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Potatoes
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Farmers' Report No. 149

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Maincrop Potato Production in Yorkshire 1957/58 and 1958/59

by

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Price Three Shillings

MAINCROP POTATO PRODUCTION IN YORKSHIRE

1957/58 and 1958/59

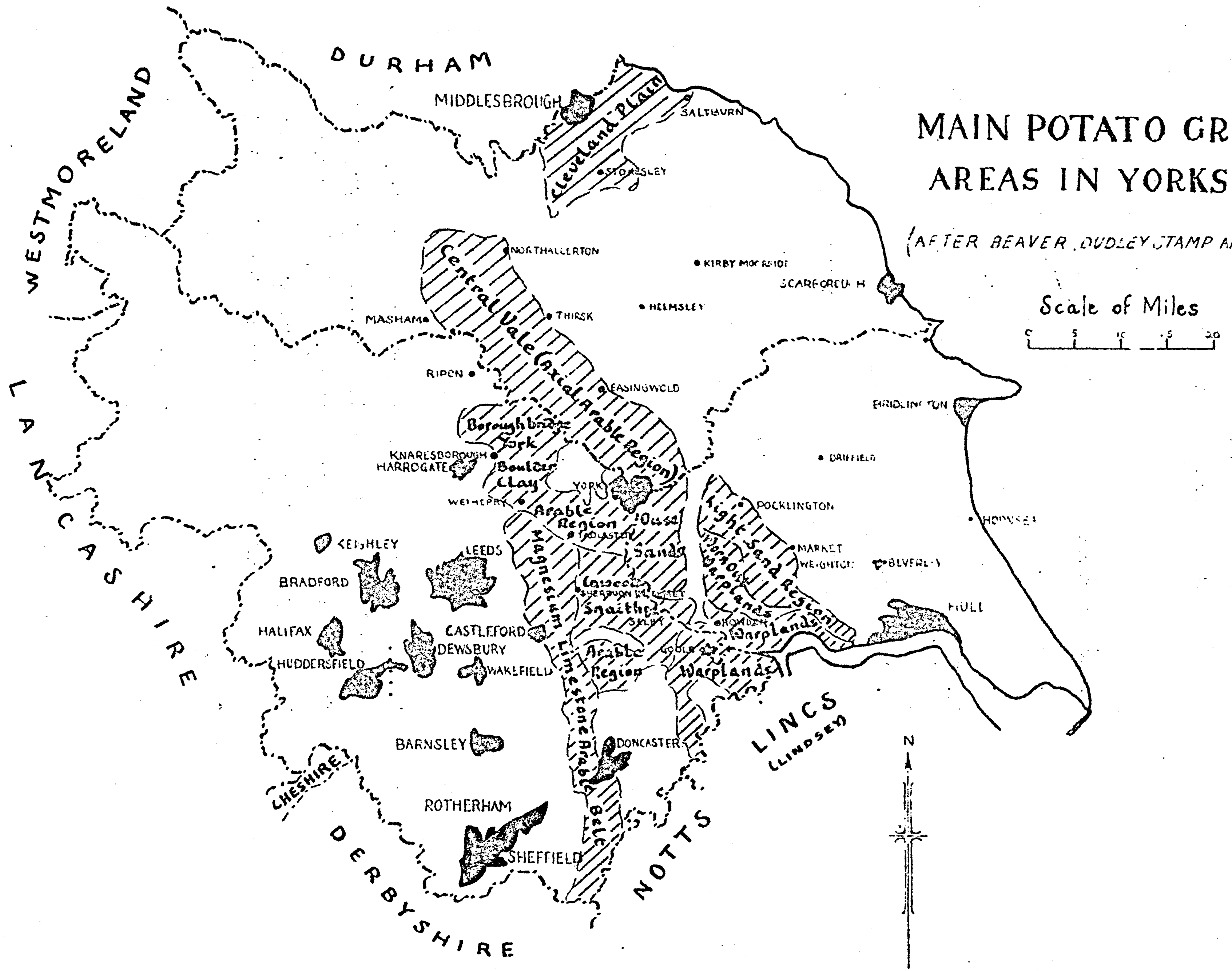
C O N T E N T S

"..... the strongest men and the most beautiful women perhaps in the British dominions..... are generally fed with this root (the potato). No food can afford a more decisive proof of its nourishing quality, or of its being peculiarly suitable to the health of the human constitution."

Adam Smith"The Wealth of Nations"

MAIN POTATO GROWING AREAS IN YORKSHIRE

(AFTER BEAVER, DUDLEY STAMP AND WOOLDRIDGE)



INTRODUCTION

Yorkshire potato growers produce about one seventh of the maincrop potatoes grown in England and Wales. During the two years under review, 1957 and 1958, the average acreage under maincrop varieties in Yorkshire was 64,000 acres. Rather less than half of these, (31,000 acres) were grown in the West Riding and the remainder were divided between the North and East Ridings in roughly equal proportions.

In the West Riding the greater concentration is found on the sandlands west of Selby and on the warplands along the lower courses of the Ouse and Don and, for a short distance, the Trent. (1) The crop is also very important on the narrow magnesium limestone belt which extends from about Bramham southwards to the county boundary and beyond. In the Boroughbridge-York boulder clay region it is less important in the rotation but makes an important contribution to the West Riding total.

In the North Riding potatoes are grown in the Cleveland plain South of Middlesborough in spite of the heavy soil, but are more important in that part of the central vale called by S.W.Wooldridge the "axial arable region", a large area about thirty miles long and eight wide which runs NW-SE and contains a variety of soils derived from sands and gravels of glacial origin. (2) The chief concentration in the East Riding is on the Ouse sands east of Selby and they are also grown to some extent in the Pocklington light sand region. In the last fifteen years or so they have been taken up in other parts of the Riding notably the Wolds.

Potatoes off the magnesium limestone have a characteristic bloom which commands an extra pound or thirty shillings a ton. (After Christmas it is so marked that they are said to look like oranges) Some of these soils are too stony for elevator diggers, however, and others are rather heavy. The warp produces high yields of good quality and the crop keeps well, but cultivations (usually requiring crawlers), and harvesting, can both be very difficult. A cold spring may retard emergence as happened in 1958. The sandlands besides having obvious advantages have the somewhat serious disadvantage that scab is prevalent and excessive shrinkage occurs if the crop is kept late.

The three Ridings show considerable differences in the relative importance of different varieties.(3) First earlies are of little account in the West Riding - the figure for 1957 was only 2.1%. Rather more were grown in the East and North Ridings, the corresponding figures being 7.3% and 11.8% respectively. Second earlies are not grown to any extent in any of the Ridings. Of the maincrop varieties, roughly two acres out of three are under Majestics. The only other varieties grown at all widely in all three Ridings are: Redskin, King Edward, Red King, and Dr.McIntosh. The North Riding differs from the others in having three other varieties of comparable importance: Arran Peak, Arran Consul and Doon Star. Dr.McIntosh is especially popular in the North Riding as are Red King and King Edward in the West Riding. (4)

The records on which this report was based were drawn almost entirely from farms in the Vale of York. Most of the principal potato areas are represented as will be seen from Map 1, but there were no records from the Vale of Pickering, and the Wolds and Cleveland were only represented by one farm each. In all 67 farms participated providing 60 completed records in 1957 and 61 in 1958.

Since a truly random sample is impossible to obtain in an investigation of this kind it may be as well to state the chief bias to which the actual sample is subject. It can be taken that the farms are representative only of moderately large farms on which potatoes are an important enterprise. In the county as a whole producers growing less than 15 acres make up 80% of the total number and, at a rough estimate, are responsible for about 40% of the total production. In the sample on the other hand only about 20% were growing under 15 acres, and the proportion growing more than 30 acres was no less than one third.

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(1) The Land of Britain, pt.46 Yorks (W.R) by S.H.Beavers
(2) The Land of Britain, pt.51 Yorks (N.R) by S.W.Wooldridge
(3) The subsequent figures are from the Potato Marketing Board Variety Statistics
(4) Since this was written the acreages of King Edward and Red King in the West Riding have slumped and in the North Riding even the acreage of Dr.McIntosh has declined. On the other hand the proportion under Majestic has gone up still further. In 1960 the proportions were: East Riding 85%, North Riding 75%, West Riding 86%.

ANALYSIS OF COSTS

The average cost of growing potatoes was estimated to be £98 in 1957 and £104 in 1958. As a first step in analysis the costs are split up in Table 1 into the familiar categories of inputs, and labour and tractor costs taken together are subdivided according to operation.

TABLE.1. AVERAGE COST OF PRODUCTION OF POTATOES IN 1957/58 AND 1958/59 (a)

Year	1957/58	1958/59
No.of Farms	60	61
	£. s. d.	£. s. d.
OPERATIONS		
Applying F.Y.M.	5. 8. 5.	4.16. 6.
Ploughing	2. 2. 7.	2. 4. 9.
Cultivations	1. 7. 9.	1. 1. 9.
Fertilizer Application	10. 5.	9. 5.
Planting	2.15. 3.	2.18. 1.
Inter-Row Cultivations (b)	2.19. 0.	3. 9. 7.
Picking, Loading & Carting	15. 0. 8.	15.15. 8.
Pieing or Storing Indoors	1.11. 1.	1. 6.10.
Sorting	4.17.10.	4.12. 6.
Sundry	14. 8.	1.11. 5.
MATERIALS		
Straw	1. 8. 8.	1. 1. 2.
Seed	19.15. 7.	24.19. 8.
F.Y.M.	13.14. 1.	13.12. 5.
Fertilizer	12.18. 7.	13. 5.10.
Miscellaneous	9. 5.	11. 0.
OTHER COSTS		
P.M.B. Levy	1. 0. 0.	1. 0. 0.
Rent	2.14. 2.	2.15. 0.
Depreciation & Repairs	7. 1. 0.	6.16. 1.
Overheads	9.12. 5.	9.14. 4.
GROSS COST	106. 1. 7.	112. 2. 0.
LESS NET ADJUSTMENT FOR MANURIAL RESIDUES	8. 3. 6.	7.15. 9.
NET COST	97.18. 1.	104. 6. 3.

(a) The type of average used is the simple or unweighted average. That is to say, all farms irrespective of acreage of potatoes grown have been given equal "weight" or importance.

(b) Includes hand hoeing and weeding.

The costs for the two years were very similar but there were some differences. The higher cost of seed in 1958 raised the average by £5 per acre. The cost of spraying was also higher in 1958 - the total spraying bill rose from £175 in 1957 to nearly £3,000 in 1958 - but as those who sprayed were still only a minority (24 out of 61) the average increase from this cause was less than £1 per acre.

The major assumptions were as follows. Tractor work and regular labour have been charged at standard rates. For wheeled tractors the rate was 4/9d per hour and for crawlers 10/- per hour. (1) These are intended to cover running charges and repairs but not the tractor driver's wages. The standard rate for regular labour is based on the statutory minimum but includes allowances for employer's share of stamps, holidays with pay, time lost through sickness and a small amount of overtime. Two wage increases occurred during the period of the costings which necessitated slight alterations to the standard rate. The actual rates used were 3/8d per hour up to the first increase, 3/10d later and 3/11d after the second increase. Casual labour was charged at actual cost including transport and other expenses where applicable.

After looking at several methods of charging farmyard manure it was decided that nothing was to be gained by departing from the customary one of charging it at a nominal price of £1 per ton. (2) Carting and spreading were charged at the estimated cost.

Methods of valuing manurial residues are now simpler than they were, and in the present study the method has been to carry forward one quarter of the cost of compound fertilizer and one third of the cost of farmyard manure including, in the case of the latter, the cost of application. This was done not only for the manures applied to the potato crop but for those applied to the previous crop, hence the term "net adjustment" appearing in Table 1. Potatoes usually followed either a cereal crop or one year seeds but a few crops were after two, three and four year leys. Seeds, and possibly to a greater extent, leys can be expected to contribute organic residues or to benefit soil structure but experimental work has so far failed to provide a basis for valuing them so the rough and ready method was adopted of charging £3 per acre wherever potatoes had been preceded by a grass crop.

Straw for clamps, at any rate in Yorkshire, is always cut by binder often at additional expense. Therefore it seemed unreasonable to value it at less than £5 per ton, and where it had to be purchased the actual price was charged. With indoor stores the position is different. The straw usually consists of medium density bales which after two years are still serviceable as bedding. This was assumed to be worth £3 per ton and this figure was then halved to allow for a two year life.

The charge made for home grown seed has an important bearing on costs. Once grown seed formed the bulk and it was charged at the figure at which it usually changes hands between farmers i.e. £1 per ton above the price of ware, resulting in a price of £13 per ton in 1957 and £24 in 1958. Twice grown seed, which was very small in amount, was charged at £10 per ton in 1957 and £20 in 1958.

Depreciation on machinery and equipment was on the basis of two separate and distinct methods according to type of machine. Anything describable as specialised potato machinery was depreciated individually at a rate appropriate to the machine. Investment on machinery varies from farm to farm and it was hoped that the figure arrived at for the individual farm would reflect the amount of machinery on it. The rate for each type of specialised machine was as follows: planters 10%; pulverizers 10%; potato ploughs 10%; spinners 10%; sorters 10%; elevator diggers 15%; special potato elevators 15%; complete harvesters 20%; indoor stores 8%; chitting equipment 10%; and irrigation equipment 10%. Indoor stores were depreciated on a straight line basis; all other depreciation was on the written down value. (On reflection the depreciation charged on complete harvesters appears too low to cover the high rate of obsolescence of those machines). Repair costs were based on the

(1) Recent work by M.Mathieson (unpublished) indicates that 3/6d per hour for wheeled tractors would have been more in keeping with the facts. If this figure had been used the effect would have been to reduce the average cost by about £2 per acre in both years.

(2) This is approximately the value of the plant nutrients it contains plus a small allowance for the cost of the straw.

farmers estimate for the current year. Depreciation and repairs on the remaining implements e.g. ploughs, harrows, scufflers etc., had necessarily to be on a less detailed basis and the method adopted was that of charging an overall figure of 10s per acre.

There is a common misconception that such expenses as hedge cutting, cleaning ditches out and time lost in wet weather are overlooked in conventional costings. It is admittedly rather difficult to decide how much to allow for these overheads but most costings make some provision for them. In the present study the method was to charge 7s for every £1 spent on manual labour plus 2s per hour of tractor work. Reference to Table 1 will show that this worked out at £9.12.5. per acre in 1957 and £9.14.4. in 1958.

THE RANGE OF COSTS

It is obvious that there must be a range of costs although mention is made all too often of the cost of growing potatoes. The extent of the range and the relative frequency of different costs is best illustrated by a frequency distribution which is provided in Table 2 for each of the two years.

TABLE.2. DISTRIBUTION OF FARMS ACCORDING TO NET COST OF PRODUCTION

Cost per Acre £	1957/58 per cent of all farms	1958/59 per cent of all farms
70-79,	3	3
80-89	29	16
90-99	31	21
100-109	17	29
110-119	10	12
120-129	8	12
130-139	2	5
140 and over	-	2

There was a fair amount of variation in both years. In 1957 the range £80- 109 included over three quarters of the farms whereas in 1958 costs showed a wider "spread" and we have to take the range £80-119 to include the same proportion.

THE ECONOMICS OF USING F.Y.M.

The cost of F.Y.M. including application was nearly £19 per acre but this is reduced to between £12 and £13 when the residual value is taken into account. This figure is largely a notional one but it is probably not unrealistic to assume that on many potato growing farms the production of F.Y.M. involves a good deal of irksome activity if not of actual expense. Handling on the sample farms was less "streamlined" than the one man outfit comprising tractor, front end loader and mechanical spreader, said to cope with 3 tons per hour up to a distance of $\frac{1}{4}$ mile, which is recommended (3). Mechanical loaders were common but not spreaders. The paucity of the latter was due, it would seem, to their high capital cost, liability to breakdown, and to the fact that with a gang of men the job is less tedious by hand. "Hilling" i.e. carting to an intermediate midden was common. The average cost of handling was 5/6d per ton for the simple operation and 8/- when it was hilled but the cost varied tremendously.

It is not surprising, therefore, that the question of dispensing with F.Y.M. should crop up from time to time, and in fact 200 acres (or 12%) of the acreage in the sample were grown without it. A recent report shows that the proportions of potato acreage receiving F.Y.M. varies from 38% to 88% according to region. (4) Lancashire and Yorkshire and the North of England in general are the only regions where the percentage is as high as 88%. Whether it is feasible to cut out F.Y.M. and whether there would be any saving from doing so are exceedingly difficult questions and all that can be done here is to touch on one or two points.

(3) G.B.Wells & J.V.Vinter - Handling Farmyard Manure. Agriculture LXV.9 Dec.1958.

(4) Report on the Survey of Maincrop Potatoes 1958. Potato Marketing Board, Rothamsted Experimental Station and N.I.A.E.

Growing potatoes without F.Y.M. appears to be technically feasible, at least on certain types of soil. On the sample farms crops from different fields were often mixed in the clamp or store so it was not easy to come by yield figures for individual fields, but on six farms where potatoes without F.Y.M. followed leys in 1957, the total yields per acre (arranged in a simple array) were as follows -

TONS PER ACRE

6.0; 7.0; 7.9; 8.0; 9.7; 9.9

Since the average was 8.05 tons yield was not adversely affected so far as one can judge. Jeffery (5) had many more cases for analysis amongst a sample of farms costed in the West Country in 1957. Here, 26 cases covering 325 acres that were grown with artificials alone gave an average yield of 9.0 tons compared with an average of 8.7 tons for a group that received 13 tons of F.Y.M. per acre in addition to fertilisers.

In the majority of cases leys or some form of grass seemed to have been substituted for F.Y.M. Cooke (6) considers this unnecessary. Where the potato crop is preceded by a ley a number of extra costs will be incurred. The extra fertilizer required to replace a moderate dressing of F.Y.M. will cost £4.10s per acre. Wireworm dust may also be required which will cost £2.10s per acre. Rototilling might bring the extra cost up to £10 per acre. Moreover, a 3 or 4 years ley if cut and removed, leaves the land depleted of phosphate and potash we are told, and even continuous grazing causes an apparent loss due to the residues of the ley not becoming immediately available to the following crop. The potash deficiency, which is the more serious, could cost up to £10 or £12 to rectify. Potatoes grown in a stockless system of farming might have to bear part of the cost of an occasional bare fallow or purely recuperative crop. There is small wonder, therefore, that emphasis seems to have shifted to the question of how F.Y.M. can be used to bring about a saving in fertilizer bills.

At least one other point should be considered, however. A stockless rotation would contain a higher proportion of cash crops than normal and as these have consistently shown higher gross profits than have livestock enterprises over a long period, any shift in the direction of the former should tend to increase the overall profit.

CULTIVATIONS - BEFORE AND AFTER PLANTING

The average cost of cultivations carried out before planting was £3.10s per acre in 1957 and a few shillings less in 1958. Where F.Y.M. was applied "shelling" followed by deep ploughing was invariably the rule. This stage is not one at which economies can easily be made. One farmer decided that he could save on his late Spring ploughing but the general direction is towards more thorough and consequently more expensive cultivations e.g. land is being ploughed deeper (7) and rototillers are being used more often.

After planting the number of cultivations was usually seven or eight, the cost being about half a crown an acre for "harrowing down" and five shillings for earthing up. While there is little scope for saving here, either, the way in which the operations are carried out can have an important bearing on returns. The idea uppermost in farmers' minds is probably the control of weeds but recent experimental work has shown that the depth of soil covering a tuber influences its size. (8) A deep covering led to an appreciable increase in ware percentage in King Edward. The final earthing up in 1958 was carried out under great difficulties which resulted in damage to haulms and smearing of the soil.

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(5) R.R.Jeffery Potato Costs 1957 Bristol University N/S No.88
(6) G.W.Cooke Fertilizer Crop Production and Soil Fertility Journal of the Farmers' Club Pt.5 1959.
(7) Report on the Survey of Maincrop Potatoes 1958 op.cit.
(8) J.D.Ivins and V.J.Montague: Note on the Influence of Depth of soil covering and Parent Tuber on the Development and Yield of the Potato Plant. Empire Jour:of Expt.Agric. Vol.XXVI No.101 p.34.

The average total cost for inter-row cultivations was £3 in 1957 and £3.10s in 1958 but about one third of it was for hand hoeing. The aim of most farmers is to eliminate hand hoeing though some say they "like to hand hoe". The following table shows that although in some cases it has been eliminated or reduced to a perfunctory operation (known as "walking over"), in others it is still of importance.

TABLE.3. DISTRIBUTION OF FARMS ACCORDING TO TIME SPENT ON HAND HOEING

Hours per acre		Nil	< 2	2-8	8-12	> 12
Percentage of farms	1957	22(a)	8	43	17	10
	1958	28	8	33	21	10

(a) It was necessary to do a small amount of hand weeding late in the season on about half of these.

The popularity of chemical methods of weed control in other crops prompts the question as to whether they have any application in potato growing. Two farmers had used MCPA but this was purely an emergency measure when wet conditions made cultivations impossible. However, experiments have been described in which potatoes were planted, ridged to final contours and sprayed once with a DNBB/TCA mixture at about the time of emergence and the result was virtually a weed free crop. (9) This sounds promising but the spray is not cheap and therefore any practical application in the near future is likely to be with the object of reducing clods (thought to be caused largely by the passage of tractors) rather than to save cost.

PLANTERS

The change from hand to machine planting started before the war but was particularly rapid between 1946 and 1954 when there was a seven fold increase in the number of machines in Yorkshire. In 1957 only 5 out of 60 farms in the sample planted by hand and in 1958 there were only 3 out of 61. Incidentally, those who plant by hand are not all small growers - there are some large growers who do it to simplify the planting of chitted seed or to employ casual labour it is desired to keep. Just over 80% of farmers possessed machines or had a share in one, while about 10% hired machines or had their crop planted by contract.

Looked at in the simplest of accounting terms, machine planting appears to have brought about a small saving in planting costs. The average cost of 20 cases in 1957 where a 2 row dropper type was used was £2.10s per acre to which we ought to add about 2s.6d for depreciation. The average of the few that were hand planted was £3.16s but there was one exceptionally high cost and a figure of £3.3s per acre might be more typical. Hence there would appear to be a saving of about 10s per acre. The 3 row machines had lower direct costs (about £2.5s) but were subject to more depreciation and the saving was rather less.

But for a correct appreciation other factors have to be taken into account. Machine planting tends to give higher yields, an observation first made by farmers and since confirmed by experimental work, but this is only true if the conflicting factor of fertilizer placement can be left out of account. Where no fertilizer was given in either case experiments showed that the yield after machine planting was nearly $\frac{3}{4}$ ton higher than after hand planting. (10) With the majority of machines in present use, however, the fertilizer has to be broadcast and worked in, which puts them at a disadvantage with any method of planting that allows the fertilizer to be "placed", and this latter category includes hand planting. In other experiments machine planting accompanied by the broadcasting of fertilizer on the flat resulted in a loss in yield of 1 ton per acre compared with hand planting where the fertilizer had been placed by broadcasting it over the ridges. (11)

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(9) I.M.Robertson — The Use of Herbicidal Sprays in the Potato Crop. Jour: of Agric.Engineering. Vol.5. No.1. 1956.

(10) G.V.Dyke — Hand and Machine Planting of Potatoes. Experimental Husbandry No.3.

(11) G.W.Cooke, M.V.Jackson, and F.V.Widdowson. Jour: of Agric. Sci. Vol. XLIV, 1954, 3, 327.

The absence of efficient placement therefore more than outweighs the intrinsic advantage of machine planting. What happens in practice is probably that farmers are having to apply 50 to 100% more fertilizer than would be required to achieve the same yield if the fertilizer were placed. Technical developments now make it possible to get the best of both worlds because fertilizer placement can now be carried out by mechanical planters. The effect should be to bring about a saving in fertilizer costs of up to £7.10s per acre in extreme cases. At the time of the survey the sample farms had been little affected by this development - out of 47 planters in use only 2 were adapted for fertilizer placement and one of them was not being used for that purpose.

All planters used until recently have suffered from a low rate of output which does not greatly exceed that of hand planting. The simple 2 row type planted on an average only 2.8 acres per day or .9 acres per man (including the tractor driver). The output of the 3 row machines was more variable but the average was 4.8 acres per day or 1.2 acres per man. The semi-automatic planter on which the operators merely fill the cups that have failed to fill automatically has been on the market for several years. It is having teething troubles but operation is helped if the seed can be graded, and when working properly they are capable of 2 acres per man per day. The fully automatic planter, which, incidentally, applies the fertilizer as well comprises a one man outfit and has an output of 8 acres per day.

Since the cost of planting is quite small (Table 1 shows it to have £2.17s per acre on an average) the most spectacular effect of the new planters will presumably be in ironing out any peak in labour requirements caused by planting and, of course, in saving fertilizer.

S E E D

Table 1 shows that the cost of seed was £20 in 1957 and £25 in 1958 but a word of warning is necessary in interpreting these figures. The home grown seed, of which a good deal was used especially in 1958, was charged at opportunity cost i.e. at the price that could have been obtained for it had it been offered for sale. In 1957 the opportunity cost of £13 per ton was not much different from the cost of production, but in charging home grown seed at £24 in 1958 a big departure from cost of production was made with the result that the 1958 figures can be said to give an inflated idea of the outlay.

The seed rate varies from farm to farm, and also with kind of seed as well as with other factors. In the following table average seed rates for the main classes of seed in each year are set out.

TABLE.4. SEED RATES FOR THE MAIN CLASSES OF SEED

	1957 cwt		1958 cwt	
Certified	23.7	(53)	23.0	(44)
Certified (3rds)	10.7	(2)	10.3	(4)
Once Grown(Home Produced)	20.7	(41)	19.3	(54)
Once Grown (Purchased)	21.6	(9)	20.1	(8)
Twice Grown	19.6	(2)	17.7	(5)

Note: Figures in brackets are the numbers of cases going to form each average.

The differences are not statistically significant but the rates are broadly in line with those found by others. Surveys have shown that seed rates in Yorkshire are several cwt per acre higher than the average rate derived from the main potato growing areas. For the latter, Boyd and Lessells (12) quote averages of 16.8 cwt per acre for once grown seed and 19.1 cwt for certified Scotch. Assuming 28" ridges and a 14" planting distance the Yorkshire rates imply a population of 16,000 plants per acre and a sett size of 2.2 oz for once grown seed and 2.6 oz for certified seed. Some samples of Scotch seed were very large, which was probably why some of the extremely high seed rates (in the region of 30 cwt per acre) occurred.

(12) D.A.Boyd and W.J.Lessels "The Effect of Seed Rate on the Yield of Potatoes, Jour.of Agric.Sci. Vol. XLIV.1954. 4, 465.

The majority of commercial growers in Yorkshire use part certified seed and part once grown. In addition a small amount of once grown seed changes hands locally and a small amount of twice grown seed is used. The following table shows what proportion of the potato acreage on the sample farms was planted with each kind of seed.

TABLE.5. PROPORTION OF POTATO ACREAGE PLANTED WITH EACH KIND OF SEED.

	1957 %	1958 %
Certified (a)	61	32
Once Grown (Purchased)	3	2
Once Grown (Home Produced)	35	64
Twice Grown	1	2

(a) includes a relatively small acreage with Irish, Wold, and Northumbrian, also the acreage planted with certified 3rds.

The most striking feature of the table is, of course, the big difference between the two years in the proportions of certified and once grown seed. If at all typical of other districts it would appear to cast doubt on the practice of obtaining estimates of the proportion of certified seed used on farms from a single year's figures. The reason for this difference is not far to seek. In the Spring of 1956 certified seed was cheap at £21 and farmers planted a big proportion of their acreage with it - 11 farmers out of 60 using 100% certified. In the back end of 1957 seed was costing £22 to £24 per ton but later the price rose and many had to pay up to £35 per ton. The high proportion of certified seed planted in the previous year combined with the use of bigger riddles than those prescribed enabled farmers to take out enough seed to plant nearly two thirds of the 1958 crop. The number planting 100% certified seed went down to 2 out of 61 in 1958.

The high cost of transporting seed from Scotland has stimulated research into the cause of deterioration and given rise to the hope that the life of certified seed might be prolonged. Crops grown from certified seed normally contain few infected plants and therefore by spraying with DDT it is possible to control the aphid carriers and thus indirectly restrict the spread of infection. Four or five sprayings at fortnightly intervals, which can be carried out with a low volume sprayer, are sufficient, so it is within the capacity of the ordinary farmer. (13) Several alternatives are open to the farmer and these have been examined by Broadbent (14) with a view to measuring the likely saving. On the assumption that certified seed would be bought every fourth year and that seed grown from it would be used in the intervening years (with due allowance for the cost of spraying treatment outlined above) the saving compared with the usual practice of keeping seed for two years was: £2 per acre when the seed was a by-product of the ware crop and 10s per acre when a small acreage was set aside for growing seed. Farmers will probably not consider these savings worth the extra trouble involved but there may be dividends of another kind arising from the greater degree of control it confers e.g. at present there are big losses from dry rot in bought seed and these might be reduced. Broadbent's advice to farmers to learn the symptoms of leaf roll and rugose mosaic is worth following even for those who keep their seed for a shorter period because even once grown seed may be unfit to plant.

The very wide range of seed rates found in practice raises the question whether some farmers might not be able to improve their returns by altering their seed rate. This is a problem on which a good deal of scientific work has been done, some of which will be touched upon when the subject is dealt with in a later section.

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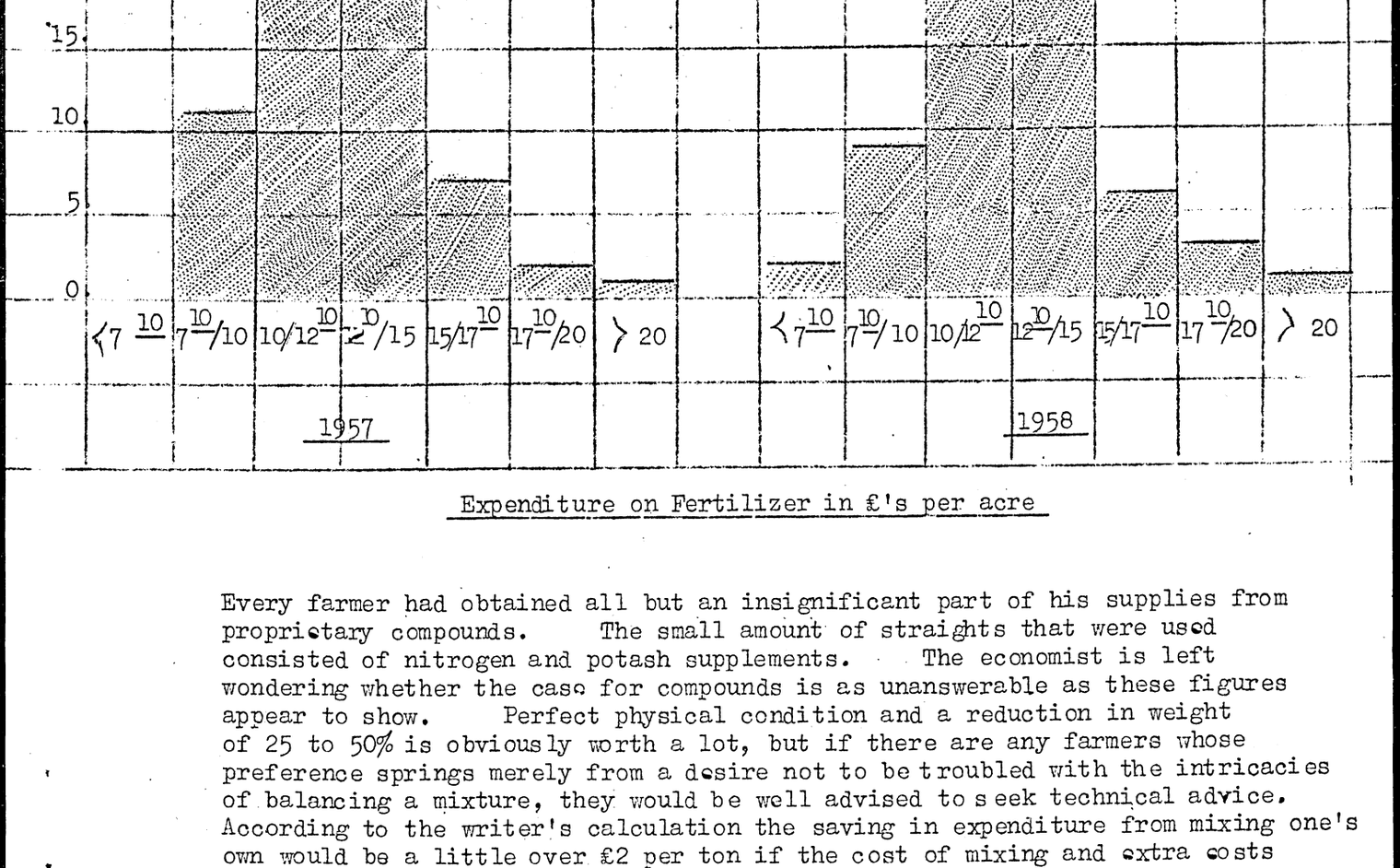
(13) L.Broadbent Control of Virus Spread in Potato Crops Outlook on Agriculture Vol.II No.1.

(14) L.Broadbent, P.E.Burt, J.S.Nix. The Cost of Using Insecticides to Maintain the Health of Potato Seed in England and Wales. N.A.A.S. Quarterly Review 38. Winter 1957.

FERTILIZER

The amount spent on fertilizer averaged £12.10s per acre in both years. (The apparent discrepancy between this figure and those given in Table 1 for fertilizer expenditure is due to the fact that the latter include Aldrin whilst the former figure does not). The average figure conceals a wide range of expenditure which the following diagram attempts to show.

Fig.1.



Expenditure on Fertilizer in £'s per acre

Every farmer had obtained all but an insignificant part of his supplies from proprietary compounds. The small amount of straights that were used consisted of nitrogen and potash supplements. The economist is left wondering whether the case for compounds is as unanswerable as these figures appear to show. Perfect physical condition and a reduction in weight of 25 to 50% is obviously worth a lot, but if there are any farmers whose preference springs merely from a desire not to be troubled with the intricacies of balancing a mixture, they would be well advised to seek technical advice. According to the writer's calculation the saving in expenditure from mixing one's own would be a little over £2 per ton if the cost of mixing and extra costs arising from the greater bulk are ignored.

The sixty or so farms in the sample bought between them thirteen different brands of fertilizer. There is thus a wide choice and it should be possible to make some small economies by buying in the cheapest market but only if a proper assessment is made of the relative worth of different brands on the basis of their plant nutrient content. (15)

HARVESTING

As is well known, harvesting is the most expensive operation and Table 1 shows that it cost between £15 and £16 per acre or about one seventh of the total cost.

The following table shows the relative importance of the different types of machine used in harvesting judged by the extent to which they were responsible for getting up the crop on 55 farms for which two years records were available. (14) The results for the two years were very similar so the average has been taken.

(15) Methods of assessing the value of fertilizers are dealt with in the M.A.F.F. publication "Manures & Fertilizers" Bulletin No.36.

(16) The fact that growers often use more than one kind of machine rules out any straightforward calculation. Where more than one machine was used each machine was reckoned as a fraction of unity, the fraction depending on the proportion of the farm acreage taken up by it.

TABLE 6. RELATIVE IMPORTANCE OF THE DIFFERENT TYPES OF HARVESTER

Type	Number	Percentage
Spinner	31.3	57.0
Elevator Digger - 1 row	13.7	24.5
Elevator Digger - 2 row	2.1	4.0
Complete Harvester	4.3	8.0
Others	3.6	6.5
	55.0	100.0

The elevator digger, which, incidentally, appears to have been invented in 1852, preceding the earliest spinner by three years would be the preference of most farmers but for its being so easily put out of action. The advantages it has over the spinner include the higher rate of picking that follows as a result of the tubers being left in a narrow band and the smaller amount of damage (except under the rather special circumstances when the soil is too dry and friable to protect the tubers.) It also introduces greater flexibility into picking and loading because it is able to work along closely adjacent rows. A 50% increase in the picking rate is sometimes quoted but the few farmers who ventured an opinion considered that it was about one-sixth more than with a spinner.

To be set against these advantages are several disadvantages, in addition to the principal one that it will often be impossible to use the machine. It will be more expensive to buy and maintain than a spinner. Depreciation, roughly estimated on a ten year life and an assumed yearly acreage of 20 acres will be about £1 per acre, and repairs, owing to the rapid rate of wear of the web and its bearings will not be less than £1 per acre. Preharvesting operation may be necessary to remove haulm or chick weed. The two years under review were both bad from this point of view - in 1957 one third of the growers used some method of removing or destroying haulms and in 1958 the proportion was higher. In both years the majority of those doing this were users of either elevator diggers or complete harvesters. The cost ranged from a few shillings per acre where it was done by harrowing to £4 per acre for contract spraying with sulphuric acid. An extra cost of £4 to £5 per acre is therefore not too much to budget for especially if the acreage is smaller than that assumed above. Nevertheless, owing to the manifold advantages of an elevator digger this sum will almost certainly be recouped in one way or another, providing soil conditions do not impose a serious restriction on its use.

The modern spinner is undoubtedly an efficient implement due in part to the fact that it combs the ridge instead of taking up the whole weight of soil. Depreciation calculated on the same basis as that for the elevator digger is 10s to 15s per acre and repairs should not amount to more than 5s per acre. The tines can be counted upon to deal with the haulms. Unfortunately damage to tubers is heavy and there were many complaints on this score. (17)

"In studying the effect of different systems of harvesting on c sts it was found that nearly 90% of the farms could be classified into one or other of four groups. On the remaining farms, seven in number, the pickers were all on piece rates but in respect of the methods used /the farms were very different, so it was decided to discard them. The distinguishing features of the four main groups are given below.

Group A. Farms on which complete harvesters were used.

Group B. Picking done by migrant piece workers who loaded the potatoes into carts or trailers moving alongside. Payment was at the rate of so much per acre.

Group C. Picking done by local labour, mainly women, and paid for at hourly rates. Loading was done simultaneously as in B but was performed by regular men.

Group D. Pickers worked in stints, two usually sharing a stint. They emptied into hampers arranged across the field from which the potatoes were collected periodically by a small team of regular men accompanied by a tractor and trailer.

(17) A technical bulletin (MAFF. FML.9) states that when working in heavy wet soil damage can be reduced if the rear edge of the share is altered from its normal position close to the points of the digging tines, to a position 1"-2" away.

Note: In groups B,C and D horses and carts were responsible for some of the haulage.
The results of the analysis, which was carried out on the 1957 data only, are presented in Table 7.

TABLE.7. COMPARATIVE COSTS OF POTATO HARVESTING ON FOUR GROUPS OF FARMS (a)

per farm

	Group A	Group B	Group C	Group D
	T. C.	T. C.	T. C.	T. C.
Yield of Crop	8.19.	8. 1.	8. 5.	8. 0.
No.of Farms	7	19	23	5
	£. s. d.	£. s. d.	£. s. d.	£. s. d.
Pre-Harvesting Operations	6. 0.	7. 0.	4. 0.	-
Spinning-out	2.18. 0.	2. 5. 0.		1.11. 0.
Picking	2.18.0.(b)		14.12. 0.	8.14. 0.
Loading	-	10. 7. 0.		4. 3. 0.
Carting	5.17. 0.	4.13. 0.		
Depreciation & Repairs(c)	5.10. 0.	16. 0.	15. 0.	6. 0.
Hampers	-	-	-	15. 0.
Total	17. 9. 0.	18. 8. 0.	15.11. 0.	15. 9. 0.

(a) Range of operations covered is from pre-treatment(haulm removal etc) to reception at clamp or store.
(b) In this case "picking off".
(c) Excludes depreciation and repairs on machinery other than the actual harvester.

Comparison of the totals suggests that the system based on pieceworkers emptying their baskets directly into trailers is the most expensive, followed fairly closely by the method of lifting by complete harvester. Where pickers employed on time rates picked into accompanying trailers or worked in stints, the costs were in both cases appreciably lower than for the first two methods. Picking in stints, because of its obvious economies, might have been expected to show up even better. The reason it did not do so is due,partly to the fact that 3 out of the 5 farms were on warpland where conditions were especially difficult,and partly to the very high carting costs on one farm which raised the average quite considerably.

A truer assessment of the relative merits of the different systems is possible if we also take into account several other features in which they differ. The following table provides additional information and makes such a comparison possible.

Table 8. COMPARISON BETWEEN GROUPS A,B,C and D ON THE BASIS OF THREE NON-COST FEATURES

	Group A	Group B	Group C	Group D
No.of Pickers (Range)	1-5	3-6	4-12	10-19
Average Acreage Lifted(per farm)	21	29½	18	34
Rate of Picking (Acres per Day)	1.3	1.7	1.3	2.3

The picture given of the complete harvester is of extensive saving in picking costs which is, however, cancelled out by increases in other costs. Higher costs under the heading of "spinning-out" (actually the cost of operating the tractor) and "carting" arise partly from the slow speed of travel and partly because progress if often interrupted for technical reasons. (18) The acreage lifted per day and per season are modest by comparison with methods B and D though comparable with C, but are subject to big variation. Thus the average daily rate varied from 1 to 2 2/3 acres and the acreage lifted in the season from 11 acres to 49 acres. The latter figure was of course only achieved by starting in August on second earlies. Spectacular performances are possible for short periods (3 acres or more per day with not more than 4 or 5 pickers-off), but too much weight should not be given to these. The case for a complete harvester rests on the reduction in labour, which usually means that regular labour will suffice, and this can be achieved without any increase in total harvesting costs providing the acreage grown is not too small and the soil not of the type that would impede an ordinary elevator digger.

The figures for group B confirm the view held by many farmers, that the system employed is expensive but has several big advantages. Lifting is done speedily due to the high rate of individual effort and to somewhat lavish use of haulage. The need for supervision is minimal and the small number of pickers aids organisation. The method of payment takes away any incentive the spinner-man might otherwise have to fill in any spare time on picking or loading but the overall effect of this is probably small. There was a higher proportion of elevator diggers at work than in groups C and D, again a factor probably not unconnected with the method of payment. In fairness it should be added that in a season like 1957, when the conditions for the potato harvest are reasonably good, the ease of picking tends to increase the differential between piece rates and time rates.

The low average cost shown by farms in group C is probably due mainly to the fact that women pickers taken on individually and working only spasmodically are not able to command such high rates of payment as workers in gangs. The small proportion of elevator diggers used (less than one third) may also have contributed. Labour of this kind has many disadvantages but by adopting a flexible system and providing regular men to do the heaviest work, the difficulties are largely overcome. It is the method that suited the greatest number of farmers but the acreage lifted in the season came out lowest and this is no accident. About 8 pickers is the maximum for smooth working and any more are an embarrassment making it necessary to split them into two gangs and bring in another tractor and trailer. Spinner men and those carting and teaming often combined other jobs with their main one which, incidentally, made it impossible to give separate figures for the different operations and is the reason why they are linked together in table 7.

The stint method used by the farmers in group D has a lot to recommend it. It was the most rapid and it enabled some large acreages to be dealt with in a season. As we have seen above, it was one of the least expensive and if conditions had been more uniform might have shown a bigger margin. Spinners were used exclusively and the relatively low figure for spinning-out almost certainly reflects a genuine economy in this operation. Not surprisingly it required the largest number of pickers and, what is not obvious from the tables, a minimum number of about a dozen before it can be used at all. The method of picking in stints is not popular with pickers, on the whole.

(18) This appears to be due to the very fine margin within which the share has to work. West states, "It should run just below the lowest tuber in the ridge. If it is too deep it lifts soil that frequently breaks up into clods and if too shallow it cuts through the tubers."
Agricultural Mechanization. Potato Harvesting. U.N. E.C.E. 1960. AGRI/MECH/15.

3.
YIELDS, RETURNS & MARGINS: UNCERTAINTY

The weather was extremely unfavourable to the potato crop in both years, though in different ways. Absence of frost during the previous winter made cultivations difficult in the spring of 1957 and many crops were planted late or under poor conditions especially on the heavier soils. For a long time drought and easterly winds checked growth, which was further retarded by night frosts, and blackening occurred as late as June. (1) May was sunny and June brilliantly so. In the latter month rainfall was average but fell during thunderstorms. In July the weather changed, becoming unsettled and showery and continued like this throughout August and September. This resulted in a certain amount of blight in some areas but in others the crop was able to make up a good deal of the growth that had been missed earlier.

In 1958 there were hard frosts in January and February, and whilst it was a late spring the condition of the seedbeds was good. However, low temperatures delayed emergence and June brought heavy thunderstorms which caused floods and some of the farms in the sample were affected, disastrously. Blight warnings were given as early as June. July, August and September were all wet months and the rainfall for the year proved to be 3½ inches above normal. There was blight in all areas by July and most crops had begun to die off in August. (2) The prolonged rain affected the growth of crops on all but the most free-draining soils.

Fortunately the weather improved for the harvest in both years, and the crop kept reasonably well on most farms, but yields suffered. In the following table the average per acre tonnage of ware, seed and chats is given for the two years.

	1957		1958	
	T. C.	%	T. C.	%
Ware	6.15¾	84.0	6.15	86.5
Seed	18¾	11.5	.14	9.0
Chats	7	4.5	. 7	4.5
Total	8. 1½	100.0	7.16	100.0

It is not possible to say by how much the yield was depressed in these two years on the costed farms. However, Ministry of Agriculture figures, which represent total yield and include earlies as well as maincrop, do enable a comparison to be made with previous years. In 1957 the average for the country as a whole was 7.1 tons per acre which was 0.8 tons below the average for the previous five years. The previous year's average had been 8.4 tons. In 1958 the yield at only 6.9 tons was even lower than in 1957.

In both years there was a big range in yield from farm to farm and this was more pronounced in 1958 than in 1957. The 1958 floods reduced some yields to a level lower than anything that had occurred in 1957 but at the same time there were a few crops that seemed to suffer hardly at all. The farms with the highest yields were about equally divided between the three Ridings but it was noticeable that they were all on free draining soil. Detailed figures showing the extent of the variation in yield are given below.

TABLE. 9. Distribution of Farms According to Total Yield per Acre

Tons	1957	1958
	%	%
Less than 5	-	10
5 - 6	3	10
6 - 7	17	11
7 - 8	30	21
8 - 9	27	26
9 -10	15	7
Over 10	8	15

(1) Yorkshire Crops in 1957. T.E.Miller Jour:of Yorks Agric.Society, Vol.109 (1958)

(2) Yorkshire Crops in 1958. T.E.Miller Jour: of Yorks Agric.Society, Vol.110 (1959)

Since returns are so much determined by national conditions of supply which in turn are the outcome of yield and acreage variations, a brief comment on this aspect is called for. The total acreage of potatoes in Great Britain in 1957 was 709,000, a drop of 11% on the previous year and the lowest for many years. The cause, we may surmise, was partly the difficulty of disposing of the 1956 crop and the adverse conditions at planting time. In 1957 prices were quite favourable but this did not lead to any large increase in plantings in 1958 - the actual figure was 723,000, an increase of 2%. Supplies might have been adequate, however, but for the exceptional weather conditions just described, and the resulting low yield.

The course of prices during these two years, whilst not enabling any clear cut conclusions to be drawn, is interesting. The 1957 crop of earlies was cleared normally and maincrops were being sold at £14.10s in September with the demand good. (3) They rose during October to £17.5s and a few growers who were selling out of the field probably made as much as if they had sold at any time during the next four months, bearing in mind that losses in weight are at a minimum at this time. By November prices had reached £18.10s per ton but they remained more or less at that figure until March, by which time all but one or two growers in the sample had sold their stocks. Towards the end of March there was a sharp rise to £25. At the beginning of April prices had got to £30 and apart from a slight recession at the end of April, remained at that level until the end of the season. The average price received by farmers in the sample was £18.19s.

During the 1958/59 season prices followed a more regular pattern except for a dramatic fall at the end. Through most of September prices were already £16 or £17 and towards the end of the month there were storms in the South of England which interrupted harvesting and sent prices up by several pounds. By the time harvesting was under way prices in Yorkshire were up to £24. During the course of the winter prices kept remarkably steady in spite of imports; the highest figure was about £26 which was reached in February and again in April. Owing to a freakish combination of circumstances the April rise was the prelude to a sudden steep fall to about £17. There was a slight recovery towards the end of the season but most of the crop that had not been sold at the high prices were sold at £17 or below. Many of the growers in the sample had kept back a small proportion of their crop, no doubt anticipating an end of season rise as in the previous two years, which together with early selling explains why the average price obtained did not work out at more than £22.18 per ton. The break in prices was attributed to the early warm weather which coincided with heavy shipments of early potatoes at comparatively low prices. The Potato Marketing Board thought that farmers had accentuated the fall by being too anxious to market.

Sales averaged £134 per acre for the 1957 crop and £158 for the 1958 crop. Returns include not only sales but allowances for potatoes (seed and chats) used on the farm. In the following table average returns are given for each of the years, together with the familiar frequency distribution.

TABLE.10. DISTRIBUTION OF FARMS ACCORDING TO PER ACRE RETURNS

£'s	1957	1958
	%	%
Less than 100	-	7
100 - 125	18	15
125 - 150	36	5
150 - 175	33	16
175 - 200	10	31
200 - 225	3	20
more than 225	-	6
Average Return	£148	£171

The very high returns naturally only came with high yields - the 6% of farms showing returns of over £225 in 1958 averaged 11 tons 8 cwt of total yield and the 20% in the next group had an average yield of 9 tons 9 cwt. In 1958 it was sufficient in the main to have a high yield to secure high returns and it was only by selling very early or very late that the advantage could be thrown away. In 1957, on the other hand, the highest returns were only achieved by a combination of high yields and a favourable selling time, and even then the level reached was lower.

(3) Report on the operation of the Potato Marketing Scheme. This figure and subsequent ones refer to Majestics quoted at Doncaster.

The difference between costs and returns gives what is usually referred to as the margin. The following table shows the average margin and the amount of variation using the same form of presentation as for yields and returns.

TABLE.11. DISTRIBUTION OF FARMS ACCORDING TO MARGIN PER ACRE

£'s	1957	1958
	%	%
Less than 0	-	5
0 - 25	17	15
25 - 50	35	16
50 - 75	35	18
75 -100	10	23
100 -125	3	18
Over 125	-	5
Average	£50	£67

The average margin for 1957 is fairly representative of the position in that year because a big proportion of the results were somewhere near it but the results in 1958 showed big differences between individual farms and hence the average for that year does not do more than give a very crude indication of the situation as a whole. In particular, it conceals the fact that about one farmer in five either had no margin at all or one of not more than £25 per acre.

UNCERTAINTY

This section would be incomplete without some mention of the part played by uncertainty. This is nowhere more evident than in yields. C.J.Black (4) has examined the yields on 31 Yorkshire farms for which 5 year records were available and only on five farms were they consistently high. Statistical analysis revealed that 49% of the variation could be ascribed to season and 20% to differences between farms . (The remaining 31% is made up of what is usually called the random element). The 20% of variation found between farms will include both the effect of soil, situation etc and the effect of management. The ability of management to influence yields would thus seem to be small compared with the effect of the numerous other factors. (5) This would explain why farmers sometimes ask one how to make sure of a good crop but, like the jesting Pilate, do not wait for an answer.

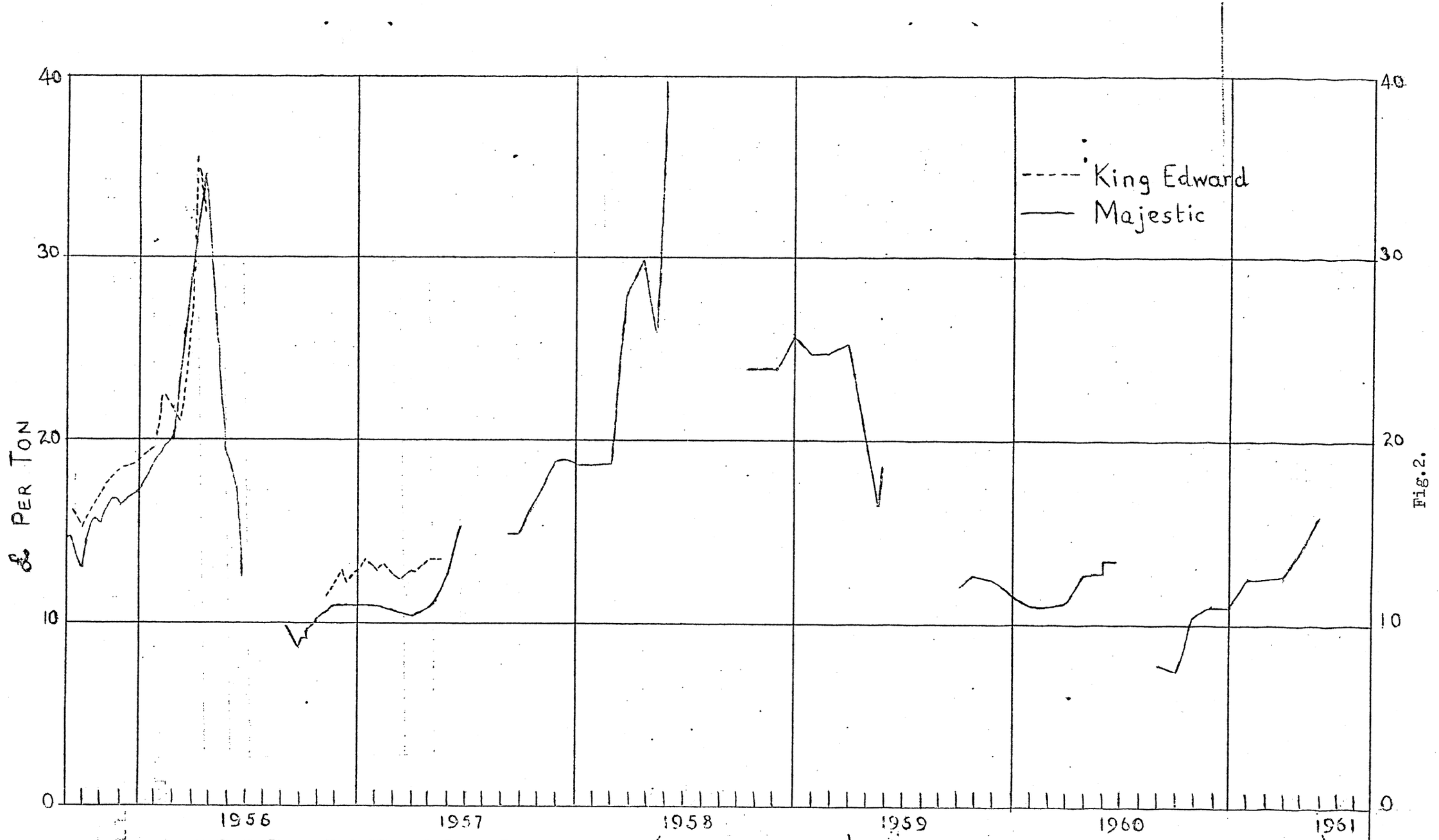
Probably few realise the full extent of the variation in potato prices. In fig.2 prices have been plotted for maincrop potatoes for the period from the resuscitation of the Potato Marketing Board up to the present time. Virtually, there have been only two types of season, those of high prices and those of low prices, but during the course of a season there may be a good deal of uncertainty as to prices in the immediate future. Two out of the three high price seasons have ended with a sudden drop in prices. In 1955/56 and 1957/58 prices climbed gradually but in 1958/59 a high level was reached at harvest and this was maintained with great steadiness throughout the season. In September 1959 it was thought that the crop was below normal but it turned out to be well above average and produced half a million tons of surplus with the usual effect on prices.

When a national surplus has occurred many farmers have had to depend for a substantial part of their remuneration on the guarantee arrangements. This was unforeseen by the Board, who believed that the main purpose of the guarantee would be to help producers "having a marginal surplus after the sale of the bulk of their crop at higher prices" .(6) The way on which the guarantee operates is therefore all important and it is necessary to realise

(4) C.J.Black Unpublished work

(5) It would seem, however, that included in the random element are various effects which, as technical efficiency improves, can be expected to come gradually within the sphere of management.

(6) Report on the Operation of the Potato Marketing Board year ended 30th June 1956.



MAINCROP POTATO PRICES (PRODUCER'S PRICES AT DONCASTER)

Sources: Potato Marketing Board, & Farming Press

Fig.2.

that the actual price received by individual farmers does not bear a very close relationship to the guaranteed price of the February Price Review. Returns tend to get whittled down in various ways. Substandard potatoes ceased to be eligible for the guarantee in 1957. Larger riddle sizes (and now the top riddle) reduce the amount that can be marketed; farmers have usually found it advantageous to buy the crop back even when they have had no opportunity for using it; often for rather obscure reasons they have unloaded potatoes onto the market at less than the guaranteed price.

Fluctuations in yields and prices combine to produce the central paradox of potato growing that the best financial results are obtained when yields are relatively poor, for when there is so little elasticity in demand as is shown for potatoes, prices are driven up sometimes to extraordinary heights. As we have seen 1957/58 and 1958/59 were highly profitable years. The average yield was only 6t.15c. of ware in both years but prices were such that the average margin was £50 per acre for the 1957 crop and £67 for the 1958 crop. Some individual results fell short of these high figures but it is perhaps rather remarkable that none showed a loss in 1957 and losses only occurred in 1958 where actual flooding had taken place.

It is a pity that the costs did not cover a season when there was a surplus but two years data from the Farm Management Scheme have been used to supplement the costings information and make a comparison of good and bad years. This is given in the following table.

TABLE.12 FOUR YEARS DATA ON SALES AND YIELD

	1956/57	1957/58	1958/59	1959/60
	£	£	£	£
Sales (per acre)	96	134	158	102
Average Total Yield	8.8 tons	8.1 tons	7.8 tons	8.9 tons
Number of Farms	50	60	61	53

(In extracting the Farm Management data a group of small cash root and milk farms that had an average yield of only 7.2 tons per acre and sales of £80 per acre was rejected in order to make the sample comparable with that of the costings). Growers seem at least to have been able to "break even" in the low price years and if we assume in addition half a ton or so of seed, there should have been a little profit on average, but this is a situation in which the average can be misleading. What concerns the individual grower is not the average but his own result and when the average is around break even point it is probable that a fair proportion make a loss. In assessing the profitability of the potato crop the relative frequency of high and low price seasons is obviously important.

All this emphasises the importance of supporting the market in years when there is a surplus.

4.

CHITTING: OPTIMAL SEED RATE

CHITTING Chitting until recently has been rather rare in Yorkshire and is still much less common than in the adjoining counties of Lancashire and Lincolnshire. Nine of the sixty-seven farms in the sample were already chitting seed and at least one other took it up shortly afterwards but this is a higher proportion than in the county as a whole which a recent survey puts at 4% of the maincrop acreage. (1) The corresponding figure for Lancashire is 40%. There are no doubt many reasons for this but possibly one is the tendency for blight to by-pass Yorkshire while affecting the other counties in its progress from South to North. (2)

The pioneers of chitting in Yorkshire used glasshouses (and in one case at least, hen houses) but interest at present seems to be mainly centred on the newly devised technique of chitting in artificial light. Buildings set free as the result of changed farm practices e.g. stables, barns and lofts are used to house the seed, usually with relatively slight modifications, the most important of which is the provision of adequate natural ventilation. Fluorescent lighting which must be of the right wave length but can be of low intensity, ensures that the shoots green properly and is used to maximum effect by moving the lighting units along the alleyways between the boxes. Heating is only necessary for short periods when the temperature is very low and is economically provided by thermostatically controlled fan type electric space heaters.

Both the technical and economic aspects have been dealt with fully elsewhere.(3) Summarising the latter, the overall cost of carrying out modest building operations and providing the equipment mentioned above will vary from £9 to £14 per ton of seed stored. The cost of boxes will vary according to the quality and the loading but may be expected to be between £13 and £17. On the farms in the sample the costs on the whole had been less, owing to economies in insulation due to the proximity of other buildings, to the absence of artificial lighting in one well lighted barn and to putting more seed into the boxes than is recommended. The last is bad practice and would be condemned not least by the farmers who had done it. Because the boxes have to be piled so as to make stable stacks they must be made to accurate limits and so the commercial article is practically obligatory.

The capital costs do not exhaust the extra charges incurred. The initial boxing will take about 4 man hours per ton and turning when carried out, which is not always the case, a further 2 hours per ton. It is difficult to obtain accurate figures for lighting and heating but at a rough estimate it will be 5s per ton. Moving the lights only takes a few minutes each day but in the aggregate will amount to half a crown or three shillings per ton. Loading onto a trailer for transport to the field is time-consuming and is made unnecessarily long on most farms because the boxes have to be carried out one by one. (A trolley would make the job easier where provision cannot be made for taking the trailer inside). Finally, at planting time there will be either delay or extra expense according to whether the planter is stopped when another box is reached down, or whether another person rides on the planter to hand down fresh boxes. Where the same team is employed the reduction in acreage planted will be from 25% to 40% compared with unsprouted seed even when help is provided for loading. Monetarily, these extra costs can be represented as follows.

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(1) R.M.Church Private communication

(2) Potato Blight Forecasting and Survey Work in England and Wales 1953-55. E.C.Large. Plant Pathology 5 (1956) 39.

(3) Sprouting Seed Potatoes in Artificial Light. N.A.A.S. Handout.

TABLE.13. EXTRA COSTS IN HANDLING SPROUTED SEED(a)

	£. s. d.
Boxing and turning	1. 0. 0.
Heating and lighting	7. 6.
Moving lighting units	3. 0.
Extra time loading	10. 0.
" " planting	15. 0.
Total Extra Cost per ton	2.15. 6.
Total Extra Cost per acre (b)	3. 4. 0.

(a) These figures have a big subjective element in view of the fact that the small number of cases make statistical methods inapplicable.

(b) Based on an assumed seed rate of 23.0 cwt per acre.

Chitting by artifical light will be preferable where buildings can be adapted especially if it is shown conclusively that seed chitted in this way has a slight advantage in final yield over that chitted in glasshouses, as experiments seem to indicate. (4). But it should not be thought that the day of the glasshouse is over, because recent improvements in construction have made them strongly competitive and where a building does not already exist they are the obvious choice. Glasshouses can cost up to £25 per ton of seed but one costed by the writer worked out at only £11.5s. This was a well constructed house of 22 ft.span, with double doors, thermostatically controlled tubular heating and a stout fence all round. It is only fair to add that it was of large capacity (60-70 tons) and that the erection had been done by farm labour. A glasshouse introduces a small saving in boxes because the usual loading rate can be exceeded. The saving in boxes will be about one seventh making the cost £12 to £14 per ton of seed. Where two or more varieties are to be chitted a separate house for each is desirable, owing to the different conditions required, and this, of course, adds to the cost but it applies equally to the other method of chitting.

RETURNS The response from chitting depends on a number of factors which may vary from farm to farm and from year to year, and it is in no way automatic. Average figures should be treated with reserve because they may be inapplicable to one's own conditions. Experiments have given results ranging from increases of 6 tons per acre to reductions of the same magnitude. Doubts were expressed at one time as to whether there is any response from chitting when planting is early. It now seems clear as a result of comprehensive experiments carried out in East Anglia that there will be some advantage from chitting even with early planting though it will normally be less than if planting had been later, and in a blight year there is the possibility that chitting will have just as big an advantage for early planted seed as for late planted. Chitting will obviously have special value when for any reason planting has to be delayed as frequently happens on the heavy warp but it should not be thought that late planting can be fully compensated for by planting chitted seed. For maximum yields both chitted seed and early planting are necessary. Another point to be aware of is that many of the figures quoted for chitting responses relate to the variety King Edward and will therefore be of little value to the Yorkshire farmer except in so far as he aspires to grow a crop of King Edward. On average King Edward will produce 1½ tons extra as a result of chitting, and Majestic 1 ton or less (5) but in trials on a few Yorkshire farms the response given by Majestic has been about 2 tons per acre.

(4) N.A.A.S.(Eastern Region) Report: Pilot Trials on Sprouting Maincrop Potatoes 1958. Unpublished Report REC/727.
N.A.A.S.(Eastern Region) Report: Trials on Sprouting Maincrop Potatoes 1959. Unpublished Report REC/758.

(5) C.V.Dodd. Broadcast talk.

Ignoring all the minor differences introduced by different types of building and loading rates etc and putting the per ton figures on to an acreage basis, it is probably near enough to say that the capital cost is, in round figures, £30 per acre. As the difference in cost between glass and fluorescent lighting is hardly significant this figure will serve for both. If a new planter has to be bought, which may well be the case a rough allowance for it can be made by adding £5 per acre to the capital cost. Writing this off in 5 years as most farmers would wish to do the annual cost is therefore £7 per acre. If for simplicity we take the extra cost of handling at £3 per acre the total cost becomes £10 per acre.

The economic justification for chitting depends a good deal upon the prices ruling for the crop. When prices are high any increase in yields obtained in this way will represent a substantial increase in income and leave a good margin to cover the increased costs, which are largely fixed. With low prices the benefit secured may hardly justify the outlay. Farmers who expect a return sufficient to enable them to recoup their capital in a short period may therefore hesitate to take on the risks involved. Those who are content to take the longer view may feel that in the long run the investment is likely to pay for itself, particularly as sooner or later a year of high prices is likely to come along in which the sprouted crop will yield a sufficiently large bonus to wipe out a considerable part of the capital costs. Farmers who are in the habit of buying Scotch seed and pieing it before use, will obtain some additional saving from chitting since boxing the seed on arrival and storing it in the chitting house cuts out the cost of pieing and sorting and also reduces losses from dry rot.

OPTIMAL SEED RATE

A good deal of research has gone into ascertaining what is the best (or optimal) seed rate. Boyd and Lessells (6) have calculated that for certified seed it would not exceed 17 cwt per acre anywhere in England and that for once grown it would be about 20 to 25 cwt per acre. The calculation was based on an assumed figure of £12 per ton for ware and £6 per ton for seed and chats. Certified seed was charged at £20 per ton. The optimal rate will, of course, vary with the cost of the seed and the price obtained for the ware but tables have now been produced from which one can read off the appropriate seed rate for any combination of seed price and expected ware price. (7)

It has already been shown in Table 4 that on the sample farms the average quantities of certified and once grown seed planted were about 23 cwt and 20 cwt respectively. Table 14 fills out the picture by showing the range of planting rates.

TABLE.14. DISTRIBUTION OF FARMS ACCORDING TO AMOUNT OF SEED PLANTED per acre

Amount of Seed	Certified		Once grown	
	1957	1958	1957	1958
cwt	per cent	per cent	per cent	per cent
Less than 15	4	8	2	11
15-20	9	15	27	45
20-25	57	50	60	38
25-30	23	17	11	6
30 and over	7	10	-	-

It will be seen that there are some quite big discrepancies between the recommended rates and those actually employed on many farms, but departures from the normal are often called for in practice and therefore it will be as well to consider some of the circumstances before concluding that all who differ from the standard are necessarily wrong.

(6) D.A.Boyd and W.J.Lessels. The effect of seed rate on the yield of potatoes. Jour:Agric.Sci. 44, 465.

(7) K.E.Hocknell. The Optimum Seed Rate for Maincrop Potatoes Farm Management Notes No.23. University of Nottingham.

The first point to note is that from a practical standpoint, "it is less important to determine the precise optimum for a given set of conditions than to know the range within which a reduction in returns below the most profitable will be negligible." (8) Even when a"negligible loss" is taken to mean a loss of 10/- per acre (a margin which may seem unduly cautious) the range within which the seed may vary without materially affecting profits is extraordinarily wide. When seed is costing £22.10s per ton the range is 11 cwt to 17 cwt per acre and when it is cheap, say £10, the range is even wider. Thus the idea of a well defined optimum is a somewhat artificial one.

The most striking fact brought out by the above table is that the majority of growers are planting certified seed at a rate far in excess of the theoretical optimum, and surveys have shown that this is not only true of Yorkshire but of several other important potato growing areas as well. This seems strange at first sight but it now seems clear that a number of factors operate in these areas to make a higher rate economic on many farms. There is, for example, the effect of variety which could not be taken into account when the original calculation was made. Majestic, which as we have seen forms a very high proportion of Yorkshire crops, produces relatively few shoots per sett and therefore needs to be planted at a higher rate. A recent survey has shown, in fact, that the seed rate for Majestic is 3 cwt per acre more than for King Edward in England, and 6 cwt per acre more in Scotland. (9) Most of those using certified seed would consider that the seed out of the crop was at least as valuable as the ware, which is another factor making for a higher optimal rate. Also, the 1958 crop was worth not £12 per ton as was assumed in the calculation but £23 per ton and this is a further factor tending in the same direction.

The use of very high rates e.g. in the region of 30 cwt per acre are more difficult to justify. There is little doubt that they come about in most cases through farmers adhering to their normal planting distance when the seed is abnormally large. In this matter there seems to be a direct conflict between the farmer's opinion and that of the scientist. Scientific opinion holds that larger seed can safely be compensated for by planting at greater distances thus keeping the seed rate per acre at the normal amount. Farmers with whom the present writer have discussed the matter have refused to believe that the normal spacing of 12-14 inches can be departed from without dire consequences though they are not very explicit as to what those would be. The chief trouble envisaged may be the occurrence of growth cracks to which Majestic is prone.

It would be a mistake to be too dogmatic on the question of high rates because there are indications that even these may be less wasteful than was once thought. Holliday (10) has argued that increasing the weight of seed per acre by increased seed size gives rise to a smaller true plant population than if the increase had been brought about by closer spacing. This means in effect that the growers who plant at these high rates are to some extent providing additional food reserves for the sprouts rather than producing a proportionally larger number of shoots, which is not a bad thing from a cultural point of view. Another point to be borne in mind is that while higher rates of planting bring no increase in the yield of ware after a rate of 25 cwt per cwt has been reached, the position is different as regards total yield. This can be expected to keep on increasing with each addition in the amount of seed planted, certainly up to 40 cwt per acre, and probably total yield is more in accord with the farmers aims, because in Majestic the difference between this and the weight of the ware fraction is largely seed.

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(8) D.A.Boyd and W.J.Lessels op.cit.

(9) Report on the Survey of Maincrop Potatoes, 1958. op.cit.

(10) R.Holliday Plant Population & Crop Yield: part II Field Crop Abstracts Vol.13. No.4.

The cost of planting at the rate of 30 cwts per acre may involve extra expenditure of £15 per acre compared with the normal rate of planting, so apart from the question of whether the extra expenditure is likely to bring any return, a case can be made out for seeking to reduce the expenditure in order to reduce outlay. Those who have a strong reluctance to increase the planting distance are not likely to be influenced by this argument but those who have no such compunction about wider spacing must surely be led by the scientific findings to explore the possibility of saving seed, perhaps on a trial basis at first. Experiments have shown that with weight of seed per acre kept constant there is no falling off in yield from wider spacing up to a limit of 24 inches. (At greater distances weed control becomes more difficult). For a seeding rate of 23 cwt per acre to be exceeded with 24 inch spacing the average size of sett would have to be more than $4\frac{1}{2}$ ozs.

Reference to table 14 shows that a number of farmers were planting once grown seed at less than a ton to the acre. In 1957 the proportion was about a quarter and in 1958 just under a half but the latter figures can perhaps be partly discounted because in that year there was a sheer scarcity of seed. (The very low rates i.e. under 15 cwt per acre were all associated with the use of thirds which is touched upon below). These growers it would seem, ought to be urged to plant more seed to the acre, unless special circumstances are known to exist that would make this undesirable. These would arise if the variety chosen were King Edward, which tends to form a relatively large number of tubers per plant many of which do not reach ware size unless growing conditions are especially favourable. The proportion of ware can be increased by wider spacing and experiments have shown that the best distance is about 20 inches between the setts. (11) Failure to realise this appears to be a common error on the part of the Yorkshire grower.

The use of thirds is sometimes frowned upon because they give a less robust plant which may be unable to cope with adverse conditions but those who used them were pleased with the results. They are somewhat more expensive than ordinary seed but at the low rates commonly used they work out appreciably cheaper per acre. On the principle that weight of seed per acre should be kept the same irrespective of an increase in size of sett these growers should have been putting on half as much seed again but the rule probably does not apply fully at this extreme (any more than at the other). However, users of thirds consistently reported that they produced large ware, which can be taken as an indication that a somewhat heavier seed rate would be preferable for optimal financial returns. The objection can be made that the planters in use did not permit of closer spacing but this could have been overcome by dropping two setts in place of one for part of the time.

There is evidence to suggest that when planting is delayed wider spacing is desirable. Thus Harvey and Short (12) experimenting in 1949 with the varieties Arran Banner and Majestic found that whereas 12 inch spacing gave the best results when planting was on 19th March, 20 inch spacing was best if planting was delayed until 6th May. Added confidence can be placed on these results by reason of the fact that similar results were obtained in the following year.

(11) F.N.Harvey & J.L.Short Effect of date of planting on yield of maincrop potatoes Exptl.Husbandry, 4.

(12) F.N.Harvey & J.L.Short op.cit.

5.

OPTIMAL RATE OF FERTILIZER APPLICATION: HARVESTING METHODS

OPTIMAL RATE OF FERTILIZER APPLICATION

The last twenty years have seen a remarkable increase in the rate of application of fertilizers. By 1948 dressings of nitrogen on potato land had gone up by over 100 per cent compared with before the war, while those of phosphate and potash were both up by about 50%. Between 1948 and 1958 there was a further increase of about 33⅓% for phosphate, 50% for nitrogen and a striking increase of 85% for potash. (1) The average level of fertilizer dressings is said to be now quite close to the theoretical optimum as worked out by Crowther and Yates. It has been shown already that the average expenditure on fertilizer by the farms in the sample was £12.10s per acre. This is equivalent to 15 cwt of a low analysis fertilizer, which, judged by the same standards is about right if one is manuring with expectation of a high selling price but rather generous otherwise. Users of high analysis fertilizers showed a strong tendency to apply at higher rates. There is an obvious advantage in using a concentrated fertilizer when the rate of application is high because of the reduction in weight, but this can hardly be the full explanation, especially as placement was not a consideration. Little is known about the principles by which farmers are guided when making decisions about fertilizers but this observation prompts one to ask whether farmers are fully aware as to what are equivalent dressings. At any rate, exhortations to farmers to use more fertilizer seem in the main to be no longer required, though that is not to say that a minority of farmers might not do better by applying more fertilizer.

Several economic reports on potato growing have referred to the disappointing results frequently obtained from large dressings of fertilizer.(2) Further evidence is provided by the following table what sets out the yields obtained by the two groups of farms with the highest fertilizer expenditure in 1957.

TABLE.15. YIELDS PER ACRE IN THE TWO GROUPS SHOWING HIGHEST EXPENDITURE ON FERTILIZER

GROUP.I. £17.10s - £22.10s		GROUP.II. £15 - £17.10s	
Code No.	Yield T. C.	Code No.	Yield T. C.
25	7. 8.	04	9. 0.
49	5. 6.	06	9. 0.
50	6. 0.	19	9.17.
51	11. 1.	26	9. 9.
56	6.18.	28	7. 9.
60	7.10.	32	8.11.
		36	9. 6.
		54	7.18.

When one considers that the average yield in 1957 was 8t.1½c. the high expenditure by the farmers in the first group would seem to have been ill judged or subject to amazingly bad luck in all the cases except one.

Whilst it is easy to point out examples of uneconomic use of fertilizer the problem of determining the correct rate of fertilizer application is made difficult by several factors, the most important of which are: the variability of soils, the effect of season, the lack of knowledge as to what the selling price of the crop will be. But fortunately within a wide range on each side of optimum the effect on profits of changes in the amount of fertilizer applied, is small.

(1) Survey of Maincrop Potatoes 1958 op.cit.

(2) See for example, J.D.Nutt. The 1957 Potato Crop, Econ.Dept. 33 Edinburgh & East of Scotland College of Agriculture Econ.Rept.33.

The average response curves of Crowther and Yates published in 1941(3) still form a useful general standard. The following table is based on their recommendations adjusted to take into account the results of some experiments carried out in Yorkshire from 1950 to 1954. (4) It shows the optimal dressing expressed in terms of low, medium and high analysis fertilizer, the problem of deciding what price to assume for the crop being side stepped by giving four sets of figures each corresponding to a level of potato prices. Finally each figure is accompanied by another in brackets which represents the reduced dressing required if the crop has received a basal dressing of F.Y.M.

TABLE.16. OPTIMAL DRESSINGS OF FERTILIZER APPROPRIATE TO FOUR LEVELS OF POTATO PRICES WITH AND WITHOUT FARMYARD MANURE. (a)

Value of Ware (per ton)	£10	£15	£20	£25
		cwt per acre		
Low Analysis	14(9)	16(11)	18(13)	19(15)
Medium Analysis	12(8)	13(9)	14(9)	15(10)
High Analysis	10(7)	11(8)	12(8)	13(9)

(a) The amount by which the dressings have been reduced to take into account the nutrient value of F.Y.M. where applied is that recommended by Boyd (5) namely, by one third to one half for moderate fertilizer dressings and by one quarter for heavy dressings, a 12 ton dressing of F.Y.M. being assumed.

The possibility of being able to reduce dressings through placement has been touched upon in another section. Conditions of high farming open up similar possibilities though the technique of making such adjustments is less well developed. The content of available potash as revealed by soil analysis gives a fairly good indication of the probable response to potash fertilizer, which is useful, as the potato is a potash loving plant. In the case of phosphate, very high or very low values are significant but intermediate values are less reliable and the determination of the likely response to nitrogen is largely guesswork. On one of the farms in the sample where manurial experiments had been carried out in 1958 the optimal dressing was found to be 2 cwt sulphate of ammonia and 5 cwt superphosphate (application of potash only depressed the yield). The cost of this dressing would have been about £4 per acre which represents a big saving on what the farmer was actually using - a dressing of 12 cwt of compound costing £11 per acre. Needless to say more research is needed and it may prove to be the case that savings of this amount will not often be possible, but even with these reservations it is something that should be kept in mind.

In attempting to obtain savings of this kind it may be difficult to obtain a compound that has the precise composition needed to provide the dressing that is required, and it is more than likely that one or two straights will have to be used as supplements. This will involve extra expenditure of say 5/- to 6/- per acre if they have to be put on separately but even if only a few units of fertilizer are being saved there will be a net saving of a pound or so. It is possible to achieve the same result in a rough and ready way by adding the straights to the compound in the drill at the time of sowing. The large grower is in the best position because he can have a fertilizer specially compounded to his own formula.

(4) G.H.A.Edwards, J.E.Watkins & J.Webber. Exptl.Husbandry.I. (1956) p.25.

(5) D.A.Boyd. The effect of farmyard manure on fertilizer responses. Jour.of Agric.Sci. Vol.52. p.384.

(3) E.M.Crowther & F.Yates. Fertilizer policy in wartime. Emp. J.Exptl.Agric., Vol.9, p.77.

It seems probable that greater efficiency in the use of fertilizers could be achieved by suiting not only the composition but the amount of the dressing to the type of soil. It is well known that in general a highly fertile soil justifies a higher rate of fertilizer application but this seems to conflict with another kind of statement often heard, to the effect that it is necessary to use more fertilizer on a "poor" soil. In this connection Holliday (6) has stressed the need to distinguish between inherent fertility and plant nutrient status. Inherent fertility depends on such factors as "drainage, moisture holding capacity, depth, texture and other features that cannot be changed except by major capital expenditure." Nutrient status is largely determined by the extent to which residues have been built up by previous manuring.

In practice both of these characteristics vary independently, with the result that different combinations are possible, which adds to the complexity of deciding what is the right fertilizer application. Where either or both differ from what are regarded as "average" conditions, an adjustment to the rate of application will be required. The general lines along which it should be done are shown, very crudely, in the following table.

TABLE.17. QUALITATIVE ESTIMATES OF RATES OF APPLICATION FOR DIFFERENT CONDITIONS OF INHERENT FERTILITY & PLANT NUTRIENT STATUS.(a)

	Low Inherent Fertility	High Inherent Fertility
Low Nutrient Status	Fairly High	Very High
Medium Nutrient Status	Moderate to Low	Moderate to High
High Nutrient Status	Very Low	Fairly Low

(a) This is an attempt to portray in words the information given graphically in the article by Holliday already referred to.

Holliday looks forward to the time when standards will have been derived for the main soil groups, and the National Soil Survey will, when completed, enable the different types of soil to be identified, but at the moment it is only possible to indicate broadly how different soils fit into the classification outlined above. Many of the traditional potato growing soils in Yorkshire are of high inherent fertility. Examples are the warp, and the sands of the Vale of York which, though light, have a conveniently high water table. Deep soils overlying porous rocks are classified by Holliday as of average inherent fertility. These would include the deeper soils on the magnesium limestone and on the chalk of the Yorkshire Wolds. On the other hand some Yorkshire soils could be classed as of low inherent fertility and these would include the thinner soils on the magnesium limestone and some of the sandlands of the North Riding that do not have a water table within root range.

Where a soil can be roughly evaluated in terms of plant nutrient status and inherent fertility it should therefore be possible to approach somewhat closer to the optimal dressing. The possibility that higher than average responses may be obtained, in particular, should not be overlooked. If all possible economies in fertilizer are made, including those from placement techniques and by making allowance for nutrients adden in F.Y.M, the saving will be under £10 per acre but where an inherently fertile soil is being under-manured the loss in potential returns may easily be several times as great.

(6) R.Holliday Soil Fertility & Fertilizer Use
Agricultural Progress Vol.30. pt.1. p.42.

A NOTE ON PICKING METHODS

Potato picking in Yorkshire as represented by the sample farmers has two well marked features:-

1. The smallness of the gangs of pickers
2. A high percentage of the crop is emptied from the picking baskets directly into trailers. // A typical gang consists of four or six Irishmen or seven to eight local women casual workers. On one farm a gang of four Irishmen picked nearly 70 acres of potatoes. These features were naturally not common to all farms but five sixths of the farmers employed fewer than 12 pickers and the proportion emptying directly into trailers was 85% if the complete harvesters are excluded.

The method has several spectacular disadvantages. The time of an able bodied woman is taken up with the trivial task of driving slowly round the field and each picker is required to walk round and round the field instead of along a 20 yard stretch as is the case with stints. On the other hand it is extremely flexible, which is useful when the number of pickers varies from day to day and, of course, it cannot be as wasteful in labour as it seems otherwise it would not have shown up so well in comparison with other methods in table 8. The need always to have a trailer (with some systems two or more trailers) in the field is sometimes difficult to meet but a bit of lattitude can be introduced at this point by having a few empty bags in reserve. The equipment represents a high capital investment because of the number of tractors and trailers required and not any kind will do. Tractor and trailer must comprise a hydraulic unit so that reversing and tipping may be done quickly. In some ways horses are preferable to tractors. They look after themselves, the carts do not churn up the pie bottoms so badly in wet weather and a fencing post put through the spokes of the wheels is as good a tipping device as one can desire. One in four of those who practised this method were still using horses; many of which had been hired.

The choice of a machine for lifting is intimately bound up with the method of picking. Time spent on useless walking is at a minimum when lifting has been done by elevator digger, due to its ability to take up closely adjacent rows. Not many elevator diggers were capable of "continuous working" i.e. the capacity to lift one row and return along the next before the first one has been picked, but this is not essential. The usual system was to take up the rows in such a way that when the trailer passed down the field one or more rows were disposed on each side of it. The ideal method then is to allot a row to each picker but usually the numbers of pickers and trailers available are such that some sort of compromise is required involving more than one picker to a row. When an elevator digger is capable of continuous working, which is the case for example, when it is a two row model there is much to be said for taking up a number of adjacent rows. One picker can then be assigned to each row (or double row in the case of a two row model) without difficulty and the pickers advance side by side in a broad front across the field. The only disadvantage is that the lifted crop is left exposed to the weather for a somewhat longer period and if it gets wet the risk of soft pot is very great.

One would not expect that the spinner with its relatively inflexible mode of operation would be compatible with the method of picking described above, and the necessity for working round a break is certainly an obstacle, but the ingenuity of farmers has found a solution. After a spinner it is usually possible to pick only one row at a time into a particular trailer. The tubers are left rather scattered so it is advisable for pickers to work two abreast in any case. It is possible in this way for six pickers to work along one row though not without a good deal of "leap frogging". The more usual method when there are six pickers is to split the gang up into two (four and two) and to provide each with a tractor and trailer. In this way it is possible to secure one of the advantages of the elevator digger but at the cost of providing an extra tractor, trailer and man. There is a way of ensuring that for a big proportion of the time picking is possible at both sides of the trailer even when using a spinner and this is by making the "breaks" small, say twenty rows wide instead of the more usual forty. However, as the loss from burying is rather high each time a new break is started, small breaks lead to greater losses. Farmers seem to be divided on the question of whether the gain in efficiency of picking offsets the disadvantage of losing more of the crop.

SUCCESSFUL POTATO GROWING

The following notes are based on the experience gained from collecting and analysing the foregoing costs. They suggest some of the factors on which successful potato growing depends.

Assuming that the basil requirements of healthy seed, a good seed bed and early planting can be taken for granted, the main lesson is the unexceptional one that all round attention at every stage is essential for good results. Correlations between any one factor and final results are always found to be weak. Kempinski (1) found that variations in net cost of manure and seed combined, accounted for only 9.5% of the variation in yield. It would seem that one cannot hope to secure more than slight improvements on average results merely by special attention to, or subtlety in the use of any one particular factor. On the other hand, neglect of a single factor may easily jeopardise success. Correct timing of operations, which is very important, may depend as much on foresight as on a knowledge of what is required there and then. (2)

The operations referred to in this report have had to do with the use of labour, materials, or machinery and equipment or with combinations of these factors, but it will be useful to discuss them collectively under the heading of inputs. Broadly speaking there are two alternative policies in relation to inputs, though the actual choice open to an individual farmer will depend on his present level of inputs. These alternatives are:

1) To increase inputs in the hope of securing a more than equivalent increase in returns.

2) To reduce inputs in such a way that costs will be cut without an equivalent reduction in returns or possibly without any reduction at all.

There is a tendency for high inputs in one part of the production process to be associated with high inputs in other parts, and similarly with low inputs. For example, certain items of equipment compel the purchase of others as in the case of the complete harvester which makes a rotary cultivator very desirable and a pulverizer almost obligatory. The potato crop is especially prone to these "chain effects." On the other hand inputs may be low all round due perhaps to shortage of capital or to an attitude of parsimony.

High inputs commend themselves to growers not only because of the possibility of bigger profits but because they offer a means of reducing uncertainty. Some of these measures call for a good deal of capital as we are reminded in the following table.

TABLE.18. APPROXIMATE CAPITAL COST OF FOUR TECHNICAL DEVELOPMENTS

	per acre
	£
Chitting	30 - 35
Indoor Storage (inc Elevator)	35 (a)
Irrigation	25
Complete Harvester	25

(a) Assumes a capacity of at least 500 tons

(1) T.Kempinski. Maincrop Potato Production in the North West. University of Manchester. Agricultural Economics Dept. Bull.85/EC.49.

(2) It is no doubt for this reason that many farmers stress the importance of earliness in carting out muck, ploughing, pulling the ridges down and earthing up.

A policy of high inputs will extend to the use of materials. Large seed withstands adverse conditions better and heavy seed rates produce more setts which may be as valuable as ware. Heavier seed rates are probably an insurance against a poor growing season. (3) Fertilizer may be an exception, however, because a policy of restricting inputs may be more generally appropriate especially where it has been used lavishly in the past and where placement methods are being embarked upon. (4) But in an effort to save on fertilizer one should avoid the danger of falling to a sub-optimal level, the adverse effects of which would more than cancel out any saving. Scientific advice would seem to be more than usually necessary in this connection.

Numerous opportunities exist for extra labour inputs. Putting an extra man on to pick out haulms as the potatoes go up the elevator into the store and using a horse drill to apply fertilizer in preference to a tractor drill are examples that were noted. The correctness of such decisions is difficult to judge but they are probably justified in many cases especially where the operation can be shown to have a direct bearing on yield or quality. A survey in East Anglia in 1959 revealed that only one tuber in three left the field undamaged and further damage occurred later. (5) Damage can sometimes be reduced by such simple means as protecting sharp metal corners with rubber but if a radical improvement is to be obtained it seems likely that additional inputs of labour and possibly of capital also, will be required, e.g. in the provision of pallets. At present they are used only as receptacles in the field and for transport to the clamp or store. This involves an expenditure of £350 which covers one tippler, one front loader adapted for lifting the pallets, 50 pallets and one baffle gate.(6) The idea of storing in pallets is attractive but the capital cost is at present felt to be prohibitive.

What are the prospects that higher inputs will lead to bigger profits? The survey data are unfortunately inadequate to provide a satisfactory answer to this question. A rough plot of individual margins against costs appears to indicate a tendency for those producers with the higher costs to obtain the higher margins but the relationship is only slight and is subject to many anomalies.e.g. a number of low cost producers had margins as big as most of the high cost producers and the highest margins of all were obtained by two producers who had costs around the average. We can probably assume, however, that high inputs will not in practise lead to the operation of the law of diminishing returns, because the inputs are not entirely,nor even mainly, successive doses of the same kind. They usually consist of a wide variety of materials, skills etc. injected at different points in the production process and for that reason the law may be irrelevant. High inputs are however a disadvantage when prices are low. If £140 per acre has been spent on the crop it will be necessary to obtain 14 tons per acre to break even at the price that commonly prevails in a glut year, and the chances of getting such a yield are not very high. On the other hand producers do not rely entirely on extra yield to recoup themselves for higher inputs. Extra returns can be obtained in a number of ways, e.g.potatoes kept late in the 1959/60 season by the use of sprout inhibitors (made possible by indoor storage) fetched an extra £3.10s.per ton. Another example is autumn chitting, which by bringing about dominance of the apical shoots can convert the variety King Edward into a more reliable cropper. (6) Thus a chitting house may indirectly enable one to obtain a premium for quality.

(3) J.E.Saunt Plant Population Studies with the Potato Crop Unpublished thesis (Leeds University)

(4) Some aspects of fertilizer policy still present a problem.e.g. Do additional inputs of seed etc. call for higher fertilizer rates? One would expect this to be so but there has been little experimental evidence in support.

(5) The New Scientist 29th Dec. 1960.

(6) Farming Reporter No.124 Sept.1960.

(7) R.D.Toosey Control of Sprout Numbers in Maincrop Potatoes Agriculture Vol.66 No.8.

CUTTING COSTS

To some farmers the policy of cutting costs or continuing to operate at an already low level of costs may seem more appropriate. One of the conclusions from this report is that such a policy is feasible, and the reasons for this appear to be as follows. Blight, frost, flooding etc. are of uncertain occurrence - the chances are that one will escape them without taking any special measures. Many technical innovations are often only marginal improvements. Increased knowledge of fertilizers reveals that recommendations in the past have been rather generous and scope exists for economy. Research on seed rates shows that the amount is not very critical and that there are advantages in low rates as well as for those around or above the theoretical optimum. Quality does not yet invariably bring higher returns. Finally, opportunist measures such as selling out of the field or making use of disused buildings for indoor storage at little or no expense can further reduce costs.

A policy of this kind probably calls for greater inputs of managerial skill and scientific advice than its opposite, described above. The margin between a clever use of minimum resources on the one hand and foolish cheeseparing on the other, can be a very narrow one. Selling out of the field cuts out the cost of pieing and there are no storage losses but it often seems to the writer to fit into the latter category.

POTATO PRODUCTION COSTS

1957 CROP

STANDARD APPENDIX

The figures in this appendix are based on records on 1436.85 acres on 60 Farms

TABLE.I. SUMMARY OF AVERAGE COSTS PER ACRE

Item of Cost		Men	Women	Youths	£. s. d.
			.....Hours.....		
Regular Labour		75.0	3.5	2.5	15. 0. 1.
Casual & Gang Labour			36.25 (Estimated)		8. 0. 8.
Power	Tractor		33.0		7. 18. 2.
	Horse		4.0		7. 9.
	Machinery Depn. & Repairs Allowance				6. 16. 8.
	Contract Services				8. 4.
	Other Fuel				6. 7.
Materials					
	Seed				19. 14. 9.
	Fertilisers & Manures Applied				31. 16. 7.
	Sundries				1. 10. 3.
Rent					2. 14. 5.
Levy					1. 0. 0.
	Total Direct Costs				95. 14. 3.
	Plus Share of General Farm Expenses				9. 10. 10.
	Less Adjustment for Manurial Residues				8. 2. 9.
	Gross Cost of Production at Delivery Point				97. 2. 4.

TABLE.2. YIELD, COSTS, RETURNS AND MARGINS

Yield per Acre		8.074 tons	
	Total	Returns on Estimated Value	
Disposal of Crop	Tons	Per ton	Per acre
Sold	10,153t.16c.	18.19. 8.	133.14. 0.
Retained on Farm for Livestock	381t. 4c.	2. 0. 0.	10. 6.
House and Perquisites	62t. 8c.	18.19. 5.	16. 6.
Seed	1005t.12c.	18.19. 5.	13. 1. 8.
Total on Average	11603t. 0c.	18. 8. 8.	148. 2. 8.
Cost	-	12. 1. 2.	97. 2. 4.
Margin	-	6. 7. 6.	51. 0. 4.

TABLE.3. SUMMARY OF AVERAGE QUANTITIES OF MATERIALS PER ACRE

Material	Area Applied Only		Overall Average per Acre
	Acres	Cwts/Acre	cwts
Seed			
Homegrown	510.80	20.76	22.10
Purchased	926.05	22.86	
Fertilisers & Manures			
F.Y.M.	1226.75	311.4	268.3
Artificials N	111.5	1.80	0.12
P	5.0	2.00	0.02
K	86.0	1.68	0.10
Compounds	1436.85	11.94	11.94

TABLE.4. SUMMARY OF AVERAGE MANUAL, TRACTOR & HORSE LABOUR USED PER ACRE IN GROWING AND HARVESTING.

Operation	Manual			Tractor	Horse
	Men	Women	Youths		
	Hrs	Hrs	Hrs	Hrs	Hrs
Pre Harvest	27.25	2.0	0.5	17.0	0.5
Carting and Spreading F.Y.M.	14.5	-	1.0	9.0	0.25
Harvesting	59.5	23.5	4.75	15.75	3.75
TOTAL	101.25	25.5	6.25	41.75	4.5

POTATO PRODUCTION COSTS

1958 CROP

STANDARD APPENDIX

The figures in this appendix are based on records on 1593.5 acres, on 61 Farms

TABLE.I. SUMMARY OF AVERAGE COSTS PER ACRE

Item of Cost		Men	Women	Youths	£. s. d.
		..... Hours			
Regular Labour		73.5	1.5	1.0	15. 3. 11.
Casual & Gang Labour			35.25 (Estimated)		8. 12. 1.
Power	Tractor		32.5		7. 17. 5.
	Horse		2.5		5. 2.
	Machinery Depn. & Repairs Allowance				6. 16. 1.
	Contract Services				1. 11. 5.
	Other Fuel				5. 11.
Materials					
	Seed				24. 19. 8.
	Fertilisers & Manures Applied				31. 14. 9.
	Sundries				1. 6. 3.
Rent					2. 15. 0.
Levy					1. 0. 0.
	Total Direct Costs				102. 7. 8.
	Plus Share of General Farm Expenses				9. 14. 4.
	Less Adjustment for Manurial Residues				7. 15. 9.
	Gross Cost of Production at Delivery Point				104. 6. 3.

TABLE.2. YIELD, COSTS, RETURNS AND MARGINS

Yield per Acre		7.811 tons	
	Total	Returns on Estimated Value	
Disposal of Crop	Tons	Per ton	Per acre
Sold	11,134t. 7c.	22.11.10.	158. 6. 2.
Retained on Farm for Livestock	399t.16c.	1.18. 8.	9. 3.
House and Perquisites	56t.12c.	21.15. 6.	1. 1. 4.
Seed	827t.14c.	22. 4. 6.	11. 9. 6.
Total on Average	12418t. 9c.	21.18. 8.	171. 6. 3.
Cost	-	13. 7. 1.	104. 6. 3.
Margin	-	8.11. 7.	67. 0. 0.

TABLE.3. SUMMARY OF AVERAGE QUANTITIES OF MATERIALS PER ACRE

Material	Area Applied Only		Overall Average per Acre
	Acres	Cwts/Acre	cwts
Seed			
Homegrown	1059	18.92)	19.81
Purchased	534.5	21.97)	
Fertilisers & Manures			
F.Y.M.	1341.25	299.25	261.56
Artificials N	52.5	1.81	0.09
P	-	-	-
K	91	3.97	0.30
Compounds	1577.5	11.97	11.78

TABLE.4. SUMMARY OF AVERAGE MANUAL, TRACTOR & HORSE LABOUR USED PER ACRE IN GROWING AND HARVESTING.

Operation	Manual			Tractor	Horse
	Men	Women	Youths		
	Hrs	Hrs	Hrs	Hrs	Hrs
Pre Harvest	27.5	2.0	-	16.5	0.25
Carting and Spreading F.Y.M.	13.0	-	-	8.5	-
Harvesting	57.75	20.0	4.0	16.0	2.25
TOTAL	98.25	22.0	4.0	41.0	2.5