878 acres; and Norfolk, 2,222 acres. Less than a 1,000 acres in total was grown in other counties both within these two regions and outside them. Details of the acreage grown in England and Wales and the East Midland Counties and Lincolnshire (Holland) are shown in Table 1.

TABLE 1 ACREAGE OF DRY BULB ONIONS

acres

| | 1961 | 1964 | 1967 | 1968 | 1969 | 1970 | 1971 |
|---|---|---|---|---|---|---|---|
| England and Wales | 2,089 | 3,786 | 5,895 | 8,396 | 7,096 | 9,276 | 13,563 |
| Eastern Region (less Lincs. Holland) | 1,152 | 2,216 | 3,558 | 4,782 | 3,790 | 4,662 | 6,878 |
| East Midland Region (plus Lincs. Holland) | 537 | 1,161 | 1,927 | 2,994 | 2,747 | 3,574 | 5,184 |
| Lincolnshire (Holland) | 462 | 1,002 | 1,732 | 2,454 | 2,226 | 2,710 | 3,780 |
| Lincolnshire (Kesteven) | 18 | 57 | 50 | 188 | 225 | 420 | 618 |
| Lincolnshire (Lindsey) | 30 | 79 | 70 | 215 | 115 | 210 | 575 |
| Derbyshire | 6 | 7 | 7 | 7 | 4 | 6 | 6 |
| Leicestershire | 5 | 4 | 3 | 4 | 5 | 35 | 46 |
| Northamptonshire | 4 | 4 | 59 | 118 | 163 | 166 | 94 |
| Nottinghamshire | 10 | 8 | 6 | 8 | 10 | 24 | 58 |
| Rutland | 2 | - | 1 | - | - | 3 | 7 |

## 1.2 Outlets for the Product[1]

There are many uses for the onion crop, the main outlets being for household consumption, catering, pickling, soup manufacture and other manufacturing such as dehydrating, canning, inclusion with frozen foods and onion oil. Approximately 200,000 tons is imported annually mainly from Spain, the Netherlands, Egypt, Poland and Chile. Since 1961 the total supply of onions has increased by 100,000 tons as shown in Table 2. Over the same period home

TABLE 2 HOME PRODUCTION AND IMPORTS OF DRY BULB ONIONS

| | Crop Year | Homegrown Output | Imports | Total Available for Consumption (c) | Homegrown onions as percentage of Total Supplies |
|---|---|---|---|---|---|
| | | '000 tons | '000 tons | '000 tons | % |
| (a) | 1961-62 | 26 | 223 | 249 | 10.4 |
| | 1964-65 | 54 | 200 | 254 | 21.3 |
| | 1967-68 | 66 | 200 | 266 | 24.8 |
| | 1968-69 | 85 | 210 | 295 | 28.8 |
| | 1969-70 | 88 | 195 | 283 | 31.1 |
| (b) | 1970-71 | 110 | 197 | 307 | 35.8 |
| | 1971-72 | 173 | 182 | 355 | 48.7 |

SOURCE: (a) AMDEC Report
(b) M.A.F.F. Horticultural Statistics
(c) Unadjusted

production has increased by nearly 150,000 tons whereas imports, mainly from the Netherlands and Egypt, have declined by 40,000 tons following the introduction of improved Dutch varieties. The disposal between outlets of the total supply of onions and of the homegrown crop in 1968-69 is given in Table 3.

(1) See also "Report on an Investigation into the Market for Onions in the U.K." prepared by Conrad Jameson, Associates Ltd., for the Agricultural Marketing Development Executive Committee, May, 1970. (AMDEC Report)

TABLE 3 DISPOSAL OF ONIONS IN 1968-69

| Disposal | Quantity | Proportion |
|---|---|---|
| | tons | % |
| (a) Total Supply | | |
| Household Consumption | 196,000 | 70 |
| Catering | 36,000 | 13 |
| Pickling | 27,000 | 10 |
| Soup Manufacture | 10,000 | 3½ |
| Other Manufacture | 10,000 | 3½ |
| Total | 279,000 | 100 |
| (b) Homegrown Crop | | |
| Household Consumption | 55,000 | 70 |
| Catering | 8,000 | 10 |
| Pickling | 7,000 | 9 |
| Soup Manufacture | 7,000 | 9 |
| Other Manufacture | 2,000 | 2 |
| Total | 79,000 | 100 |

SOURCE: AMDEC Report

Similar figures are not available for 1971-72, but as indicated in Table 2 both the total supply and the proportion provided by home production have increased. It is also likely that the proportion of both total supply and of home production going for manufacturing has risen.

The catering trade generally uses unprepared ware onions. The main users are office and factory canteens, particularly in the north of England and Scotland. Hotels and Restaurants also prefer

fresh unprepared onions. There is a small but increasing use made by the catering trade of ready prepared onions, which are first peeled and sold to the trade whole, sliced or diced. Thin-skinned varieties such as Bola, which are easy to peel, are required for this purpose. Institutions such as private schools, nursery establishments, and industrial canteens which have a predictable demand at a predictable time are showing a preference for dehydrated onions although they are more costly to purchase and prepare.

Most of the onions used for pickling and for inclusion in pickles and other sauces are imported. Until 1972, all silver skin or cocktail onions were imported (about 3,000 tons annually) provisionally preserved in brine. The problems of harvesting and peeling and skinning associated with growing silverskins in this country are now thought to be solved. Picklers are graded out of the ware crop, but often they are not considered satisfactory because they tend to be the wrong shape and it has been more difficult recently to get a price for them. There has been a definite swing recently to growing a specific pickling onion crop dressed to 1" to 1¼" in size. The most common variety grown is New Brown Pickling and home producers supply about a quarter to one third of the picklers annual requirement. Pickling onions are a highly specialised crop to grow and it is advisable to grow on contract to a processor or a peeling factory.

It is estimated that about 10,000 tons of unprepared onions are used annually in soups. Manufacturers prefer a round, pale, creamy white coloured onion, which must not be marked, stained, bruised, diseased or show any green parts. Flavour is important,

but requirements vary from buyer to buyer. Similarly, size requirements vary, and both fresh and kibbled onions are used. Dehydrated onions and onion powder are used in the preparation of packet soups which have recently made deep inroads into the sales of canned soups.

Onions are incorporated in a vast number of other products such as meat pies, hamburgers, steak and kidney puddings, sausages, stuffings, stocks and cubes for gravies. The demand for these products is met almost entirely by imported dehydrated onions and onion powder, and the usage has risen rapidly in recent years. Considerable quantities of fresh onions are used for inclusion in frozen foods, particularly beef-burgers, rissoles, and cornish pasties, but only a small quantity is canned. Onion oil which is much more concentrated than powder is used for flavouring savoury foods. Most of the requirements are supplied by English onions and some of the oil is exported.

Requirements vary considerably but the following list gives an indication of the sizes, measured by the diameter of the bulb, into which onions are graded in the U.K. for different outlets:

| | |
|---|---|
| Market Trade | Picklers: under 1" (under 25mm) |
| | Small ware 1"-1¾" (25mm-45mm) |
| | Pre-packing into nets: 1⅝"-2" (41mm-50mm) |
| | Catering: Over 1¾" (over 45mm) |
| Processing: | Soups: 1½"-2½" (35mm-65mm) |
| | Pickles (whole): under 1" (under 25mm) |
| | Pickles (chopped) and sauces: Various sizes |
| | Canning: 1¼"-1¾" (36mm-45mm) and 1¾"-2¼" (45mm-55mm) |
| | Dehydration: over 1½" (over 35mm) |

The "European Standards" which apply in the E.E.C. are:-

| | |
|---|---|
| Pickling onions: | 10mm and over but under 15 mm |
| | 15mm - 20mm |
| | 20mm - 30mm |
| | 30mm - 45mm |
| Onions for consumption fresh: | Minimum 40mm with maximum deviation 20mm between bulbs in same package marked as containing one size |

## 1.3 The Scope of the Study

A sample of 15 co-operators was drawn from a random list of growers in the East Midland Region plus Lincolnshire (Holland). The sample covered 243 acres of onions which represents 4 per cent of the acreage grown in this region in 1971 and 1.8 per cent of the total acreage grown in England and Wales. The distribution of the sample by couty is given in Table 4.

TABLE 4 DISTRIBUTION OF THE SAMPLE BY COUNTY

| County | Number of Growers | Acreage |
|---|---|---|
| Lincolnshire (Holland) | 11 | 198 |
| Lincolnshire (Kesteven) | 2 | 27½ |
| Lincolnshire (Lindsey) | 1 | 2½ |
| Northamptonshire | 1 | 15 |
| TOTAL | 15 | 243 |

## 1.4 Special Features of the 1971 Crop

Conditions for growing the crop in 1971 were generally good except that June was cold and wet. The weather at harvest was particularly good. Yields out of the field were high but there was a considerable loss during storage largely due to neck rot and the quality of the onions sold was not generally good.

# 2. GENERAL HUSBANDRY (2)

## 2.1 Place in the Rotation

The place of onions in the rotation is extremely important because they are subject to several serious pest and diseases. Stem and bulb eelworm (Anguillulina dipsaci) is the most dangerous pest whilst the most common diseases are white rot (Sclerotium cepivorum), neck and bulb rot (Botrytis allii, b. byssoidea), downy mildew (Peronospora destructor), and shanking (Phytophthora spp.). These can all build up to cause serious losses if onions are grown for more than two successive years, or, in the case of eelworm, in a close rotation with other host plants. The strain of eelworm which attacks onions also affects oats, clovers, lucerne, sugar beet, leeks, peas, carrots, parsnips, broad beans, dwarf French beans, rhubarb and strawberries. There are a number of weed hosts including chickweed, mouse-ear chickweed, cleavers and groundsel. In addition, the daffodil and tulip strain of stem and bulb eelworm will attack onions. Onion eelworm can be brought onto the farm with the seed so it is essential that only fumigated seed should be purchased.

The best crops to precede onions are wheat and barley. Potatoes were at one time considered suitable but in the last few years, when the winters have been mild, volunteer plants arising from potatoes carried over the winter have caused serious difficulties in following crops of onions. It has also been found that onions can suffer from shanking following crops of potatoes which have had pink rot (Phytophthora erythroseptica). At least two years should be allowed

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(2) Recommendations quoted in this section are taken from "Dry Bulb Onions" N.A.A.S. Horticultural Enterprises Booklet No.1, M.A.F.F., 1970.

between crops of onions and leeks and the other hosts of stem and bulb eelworm.

## 2.2 Soil and Cultivations

The soils on which onions can be grown successfully are limited. The ideal soil is a well-drained silt or brickearth. Peat is almost as good although onions ripen more slowly on soil with a high organic matter content, and weed control and drying off is more difficult than on mineral soils. The suitability of a soil decreases progressively as it becomes heavier or lighter. Two-thirds of the sample was grown on soils described as silt and a third on loam. The pH of the soil should be between 6.2 and 7.5 on mineral soils and between 5.4 and 7.5 on peat. Steep slopes are suitable for the necessary cultivations to be carried out satisfactorily and stones cause problems at drilling leading to variability of plant stand and make mechanical harvesting difficult. The crop needs moisture throughout its growing life but uneven irrigation can cause variable growth and ripening. It is better to grow onions on soils which do not require irrigation; that is, those holding more than 1½" available water per foot depth. A fine level seed bed is required and the best time for sowing is during the second half of March, which again places a limitation on the type of soil which is suitable.

## 2.3 Seed and Sowing

Seed should be fumigated with methyl bromide to eliminate eelworm and dressed with dieldrin as a protection against onion fly. The seed can be drilled with any type of spacing drill or line seeder, but spacing drills using cell wheels or perforated belts are the most accurate. The seed should be drilled ¼"-¾" deep in March, preferably during the second half of the month. It can be

sown up to mid-April but the yield of April drillings is likely to be lower. Only two farmers in the sample sowed in April and then in the first week. A plant population of eight plants per sq. ft. in rows of not more than 18" apart is ideal but the row width will be determined by that required by the implements used for post drilling operations such as inter-row hoeing and under-cutting at harvest. The varieties and seed rates used by the farmers in the sample are shown in Table 5. The varieties are all mid-season

TABLE 5 VARIETIES AND SEED RATES

| Variety | | Average Seed Rate | Acreage | Proportion of total acreage |
|---|---|---|---|---|
| | | lbs. per acre | acres | % |
| Produrijn | Mid Season | 3.48 | 89 | 36.7 |
| Rijnsburger | | 3.25 | 54 | 22.2 |
| Bola | | 3.12 | 46½ | 19.1 |
| Fenman | | 3.00 | 17 | 7.0 |
| Early Maincrop | | 4.50 | 8½ | 3.5 |
| Bono | | 4.50 | 8 | 3.3 |
| Rheingold | | 4.00 | 6 | 2.5 |
| Wijbo | | 4.00 | 3 | 1.2 |
| Mabol | | 4.00 | 1 | 0.4 |
| Primeur | Late | 4.45 | 10 | 4.1 |
| | | 3.46 | 243 | 100.0 |

Rijnsburger type onions except Primeur which is a late Rijnsburger. Rijnsburgers are described by the N.I.A.B. as being round and oval in shape and the graded-out onions of this type are more acceptable for pickling than the flatter type of onion. An assortment of row

widths was used. Of the nine who sowed in single rows, six used 18" or 19" rows and three 13" rows. The remainder sowed in beds, mostly 4" x 13" rows with 18" between the beds. The average seed rate for all varieties fell between 3lbs. and 4½lbs. per acre. Individual lots were sown at as little as 2½lbs. per acre up to a maximum of 6lbs. per acre, but only seven acres was sown outside the range 3lbs. to 4½lbs. per acre. The seed rate required to give 8 plants per square foot considered to be the optimum can be determined by using a standard formula.(3)

Seed rates used were on the low side and the uniformity of the rates chosen would appear to indicate that insufficient attention is being given to adjustment of the rate for variation in germination and seed size needed to achieve optimum plant population.

## 2.4 Fertilisers

The whole acreage received a dressing of fertiliser, details of which are given in Table 6. Average application provided 88 units of nitrogen per acre, 100 units of phosphate and 207 units of potash, a ratio of approximately 1:1:2½. However, fertilisers with ten different analyses were used giving a variety of levels of nutrients per acre. Unfortunately the soil designations were too imprecise and the sample too small for rates of application to be related to soil type and their specific requirement.

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(3) Seed in lbs = $\frac{272 \times \text{Required No. of plants per sq. ft.}}{\text{Seed per oz. in '000s} \times \text{Laboratory germination \% minus 30\%}}$

TABLE 6 FERTILISER APPLICATION

| Analysis | | | Average Rate of Application | Units Applied per acre | | | Acreage Treated | Proportion of Total Acreage |
|---|---|---|---|---|---|---|---|---|
| N | P | K | cwts.per acre | N | P | K | acres | % |
| 13 | 13 | 20 | 6.0 | 78 | 78 | 120 | 12 | 4.9 |
| 10 | 10 | 18 | 10.0 | 100 | 100 | 180 | 2½ | 1.0 |
| 11 | 14 | 21 | 10.0 | 110 | 140 | 210 | 90 | 37.0 |
| 12 | 10 | 19 | 5.0 | 60 | 50 | 95 | 2 | 0.8 |
| 17 | 11 | 22 | 7.0 | 119 | 77 | 154 | 2 | 0.8 |
| 7 | 7½ | 20 | 9.0 | 63 | 68 | 180 | 15 | 6.2 |
| 8 | 8 | 24 | 6.7 | 53 | 53 | 160 | 3 | 1.3 |
| 9 | 9 | 27 | 7.2 | 65 | 65 | 195 | 25 | 10.3 |
| 7 | 7 | 21 | 11.2 | 78 | 78 | 234 | 88½ | 36.4 |
| 7 | 21 | 6½ | 10.0 | 70 | 210 | 65 | 3 | 1.3 |
| Mean | | | 9.8 | 88 | 100 | 207 | - | - |
| | | | | Total | | | 243 | 100.0 |

## 2.5 Crop Protection

The whole acreage was sprayed at least twice with herbicides to control annual weeds. A variety of materials were used, details of which are given in Table 7. The residual herbicides propachlor and pyrazone plus chlorbufam were used in both their pre- and post-emergence roles, the latter often on the same crop. Pyrazone plus chlorbufam was the most commonly applied herbicide being used on over half the cumulative acreage sprayed. There is no satisfactory weedkiller for controlling perennial weeds in onions.

No fungicides or pesticides were applied to the crop other than the seed treatments.

One grower with 22 acres used maleic hydrazide as a sprout suppressant applied at approximately 50% die-down.

TABLE 7 HERBICIDES

| Chemical | Type of Herbicide | Acreage Sprayed | Proportion[a] Acreage Grown | Purpose[b] |
|---|---|---|---|---|
| | | acres | % | |
| Triallate | Pre- or post-drilling contact | 24½ | 10.1 | Wild Oats |
| Paraquat | Pre-emergence contact | 28 | 11.5 | Grasses and broad leaved annuals |
| Paraquat plus Diquat[c] | Pre-emergence contact | 5 | 2.1 | Grasses and broad leaved annuals |
| Diquat | Pre-emergence contact | 90 | 37.0 | Grasses and broad leaved annuals |
| Dimexan | Pre-emergence contact | 35 | 14.4 | Grasses and germinating weeds |
| Paraquat with Pyrazone plus Chlorbufam[c] | Pre-emergence contact with pre-emergence residual | 22 | 9.1 | Grasses and germinating weeds |
| Propachlor | Pre- and post-emergence residual | 33½ | 13.8 | Annual weeds |
| Pyrazone plus Chlorbufam[c] | Pre- and post-emergence residual | 341½ | 140.5 | Germinating weeds |
| Propachlor with Chlorpropham[c] | Pre- and post-emergence residuals | 2 | 0.8 | Germinating weeds and established chickweed |
| Pyrazone plus Chlorbufam with Chlorpropham[c] | Pre- and post-emergence residuals | 2½ | 1.0 | Germinating weeds and established chickweed |
| Ioxynil | Post-emergence contact | 3½ | 1.4 | General weed control |
| Ioxynil plus Linuron | Post-emergence contact and residual | 39½ | 16.3 | Broad leaved weeds particularly hemp-nettle and corn marigold |
| | | 627 | 258.0 | |

(a) Proportion of 243 acres grown
(b) As described in M.A.F.F. "List of Approved Products and their uses for Farmers and Growers".
(c) "Plus" denotes a proprietary mixture of chemicals. "With" denotes the use by the farmer of two proprietary sprays applied together.

## 2.6 Harvesting

The first harvesting operation, undercutting and windrowing, should be started as soon as the tops die down and completed by the end of the first week in September. It is usually carried out as one operation but may be done separately. The onions are left in the windrow for five to ten days, until the tops are thoroughly wilted, to partially dry and cure in the field. They are then picked up, either by hand or by an elevator-type potato or vegetable harvester, generally with the share removed or replaced by a power-driven rotating square bar. The onions can be bagged, boxed or loaded directly into trailers and taken to the store. Care must be taken not to bruise them when handling into store, where the curing and drying is completed.

Seven growers with 26½ acres picked up their crop by hand and another two with 18 acres harvested partly by hand and partly by machine. One with three acres employed a contractor. The remaining 195½ acres was picked up by mechanical harvester, four growers using Whitseds and one a Grimme.

## 2.7 Drying, Curing and Storing

The amount of drying and curing which takes place in the windrow will depend on the prevailing weather conditions. In a good year such as 1971 onions will colour well in the field. Drying should begin as soon as the onions are brought into store. Air at 65%-75% relative humidity should be blown through the stack at 250cu.ft. per minute per ton for up to three days to produce rapid, uniform and continuous drying. When the onions at the top

of the stack are crisp and the inlet and outlet humidities are within 10% of one another drying is complete. Whether the additional expense of heat is worthwhile will depend on the premium being paid for good colour.

If the onions have not cured well in the field their skin colour can be improved by heating the dried onions to temperatures above 21°C but not in excess of 29°C. The stack should be warmed up slowly and then maintained at a uniform temperature. The relative humidity should be kept at 70%-80%, lower values leading to split skins and higher values allowing moulds to develop. The amount of colouring produced is directly proportional to the length of time for which the onions are kept at a high temperature.

Ventilated stores are usually adequate for onions cleared up to the end of March, the stack being kept as cold as possible without being frozen. When the temperature of the ambient air is below stack temperature then air not colder than 3°C below stack temperature is blown through (provided it is not below 0°C). A differential themostat and sensing elements are required to control the fan. The stack should not be higher than 10ft., the building must be dry and frost proof and straw bales lining the walls will usually provide sufficient insulation. Condensation arising from differences between ambient and stack temperature will be absorbed by the straw bales and a loose layer of straw should also be spread on top of the stack.

A refrigerated store may be needed if the onions are kept after the end of March to maintain them at an optimum temperature of 1°C with a relative humidity of 70%-75%.

Before removing from the store, the onions should be crisped by blowing air about 2°C higher than that of the onion stack through them for a period of up to 24 hours immediately before starting to unload. Dry tops are removed by machine and then passed over an inspection belt so that thick-necked, diseased, dirty or skinned onions can be removed by hand. Since there is a better market for graded onions they are usually graded by a sizing machine of reciprocating riddle, spool or diverging belt type.

Storage and drying facilities in this study varied from ventilated stores generally used by those with larger acreages harvested mechanically to adapted sheds and, in two cases, netting containers in the field used by those with smaller acreages. The greater proportion of the crop was stored loose, but several of the growers with small acreages stored all or part in bags or boxes in sheds. Apart from two growers who had their onions graded through a marketing co-operative only one other disposed of his crop ungraded.

## 2.8 Labour and Machinery Requirements for Growing and Harvesting

Owing to the reliance on casual labour for harvesting and grading, seldom paid on an hourly basis, it is only possible to show the labour and tractor requirements of the whole sample for growing up to the point of harvesting. These figures are given in Table 8. The wide range in requirements is due mainly to whether or not the crop was hand-weeded.

TABLE 8 AVERAGE LABOUR AND MACHINERY REQUIREMENTS FOR GROWING UP TO HARVEST

hours per acre

| Operation | Labour | Tractor |
|---|---|---|
| Ploughing | 1.5 | 1.5 |
| Working down and drilling | 2.9(a) | 2.9(a) |
| Post-drilling | 17.4(b) | 2.0 |
| Total | 21.8 | 6.4 |
| Range | 5.8 - 53.6 | 4.0 - 16.5 |

(a) Including 0.7 hours per acre for contract drilling

(b) Including 14.0 hours per acre casual labour for hand-weeding, 31.1 hours per acre were used by those hand-weeding including 26.7 hours per acre casual. 2.4 hours per acre were used by those not hand weeding.

The labour and tractor requirements of the five growers harvesting all their crops mechanically, all of whom grew more than 20 acres, are given in Table 9. Three of these growers undercut and windrowed in one operation using one man; one used a modified steerage-hoe employing an extra man on the hoe; and the other undercut and windrowed separately. The rate of work when undercutting and windrowing in one operation was between 7 and 10 acres in an eight hour day.

TABLE 9 LABOUR AND TRACTOR REQUIREMENTS FOR MECHANICAL HARVESTING

hours per acre

| Operation | Labour | Tractor |
|---|---|---|
| Undercutting and windrowing | 1.1 | 0.9 |
| Picking up and Carting to Store | 20.4 | 13.8 |
| Total | 21.5 | 14.7 |
| Range | 7.6 - 27.2 | 6.2 - 18.2 |

The team used for picking up varied considerably. Three growers had no sorters on the harvester, but the other two had two and four women respectively sorting on the machine. One grower employed a gang of women for lifting the headlands by hand, and another, using no sorters on the machine, had a woman picking up the row ends and removing rubbish from the windrows. Apart from the sorters on the machine, the size of the team depended on the number of trailers used, generally 3 to 4 per harvester. A typical team would, therefore, be one man and tractor drawing the harvester, three or four with tractors and trailers and one man at the store. The teams operated at a rate of 2 to 3 acres in an eight hour day except for one grower using a Whitsed celery harvester with no sorters on the machine who recorded nearly six acres cleared per day.

## 3. FINANCIAL RESULTS

Average output, variable costs and gross margin per acre for the whole sample of 15 growers covering 243 acres together with the ranges of each item are given in Table 10. In addition to the gross

TABLE 10 AVERAGE OUTPUT, VARIABLE COSTS AND GROSS MARGIN

| | Average | Range |
|---|---|---|
| Acres grown per farm | 16.2 | 2.0 - 90.0 |
| Sales per acre tons | 9.4 | 4.1 - 21.6 |
| Average price per ton sold £ | 12.07(a) | 6.5 - 20.0 |
| | £ per acre | £ per acre |
| OUTPUT | 113.99 | 47.0 - 311.6 |
| VARIABLE COSTS: | | |
| Seeds | 12.69 | 8.3 - 20.8 |
| Fertilisers | 14.19 | 8.1 - 20.1 |
| Herbicides | 14.02 | 6.0 - 24.0 |
| Sub Total | 40.9 | 29.6 - 54.5 |
| MARGIN OVER MATERIAL COSTS | 73.09 | 6.8 - 257.1 |
| Contract | 1.21(b) | Nil - 14.0 |
| Contract Haulage | 7.19(c) | NA |
| Grading and Sorting | 22.08(d) | Nil - 108.3 |
| Other Casual | 5.90(e) | Nil - 39.3 |
| Miscellaneous | 23.82(f) | Nil - 65.0 |
| Sub Total | 60.20 | 10.4 - 180.1 |
| TOTAL VARIABLE COSTS | 101.10 | 50.6 - 234.6 |
| GROSS MARGIN | 12.89 | (-)51.7 - 149.3 |

Notes: (a) Two growers sold their crop to a grader at an average price per ton of £8.17. The remainder sold at an average price of £13.17 per ton.

(b) Mainly drilling at £2.21 per acre drilled.

(c) Only one grower used contract haulage at a cost of £3.00 per ton.

(d) All growers graded and sorted the crop except one who sold them ungraded and two who sold direct to a grader at a reduced price per ton. The cost per acre for those who carried out this operation was £28.61 per acre or £2.99 per ton.

(e) Hand-weeding, Hand-hoeing, Picking up..

(f) Mainly nets, bags and sacks at £26.45 per acre incurred by all except the three growers not grading.

margin, the margin over material costs (seed, fertilisers, and herbicides) is also shown because of the variability in the use of the other inputs particularly casual labour and contract.

## 3.1 Output

Some returns for yield from the field and out of store were unreliable so yield is shown in Table 10 as the quantity actually sold per acre. Considerable losses can occur in storage and the quantity taken out of store may not necessarily be sold. In this sample two growers had to dump half the amount taken out of store and another sold only one third. The sales per acre were considerably below the average for the country as a whole, probably because of losses in store. The United Kingdom figures for the last five years are given in Table 11.

TABLE 11 ESTIMATED GROSS PRODUCTION AND OUTPUT OF DRY BULB ONIONS IN THE UNITED KINGDOM

| | | | 1967 | 1968 | 1969 | 1970 | 1971 |
|---|---|---|---|---|---|---|---|
| Gross production | (a) | '000tons | 74.7 | 99.4 | 96.6 | 119.9 | 199.7 |
| Gross Yield per acre | (a) | tons | 12.7 | 11.8 | 13.6 | 13.0 | 14.8 |
| Output (Sales) | (a) | '000tons | 66.2 | 85.0 | 88.3 | 110.5 | 172.6 |
| Output per acre | (a) | tons | 11.2 | 10.0 | 12.4 | 11.9 | 12.8 |
| Waste | (a) | % | 11.4 | 15.7 | 9.4 | 7.8 | 13.6 |
| Net Price to Growers (b) | | £ per ton | 17.1 | 14.8 | 38.6 | 28.9 | 15.3 |

SOURCES: (a) M.A.F.F. Annual Estimates of Area, Gross Production and Output of Vegetables for Human Consumption (excluding potatoes) in the United Kingdom.

(b) M.A.F.F. Horticultural Statistics.

The average price per ton received was £12.07. Two growers sold their crop to a grader at an average price of £8.17 per ton

so avoiding the cost of grading and sorting the crop. The remainder, all except one of whom graded and sorted the crop, sold at an average price of £13.17 per ton. All growers were paid ex-farm except for one who employed a haulier for delivery to the point of sale at a cost of £3 per ton. Two growers belonged to a group which undertook to grade, store and sell the onions and another belonged to a marketing co-operative.

## 3.2 Variable Costs

A feature of the variable costs is the high level of material costs, particularly seeds and herbicides. Contractors were used by seven growers for drilling. Grading and sorting was carried out largely by casual workers. Where regular labour was used it was charged at 50p. for men and 30p. for women and included in the grading and sorting costs which averaged £2.99 per ton sold. Casual labour was also employed for a number of jobs including hand-weeding, hand-hoeing, picking into trays and bags, and mechanical harvesting. Most of the miscellaneous costs which amounted to nearly £24 per acre were expended on containers of one sort or another and the rest related to the variable costs of drying.

## 3.3 Gross Margin

The average gross margin of £12.89 per acre is very poor especially as the crop makes a heavy demand upon fixed resources. The output, variable costs and gross margin are compared in Table 12 with those achieved for sugar beet, potatoes, and red beet on farms in the East Midlands in 1971, all crops which also incur high fixed costs. The output is lower, and the material costs incurred by

onions are almost double those of sugar beet and red beet and approaching those of potatoes. The cost of casual labour is even higher than red beet although haulage is considerably less. Onions have the heavy additional burden of the cost of containers such as bags, nets, trays, etc. and consequently the total variable costs are well above those of the other three crops.

TABLE 12 OUTPUT, VARIABLE COSTS AND GROSS MARGIN OF ONIONS COMPARED WITH RED BEET, SUGAR BEET AND POTATOES IN 1971

£ per acre

| | Onions | Red Beet (b) | Sugar Beet (a) | Maincrop (a) Potatoes |
|---|---|---|---|---|
| OUTPUT | 113.99 | 134.61 | 130.71 | 168.61 |
| VARIABLE COSTS: | | | | |
| Seeds | 12.69 | 5.45 | 4.17 | 28.81 |
| Fertilisers | 14.19 | 12.24 | 15.49 | 16.50 |
| Sprays | 14.02 | 5.69 | 3.39 | 6.27 |
| Sub Total | 40.90 | 23.38 | 23.05 | 51.58 |
| MARGIN OVER MATERIAL COSTS | 73.09 | 111.23 | 107.66 | 117.03 |
| Casual Labour | 27.98 | 21.54 | 4.01 | 18.40 |
| Haulage | 7.19 | 15.52 | 7.03 | 0.20 |
| Contract | 1.21 | 0.27 | 1.00 | 2.07 |
| Miscellaneous | 23.82 | 2.93 | - | 7.05 |
| Sub Total | 60.20 | 40.26 | 12.04 | 27.72 |
| TOTAL VARIABLE COSTS | 101.10 | 63.64 | 35.09 | 79.30 |
| GROSS MARGIN | 12.89 | 70.97 | 95.62 | 89.31 |
| RANGE | (-) 51.66 to (+)149.28 | 4.7 to 145.1 | 56.81 to 135.06 | 36.77 to 161.29 |

SOURCES: (a) Kerr, H. W. T. and Johnson, H. W. "Farming in the East Midlands - Financial Results" 1971-72, 1973.

(b) Kerr, H. W. T. "Red Beet - A Study of the Production Economics of the 1971 Red Beet Crop in the East Midland Region". Nottingham University 1973.

## 3.4 Assessment of Fixed Costs

An assessment was made of the fixed costs the details of which are shown in Table 13. The assumptions upon which the assessment was based are given beneath the Table. The high level of rent is a relection of the fact that just over 80% of the sample acreage

TABLE 13 GROSS MARGIN, ESTIMATED FIXED COSTS AND NET MARGIN

| | £ per acre |
|---|---|
| GROSS MARGIN | 12.89 |
| FIXED COSTS: | |
| Regular labour | 16.87 |
| Allowance for overhead labour | 5.06 |
| Tractors | 14.12 |
| Share of cost of general machinery | 14.12 |
| Special equipment: Depreciation | 2.79 |
| Repairs | 0.75 |
| Fuel | 0.20 |
| General overheads | 4.00 |
| Rent, including drainage rates | 22.05 |
| TOTAL FIXED COSTS | 79.96 |
| NET MARGIN | (-)67.07 |
| RANGE | (-)142.23 to (+) 48.78 |

BASIS OF ASSESSMENT OF FIXED COSTS

| | |
|---|---|
| Regular Labour: | Men 50p. per hour: Women 30p. per hour |
| Overhead Labour: | Addition of 30% to total direct labour calculated as above. |
| Tractors: | 55p. per hour |
| Tractor Overheads and Share of General Equipment: | 55p. per tractor hour |
| Special Equipment: | Depreciation: Machinery 20% diminishing balance<br>Repairs: Estimate of annual cost by farmer<br>Fuel: Estimate of annual cost by farmer |
| General Overheads: | £4 per acre based on average for Cash Cropping farms in East Midlands Farm Management Survey |
| Rent and Drainage Rates: | Actual or in the case of owner-occupiers raised rental value |

was located in the Holland division of Lincolnshire where land values are higher than in the rest of the Region. The results demonstrate that the gross margin was totally insufficient on average to cover the high level of fixed costs incurred by this crop.

All these results were calculated by dividing the aggregate figures by the total acreage. They exhibit a considerable bias towards the lower end of the performance level because the farm growing the biggest acreage returned a negative gross margin, which was also the lowest in the group. The gross margin calculated by taking the simple average of each grower's gross margin was £42.25 per acre, compared with £12.89 per acre (shown in Tables 10, 12 and 13), demonstrating the bias created by the figure for this one farm. When, however, it was excluded from both calculations, the average gross margin determined from the aggregate of the rest of the sample was £50.86 per acre, close to the simple average of each grower's gross margin of £48.96 per acre, indicating a more normal distribution of performance in the rest of the sample. Although this higher gross margin of around £50 per acre might provide a better indication of the general performance in 1971, it would still have been insufficient to have covered the average fixed costs. Nevertheless, five growers achieved a positive net margin, three of them in excess of £30 per acre. In order to obtain this, a gross output of at least £200 per acre and a gross margin of at least £70 per acre was needed. In general a high output was obtained by achieving sales per acre well above the average, although one successful grower whose sales per acre were close to the average sold at the high average price of £20 per ton on contract for pre-

packing. Poor results were generally due to low output, but in one case, the highest output in the sample (the product of the highest sales per acre and a good price per ton) was negated by exceptionally high variable and fixed costs. In three cases waste in excess of 50% out of store and low prices for that sold resulted in negative gross margins.

A feature of these results was the wide variation about the mean of all the major factors, indicating the risk involved in growing this crop.

## 4. INTRODUCING ONIONS INTO THE ROTATION

In the past onions have been recommended in some instances as a break crop on general arable farms. However, if they are to be grown successfully the farmer must be prepared to devote considerable managerial time and skill to them and to invest in the necessary special equipment. They are not an easy crop to grow: the soils on which they thrive are limited, they are subject to a number of pests and diseases which are not easy to control and as a result there is little flexibility in their placing in the rotation. Special equipment is required for sowing, harvesting, drying, storing and grading; and curing and drying is a particularly skilled job. Details of the special equipment required are given in Table 14 together with the potential seasonal capacity and current (1973) cost. A newly erected special store exclusive of the equipment listed in Table 14, would cost approximately £20-25 per ton stored. The total capital required to introduce a given acreage of onions in specific circumstances can be estimated from this data.

Since harvesting has to be completed by mid-September the regular labour requirements will clash with those of the cereal harvest in most years.

For these reasons, onions should only be considered as a specialist crop, one which provides the opportunity to make use of equipment which may be available on farms growing similar field-scale vegetable crops. Of the farms in the sample only one did not grow sugar beet, potatoes or bulbs. Of the other fourteen growers eight grew sugar beet, potatoes and bulbs; three grew sugar beet

TABLE 14 SPECIALISED MACHINERY AND EQUIPMENT USED IN BULB ONION GROWING: APPROXIMATE CAPACITY AND COST

| Machinery and Equipment | | Potential Capacity under average conditions | Approximate 1973 costs |
|---|---|---|---|
| Seed drills: | 4 unit | 60 acres per season | £202-490 |
| | 6 unit | 90 acres per season | £288-665 |
| Lifter/Windrower | | 75 acres per season | £400 |
| Harvester: | Medium | 30 acres per season | £1,750 |
| | Large | 50 acres per season | £2,800 |
| Elevators: | Length 17' | | £410 |
| | Length 30' | | £748 |
| Toppers: | Helical roller | 1-4 tons/hr | £200-550 |
| | Down draught fan | 3-4 tons/hr | £1,300 |
| Inspection belt: | 10' x 24" | | £200 |
| Sizers: | Reciprocating riddle | 2 tons/hr | £250 |
| | | 4 tons/hr | £350 |
| | Spool | 4 tons/hr | £650 |
| | Diverging belt | 2 tons/hr | £700 |
| | | 4 tons/hr | £900 |
| Fan: | 20,000 cfm (3 phase) | 200 tons | £430 |
| Heaters: | Electric 60 kw[(a)] | 200 tons | £130 |
| | Propane gas burner | 200 tons | £50 |
| | Oil burner with heat exchange unit | 200 tons | £250 |
| Main Tunnel: | Metal, per ft. run | | £9 |
| Lateral ducts: | Metal, per ft. run | | £0.60 |
| | Weld Mesh per ft. run | | £0.25 |
| | Wood, per ft. run | | £0.80 |
| Differential thermostat | | | £40 |
| Dial hygrometer (good quality) | | | £20 |
| Wet and dry bulb thermometer | | | £4 |
| Distant reading thermometer: 8 point | | | £60 |

(a) Electric heaters can be easily automated whereas oil and gas burners cannot.

SOURCE: M.A.F.F. "Dry Bulb Onions" N.A.A.S. Horticultural Enterprises. Booklet No.1 1970 (Revised by D. E. Manns, A.D.A.S. Mechanisation Advisory Officer).

and potatoes; one sugar beet only and two grew bulbs only. Of the seven farms of 100 acres and over only one did not grow sugar beet, potatoes, and bulbs. All the growers used existing buildings as

stores, although one planned to erect a special store the following year and specialised equipment was generally employed for other similar crops grown on the farm so that the average initial investment in equipment purchased specifically for onions amounted to only £20 per acre grown.

## 5. CONCLUSIONS

The acreage of dry bulb onions grown in 1971 was easily the highest for the last ten years and showed an increase of nearly 50% over the previous year. Although average gross yield per acre was high, there was considerable waste in store, the quality of the crop was poor and the average net price per ton received was low so that 1971 was not a good year for the grower (see Table 11). The average results of the growers included in this study were below the average for the country as a whole in respect of output per acre and the price per ton received (see Table 10). In 1972 the acreage sown fell to 12,248 acres, estimated gross yield was about the same as in 1971, but the proportion of wastage was, if anything, greater. However, a world shortage of onions appeared during the year and prices to the grower were very much firmer, particularly towards the end of the season when they reached as much as £100 per ton. Despite rising costs, therefore, the 1972 crop should have paid growers considerably better than the 1971. Sales of 12 tons per acre at £25 per ton, probably about the average price to the grower in 1972, would provide a net margin of over £80 per acre even allowing for a rise of 20% in the average total cost shown in this study. Figures for 1973 suggest that the acreage sown has returned again to the level of 1971[4] and neck rot, which was largely responsible for losses during storage in previous years, has been controlled by the use of Benomyl. It is anticipated that

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(4) M.A.F.F. June 4th Returns (Provisional)

the world shortage will continue at least into 1974 so that prospects for the 1973 crop also look good.

Onions should only be considered as a specialist crop, because of the limited soil types on which they can be grown successfully, their susceptibility to various pests and diseases and the special managerial skills required for the curing, drying and storage processes. The limited resources engaged on this study did not allow a detailed examination of this last aspect of onion production, but the impression was gained that it is here that the grower has the greatest scope for improvement. Enough was known in 1971 about the techniques of curing, drying and storing for growers to take out a product of adequate quality, but it would appear that this knowledge was not being strictly applied. There are indications that some improvement may have been made during the last two seasons assisted now by the availability of a chemical control for neck rot.

The market for fresh onions is inelastic, so the only possibility for expansion of this outlet is in the substitution of imports. This potentiality has been largely realised, but attempts are being made to extend the period of sale by growing autumn-sown onions.(5) The most promising area for expansion lies in the production of onions for processing. There is a rapidly growing demand for onions for canning, which the home producer could meet. The canners are becoming dissatisfied with the commonly grown varieties which tend to brown too easily and they are looking for silverskins. Now that essential facilities for peeling and grading have been provided, silverskins can be produced successfully in

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(5) National Vegetable Research Station, Wellesbourne. Annual Reports, 1971 and 1972.

this country. Another area of rapid expansion is in the use of onions in frozen recipes and for the production of frozen rings. There is also likely to be a steady increase in the demand for pickling onions and the home product could replace onions in brine imported mainly from Poland. Onions are also required for dehydrating. It is unlikely that the homegrown product can ever match the dry matter yield of Middle Eastern onions, which is 50% higher, but rising prices may give opportunities in this market.

The present world shortage of onions may be short-lived, but foreign exchange rates have moved against imports by as much as 25% in the last year. The countries mainly exporting to the U.K. are outside the E.E.C. and the Commonwealth and although the change from the present graduated tariff to the E.E.C. flat rate of 12½% ad valorem represents some increase in overall rate, it is hardly likely to influence the situation. There would, therefore, appear to be long-term opportunities for an expansion of production in the U.K. within the limitations set by the suitability of soil type and rotational restrictions. To realise any potential for expansion, the British grower must achieve a consistently high quality, a requirement which underlines the importance of curing, drying and storing correctly. There is evidence that the home producer is becoming more aware of the importance of quality and he has the advantage over growers in other countries, including E.E.C., of experience in the technique of large-scale production.

There would appear to be scope for an extension of grower co-operation is storing, grading and marketing and, perhaps in the provision of facilities for peeling and preparation for special

outlets. Such a development in conjunction with contracts might assist an orderly expansion of production in line with market requirements as opportunities present themselves.

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