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ALTERNATIVE CROPS FOR THE CEREAL GROWER

A Commentary on the Break Crop Situation

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ALTERNATIVE CROPS FOR THE CEREAL GROWER - MAKING THE CHOICE

A commentary on the Break Crop Situation

This paper was presented to the National Power Farming Conference at Bournemouth, February 1974

J.A.L. Dench

1974

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* Break Crops by J. A. L. Dench and others. Agricultural Enterprise Studies in England and Wales, Economic Report No. 13. Department of Agricultural Economics and Management, University of Reading 1972. 75p.

ALTERNATIVE CROPS FOR THE CEREAL GROWER - MAKING THE CHOICE

The title - alernative crops for the cereal grower - implies those crops which can be grown in order to improve farm profits, or to prevent or reverse a deterioration in profits, with a minimum change in the existing farm system, i.e. without changing its essentially cereal growing nature. Within this fairly limited objective there are a number of different considerations which lead individual cereal growers to seek to include an alternative crop in their system. Some of the main aims can be summarised as follows:

1) Financial

The introduction of a more profitable crop in terms of gross margin than barley.

2) Technical

To maintain or improve the profitability of the cereal crops:

(a) By improving their yield as a result of:

(i) improved soil structure, including addition of organic matter;

(ii) better weed control through a change of control measures, especially of persistent grass weeds;

(iii) arresting or reducing the build-up of cereal pests and diseases, by means of a change of plant species.

(b) By keeping cereal growing costs down - particularly fertiliser and spray costs as a consequence of (a) (i) (ii) and (iii).

(c) By providing an opportunity to introduce more wheat into the cropping sequence.

3) Managerial

To achieve easier or better farm organisation of labour and machinery so enabling either:

(a) the existing resources to carry the work-load better and so for example, achieve better timeliness and improved output as a consequence, or,

(b) the existing resources to handle a larger arable area, or,

(c) a reduction in the input of resources on a given arable area, e.g. by reducing 'peaks' in demand requiring the use of casual labour or contract services.

Most decisions will, of course, be based on a combination of these factors further influenced by such things as personal preferences or experience of the grower, any local marketing opportunities available and by any particular advantages or disadvantages that the farm itself may possess by reason of its soil, topography, fixed equipment and so on. Future market prospects for the crop relative to cereals and other alternative crops will also have an important influence on the choice of crop.

Clearly the introduction of a new crop or enterprise into any farm system will almost certainly make new demands of a technical or organisational nature and may require changes in the fixed cost structure of the farm by, for example, involving some further capital investment or a change in the labour resources needed.

The decision:

(i) whether to introduce an alternative crop

(ii) which crop to introduce

(iii) what area to devote to it,

will depend on whether the <u>combined</u> effect of these factors will confer an economic advantage <u>over a period of years</u> taking the farm system as a whole.

(I) <u>WHETHER TO INTRODUCE AN ALTERNATIVE CROP</u>

The alternative of not growing a change-crop at all, or very seldom, is of course a workable one on suitable soils, and with adequate levels of management; cereal yields becoming stabilised after a time at what may be an acceptable level. However, even with the very high standard of technical skill and management required for success of this apparently simple system, changing relationships between cereal prices and production costs can, from time to time, make continuous cereal growing distinctly less profitable. In the past few years many cereal growers have been squeezed between steadily rising costs and fairly static or only slowly increasing output. In this type of situation there is frequently little room for the continuous cereal grower to manouver either through reducing his costs or by increasing yields. The former because no one input dominates the cost structure so offering scope for substantial economy and the latter because the limit will already have been approached given existing techniques and varieties. Measures in either of these directions tend eventually to be overtaken by a continuation of the general economic trend which gave rise to the problem in the first place.

The recent increase in grain prices has provided a respite from this situation and as a consequence it may be asked whether there is

less need for 'break-crops', except perhaps to act as a wheat entry or where soil conditions etc. particularly require them. Just how the relationship between cereal prices and production costs will settle down in the next few years is, of course, extremely uncertain but it is clear that world shortage of raw materials and fuel, combined with inflation, will continue to push up costs in the immediate future. This could bear heavily on the cereal grower who is finely balanced on a high physical level of inputs in order to maintain yields. The present position is not in fact as rosy as might be thought. From Table 1 it will be seen that even at the high output levels resulting from barley selling at £60 per ton and wheat at £65, variable costs still absorb almost exactly the same proportion of gross output as they did five years ago - about 21%.

Table 1 Variable costs as % of gross output

Barley 30 cwt per acre

	1968		1973	
	£/acre	%	£/acre	%
Gross output	35.50	100	90.00	100
Variable costs	7.40	21	20.00	22
Gross Margin	28.10	79	70.00	78
Wheat 34 cwt per acre				
Gross output	42.80	100	111.00	100
Variable costs	9.10	21	23.00	21
Gross Margin	33.70	79	88.00	79

These figures ignore increases which have taken place in 'fixed costs', particularly machinery.

The higher grain prices will however make certain technical advances economically possible, for example the use of sprays to control foliar disease or blackgrass. It is now just worth while to spend nearly £3 per acre to achieve an increased barley yield of 1 cwt per acre. So we may see average yields (and costs) rising with a consequent improvement in margins.

The situation has changed in another way during the last year or so, partly due to the change towards E.E.C. price levels but mainly because of shortages in feed protein. The effect has been a significant improvement in the financial attractiveness of several crops which previously produced relatively poor gross margins but which, in other respects, were attractive alternative crops for the cereal grower.

Table 2 Index of average gross margins (Barley = 100)

	1971	1973
Winter Wheat	133	126
Spring Wheat	108	104
Spring barley	100	100
Oats	101	100
Spring oilseed rape	73	83
Winter oilseed rape	100	111
Peas harvested: for processing	110	127
for feed	70	73
Field beans	70	87
Herbage seed	100 to 183	84 to 211
Grain maize (contract dry)	90	83
Vining peas (contract harvest)	140	136

The gross margin from spring oilseed rape and field beans for example has improved from about 70% to about 85% relative to barley. The indications are that the adverse gap in profitability between barley and some alternative crops is likely to remain narrower than it has been.

(II) WHICH CROP TO CHOOSE

Comparisons are made easier if we first categorise the whole range of alternatives according to their impact on the farm organisation and capital structure. On this basis they fall into three main groups:

1. Grass in the form of short or medium term leys for livestock
2. Vegetable and root crops for human consumption
3. Combine harvested cash crops

(A fourth group of alternatives could be those which do not significantly affect fixed costs or contribute anything directly to output - fallows and green manure crops)

Clearly if the premise with which this paper began is adhered to - that alternative crops for the cereal grower are principally those which can be introduced without changing a farm's essentially cereal growing system - then the choice must be confined largely to the crops in Group 3 and perhaps the fourth group. In making any choice, however, one should not entirely ignore the wider context within which it is made. So some very brief comments on the other two groups seem to be justified.

GRASS AND LIVESTOCK

There is plenty of evidence to suggest that three-year leys can contribute significantly to cereal margins through increased yields in subsequent crops and by keeping variable costs down. They are also probably one of the most effective means of improving soil structure and increasing soil organic matter. The introduction or expansion of a livestock enterprise to utilize leys will however have a marked effect on the labour and capital structure of the farm, and also on the managerial effort involved, although it is frequently possible to introduce one of the more extensive sheep or cattle systems without excessive demands in these respects, especially if lambing or calving dates can be timed to avoid busy periods on the arable.

Table 3 Margins from cattle and sheep enterprises

	Gross Margin	Labour*	Interest on average capital** @ 14%	Margin over variable costs assumed labour and interest
	£	per	acre	
Rearing dairy youngstock	40	10	14	16
Single suckle beef cows	30	4	17	9
18 month (semi-intensive beef)	40	13	16	12
2 year old beef	29	7	13	9
Ewe flock (fat lamb)	38	9	11	18

* Approximate only - actual marginal cost will depend on size of enterprise and other factors.

**Average investment in livestock and variable costs only.

Margins from these enterprises are not very attractive but even so the introduction of leys and livestock may be justified (as the example in Table 4 demonstrates) for those who for various reasons favour such a course.

Table 4 Extensive livestock - a budget

(a) Continuous barley production: yield 29 - 30 cwt, gross margin £65 per acre (above - average variable costs)

Change to:

(b) A 6 year rotation including leys for livestock and wheat giving improved cereal yields with average variable costs.

	Contribution to farm gross margin		
Ley 2 years + catch crops	£		£
= $2\frac{1}{2}$ years, margin £9 to £20 per acre	23	to	45
Wheat yield 120% of average = 41 cwt	110		
Wheat yield 100% of average = 34 cwt	88		
Barley* " 100% of average = 30 cwt	70		
Barley* " 100% of average = 30 cwt	70		
	361	to	383
	($\div$ 6)		
Average margin per acre before charging fixed costs of cereal system =	60	to	64

* undersown to a ley or catch crop

VEGETABLE AND ROOT CROPS

These crops provide a good species break from cereals and are therefore beneficial in reducing the incidence of cereal pests and diseases, and in checking the build-up weeds associated with cereal growing. Fertilizer requirements for following cereal crops may also be reduced. They are not, however, a remedy for dirty land and they confer only limited benefits on the soil structure.

Lateness of harvesting root crops and such crops as sprouts, can preclude planting winter wheat afterwards and can create structural problems on some soils.

Examples of crops in this group are:

Potatoes

Sugarbeet

Mechanised vegetable crops such as:

Carrots

Brussels sprouts

Vining peas for canning or freezing

They produce a high value of output per acre but they require a high degree of expertise of a type differing considerably from that which

cereal growing demands. They also require expensive specialised machinery, which is frequently group owned, and many have a high labour requirement which may be very seasonal. Together with the high output and potential for high profit margins these crops, particularly vegetables, also involved high risks. Growing costs are high so that there is a lot at stake if the crop should fail at a late stage or the quality does not reach the required standard.

Crops of this type can thus have a very marked effect on the fixed costs and general organisation of the farm, and for this reason their introduction onto a cereal farm may result in a change of system within a few years to one in which cereal growing takes the secondary role of a change or alternative crop.

Production is restricted to some extent by the availability of quotas or contracts with processors. Suitability of soil type, proximity to a market outlet or processing plant and-for crops such as sprouts - to a supply of suitable casual labour, are also important considerations. These crops should only be considered if it is intended to make them a fairly permanent feature of the farm system, they are not crops which amateurs are likely to grow successfully.

Of the examples listed, probably vining peas involve the least modification to a cereal growing system in terms of labour requirements and general farm organisation.

Table 5 Vining Peas	Average	Premium
Yield cwt per acre	35	48
	£ per acre	
Gross Output (1974 estimated)	150.00	210.00
Variable costs:		
Seed	15.00	
Fertiliser	3.30	
Spray materials: herbecide	3.40	
pesticide	1.20	
Sundry	1.10	
	24.00	
Gross margin (without contract)	126.00	186.00
Contract harvesting and haulage	31.00	41.00
Gross margin (contract harvest and haul.)	95.00	145.00

Approximate capital requirements (1973)

Drills	(corn drill may be suitable)	£350 to £450
Cutters	Tractor mounted	£400 to £500
	Self propelled	£3000 to £3500
Viners	Tractor drawn	£8000 to £9000
	Self propelled	£16,000

This sort of capital written off over 10 years and charging interest at the current 14% on the average investment represents about £10 per acre.

Table 6. Combine Harvested Cash Crops - Estimated Output, Variable Costs and Gross Margin - January 1974

PER ACRE

	Yield		Output		Variable Costs					Gross Margin	
	Average	Premium	Average	Premium	Seed	Fert	Sprays	Sundry	TOTAL	Average	Premium
	cwt	cwt	£	£	£	£	£	£	£	£	£
Winter Wheat	34	40	111	130	9.8	10.5	2.3	-	23	88	107
Spring Wheat	29	33	94	107	9.8	9.7	1.7	-	21	73	86
Spring Barley	30	34	90	102	9.0	9.7	1.7		20	70	82
Oats	33	37	88	102	8.3	8.1	1.7		18	70	84
Spring Oilseed Rape	17	20	81	95	4.0	14.9	3.4	0.5	23	58	72
Winter Oilseed Rape	20	23	100	115	4.0	15.1	2.3	1.0	22	78	93
Peas: Harvested for processing	22	27	121	149	20.0	4.1	7.2	0.5	32	89	117
" " feed	22	27	83	101						51	69
Field Beans	22	28	83	105	9.3	6.2	5.3	1.0	22	61	83
Herbage seed			75to170	95to235	5.0	12.0	-	4.0*	Varies with Variety	59to148	75to215
Grain Maize	35	45	98	126	7.2	15.4	4.0	0.5	27	71	99
					Contract dry			(13to19)	(40to46)	(58)	(80)

* The minimum - if seed requires cleaning by the merchant the cost will depend on initial purity and can be as high as £1.28 per cwt. i.e. £12.80 per acre for a 10 cwt crop.

COMBINE HARVESTED CASH CROPS

This group comprises the most readily available alternative crops for the cereal grower, the principal ones being listed in Table 2 (excluding vining peas). A number of crops, mostly grown for seed, can be added to this list but they are of relatively minor importance in terms of area grown in this country at present:

Mustard
Linseed
Corriander
Lupins
Root crops for seed e.g. Sugarbeet

In general the market outlets for these less important crops are strictly limited and they are therefore nearly all grown under contract. Gross margins may be quite attractive ranging from about £50 to £150 per acre but can vary widely between seasons and between crops.

There are several new crops to this country which, if technically successful, could be attractive alternative crops for cereal growers, they include;

Navy beans
Soya beans
Sunflowers

We thus come back to a 'short list' of crops for which there is an established and relatively easily accessible market, most of which do not differ markedly from cereals in their labour or machinery requirements:

Oats
Oilseed rape
Peas for harvesting
Field beans
Herbage Seed
Grain maize
Leys for mowing - not strictly a crop in this group, similar in rotational respects to herbage seed but producing a relatively low gross output.

The choice which an individual cereal grower may make from these alternatives will, of course, depend on the relative importance given to the considerations listed at the beginning of this paper - and some general comment on each of these considerations now follows.

FINANCIAL FACTORS

The Gross Margin contributed by the crop

A guide to profitability of the crops is given by the 'average' and 'target' or premium gross margin figures set out in Table 6. They are, of course, generalisations only. The actual profitability in a particular situation will depend not only on the gross margin potential of the crop itself but also to a considerable degree on the skill of the grower and on such factors as its suitability to the soil and climate conditions, the plant nutrient status of the soil, the prevalence of weeds and the extent to which the crop is susceptible to shortcomings in these factors. At current costs and prices winter oilseed rape, peas harvested for processing and herbage seed have average gross margins which are higher than barley. A 34 cwt crop of wheat however has a better gross margin than all the crops in Table 6 except the higher value herbage seed crops (S23 perennial ryegrass for example)

TECHNICAL FACTORS

The effect of introducing an alternative crop (a break-crop) on the yields of succeeding cereal crops is difficult to assess with any precision. Evidence from trials varies considerably but the general indication is pretty conclusive that under most conditions there is a benefit, also that the differences between individual short term break-crops is relatively small.

Soil structure

Generally there is relatively little scope for improving soil structure and organic matter content through arable cropping although short-term leys can confer short-term benefits. On the other hand peas beans and oilseed rape are themselves very susceptable to such defects as compacted soil layers and pans. Crop residues from some crops can hinder seed bed preparation afterwards if they are not well fragmented and incorporated into the soil, and late harvesting of maize, field beans and spring oilseed rape can cause structural damage to some soils under wet conditions.

Weed control

Oilseed rape is a good smother crop and is also tolerant of many sprays used for grass weed control - a valuable combination. Spring rape and peas offer opportunities for autumn and spring cultivations to check weeds but peas and field beans are 'open' crops which unless sprayed can allow a build up of weeds, especially couch in beans. Herbage seed stands can also allow a build up of couch and leys for conservation may result in an increase in annual grass weeds as well.

Cereal pest and disease control

In their favour, most alternative crops are immune to take-all and other soil-borne diseases of cereals - oats maize and italian ryegrass being the least resistent and all are immune to the straw and leaf diseases (glume blotch in wheat and mildew in barley). Crops which allow volunteer cereals or couch to persist are obviously less effective as disease breaks - leys and beans are probably the crops in which this is most liable to occur.

The alternative crops themselves are not of course without disease problems, which can increase when an increased acreage is grown in a particular locality. Weevil in oilseed rape and pea midge are examples. Increased frequency in the rotation can also result in disease problems, examples being chocolate spot in beans and club root in brassicas.

Reduced variable costs

Benefits conferred in terms of reduced variable costs of growing succeeding cereal crops are difficult to quantify in that they are mostly indirect benefits through disease and weed reduction. Only leguminous crops - peas, beans or leys containing clover - appear to have a direct effect in terms of nutrient residues.

Wheat entry

The value, or otherwise, of a crop as a wheat entry depends very largely on its effectiveness in providing a disease 'break' especially from take-all. Trials on Experimental Husbandry Farms indicate that the benefits are generally less after oats than after beans but that there is a better response in winter wheat after most break crops than when it is introduced directly after long runs of barley. Some crops are harvested too late for winter wheat to be planted afterwards e.g. maize, field beans and sometimes spring oilseed rape.

Other grains in cereals

The E.E.C. marketing regulations set strict standards for adulteration of wheat and barley with other grains. In this respect it is worth remembering that alternative crops allow opportunities to rid land of potential volunteer cereal plants especially after a dry autumn when shed grain is reluctant to germinate.

MANAGERIAL FACTORS

Labour and machinery requirements

Most of the alternative crops in Table 6 have low labour requirements which fit in well with the labour profile of cereal growing* by helping to extend the planting and harvest period. Field beans, spring oilseed rape, maize and clover for seed are all harvested after the main rush of harvest is over, while winter oilseed rape, peas, the ryegrass especially cocksfoot and fescues come to harvest before. Maize and red clover harvest however can compete with winter wheat planting as can the planting time of winter beans. Planting winter oilseed rape tends to come at a rather busy time in late August and early September although this is not a serious problem if the crop follows winter barley and is planted with a minimum of cultivations. Spring beans are usually in the ground before spring barley while spring oilseed rape, maize and undersown grains can be planted after barley drilling. Peas are perhaps the crop which is most likely to conflict with spring barley at planting time if conditions are not right for planting them erlier. These remarks are of course generalisations as the weather conditions will obviously have a big effect on timing.

Additional capital for machinery and equipment

This requirement is virtually negligible for field beans. Difficulty may be experienced in planting them deep enough with some corn drills and agitators may be required in the seed box to prevent bridging. Auger type grain conveyors can be unsatisfactory for handling undried beans and combines may become very dirty especially in wet harvesting conditions.

A lot of cereal growing equipment is capable of handling small seed crops such as oilseed rape and herbage seed without modification but some corn drills, combines and dryers may require modifications which could amount to between £200 and £300 in total. Typical modifications are fitting restrictors or small seed boxes to drills, additional sieves and modifications to the air flow mechanisms of combines, false floors to ventilated bin drying systems and additional screens to cleaners.

* see appendix.

When modifications are required for peas they are usually agitators in some drills and crop lifters for combines - a total of £150 or so. Grain augers and chain and flight conveyors are liable to cause considerable damage to peas and may have to be replaced by bucket elevators and belt conveyors. When peas are combined direct their prostrate nature may result in considerable stone damage to combines.

Winter oilseed rape, peas and herbage seed crops may be harvested by cutting and windrowing first, threshing later using a combine fitted with a pick-up reel. This precedure can give more evenly ripened material for threshing, reduced shattering losses and improved quality. Also, the time of combining is less critical. Tractor mounted windrowers may cost £400 to £550 and pick-up reels £300 to £400.

Grain maize is the odd man out in that the additional equipment required can be substantial. A precision drill will cost £350 to £400 and harvesting machinery can range from a simple combine attachment, suitable for small acreages up to 50 or so, costing £300 to £400 through picker attachments in the £2000 to £3000 range up to complete maize harvesters costing £8000 to £10,000. Farm dryers do not usually require much modification to handle maize but few have the capacity to keep pace with anything but very small harvesting equipment because of the high moisture (38%) at which the crop is frequently harvested and the need to dry it slowly. Some form of contract or centralised group drying arrangement is therefore often necessary.

PRESENT MARKET AND FUTURE PROSPECTS

Recently the E.E.C. has been producing just over half its requirements of maize and less than a quarter of its vegetable oil needs, so that there is still substantial scope for expansion in maize and rape production under the C.A.P. support. Nearer home, production of oilseed rape in the U.K. will have to expand a further four-fold (to about 126,000 acres) before production equals our present rape - oil consumption and beyond that there could still be scope for substituting rape - oil for other imported vegetable oils as well as exporting it to other E.E.C. countries. Contracts are being offered now for the 1974 crop at well over £100 a ton ex farm. In the long term however expansion of soya bean production in USA and S.America, which has been stimulated by the present protein shortage, could bring down the world prices for vegetable oils and indirectly influence the C.A.P. support. Conversely the switch from maize to soya in the Americas coupled with shipping difficulties created by fuel shortages may keep the feed grain market buoyant.

The prospects for feed beans and peas appear rather less hopeful with the prospect of increasing supplies of other vegetable proteins

(sunflower, rape and soya); a view supported by the recent E.E.C. directive limiting price support for feed peas and beans. The E.E.C. market for harvested peas of high processing quality appears likely to remain good, however. The problem for U.K. growers will be in meeting the continental quality requirements in our uncertain climate. The low Community tarriff also means that we will be in fairly direct competition with non E.E.C. producers. However, after the cut back in recent years, processors in the U.K. are again offering new contracts at over £130 a ton for top quality. The prospects for expanding our share of the frozen pea market in Europe appears to be even more promising in view of the rising demand and the fact that we are closer to the European consuming centres than is their traditional supplier - Sweden.

It seems that the seed trade for reasons which are not very clear, is coming to regard Britain as the place to grow herbage seed and there is therefore considerable scope for expanding production here. The current prices for seed coupled with the prospect of a high E.E.C. subsidy for the next few years could well encourage this. The main uncertainty at the moment is the extent to which Danish farmers (who are major producers of herbage seed) will switch under the influence of the C.A.P. to other crops such as oilseed rape. Prices are difficult to forecast from year to year because the demand/supply position is not known until after harvest, for this reason most growers favour open contracts, under the present conditions of seed shortage.

CONCLUSION ON COMBINE HARVESTED CASH CROPS

To sum up on the merits of these crops; oilseed rape and field beans are relatively easy crops for the cereal grower to handle and in general they help to even out the labour peaks associated with cereal production. Beans have up to now had the disadvantage of a high variability in yield and are not very effective checks to grass weed build up.

Peas for harvesting fit in well labour - wise but require considerable expertise to get good quality with low waste and strain. Even for the experts the quality is very dependent on good weather at harvest time.

Herbage seed production has a relatively low labour requirement, and can also fit well into a cereal system, but it is essentially an enterprise which requires long term planning and must occupy a central place in the farming system. It is financially rewarding for those prepared to persevere and gain the necessary experience and expertise. Production is mainly confined to the southern and eastern counties where the weather is more likely to be sunny and dry at harvest time.

Grain maize is a crop with a potential for high gross margins under favourable conditions and skilled handling but which requires further development in growing techniques and varieties before it becomes established as a widely grown crop in this country. Average yields here do not at present compare very well with the European average of about 45 cwt per acre. The crop needs a well drained fertile soil and, with the varieties at present available, production is confined to situations below 400 feet south of a line from Bristol to Norwich.

(III) WHAT AREA TO GROW

Besides the actual choice of crop the extent of improvement in yield of subsequent cereal crops will also depend on:

1) The duration of the break cropping
2) The extent of build-up of cereal soil borne pests and diseases at the point when the break-crop is introduced

Generally a one-year break after a long sequence of take-all or eye-spot susceptable cereal crops will only improve the yield of the crop immediately following it, with a reduction in the yield of subsequent crops. An example of the yield pattern which may occur is show in Table 7.

Table 7 - A likely pattern of barley yields after a one year break

1st	Barley crop		+20%
2nd	Barley crop		-15%
3rd	Barley crop		-10%
4th	Barley crop		-10%
5th	Barley crop	=	continuous yield

Two year breaks - a ley or two arable crops - have been shown to be consistently more effective than single year breaks after a long cereal run in achieving an improvement in the two or three following cereal crops although on some farms and in some years the difference in benefit is small.

An effective and, judging from our surveys, a fairly widespread use of one-year breaks is to introduce them fairly frequently in order to maintain a high level of cereal yield which has already been established by, for example, a longer break such as a three year ley. This practice also provides a frequent entry for wheat. The budget in Table 8 illustrates the likely economics of such a course when one of the relatively lower gross margin crops is employed.

Table 8 Budget for a rotation of spring oilseed rape, winter wheat, barley, barley

	Contribution to farm gross margin £
Spring oilseed rape yield 17 cwt	58
Wheat yield 120% of average = 41 cwt	110
Barley " 100% of average = 30 cwt	70
Barley " 100% of average = with increased fertiliser	67
	305
	4
Farm gross margin per acre	= £76

(Average for continuous barley say £65)

One quarter of the arable area of a farm is probably about the upper limit for an alternative crop. Apart from the increased pest and disease risk when a crop is grown too frequently, some contracts - processed pea for example - may stipulate that the crop must not be grown more frequently than one year in four.

Following the line of reasoning behind the budget in Table 8 the ideal choice might appear to be a crop that is potentially more profitable than barley and which can be followed by wheat, and to grow as large a proportion of these two as it is safe to without running too great a risk of pest or disease build-up. The next alternative is to use a potentially less profitable crop, as in the example, in order to maximise the wheat acreage and yield. Introducing a single alternative crop into a long barley sequence seems likely to confer the least potential benefit unless there are particular circumstances favouring such a course.

Finally I would like to conclude by quoting a comment by R.G.Hughes on the influence of technical skills and management level on the profitability of cereal growing.

> "The ability of individual growers in handling the basic resources - soil, labour and machinery - together with their individual skills in crop management, have been shown (by ADAS surveys) to have a much greater influence on cereal yield than cropping sequences."

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