Beans

UNIVERSITY OF NOTTINGHAM

Department of Agriculture and Horticulture

FIELD BEANS

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Agricultural Enterprise Studies
in England and Wales
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FIELD BEANS

A study of the husbandry and production economics
of the 1973 Field Bean Crop in England

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AGRICULTURAL ENTERPRISE STUDIES IN ENGLAND AND WALES

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

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

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

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FOREWORD

For a number of years, this Department has been interested in break crops. One study of Field Beans has already been published by W.S. Senior[1] relating to the 1968 and 1969 crops. The present study is the outcome of a B.Sc. (Honours) dissertation following the technique used by Hebblethwaite and Davies[2] for a study of the 1965, 1966 and 1967 crops. Unlike the previous studies of break crops undertaken by the Department, this was based on a postal questionnaire and not on direct visiting. An advantage of this procedure was that a larger sample covering the whole of England could be used, but the data collected did not cover the use of labour and machinery. Subsequently a further analysis was made of the orginal dissertation material so as to render it comparable in certain respects with Senior's earlier work. In order to make the data as topical as possible an estimate was made of the output, variable cost and gross margin of the 1974 crop together with a forecast for the 1975 crop using the physical information obtained from the 1973 investigation.

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(1) Senior, W.S. Field Beans as a Break Crop. Agricultural Enterprise Studies in England and Wales Economic Report No. 10. University of Nottingham, Department of Agriculture and Horticulture. February 1972.

(2) Hebblethewaite, P.D. and Davies, G.M. The Production, Marketing and Utilisation of the Field Bean (Vicia faba). R.H.M. Agriculture, 1970.

1. INTRODUCTION

1.1 Acreage of Field Beans Grown

The field bean (Vicia faba L) is one of the most ancient of cultivated plants and from early times it has had a great potential as a source of home grown protein for livestock and as a break crop in cereal production. Nevertheless, except for a few spasmodic recoveries generally associated with periods of war, the crop has declined in popularity since agricultural statistics were first kept, and the acreage grown annually has fluctuated more than that of other arable crops. By 1963, the acreage had fallen to 58,000 acres following a period of popularity during the second world war. Interest revived in the mid-sixties when farmers finding continuous cereal growing unsatisfactory were looking for a break crop to provide a rotation. The acreage grown reached a peak of 229,000 acres in 1968, but after three years of good yields it was a poor year because of chocolate spot, and by 1972 the acreage had again declined to 130,000 acres. In the last two years, there has been another small revival to 166,000 acres grown in 1974. The acreage of field beans grown in England is shown by regions in Table 1. The pattern

TABLE 1 ACREAGE OF FIELD BEANS GROWN IN ENGLAND BY REGIONS

	1968	1969	1970	1971	1972	1973	1974(1)
Eastern Region	127,171	124,834	105,430	91,059	83,009	95,315	104,500
South Eastern	30,385	33,782	26,958	15,177	9,482	10,491	14,000
East Midland	41,094	32,819	30,471	26,606	22,781	25,319	26,400
West Midland	10,748	10,638	9,336	7,083	5,722	6,041	8,400
South Western	8,942	10,463	8,173	4,831	2,931	3,103	3,900
Northern	1,648	1,454	1,555	1,527	1,212	1,607	2,100
Yorks and Lancs	7,928	5,942	6,603	5,619	4,819	5,300	6,700
England	227,915	219,931	188,525	151,901	129,954	147,175	166,000

SOURCE: M.A.F.F. June 4th Returns.

(1) Provisional.

of fluctuation in the acreage grown in the main bean growing regions between 1968 and 1974 is similar to the national pattern, but the biggest proportional reductions over these years have taken place in the South Eastern and the South Western regions.

1.2 Disposal and Use of the Field Bean Crop

There are five main outlets for the crop; feed manufacture, export, seed, on the farm stock feeding and feed for pigeons. The total production and the quantities disposed of through these outlets are shown in Table 2 for the years 1968/69 to 1973/74. Only a small proportion of the crop is used by feed manufacturers. Beans are difficult to process especially if the moisture content is more than 15%, but perhaps the most important factor which prejudices their use by the large manufacturer is that the home grown crop can never represent more than a very small proportion of the total feedstuff or possible protein requirement of this country. Furthermore, the supply lacks continuity because of the fluctuation in the acreage grown and the yields obtained from year to year. The quantity going for manufacture rose to its highest level of 26,000 tons in 1972/73 but dropped away again in 1973/74 despite the high price of protein that year.

An important export trade was built up after 1965 reaching a peak in 1968, but thereafter, falling away both in quantity and as a proportion of total production. The main importing countries are Germany and Holland, but a quantity has also been exported to Belgium, Italy, Spain, France, Malta and Egypt. For a time before Britain joined the Common Market, the price of beans grown in this country compared favourably with that of cereals in the Community, and with an ad valorem tariff of only 9% European manufacturers were encouraged to substitute them for cereals despite their drawbacks. This advantage no longer exists.

The demand for seed will fluctuate with changes in the acreage grown. Crops sold for seed have to be of high quality, but, as shown in this study, a large proportion of growers are retaining their own seed.

TABLE 2

ESTIMATED PRODUCTION, DISPOSAL, YIELD AND ACREAGE OF FIELD BEANS IN ENGLAND AND WALES 1968/69 to 1973/74

	1968/69		1969/70		1970/71		1971/72		1972/73		1973/74	
	'000 tons	%	'000 tons	%	'000 tons	%	'000 tons	%	'000 tons	%	'000 tons	%
Total Annual Production	221	100.0	231	100.0	157	100.0	131	100.0	163	100.0	184	100.0
Feed Manufacturers	17	7.7	18	7.8	23	14.6	25	19.1	26	16.0	21	11.4
Export Trade	129	58.4	120	51.9	76	48.4	70	53.4	70	42.9	62	33.7
Seed	21	9.5	19	8.2	13	8.3	11	8.4	10	6.1	14	7.6
Used on Farms(1)	39	17.6	59	25.6	30	19.1	10	7.6	42	25.8	72	39.1
Pigeon Feed(2)	15	6.8	15	6.5	15	9.6	15	11.5	15	9.2	15	8.2
Yield cwts/acre	19.3		21.0		16.6		17.3		25.1		25.0	
Acreage '000 acres	228		220		189		152		130		147	

Source: M.A.F.F. Statistics Division.

Notes: (1) Used on farm of origin and direct sales to other farms for livestock feed.

(2) Assuming a static demand of 15,000 tons annually. In the original statistics the quantity sold for pigeon feeding is included in that used on farm.

Traditionally, the crop has been grown as a source of protein for feeding on the farm. Beans, which are a useful source of the important amino-acid lysine, can be fed to all classes of cattle, sheep and pigs, but they are most commonly fed to beef cattle. The dry matter composition is shown in Table 3.

TABLE 3 DRY MATTER COMPOSITION OF FIELD BEANS
(AS A PERCENTAGE OF THE DRY MATTER)

Percentage

	Spring Beans	Winter Beans
Crude Protein	31.2	26.7
Ether Extract	1.6	1.5
Crude Fibre	8.2	9.0
Nitrogen - free extractives	55.3	59.0
Total Ash	3.7	3.8

The quantity of beans fed either on the farm of origin or sold directly to other farmers for livestock feeding fluctuates widely from year to year. Over the six years shown in Table 2, the smallest amount was fed in 1971/72 when the total production, though not acreage, was the lowest. The greatest quantity was fed in 1973/74 when the price of protein was very high.

Good, clean, small-seeded tick varieties are required for feeding pigeons. It is estimated that there is a static demand by pigeon-fanciers for around 15,000 tons annually.

1.3 The Scope of the Study

This study of the 1973 crop is based on data returned in postal questionnaires by 72 growers, six of whom grew both spring and winter crops. Of the total 3946 acres covered, representing 2.7% of the acreage grown in England that year, 2958 acres (75%) were sown to spring beans and 988 acres (25%) to winter beans. The sample was well distributed over the bean growing counties in England as shown in Table 4. The average farm size in the survey was 707 acres; 84.7% of the growers were farming over 300 acres, and 16.7% over 1,000 acres, the latter covering 40.4% of the total acreage. The average acreage of beans grown per farm was 54.8 acres.

TABLE 4 DISTRIBUTION OF GROWERS AND ACREAGE BY COUNTY

County	No. of Growers	Acreage Grown
Berkshire	5	235
Buckinghamshire	2	30
Cambridgeshire	6	441
Essex	6	251
Gloucestershire	1	23
Hampshire	5	215
Herefordshire	2	208
Hertfordshire	1	45
Huntingdonshire	6	347
Leicestershire	4	240
Lincolnshire	4	156
Norfolk	6	254
Northamptonshire	3	70
Oxfordshire	3	129
Rutland	1	50
Shropshire	1	100
Staffordshire	4	224
Suffolk	4	657
Sussex	2	30
Warwickshire	4	201
Worcestershire	2	40
TOTAL	72	3946

1.4 Weather Conditions in Relation to the 1973 Crop

The autumn of 1972 was generally dry and favoured the sowing of winter crops, but it was followed by a wet December. Paradoxically, 1973 was a year of above average rainfall which, nevertheless, had an above average amount of sunshine. The first three months of the year were generally dry and conditions for sowing in March were excellent. Rainfall was high in May, June and July, encouraging vegetative growth, but August was dry and conditions were generally favourable throughout the harvest period.

2. HUSBANDRY

2.1 Rotation

Field beans are used primarily as a break in the cereal rotation in order to get back into winter wheat and they are one of a small group of break crops, including oil seed rape and threshed peas, which do not require investment in additional fixed resources. On the farms surveyed, field beans were the most important arable crop followed by rotational grass, oats and sugar beet. One fifth of the total acreage was in arable break crops and 58% of the total acreage was sown to cereals. The rotational systems used can be classified into three main groups depending on the number of other break crops used in conjunction with beans:-

(a) Wheat and barley with field beans as the only one year break - 17 growers.

(b) Wheat and barley with two break crops - one being field beans - 25 growers.

(c) Wheat and barley with three or more break crops - one being field beans - 15 growers.

Of the 57 growers who reported their rotations, the majority favoured a break of more than one year demonstrating an awareness of the doubtful effectiveness of one year only in controlling disease.(3) The most common break crops besides field beans grown in the most popular group (b) rotation were oats and sugar beet. Seven out of eight growers in this group using oats as their second break placed them the year before field beans giving a two year break. The most common combination of break crops in group (c) was field beans, oats and grass. Ninety-five per cent of growers followed the bean break with winter wheat and the remaining 5% followed it with spring wheat. The autumn of 1973, however, was favourable for sowing of winter wheat.

2.2 Soil and Cultivations

Beans were grown on six major soil types; heavy 11.4%; heavy loam 42.8%; loam 17.0%; light loam 5.8%; light 18.8%; calcareous 4.2%;

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(3) Hebblethwaite, P.D. and Davies, G.M. Op. Cit.

indicating that about 55% of the crop was grown on heavy or heavy loam soil. An analysis of the yield on the different types of soil did not indicate that soil type was a major factor in determining the yield of the crop, the performance being dependent on many other factors, particularly weather.

2.3 Sowing

(a) Winter Beans

It is held that the optimum sowing period for winter beans covers the whole of October. In the survey, the early and mid-October sowing periods were the most popular in terms of the number of growers although the largest acreage was sown in the late October period. In a year when autumn and early winter was mild, November sowings showed no yield disadvantage compared with October.

(b) Spring Beans

The advantage of early sowing of spring beans has been demonstrated[4] and the fact that 77% of the growers growing 84% of the acreage had sown their crops before the 10th March indicates that the majority are aware of it. Yield analysis showed that there can be a difference of 5 cwt per acre between mid-February and April sowings.

Approximately 40% of the acreage was sown by combine drill and another 40% by cereal drills. Of the remainder 12% was broadcast or drilled and then ploughed in, and 4% was sown using a cultivator with a seed box fixed on top of it. It is generally regarded that four inches is an adequate depth to sow the seed to avoid simazine damage and damage from pigeons[5] and just over half the acreage was sown at four inches deep or more. Simazine damage was reported on half the acreage sown at 2" - 4" deep, but damage was also recorded on crops sown at depths greater than four inches. The late spring and early summer months had an above average precipitation in 1973 and previous studies have shown a correlation between wet weather and simazine damage.[6] The method

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(4) Hebblethwaite, P.D. and Davies, G.M. Op. Cit.
(5) Hebblethwaite, P.D. and Davies, G.M. Op. Cit.
(6) Hebblethwaite, P.D. and Davies, G.M. Op. Cit.

of sowing was also important in relation to simazine damage. Crops sown by cereal drills with Suffolk coulters showed no damage, whereas the highest proportion of damage occurred in crops sown by cereal drills with disc coulters and by combine drills.

The most popular row width was 7 inches and 55% of the acreage was sown in rows between 4 and 9 inches in width. The seed rates recommended by the N.I.A.B. have been between 200 lbs and 250 lbs per acre for winter beans, 200 lbs per acre for spring tick beans and 250 lbs to 300 lbs for spring horse-beans.(7) However, the average seed rate used in the survey was 182.4 lbs per acre for winter beans and 183.5 lbs per acre for spring beans. The factors involved in the use of lower than recommended seed rates in both crops are probably higher seed costs, better quality seed and especially in the winter crop, the danger of chocolate spot in crops sown at high seed rates. Farmers also believed that lower seed rates gave healthier plants, better tillering improved pollination and consequently higher yields. The advantage of lower seed rates has been supported by later work yet to be published.(8)

2.4 Variety

The proportion of the total acreage of winter and spring varieties grown is shown in Table 5.

TABLE 5 VARIETIES GROWN AND PROPORTION OF ACREAGE SOWN

	No. of Growers	Proportion of Total Acreage
		%
Winter		
Throws MS	24	96.0
Daffa	1	2.0
Not Known	1	2.0
Spring		
Minor	12	15.6
Maris Bead	41	77.5
Herz Freya	1	3.1
Maxime	2	3.8

(7) N.I.A.B. Field Bean Varieties. Farmers Leaflet No. 15, 1967.
(8) Ingram, J. M.Phil. Thesis. University of Nottingham. Unpublished.

(a) Winter Varieties

Ninety-six per cent of the acreage was sown to the variety Throws MS, the only other variety grown being Daffa.

(b) Spring Varieties

Maris Bead, the most popular variety, was sown on three-quarters of the acreage. The only other variety of importance was Minor. Maxime is a new variety which is very similar to Minor and a few growers used it. Hertz Freya is now classified as becoming outclassed by the N.I.A.B. and only one grower in the sample grew it.

Nearly 96% of the seed sown was retained from the previous year. Yield analysis showed no significant difference in average yields between the two sources of seed demonstrating that there is little benefit in growing the more expensive purchased seeds. However, it is probably beneficial in most cases to buy new seed every few years since it can lose its vigour in some circumstances.

2.5 Fertilisers

The proportion of the acreage receiving fertilisers and the three major nutrients, nitrogen, phosphate and potash is shown in Table 6.

TABLE 6 PROPORTION OF CROP RECEIVING FERTILISER

Percentage

	Winter	Spring
Proportion of Acreage Receiving Fertiliser	7.1	76.8
Proportion of Fertilised Acreage Receiving N	nil	28.53
Proportion of Fertilised Acreage Receiving P	100.0	100.00
Proportion of Fertilised Acreage Receiving K	100.0	88.26

The rates of application of nitrogen, phosphate and potash applied to winter and spring crops are shown in Table 7. Only 7% of the winter acreage received fertiliser, all as phosphate and potash, with an average application per acre of nearly 50 units of each nutrient.

TABLE 7 RATES OF FERTILISER APPLICATION

Units per acre

	Fertilised Acreage		Total Acreage	
	Winter	Spring	Winter	Spring
Nitrogen	-	17.92	-	3.93
Phosphate	47.26	37.81	3.36	29.04
Potash	47.26	40.96	3.36	27.77

Fertiliser was applied to three-quarters of the spring acreage, all of it receiving phosphate and nearly all of it receiving potash at an average rate of about 40 units per acre in each case. A little under 30% of the acreage received nitrogen at an average rate of 18 units per acre.

Farmers growing larger acreages preferred to broadcast fertiliser because it is relatively faster and sowing can be completed more quickly, but yield analysis suggested that combine drilling gave a little higher yield.

2.6 Crop Protection

Details of the crop protection programme are given in Table 8.

TABLE 8a CROP PROTECTION

Chemical	Proportion of Acreage Sprayed
(a) Herbicides:	%
Winter Crop:	
No Herbicide	9.6
Simazine only	87.4
Simazine and Barban	3.0
	100.0
Spring Crop:	
No Herbicide	1.6
Simazine only	78.3
Simazine and Barban	20.1
	100.0

TABLE 8b CROP PROTECTION

Chemical	Proportion of Acreage Sprayed
(b) Aphicides:	%
Winter Crop:	
No Control	100.0
Spring Crop:	
Demeton-S-Methyl	30.9
Menazon	2.6
Demephion	0.8
Phorate Granules	25.4
Disulfoton Granules	17.6
No Control	22.7
	100.0

Ninety per cent of the winter crop acreage and almost all the spring crop acreage was sprayed with the pre-emergence herbicide simazine. Three per cent of the winter acreage and a fifth of the spring acreage was treated with barban for the control of wild oats. In addition, two growers used triallate instead of barban and one used dinoseb in conjunction with simazine. Inter-row cultivations were not used as a method of weed control by any growers in the sample.

Application rates of simazine varied between 1¼ and 4 lbs commercial product per acre, the average application to those acres treated being 2.21 lbs of simazine to the winter crop and 1.47 lbs per acre to the spring crop. Barban, the recommended rate for which is 4 pints per acre, was used at a rate of 1 to 4 pints per acre, the average rate on the winter crop being 4 pints per acre and on the spring crop 2¼ pints per acre.

Damage caused by spray did not appear to be dependent on the dose rate to any great extent. Simazine and barban combined caused relatively little spray damage and crops treated with simazine alone received the most damage. Spray damage did not appear to be connected with soil type but was related to the method of sowing.

Five systemic organo-phosphorous insecticides were used to control aphids. Demeton-S-methyl is used mainly as an erradicant treatment only in years when the aphid population is high enough to warrant its use but phorate and disulfoton granules are used as preventative methods of control. The preventative method is more expensive and has to be carried out every year regardless of the aphid population, but it has the advantage of reducing damage if the crop is sprayed using ground tackle and it does not harm the bee population. Preventative treatment was used on 43% of the spring crop acreage but no aphicides were used on the winter crop.

Both granular and liquid insecticides were applied either by contractor using aerial or ground tackle or by the growers themselves using ground machinery. Details of the methods employed are shown in Table 9. Nearly three-quarters of the acreage was treated from the

TABLE 9 METHOD OF TREATMENT FOR APHID CONTROL

Percentage

			Proportion of Acreage Treated
Contract	Spray	Air	40.1
		Ground	3.3
	Granules	Air	34.9
		Ground	16.4
Grower	Spray	Ground	0.9
	Granules	Ground	4.4

air either with spray or with granules betraying a concern about damage caused by ground application even for the preventative granular treatment. In fact, 40% of the growers using ground machinery reported damage from the application.

Only one grower used headland treatment alone and he had to spray the whole crop later with demeton-S-methyl.

Only one grower reported an infestation of bean weevil in the crop but it was not bad enough to require control.

The main diseases of field beans are not amenable to chemical control. Forty-nine per cent of the growers growing 46% of the acreage reported an attack of chocolate spot (Botrytis spp.), the majority of these being mild. Only 6% of the growers reported severe attacks and 6% of the growers medium attacks, all of thes being on winter crops. Chocolate spot was not severe in 1973, but only four of the twenty-six winter crops were free of it and the disease is still a major hazard.

The level of Ascochyta (Ascochyta fabae) was much lower than chocolate spot, 15% of the growers growing a similar proportion of the acreage confirming incidence of the disease. Since ascochyta is mainly a seed borne disease it is probable that insufficient attention is being paid to the source of the seed. Nevertheless, all but one of these outbreaks was described as mild so it is unlikely that the disease had any great effect on yield, but growers using their own seed should always have it tested for ascochyta level.

Only 7% of the growers growing 6% of the acreage confirmed an outbreak of black-leg (Fusarium) and in all cases the attack was described as mild.

2.7 Harvesting

All the growers in the sample harvested their crops with tanker combines. The 1973 harvest was favourable, but nevertheless 38% of the growers reported that they had problems and some of those who reported no difficulties stated that this was the first year in which this had ever been so. The most common problem was that of tall stems and uneven ripening of the pods caused by the abundance of moisture available throughout the growing season. This presented combines with a large volume of green matter to separate from the beans and the haulm tended to wrap round moving parts and sap blocked the riddles. The next most common problem was over-ripe pods shattering at cutting, probably associated with the crop being combined too late. Further problems encountered were lodging of crops and beans collecting on the divider. These two are connected and both slow down the combining considerably, particularly when a crop which has been sown by one of the ploughing methods is badly lodged. Diquat can be used to desiccate the crop to

solve the problem of green haulm, but no growers in the study used this technique in 1973.

Fifty-eight per cent of the acreage was harvested during the first half of September and 94% of the acreage had been harvested by September 30th. There are two factors which are tending to bring the harvesting of the spring crop forward. Firstly, there is a tendency to sow earlier, and secondly there has been a change of variety from Minor to Maris Bead, an earlier maturing variety.

Some growers consider the late maturity of the crop to be a disadvantage, but others took the opposing view on the grounds that it helps to spread the work-load at harvest. Disposal of the haulm after harvest can be a difficulty especially for those who direct drill or carry out minimal cultivations for the following crop.

2.8 Drying and Storage

The product of 71% of the crop acreage was dried. Continuous flow drying was the most popular method accounting for nearly 60% of the acreage dried, despite the fact that high temperature drying can cause the skin of the beans to crack. Drying is best carried out slowly at low temperatures; on-the-floor and in-bin drying are ideal for this and these two methods were used equally for the remaining acreage. Batch and sack-drying, requiring a high labour input, were used for an insignificant proportion of the acreage. Growers, of course, choose their drying system primarily for cereals and beans are only a secondary consideration. As might be expected the growers with larger acreages were generally using the lower labour requirement systems.

The whole crop was stored and none was sold directly off the combine. The most popular method of storage was on-the-floor which accounted for 51% of the acreage, the next was in-bin used for 44% and the produce from the remaining acreage was stored in-sack. Although the produce of the higher proportion of the acreage was stored on-the-floor, a greater percentage of growers used in-bin storage indicating some preference amongst the larger acreage growers for on-floor storage.

Eighty per cent of the growers used moisture meters. The average moisture content was 18.4% off the combine, with a range of 14-30% and the average when sold was 15.4% with a range of 13-18%, which confirms the complaints of buyers that their requirements for less than 15% moisture content are not being generally met.

2.9 Bees

Forty-one per cent of the growers used hive bees in the crop, 62% of them borrowed the hives, 28% rented them and the other 10% owned them themselves. Thirty-five per cent used the recommended rate of 1-2 hives per acre.

Rents paid per hive varied from £1.75 to £3.85, the majority paying £3 or over. However, with a price of beans at £60 per ton an extra yield of only one hundredweight per acre would be required to pay for one hive per acre at £3 per hive. Nevertheless, it is still debatable whether the presence of bees in the crop increases yield.

2.10 Problems other than Harvesting

One third of the growers reported problems other than those encountered at harvesting. The most frequent was the infestation of grass weeds particularly couch grass (agropyron repens) which is not controlled effectively by any of the herbicides. Other weeds mentioned as problems were wild oats (avena fatua), black grass (alopecurus myosuroides), black bindweed (polygonum convolvulus), and cleavers (galium aparine).

Many growers would like to sow spring crops earlier but are limited by weather and soil conditions. Similarly, a number would like to sow deeper but a few reported difficulty in obtaining adequate depth. Improvements in this direction could be made by using Suffolk coulters on the drill, ploughing the seed in or using the new method of cultivator with seed box attachment.

Winter bean growers reported chocolate spot to be their major problem. The only other problem recorded was damage by pigeons which caused trouble particularly after sowing and also at harvest. Damage after sowing is related to depth and can be overcome by sowing deeper. Pigeon damage before harvest is more difficult to overcome but can be reduced by using bird scarers.

3. FINANCIAL RESULTS

3.1 Output, Variable Costs and Gross Margin. 1973 Crop

The output, variable costs and gross margin of the 1973 winter and spring bean crops are shown in Table 10.

TABLE 10 OUTPUT, VARIABLE COSTS AND GROSS MARGIN
WINTER AND SPRING BEANS 1973 CROP

	Winter	Spring
Yield per acre cwts	30.20	27.80
Price per ton £	76.60	75.40
OUTPUT	£ per acre 115.67	£ per acre 104.81
Variable Costs :		
Seed	4.40	4.40
Fertiliser	0.21	2.78
Crop Sprays: Herbicide	2.69	2.02
Aphicide	-	2.41
Miscellaneous	1.00	1.00
Total	8.30	12.61
GROSS MARGIN	107.37	92.20
Acreage Costed	acres 988	acres 2958

Notes:

Seed — 57% acreage sown with own seed charged at £41 per ton.

Fertiliser — Figures shown above are expressed per acre grown.
- Winter - £3.02 per acre to acres receiving fertiliser.
- Spring - £3.62 per acre to acres receiving fertiliser.

Sprays — Figures shown above include contract costs and are expressed per acre grown.
- Winter - Herbicide £3.53 per acre sprayed.
- Spring - Herbicide £2.05 per acre sprayed. Aphicide £2.67 per acre sprayed.

Estimated cost of contract: £1.07 per acre grown £1.57 per acre sprayed by contract.

Miscellaneous - To cover hire of beehives, variable cost of drying, bird scarers etc.

The yield of both the winter and the spring crop was high and the yield of the sample as a whole was considerably better than the national average for all beans shown in Table 11.

TABLE 11 ESTIMATED NATIONAL AVERAGE YIELD OF FIELD BEANS 1968-1974

Crop Year	Est. Av. Yield cwts/acre
1968	19.3
1969	21.0
1970	16.6
1971	17.3
1972	25.1
1973	25.0
1974	24.0

Sources: M.A.F.F. Crop Statistics - Beans for Stockfeeding.

The price per ton received was also high and probably more than the national average because most of the growers sold their crop in the first three months of 1974 when the prices were at their best.

The seed cost was the highest individual variable cost incurred, half the total variable cost for the winter crop and a third of the total for the spring crop. The cost of fertiliser for the winter crop was much lower than the spring and reflects the fertiliser usage shown earlier. The cost of sprays includes contractors charges for both ground and aerial spraying. Aphicides were only applied to the spring crop and this and the additional cost of fertiliser is the main reason for the higher total variable cost of the spring crop.

With a higher yield and therefore a higher output as well as lower variable costs, the gross margin of the winter crop was some £15 per acre higher than that of the spring crop. Both compare favourably with the gross margin of winter wheat in 1973 and they are considerably better than that of barley (See Table 15).

3.2 Output, Variable Costs and Gross Margin of Winter and Spring Beans 1968 to 1973

Results are given for winter beans in Table 12 for 1968, 1969 and 1973. Unfortunately no figures are available for the 1970, 1971

TABLE 12 OUTPUT, VARIABLE COSTS, GROSS MARGIN
WINTER BEANS 1968, 1969, 1973

	1968	1969	1973
Yield per acre cwts	16.38	22.89	30.20
Price per ton £	34.44	33.80	76.60
OUTPUT	£ per acre 28.21	£ per acre 38.67	£ per acre 115.67
Variable Costs:			
Seed	3.99	3.87	4.40
Fertiliser	1.99	1.14	0.21
Crop Sprays	2.21	1.40	2.69 (1)
Contract	0.30	0.26	-
Miscellaneous	0.15	0.41	1.00
Total	8.64	7.08	8.30
GROSS MARGIN	19.57	31.59	107.37
Acreage Costed	acres 2135	acres 1377	acres 988

Sources: 1968 and 1969 Senior, W.S. Op. Cit.

Notes: (1) Contract charges included in cost of spray.

and 1972 winter bean crop. The 1968 and 1969 figures are taken from the study conducted by Senior. Corresponding figures are given in Table 13 for spring beans for all years between 1968 and 1973. The 1968 and 1969 figures are taken from the same source as the winter beans. The 1970 to 1972 figures relate to a sample of East Midlands growers covering only a small acreage. Results are given for all beans between 1968 and 1973 in Table 14 where the 1970 to 1972 figures are taken from the M.A.F.F. gross margin reports[9] and relate to acreages more equivalent to those in the 1968, 1969 and 1973 studies. In this

(9) M.A.F.F. Gross Margin Reports. 1970, 1971, 1972.

TABLE 13 OUTPUT, VARIABLE COSTS, GROSS MARGIN
SPRING BEANS 1968-1973

	1968	1969	1970	1971	1972	1973
Yield per acre cwts	18.90	20.84	14.37	21.88	24.09	27.80
Price per ton £	35.80	34.82	43.40	31.33	45.09	75.40
			£ per acre			
OUTPUT	33.83	36.29	31.18	34.28	54.31	104.81
Variable Costs :						
Seed	4.03	4.18	3.20	4.59	4.37	4.40
Fertiliser	2.60	2.31	2.04	2.08	1.06	2.78
Crop Sprays	3.10	3.35	2.37	3.40	2.86	4.43 (1)
Contract	0.42	0.67	0.40	0.94	2.73	-
Miscellaneous	0.21	0.12	0.04	0.02	-	1.00
Total	10.36	10.63	8.05	11.03	11.02	12.61
GROSS MARGIN	23.47	25.66	23.13	23.25	43.29	92.20
Acreage Costed	acres 6255	acres 5422	acres 351	acres 289	acres 164	acres 2958

Sources: 1968 and 1969 Senior, W.S. Op. Cit.

1970, 1971 and 1972 East Midlands FMS.
Kerr, H.W.T. and Johnson, H.W., Farming in the East Midlands, Financial Results, Nott. Univ.

Notes: (1) Contract charges included in cost of sprays.

case only the material costs, seed, fertilisers and sprays are included to derive the gross margin.

All these figures show that it is only in 1972 and 1973 that the return from beans has improved. This is largely due to the higher price received as a result of the world protein shortage, but it would also appear that there has been some improvement in yield, confirmed by the national averages given in Table 11.

The gross margins of winter beans, spring beans, all beans, barley and wheat are compared in Table 15 from 1968 to 1973 inclusive (Gross Margin = Output less material costs only).

TABLE 14 OUTPUT, MATERIAL COSTS, GROSS MARGIN
ALL BEANS 1968-1973

	1968	1969	1970	1971	1972	1973
Yield per acre cwts	18.3	21.3	N/A	N/A	N/A	28.4
Price per ton £	35.5	34.6	N/A	N/A	N/A	75.7
	£ per acre					
OUTPUT	32.4	36.8	30.2	25.9	53.9	107.5
Variable Costs:						
Seed	4.0	4.1	3.4	3.9	3.8	4.4
Fertiliser	2.4	2.1	1.0	1.5	1.3	2.1
Crop Sprays	2.9	3.0	2.6	2.5	2.4	4.0
Total	9.3	9.2	7.0	7.9	7.5	10.5
GROSS MARGIN	23.1	27.6	23.2	18.0	46.4	97.0
Acreage Costed	acres 8390	acres 6799	acres 4237	acres 4061	acres 3525	acres 3946

Sources: 1968 and 1969 Senior, W.S. Op. Cit.
1970, 1971 and 1972 M.A.F.F. Gross Margin Reports Farm Management Survey.

These figures show that the gross margin of beans was generally lower than barley from 1968 until 1971. In 1972, the gross margin was a little better than barley, and in 1973 it was nearly 40% higher and compared favourably with winter wheat.

TABLE 15 COMPARISON OF GROSS MARGINS[1] OF WINTER BEANS SPRING BEANS, ALL BEANS, BARLEY AND WHEAT 1968-1973

	1968	1969	1970	1971	1972	1973
	£ per acre					
Spring Beans	24.1	26.5	23.6	24.2	46.0	93.2
Winter Beans	20.0	32.3	N/A	N/A	N/A	108.4
All Beans	23.1	27.6	23.2	18.0	46.4	97.0
Barley	27.8	28.6	28.6	31.6	41.1	70.5
Wheat	29.2	38.2	43.3	49.3	51.8	91.7
	acres	acres	acres	acres	acres	acres
Acres Costed						
Spring Beans	6255	5422	351	289	164	2958
Winter Beans	2135	1377	N/A	N/A	N/A	988
All Beans	8390	6799	4237	4061	3525	3946
Barley	42867	42169	40047	42630	38696	6984
Wheat	31897	26664	31686	38808	39260	5018

Sources:

Beans	1968 & 1969	Senior, W.S. Op. Cit.
	1970, 1971 & 1972	Spring, East Midlands FMS All Beans, M.A.F.F. Gross Margin Reports. (Note: Very small sample for Spring Beans.)
Barley	1968-1972	M.A.F.F. Gross Margin Reports.
	1973	East Midlands FMS.
		Figures Relate to all Barley 1968 & 1969; Spring Barley 1970-1973.
Wheat	1968-1972	M.A.F.F. Gross Margin Reports.
	1973	East Midlands FMS.
		Figures Relate to all Wheat 1968 & 1969; Winter Wheat 1970-1973.

Note: (1) Gross Margin = Output less Material Costs.

3.3 Estimate of Output, Variable Costs and Gross Margin for 1974 and Forecast for 1975

An estimate of output, variable costs and gross margin of winter and spring beans in 1974 is given in Table 16, and a forecast for the 1975 crop is shown in Table 17. The costs used for both are the best estimates that could be made at the time of writing, and the physical assumptions, shown in detail beneath the tables are based on the 1973 crop study.

TABLE 16 ESTIMATE OF OUTPUT, VARIABLE COSTS AND GROSS MARGIN OF WINTER AND SPRING BEANS. 1974 CROP.

	Winter	Spring
Yield per acre cwts	29	26
Price per ton £	60	60
OUTPUT	£ per acre 87.0	£ per acre 78.0
Variable Costs :		
Seeds	7.6	7.7
Fertiliser	0.3	3.6
Crop Sprays: Simazine	1.4	1.2
Barban	0.2	0.8
Aphicides	-	2.0
Contract	-	1.4
Miscellaneous	1.2	1.2
Total	10.7	17.9
GROSS MARGIN	76.3	60.1

Assumptions:

Output Yields based on 1973 yield adjusted by difference between 1973 and 1974 yields reported by M.A.F.F. for all beans with an allowance for greater differential between winter and spring arising from poor harvest conditions in 1974.

Seeds 1.7 cwts per acre @ £110 per ton for winter and £115 per ton for spring: purchased sown on 40% of the total acreage: £75 per ton for all retained seed sown on 60% of the acreage.

Fertilisers Winter 2 cwts per acre of 0.20.20 @ £37 per ton to 7% of the acreage. Spring 2 cwts per acre of 9.25.25 @ £52 per ton to 70% of the acreage.

Sprays

Herbicides Simazine Winter 2.2 lbs @ 70p/lb - £1.5 per acre to 90% of acreage. Spring 1.75 lbs @ 70p/lb - £1.2 per acre to 100% of acreage.

Barban Winter 4 pints @ £1.75/pint - £7.0 per acre to 3% of acreage. Spring 2.25 pints @ £1.75/pint - £3.9 per acre to 20% of acreage.

Aphicides Spring only. 100%.

Metasystox 6 fl.ozs/acre @ 21¼p/fl.oz - £1.3 per acre to 44% of acreage.

Phorate 10 lbs/acre @ 23p/lb - £2.3 per acre to 33% of acreage.

Disulfoton 10% 10 lbs/acre @ 28p/lb - £2.8 per acre to 23% of acreage.

Contract Application of Aphicide to spring only 91% treated by contractor, 9% by grower.

Aerial Spray and Granules @ £1.8 per acre to 72% of acreage.

Ground Spray @ £1.4 per acre to 3% of acreage.

Granules @ £1.0 per acre to 16% of acreage.

TABLE 17 FORECAST OF OUTPUT, VARIABLE COSTS AND GROSS MARGIN OF WINTER AND SPRING BEANS. 1975 CROP.

	Winter	Spring
Yield per acre cwts	30	28
Price per ton £	60	60
OUTPUT	£ per acre 90.0	£ per acre 84.0
Variable Costs :		
Seeds	6.0	6.3
Fertiliser	0.5	6.9
Crop Sprays: Simazine	1.7	1.5
Barban	0.2	0.9
Aphicides	-	2.4
Contract	-	1.5
Miscellaneous	1.5	1.5
Total	9.9	21.0
GROSS MARGIN	80.1	63.0

Assumptions:

Output Yield similar to 1973 survey. Price same as that anticipated for 1974 crop.

Seeds 1.7 cwts per acre @ £85 per ton for winter and £95 for spring: purchased sown on 40% of the total acreage: £60 per ton for all retained seed sown on 60% of the acreage.

Fertilisers Winter 2 cwts per acre of 0.20.20 @ £68 per ton to 7% of acreage. Spring 2 cwts per acre of 9.25.25 @ £98 per ton to 70% of acreage.

Sprays

Herbicides Simazine Winter 2.2 lbs @ 87½p/1b - £1.9 per acre to 90% of acreage. Spring 1.75 lbs @ 87½p/1b - £1.5 per acre to 100% of acreage.
Barban Winter 4 pints @ £2/pint - £8 per acre to 3% of acreage. Spring 2.25 pints @ £2/pint - £4.5 per acre to 20% of acreage.

Aphicides Spring only. 100%
Metasystox 6 fl.ozs/acre @ 29p/fl.oz - £1.7 per acre to 44% of acreage.
Phorate 10 lbs/acre @ 27p/lb - £2.7 per acre to 33% of acreage.
Disulfoton 10% 10 lbs/acre @ 33p/lb - £3.3 per acre to 23% of acreage.

Contract Application of Aphicides to spring only. 91% treated by contractor, 9% by grower.
Aerial Spray and Granules @ £2 per acre to 72% of acreage.
Ground Spray @ £1.5 per acre to 3% of acreage.
Granules @ £1.1 per acre to 16% of acreage.

Since the yields in the 1973 study were high compared with the national average, outputs and gross margins were revised for 1973, 1974 and 1975 using national average yields and these results are shown in Table 18.

TABLE 18 REVISED OUTPUT AND GROSS MARGIN AT NATIONAL AVERAGE YIELDS 1973, 1974 and 1975 ALL BEANS

	1973	1974	1975
Yield per acre cwts Price per ton £	25.0 75	24.0 60	24.7(1) 60
OUTPUT	£ per acre 93.75	£ per acre 72.0	£ per acre 74.1
Variable Costs	11.53	16.1	18.2
GROSS MARGIN	82.22	55.9	55.9

Notes: (1) Average of last three years.

It seems unlikely that the average price growers will receive for the 1974 and 1975 crops will be as high as it was for the 1973 crop and this is going to lead to a reduction in output. At the same time the increase in variable costs shown in 1973 is likely to accelerate and will result in lower gross margins in 1974 and 1975. If this turns out to be so and barley and wheat gross margins remain at around the same level then the use of beans as a break crop will not be as attractive a proposition as it was in 1973.

3.4 Estimate of Fixed Costs

An estimate of the fixed costs likely to be incurred for the 1973 crop is shown in Table 19. There is little difference in the use of labour and machinery on the winter and spring crops and these figures therefore refer to both. They were not obtained directly from the study but were derived from the various sources given beneath the table.

TABLE 19 ESTIMATE OF FIXED COSTS 1973 CROP

	£ per acre
Labour 6½ man hrs @ 66p/hr	4.29
Allowance for overhead labour @ 30% of above	1.29
Tractors 6½ hrs @ 65p/hr	4.23
Share of general machinery @ 65p/tractor hr	4.23
Combine ½ hr @ £6/hr	3.00
General overheads @ £6/acre	6.00
Rent and Rates @ £9/acre	9.00
TOTAL	32.04

Based on the following sources:

1. Labour, Tractor & Combine Rates of Work, J. Nix, Farm Management Pocketbook, Wye College, Sept. 1974.
2. Cost of Labour, Average Cost of Employing Tractor Drivers from Agricultural Labour in England and Wales 1973, M.A.F.F., Nov. 1974.
3. Tractor & Combine Costs - Physical data from H.W.T. Kerr, Farm Planning Handbook, University of Nottingham, 1969.
4. General Overheads) Average of All Farms, East Midlands
   Rent and Rates) FMS, 1973-74.

If these estimated fixed costs are deducted from the gross margin shown in the previous table the net margins for winter beans, spring beans and all beans would be those shown in Table 20.

TABLE 20 ESTIMATE OF NET MARGIN 1973 CROP

£ per acre

	Winter Beans	Spring Beans	All Beans
Gross Margin	107.4	92.2	96.5
Fixed Costs	32.0	32.0	32.0
Net Margin	75.4	60.2	64.5

Evidence from the East Midlands Farm Management Survey[10] suggests that fixed costs rose by 19% between the 1972 and 1973 harvest years. If a similar rate of increase is applied to the estimated fixed costs for 1973, the 1974 figure would be £38.1 per acre and the 1975, £44.7 per acre, giving a net margin for all beans of £18.1 per acre in 1974 and only £11.2 per acre in 1975.

(10) Kerr, H.W.T. and Johnson, H.W. "Farming in the East Midlands - Financial Results 1973-74". University of Nottingham, Dept. of Agriculture and Horticulture. January, 1975.

4. VALUE OF BEANS AS A BREAK CROP

The main functions of a break crop are to decrease disease in the following crop, improve soil structure, reduce the weed population and, if possible, provide some residual nutrient. All these benefits were noted by growers taking part in the study. The majority stated that beans have a value in tne control of cereal diseases and only two considered them to have none at all. There is increasing evidence that a one or even a two year break is insufficient to control the pests and diseases of cereals, particularly eelworm and eyespot.(11) The majority of growers in the study favoured a break of at least two years and nearly as many used a rotation with three or more break crops as those who used beans as a one year break. Over half the growers (57%) said that they reduced the level of nitrogen applied to the following wheat crop and suggested a reduction of 20 units per acre. Nearly 10% said they also reduced phoshpate and potash levels but could give no realistic estimate of the saving. Beans were considered to be a good entry for wheat because of their improving effect on soil structure and they were said to provide an opportunity for controlling weeds, particularly wild oats. An attempt was made to evaluate these benefits. The increase in yield of the following wheat crop due to disease control was valued at an average of £7.8 per acre and at £6.2 per acre due to improved soil structure. The saving in nitrogen was put at £1.1 per acre giving a total benefit from including beans in the rotation of £15.1 per acre at 1973 prices.

A survey of 43 growers co-operating in Hebblethwaite and Davies' previous investigation who had given up growing beans since 1968 revealed that the major reasons for doing so were variable yields and uneconomic returns. These two factors are obviously interrelated and both reasons were often given by the same grower, half giving variable yields as their reason and a third uneconomic returns. A further quarter had changed to another break crop but did not give their reasons. Other reasons given were difficulties at harvest (18%), weed problems (18%) and damage to machinery (6%). Only one grower had given up beans to return to a continuous cereal system and all the rest substituted

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(11) Hebblethwaite, P.D. and Davies, G.M. Op. Cit.

beans by another break crop.

No additional fixed resources in the form of extra capital investment or labour are required to introduce beans as a break into a rotation including cereals. Small expenditure may be required for simple adaptions to existing machinery and some allowance should be made for greater wear and tear on the combine.

5. CONCLUSIONS AND FUTURE PROSPECTS

The field bean acreage has steadily declined over the last century except for a few short periods, and acreage fluctuations have been far greater than in any other important arable crop. The major reasons for this decline have been low and unstable yields and the availability of better quality cheaper protein from abroad. Between 1964 and 1968 there was a renewed interest in the crop as a break for intensive cereal systems, but there was a further decline associated with poor yields from then until 1972, although there is little doubt that there was no loss of interest in break crops in general during this period.

There has been some recovery in the acreage over the last two years stimulated by higher prices arising from the world protein shortage, but the future of the bean crop still looks uncertain. On the credit side, it is probable that some newer high-yielding varieties will become available, and there are good prospects for a chemical control of chocolate spot, one of the main reasons for fluctuating yields particularly in the winter crop. However, of the main outlets, only feeding directly on the farm would appear to offer any scope for expansion. The feed manufacturers have problems in using beans for compounding and the price differential between cereals in the E.E.C. and beans grown in this country which existed for a period before Britain joined the Community will not occur again. It is improbable, therefore, that the demand by home or continental compounders will increase. Consumption on the farm did increase substantially in 1973-74 when imported protein became very expensive, but protein prices have eased considerably in 1974 and may well drop further in 1975 and 1976. If this happens the bean crop will once again appear less attractive and any substantial expansion on the acreage is unlikely over the next few years.

Nevertheless, in the long term the prospects are for a continuing world shortage of protein and even now Western Europe is heavily dependent on the United States soya bean crop for its supply of vegetable protein. Perhaps this is the time for a renewed effort to overcome the technical problems which beset the field bean crop.

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