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Organic Farming Centre

Annual Report 1990

ORGANIC FARMING CENTRE

The Organic Farming Centre was founded in 1989 by the Edinburgh School of Agriculture and the Centre for Human Ecology, and is the first project of its kind in Europe to receive major institutional support.

This breakthrough has occurred at a time when organic food is in high demand by both retailers and consumers, and organic farming is recognised as one answer to a range of environmental concerns.

The Organic Farming Centre was established to carry out a programme of:

- ***Research and Development into crop and animal husbandry.***
- ***Information and training services.***
- ***Market research and development.***

The Edinburgh School of Agriculture/Scottish Agricultural College, Edinburgh has an international reputation in both temperate and tropical agriculture, based on its long experience in teaching and high calibre research and development.

The Centre for Human Ecology provides a forum in the University of Edinburgh for the development, teaching and application of long-term sustainable options for the future.

The Organic Farming Centre is sponsored by:

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ORGANIC FARMING CENTRE

ANNUAL REPORT 1990

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EDINBURGH SCHOOL OF AGRICULTURE
UNIVERSITY OF EDINBURGH
CENTRE FOR HUMAN ECOLOGY

ORGANIC FARMING CENTRE

SECTION 1

EXPERIMENTATION

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SECTION 1

EXPERIMENTATION

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CHAPTER 1

INTRODUCTION

CLIMATE

Jamesfield farm (see Appendix 1) is situated on, or extremely close to, the boundaries separating agroclimatic areas 7 and 9 in Scotland (Francis, 1981). Agroclimatic areas are regions of very similar climate delineated by the Meteorological Office. The predominant agricultural land-use in agroclimatic areas 7 and 9 is arable/horticulture (Francis, 1981). As can be seen from the data given in Table 1, the climate at Jamesfield farm is very suited for vegetable production. The accumulated temperature which is a good index of the suitability of the climate for sustained vegetative growth is exceeded in Scotland only by the accumulated temperatures in the coastal area of East Lothian Region and the south-west coastal area of Strathclyde and Dumfries and Galloway Regions.

WEATHER

The weather in the area of Jamesfield farm during 1990 was largely warmer and wetter than the long term average (compare mean temperature and total rainfall statistics in Tables 1 and 2).

The period of January to August inclusive was warmer than normal. By contrast, the months of September to December inclusive were cooler than average. The warm weather throughout most of the 1990 growing season with episodes of high temperatures at times (eg. end of April-beginning of May; during August) led to problems of drying of the soil which could have been alleviated by irrigation. However, drying of the soil was not a problem at other times of the year.

January and February were the wettest 2 months ever recorded by the Meteorological Office in Scotland and rainfall was well above normal in the Jamesfield farm area during these months as well as during October. A wet January and February followed by a March of average rainfall but, more particularly, by an April of above average temperature and below average rainfall led to relatively quick drying of an initially very wet soil which caused some problems with seedbed preparation at Jamesfield farm. In particular, it led to the formation of soil aggregates which were very difficult to break down with normal cultivation techniques.

A wet October caused some difficulties with the potato harvest. Snow fell once only at Jamesfield farm during 1990: on 24 January when it lay to a depth of 1cm. Although it quickly disappeared thereafter, this snowfall coincided with the arrival of the Merino sheep at the farm. They did not appear to be discomforted by the prevailing weather conditions at the time of their arrival, nor by the persistent,

TABLE 1 **Mean values of the basic meteorological variables for the area around Jamesfield farm [interpolated from values given by Francis (1981) for agroclimatic areas 7 and 9; most values are means of a 19-year period from 1957 to 1975: some (eg. air temperature, rainfall, growing season) cover a 30-year period from 1941 to 1970]**

Month	Air temperature (°C)	Rainfall (mm)	Potential Evapo-transpiration (mm)	Sunshine (hours)
(i)				
January	2.6	63	5	5
February	3.0	47	10	80
March	5.0	45	30	107
April	7.4	62	50	160
May	9.8	53	75	178
June	12.9	73	88	180
July	14.4	82	82	172
August	14.0	65	63	132
September	12.3	65	37	105
October	12.4	70	18	95
November	9.4	67	5	62
December	5.5	68	5	45
Total		760	468	1321
Mean	9.1			

(ii)

Growing season 220-225 days (5 April - 10,15 November)

(iii)

	Median	Inter-quartile range
Access period (days)	217	180-250
Ending field capacity	early March	late Feb - mid-March
Return to field capacity	early Nov	early Oct-late Nov
Maximum summer soil moisture deficit (mm)	87	65-97
Excess winter rainfall (mm)	255	175-325
Accumulated temperature (degree days above 0°C, Jan-June incl.)	1280	1200-1360
Date of last spring air frost	mid-April	early April-early May

occasionally strong, westerly winds throughout much of February and March. During March, the swollen Tay River burst its banks to flood low-lying farmland in the area of Jamesfield farm, although not the farm itself.

SOILS

The soils of the vegetable cropping field at Jamesfield farm (see Appendix 2) belong to the Carpow soil association. This association comprises soils developed on middle and upper river terrace deposits which contain materials derived from Old Red Sandstone sediments and lavas together with a significant inclusion of material of Highland metamorphicorigin. The principal soils of the Carpow association are the freely *drained Carpow series and the imperfectly *drained Carey series. Carey soils normally have higher proportions of silt and very fine sand than Carpow soils which reduce the permeability of Carey soils and account for much of their impeded drainage status. The imperfectly drained soils of the Carey series predominate in the vegetable cropping field. These soils are normally underdrained, but the efficiency of the underdrainage in the cropping field was found to be sub-optimal. Wetness problems may be encountered therefore in years of high rainfall.

TABLE 2 **Temperature and rainfall statistics for Perth weather station during 1990 (copyright Meteorological Office, Edinburgh).**

Month	Mean temperature (°C)	Total rainfall (mm)
January	5.3	163
February	5.8	199
March	7.8	48
April	8.0	30
May	11.6	41
June	13.1	136
July	15.5	29
August	15.6	57
September	11.9	31
October	10.1	121
November	5.4	35
December	3.9	76
Total		966
Mean	9.5	

* **Footnote:**

In soil survey terminology, 'free', 'imperfect' and 'poor' have very precise meanings, viz. in freely drained soils, a water table occurs within one metre of the surface only ephemerally and on rare occasions; in imperfectly drained soils, in the absence of underdrainage, a water table occurs within 700mm of the surface for between 90 and 180 days each year; and, in poorly drained soils, a water table occurs within 700mm of the surface for more than 180 days each year.

The 'land capability class for agriculture' was determined for the vegetable cropping field by applying the guidelines given in Bibby et al (1982). On the basis of this classification, the Carpow soils are classed as 2_c and the Carey soils as 2_{wc}. The 'c' subscript denotes that the principal limitation is climate and the 'w' subscript denotes an equal wetness limitation. Class 2 land is capable of producing a wide range of arable crops: 'Cropping is very flexible and a wide range of crops can be grown though some root and winter harvested crops may not be ideal choices because of difficulties in harvesting. The level of yield is high but less consistently obtained than on Class 1 land due to the effects of minor limitations affecting cultivation, crop growth or harvesting. The limitations include, either singly or in combination, slight workability or wetness problems, slightly unfavourable soil structure or texture, moderate slopes or slightly unfavourable climate. The limitations are always minor in their effect however and land in the class is highly productive' (Bibby et al, 1982).

The soil pH and availabilities of the major nutrients, potassium, phosphorus and magnesium, were found to be rather variable across the vegetable cropping field. Soil pH values ranged from 5.8 to over 7.5. Of the nutrients, potassium was moderately available and phosphorus and magnesium were freely available.

CHAPTER 2

VEGETABLE PRODUCTION

INTRODUCTION

The rotation at Jamesfield farm is essentially stock-less and, etherefore, from an organic standpoint, less than ideal. To minimise inconvenience to the farmer, the decision was taken to concentrate the vegetable experiments on one area rather than scatter them across the various commercial crops on the farm. The area chosen was found by prior survey to have a weed problem, principally couch grass (Elymus repens) towards the eastern end of the field. The decision was taken, therefore, to grow so-called 'cleaning' crops during 1990, i.e. potatoes and brassicas [no clubroot (Plasmodiophora brassicae) spores or potato cyst nematode (Globodera pallida and G. rostochiensis) cysts were found in soil of vegetable field by prior survey]. Because of the previous rotation (see Appendix 2), and the decision to grow 'cleaning' crops, the vegetable experimental area is essentially a remedial situation rather than an ideal one: the field is still in conversion and will be for some time to come. Ideally, the vegetables would have been preceded by a 3-4 year grass/clover ley to build up soil fertility. The soil was fertilised with off-farm farmyard manure [in the autumn, at the rate of 30.1 tonnes/hectare (12 tons/acre), w/b 6 November 1989, and in the spring at the rate of 20 tonnes/hectare (8 tons/acre), w/b 8 April, 1990; manure came from Simmental cross cows and heifers fed on silage, bruised barley, high phosphate minerals, feeding barley straw and pot ale syrup and had been stored in covered cattle courts from beginning of December 1988]. The manure short-circuited the need for a grass/clover ley preceding soil nutrient-demanding vegetable crops.

At the suggestion of the farmer, the soil in the vegetable field was ploughed in the autumn. From the organic viewpoint, the soil would have preferentially been ploughed in the spring, reducing overwintering nutrient leaching losses. The farmer urged ploughing in the autumn because, with his knowledge of local soil conditions, the soil in the vegetable field would have been difficult, if not impossible, to plough in the spring - as turned out to be the case in one of the livestock fields in the spring of 1990 because of very wet soil conditions (the vegetable field was subsoiled w/b 25 September 1989, and mould board ploughed w/b 9 October 1989). The situation is then not ideal from the organic standpoint but is not likely, however, to be very different from what many farmers would find if they wanted to grow organic vegetables.

The range of vegetables grown at Jamesfield farm during 1990 comprised crisphead and Little Gem lettuces, calabrese, cabbages, and potatoes. All commercially grown vegetables were produced to The Soil Association Standards for Organic Agriculture (Anon, 1989) and marketed by Polytun Growers Limited, of Bridge of Earn. Planting commenced in mid-April and ceased in early August.

LETTUCES

Three varieties of crisphead lettuces were grown: Kelvin, Malika and Caledonia; and one variety of Little Gem lettuce was grown: Little Gem. Crisphead lettuces were grown in 60cm wide rows at 30cm plant spacing. Little Gem lettuces, by comparison, were grown in 20cm wide rows at 20cm plant spacing. All lettuce plants were raised in peat blocks and transplanted on seventeen dates between April and July.

Weed management posed a greater problem with the crisphead lettuces than with the Little Gem lettuces, mainly owing to the close plant spacing and longer growing season of the crisphead lettuces. A traditional steerage hoe was found to be most effective. An Opico Rolling Cultivator was used initially, but problems were encountered if the machine was set to weed too close to the plants, or its forward speed was too fast. In both instances, soil tended to be thrown into the hearts of the lettuces, resulting in complaints from buyers. This problem did not occur with the brassica plants where the Opico machine was the most useful mechanical weeder (see under Calabrese and Cabbages). In addition to mechanical weeding between plant rows, hand weeding with hoes between plants in the rows occurred once, often twice.

In general, few pest and disease problems were encountered with the lettuce crops during 1990. The exceptions were aphids (principally peach-potato aphids, Myzus persicae), rabbits (Oryctolagus cuniculus) and roe deer (Capreolus capreolus). A combination of fencing and netting gave a reasonable degree of management of the rabbit and deer problems. Once the aphid numbers started to increase on the lettuces early in the growing season, two sprays of 'Savona' were applied at the manufacturer's recommended rate and interval (active ingredient: natural fatty acids; Koppert (UK) Ltd., P.O. Box 43, Tunbridge Wells, Kent, UK). No further sprays were needed as the aphid numbers declined reasonably rapidly in mid-season, perhaps as a consequence of the predatory activities of noticeably high numbers of ladybird beetles (Coccinellidae).

CALABRESE AND CABBAGES

Two varieties of calabrese were grown: Corvet and Shogun; and several varieties of cabbages were grown, including Pedrillo (summer cabbage), Freshma (autumn cabbage) and Celtic (Savoy x White cabbage hybrid). All calabrese and cabbages were transplanted as peat modules. Calabrese plants were grown in 60cm wide rows at 20cm plant spacing. Cabbage plants, by comparison, were grown in 60cm wide rows at plant spacings varying with type.

Much of the brassica area was covered with a fabric cover ('Agryl P17', a non-woven sheet made of continuous heat sealed polypropylene fibres without the use of a chemical binder; available from Polycrop Growing Systems, Farthing Road, Ipswich, Suffolk IP1 5AP) to prevent a cabbage root fly (Delia radicum) attack. The worth of this policy was amply demonstrated by the high incidence of damage to plants by the first generation attack of the root fly in an area left deliberately uncovered. The damaged plants died later in the season with the onset of warm, dry weather conditions. Apart from cabbage root fly, the main pests to affect the brassicas during 1990 were the cabbage aphid (Brevicoryne brassicae) and caterpillars of the small cabbage white butterfly (Pieris rapae). The aphids were more of a nuisance than an economically important pest, especially on the savoy types of cabbages. The caterpillar problem was, however, more widespread. Applications of Bacillus thuringiensis var. kurstaki ('Dipel 4L'; Abbott Laboratories, 14 Street & Sheridan Road, North Chicago, Illinois 60064, U.S.A) did not appear to alleviate the problem, possibly owing to the high seasonal temperature and incidence of ultraviolet light, both of which reduce the efficacy of the Bacillus preparation. The cabbages affected by caterpillars had to be more severely trimmed than the relatively unaffected plants at the time of cutting.

The main diseases of calabrese and cabbages during 1990 were downy mildew (Peronospora parasitica) on both types of plant and bacterial spear rot (Erwinia spp. and Pseudomonas spp.) on calabrese. The spear rot was not serious, occurring late in the season. The downy mildew was, however, more serious. The transplant, weakened by the disease, suffered badly in comparison with healthy plants from a lack of soil moisture later in the season. Shortly after transplanting, the fabric cover was observed to ameliorate to some extent the deleterious effects of the disease on the plants. An attempt was made to control the downy mildew disease of the transplants in the raising polytunnel by applying copper sulphate (according to Soil Association Standards, a synthetic fungicide could have been used, but its use was deemed not to be in the organic spirit). While controlling the disease to some extent, the copper sulphate was rather seriously phytotoxic.

The Opico Rolling Cultivator was found to be the most effective machine for suppressing weeds in the brassicas, particularly in later planted calabrese where it was used to throw soil aggressively into the rows to cover weeds there while, at the same time, mulching smaller, germinating weeds between the rows.

One of the major disadvantages of using fabric covers as floating mulches to manage migrant insect pests on organically grown brassica crops is an increased weed problem (McKinlay, 1987;1990). As a consequence, a steerage hoe had to be used and casual labour employed to weed between and in the rows, respectively. The extra disturbance of the soil which these cultivations caused led, presumably, to increased soil moisture losses at a time and in a season when the opposite effect was what was needed. The lack of irrigation during 1990 was without doubt a problem. The earlier plantings of calabrese, for instance, did not form marketable spears, but flowered prematurely to give a disappointing overall marketable yield of 2.2 tonnes/hectare.

POTATOES

A total area of 2.1 hectares of commercial potatoes was grown by the Organic Farming Centre at Jamesfield farm during 1990. Approximately one half of the total area was stone-separated; the other half was not. Tubers (variety 'Cara'; class AA; 55-60mm; untreated with sprout suppressant) were planted on 3 May at 37.5cm inter-tuber spacing in furrows 85cm apart.

At, and shortly after, plant emergence, weeds in the area which had been stone-separated were controlled by a combination of harrowing down the ridges followed by ridging up as well as the use of an inter-row cultivator. Weed control in the stone-separated area was given by a disc weeder/ridger. Vigorous haulm growth which was able to suppress weed development, combined with early mechanical weed control, helped to keep the potatoes relatively weed-free during 1990.

Bordeaux mixture was applied twice to suppress any potato blight (Phytophthora infestans) development. It was applied on 6 July and 2 August at a rate of 5kg/hectare. Blight was first observed in the crop towards the end of August and the haulms were pulverised very shortly thereafter. Apart from this late and low incidence of blight, and very small areas of plants infected with blackleg (Erwinia carotovora var.atroseptica) and stem canker (Rhizoctonia solani), the potatoes were reasonably disease-free. Powdery scab (Spongospora subterranea) was observed on a proportion of the harvested tubers, but the incidence of the disease was too low to affect the marketability of the tubers.

The stone-separated area achieved an average harvestable yield of 24.7 tonnes/hectare (10 tons/acre); 57% were accepted for pre-packing. By comparison, the area which had not been stone-separated achieved an average harvestable yield of 34.6 tonnes/hectare (14 tons/acre); 68% were accepted for pre-packing. The difference in pre-packing acceptance figures between the two areas appears to reflect a difference in the size of the potatoes: from the 8 sample digs taken in each area, a higher percentage of the tubers in the area which was not stone-separated was found to be over 45mm, the minimum size for pre-packing.

Because of changes in the soil type between the area in the field which was not stone-separated and the area which was - with the soil in the stone-separated area becoming heavier - the evidence for differences in yield between the two areas has to be interpreted with caution. There are three possible reasons why stone separation reduced yield. Firstly, plant nutrition was poor. During the process of stone separation, the soil was worked with a bed-making machine which may have buried the spring application of farmyard manure too deep for efficient root uptake of nutrients. This possibility is supported by the observation that the haulms of the plants in the stone-separated area were paler and less vigorous than the haulms of plants growing in the area which had not been stone-separated. Secondly, stone and clod removal led to impeded soil drainage. Although the 1990 growing season at Jamesfield farm was largely dry, a spell of very wet weather occurred at the end of June (see Table 2) which led to water lying in the furrows of the stone-separated area, unable to drain away. At this time, the plants in this area appeared to be stressed because their leaves were curled upwards. An observation which supports the possibility of the differences in yield between the two areas being caused by impeded soil drainage is the higher incidence of blackleg in the stone-separated area. The spread of the blackleg pathogen is accelerated by poor drainage. Blackleg disease could, of course, have been the principal cause of reduced yields and tuber sizes. To disentangle the interaction between poor drainage and blackleg incidence is not an easy task. The third possible reason why stone separation reduced yield concerns weed cover. At harvest, the stone-separated area had a greater incidence of weeds [especially chickweed (Stellaria media)] which arose, presumably, because the ridges in this area were not harrowed down and re-built for fear of pulling back up to the soil surface the previously separated out and buried stones and clods. The weeds did not impede, however, the progress of the potato harvester. Whatever the cause(s) of the difference in yields between the stone-separated area and the area which was not stone-separated, the study should be repeated.

BRASSICA EXPERIMENTS

CALABRESE DISEASE MANAGEMENT
CABBAGE DISEASE MANAGEMENT

Introduction

The two major shoot diseases of calabrese are downy mildew (Peronospora parasitica) and bacterial spear rot (Erwinia spp. and Pseudomonas spp.).

Downy mildew can occur either very early or late in the development of calabrese. Early seedling infections can lead to seedling or systemic infection which becomes evident only at maturity when the spears are cut open to reveal internal discolouration and sporulation of the fungus. With late infections, fungal growth and sporulation can occur directly on the surfaces of the spears.

Bacterial spear rot of calabrese is a difficult disease to manage because it occurs on the mature spears, close to harvest when the scope for treatment is limited. Although its occurrence is unpredictable, spear rot has become in recent years the most important disease of calabrese in the UK.

Because the incidence of diseases on brassicas at Jamesfield farm during 1990 was not high - no disease developed at all in the cabbage experiment - results are presented for the calabrese experiment only. Although this experiment was designed to test a range of treatments for the management of downy mildew and bacterial spear rot, the appearance of powdery mildew (Erysiphe cruciferarum) in response to a prolonged period of warm, dry weather gave the opportunity of testing the treatments against this disease. Powdery mildew can reduce calabrese yields if it infects the young, developing spears.

Objective

To assess a number of novel treatments for the management of a range of foliar diseases of calabrese. Foliar diseases, such as downy mildew and bacterial spear rot, are much more likely to require specific treatments than soil-borne diseases which, to some extent, can be controlled with rotations.

Method

Experimental details, including layout and treatments, are given in Appendices 4 and 5. The calabrese seedlings were raised under polythene in modules. Following transplanting, each of the plants in the middle two rows of every plot (excluding end-of-row plants) were monitored regularly for the natural occurrence of disease. The degree of infection was assessed subjectively on a 0-5 scale (5 = severe infection). At the same time as assessing for infection, the plants were assessed, again subjectively, for treatment toxicity on a 0-5 scale (5 = severe scorch) and for vigour on a 1-10 scale (10 = high vigour).

Results

Although downy mildew infected the calabrese seedlings before transplanting, thereby providing a continuous source of inoculum throughout the life of the plants, disease incidence never rose above low to moderate. In consequence, no disease score was significantly ($p<0.05$) different from untreated.

The leaves of calabrese plants treated with Bordeaux mixture became scorched soon after the initial applications. Leaf scorch was eliminated by reducing the dose of later applications by 50%. The cabbages did not appear to be deleteriously affected by the full dose of Bordeaux mixture.

Powdery mildew infection appeared on the leaves of the calabrese plants during early September, about eight weeks after transplanting. The incidence of disease was assessed on 24/9/90 and again on 12/10/90. On both occasions, Bacillus subtilis and Bordeaux mixture significantly ($p<0.05$) reduced the expression of the disease compared to untreated (Table 3). On 12/10/90, sodium bicarbonate appeared visually to reduce the incidence of powdery mildew, but the disease score did not differ significantly ($p>0.05$) from untreated.

TABLE 3 **Calabrese disease management: powdery mildew infection on Calabrese** [1]

Treatment	Assessment dates	
	24/9/90	12/10/90
Untreated	2.5	2.8
Marjoram oil	2.5	3.0
Waterglass	2.7	2.7
Equisetum	2.2	2.5
Bacillus subtilis	1.7	1.7
Sulphur	2.2	2.2
Bordeaux mixture	1.0	1.5
Sodium bicarbonate	2.2	2.0
'Bio-S'	2.2	2.8
LSD p = 0.05	0.8	1.1

[1] mean disease index on leaves (scored on 0-5 scale: 0 = no disease; 5 = severe disease), and least significant differences.

Bacterial spear rot did not occur in the calabrese experiment, despite leaving the spears to develop over the longest period of time possible - until the buds began to break.

Discussion

The low to moderate incidence of downy mildew disease and the complete lack of bacterial spear rot disease in the experiment prevented the rigorous testing of the treatments for the management of the major foliar diseases of calabrese. The incidence of these diseases in commercial crops of calabrese, grown conventionally elsewhere in Fife, was also low during 1990. Compared to conventional systems, the reduced amounts of fertilizer nitrogen applied at Jamesfield farm are likely to have contributed to an increased resistance by plants to disease (Robertson, 1988). Overhead misting or irrigation of experimental calabrese may ensure reliable incidences of both downy mildew and bacterial spear rot diseases.

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[R. Harling; J. Chard: Scottish Agricultural College (Edinburgh)]

CALABRESE VARIETIES

Objective

To assess the growth and development of a range of calabrese varieties in an organic production system.

Method

Experimental details, including layout and varieties, are given in Appendix 6. Transplants were raised from seed sown into 308 cell modular trays in an unheated glasshouse on 5 June 1990. The plants were covered in the field with a fabric cover ('Agryl P17'; Polycrop Growing Systems, Suffolk IP1 5AP) from transplanting until 31 July to provide protection from cabbage root fly and other air-borne pests. Harvesting commenced 6 September and 7 harvests were made finishing on 18 October. The maturity, yield and quality characteristics of all spears which were each cut to a total length of 15cm were assessed at harvest.

Results and Discussion

The maturity, yield and quality characteristics of the spears of the calabrese varieties tested in the experiment are given in Tables 4 and 5.

Marketable yields, which did not differ significantly ($p>0.05$) between the varieties, were lower than would be expected in conventional systems. The main reason for lowered yields appeared to be narrower-than-normal head stalks (or butts). Just why the stalks were narrow is unknown, but may have resulted from a lowered availability of fertiliser nitrogen in the organic system (in comparison to conventional systems) or to a lack of soil moisture arising from the dry season. Further work is needed to clarify the causes of narrow stalks because stalk diameter is a major factor influencing market acceptability of calabrese varieties. Although stalks were narrow, head diameters were satisfactory. The proportion of plants producing marketable heads was good but mean headweights were low.

Marathon was the highest yielding variety with a high proportion of marketable heads and the highest proportion of large (125mm+) heads but also the highest proportion of thick (30mm+) stem butts. The heads of this variety were very dome-shaped with good bud quality. For outlets where the thick stems of Marathon may not be acceptable, the newer variety, Lancelot, appears promising. the yield of Lancelot in the experiment was second only to Marathon. Lancelot stems were slender, its heads were rather flat, and its buds were evenly sized, although quite large. Neptune and Coaster were relatively high yielding but appeared to be prone to hollow stem and looseness of the heads. Samurai and Shogun were late maturing and somewhat similar to Marathon. Of the standard varieties for producing high quality, slender stemmed heads - Corvet and Skiff - Corvet was particularly pale coloured. Caravel is a possible alternative to Corvet and Skiff producing small, high quality, spherical heads with extremely slender stems. The yields of Caravel were low but the heads were very well presented above the plants.

TABLE 4

Yield Maturity of Calabrese Varieties (means and standard errors)

Variety	Seed Source	Transplanting to 50% harvest (days)	Marketable Yield (Kg/m²)	Marketable No. Heads/Plant	Head Diameter (%)			Butt Diameter (%)	
					0 - 75 mm	75 - 125 mm	125 + mm	0 - 30 mm	30 + mm
Caravel	RSL	64	0.38	0.76	44.0	46.7	9.3	98.3	1.7
Coaster	RSL	64	0.46	0.73	19.0	63.0	18.0	83.0	17.0
Corvet	RSL	72	0.40	0.54	18.7	68.0	13.3	72.7	27.3
Hi-Calibur	HMI	62	0.38	0.76	44.7	46.7	8.7	90.3	9.7
Lancelot	PET	64	0.59	1.04	40.7	48.3	11.0	87.0	13.0
Marathon	SAK	79	0.66	0.83	19.7	56.3	24.0	69.0	31.0
Neptune	RSL	64	0.56	0.75	27.7	52.3	20.0	72.3	27.7
Samurai	SAK	84	0.46	0.67	22.0	65.7	12.3	75.0	25.0
Shogun	SAK	81	0.45	0.71	26.7	62.7	10.7	79.7	20.3
Skiff	RSL	69	0.45	0.70	30.3	61.0	8.7	70.3	29.7
Sumosun	BJO	62	0.38	0.82	35.3	62.0	2.7	78.3	21.7
SE (20df)		1.7	0.069	0.070	8.23	5.35	5.60	6.71	6.71

Key to Seed Sources:

BJO - Bejo Zaden
HMI - Harris Moran International
PET - Peto Seed Co. Inc.
RSL - Royal Sluis
SAK - Sakata Seed Corporation

TABLE 5

Quality Characteristics of Calabrese Varieties (means and standard errors)

Variety	Bud Colour	Bud Size	Evenness of Bud	Head Shape	Cluster Separation	Stem Angle Branching	Defects (%)			
							Hollow Stem	Loose	Immature	Others
Caravel	8.3	6.7	8.2	7.9	7.9	3.1	0	0	17	0
Coaster	7.0	6.9	7.5	6.4	6.9	1.5	11	7	6	1
Corvet	4.3	4.4	6.4	6.3	7.8	1.8	0	1	31	0
Hi-Calibur	8.5	8.2	8.3	7.6	8.4	2.0	0	1	4	1
Lancelot	7.3	7.4	7.5	5.5	7.9	3.9	0	0	0	1
Marathon	7.3	6.3	6.8	7.1	8.2	1.9	0	1	6	0
Neptune	6.5	6.7	7.1	5.4	7.4	2.5	11	4	5	0
Samurai	7.0	6.1	6.7	6.9	7.0	1.8	0	2	17	0
Shogun	7.5	6.0	6.7	6.1	8.5	1.1	1	1	18	2
Skiff	6.2	4.8	6.2	5.6	6.7	4.5	1	2	17	0
Sumosun	6.9	7.7	8.0	6.4	8.0	1.8	0	2	4	2
SE (20df)	0.54	0.49	0.47	0.36	0.41	0.60	-	-	-	-

Key to Quality Scores

Bud Colour	1 = Pale	10 = Dark
Bud Size	1 = Small	10 = Large
Evenness of Bud Size	1 = Uneven	10 = Even
Head Shape	1 = Flat	10 = Sphere
Cluster Separation	1 = Bud clusters over whole surface	10 = No bud clusters
Stem Angle Branching	1 = Long acute angled	5 = Short obtuse angled

The earliest varieties were Sumosun and Hi-Calibur. Although low yielding, the quality of the heads of both of these varieties was good with large, even buds. Both varieties could be useful in organic systems because of their rapid maturity, although the stems of Sumosun tended to be thick.

The experiment included a wide range of calabrese types, most of which demonstrated some usefulness for organic systems depending on the required production season and spear specifications. Greater experience is needed to assess which factors are most important when selecting calabrese varieties for organic husbandry before firm recommendations can be made. Bacterial spear rot (Erwinia spp. and Pseudomonas spp.) and downy mildew (Peronospora parasitica) were virtually absent in the experiment and may be less important in an organic production system than in a conventional production system. The tendency of some varieties to produce thick stems in conventional production systems appeared to be much reduced by organic production.

[M. Sutton : Scottish Agricultural College (Edinburgh)]

SENSORY EVALUATION OF CALABRESE VARIETIES

Objective

To evaluate objectively the sensory attributes of 3 varieties of calabrese.

Method

A sample of spears (approximately 1kg), from each of 3 varieties of calabrese (Samurai, Marathon and Shogun) was harvested on 2 October 1990 from the calabrese varieties experiment. The samples were immediately packed in ice, held overnight, and despatched to the AFRC Institute of Food Research (IFR), Reading Laboratory on 3 October. On receipt (4 October), the samples were placed in frozen storage for approximately 8 weeks prior to use. A retail sample of calabrese, variety unknown, was purchased at the same time from a local supermarket and treated identically.

Samples were taken from the freezer and partially thawed for 10 minutes at ambient temperature. Following rinsing under cold tap water, the stalks of the calabrese were cut off at the lowest bifurcation and the heads were cut into pieces. The samples were steamed in a microwave oven. They were then drained, and 3 pieces of each variety placed in small, glass dishes. Samples were kept on warming plates throughout sensory evaluation.

The assessment was conducted by 'fixed choice profiling' using 8 members of the IFR professional sensory panel. Samples were assessed for aroma, taste (flavour), and texture. Two sessions helped to develop the profiling descriptors. The panel reached a consensus of 7 descriptors for aroma, 9 for taste, and 6 for texture, listed below.

<u>Aroma</u>	<u>Taste</u>	<u>Texture</u>
Green grass	Bitter	Crunchy
Chemical	Green grass	Chewy
Musty	Overcooked	Bitty-clingy
Bitter	Acid	Stringy
Acid	Musty	Moist-juicy
Sweetness	Sweet	Hard
Overcooked	Nutty	
	Chemical	
	Spicy	

The samples were then judged on these attributes in one practice session and 4 replicate test sessions. All 4 varieties were assessed by all panellists in all sessions. The data were analysed by Principal Components Analysis.

Results

The organically grown varieties of calabrese showed a larger variation in aroma than the retail variety. In addition, the retail variety was differentiated from the other varieties by its greater association with 'green grass' (ie. raw, vegetable) aroma. Shogun tended toward 'overcooked' aroma.

The retail variety differentiated from the other varieties in taste. Samurai and Marathon replicated poorly and did not exhibit clear associations with any particular descriptors. Shogun was aligned with 'bitter', 'spicy', 'chemical' and 'overcooked' descriptors. The retail variety showed a strong association with 'green grass', 'nutty' and 'sweet' descriptors.

Considerable variation occurred in the perception of the texture of the organically grown varieties; none appeared to be closely aligned with any set of descriptors. The retail variety differentiated from the other varieties in texture and was associated with 'moist' and 'crunchy' descriptors.

Discussion

The experiment was clearly only a very preliminary examination, and suffered from a number of fairly obvious flaws. A principal problem would, of course, be the very different nature of the retail variety from the other varieties. It would not only most likely be a different variety, but also its entire history and treatment up to the time of arrival at the laboratory would have been very probably substantially different as well as unknown.

[D. Mela : AFRC Institute of Food Research, Reading Laboratory)]

CALABRESE TRANSPLANT RAISING SYSTEMS

Introduction

The growth of vegetable transplants in modular trays with cells of small volume (approx. 115ml/cell) is normally controlled by carefully governing the availability of fertiliser nitrogen and potassium both in the compost and the liquid feed.

Objective

To assess the growth and development of calabrese transplants raised from seed sown in compost either without fertiliser nitrogen followed by a high rate of liquid feeding or with small amounts of fertiliser nitrogen followed by a lower rate of liquid feeding. As propagation systems should, ideally, allow some flexibility of transplanting date, the feasibility of 'holding' transplants on organic fertilisers was also studied.

Method

Experimental details, including layout and treatments, are given in Appendix 7. Seed of the calabrese variety, Corvet, was sown on 15 May 1990 in 4 different compost mixes in an unheated glasshouse. All composts were based on sphagnum peat, had their pH adjusted to 5.5-5.8 with ground limestone and contained all the phosphate necessary for propagation. Before the first transplanting date on 14 June, plant development was assessed by measuring heights, fresh and dry weights of 50 seedlings. Fresh weights only were measured before the second transplanting date on 29 June. The plants were covered in the field with a fabric cover ('Argyl P17'; Polycrop Growing Systems, Suffolk IP1 5AP) from transplanting until 20 July to provide protection from cabbage root fly and other air-borne pests. Harvesting commenced 24 August and 9 harvests were made finishing on 18 October 1990. The maturity, yield and quality characteristics of all spears which were each cut to a total length of 15cm were assessed at harvest. The heights and fresh weights of 5 plants (excluding roots)/plot were measured at the last harvest.

Results and Discussion

The calabrese heights, fresh and dry weights as well as the maturity, yield and quality characteristics of the plants at harvest in this experiment are given in Tables 6 - 10.

All fertiliser treatments gave satisfactory crops with no significant ($p>0.05$) differences in head quality or incidence of defects. Statistically significant ($p>0.05$) differences were found with crop vigour [Table 7] and total and marketable numbers of spears/plant [Table 8].

TABLE 6

Calabrese Transplant Raising Systems: seedling heights, fresh and dry weights at transplanting (means)

Treatment	Planting date			
	14 June		29 June	
	Plant Height (cm)	Plant Fresh Weight (g)	Plant Dry Weight (g)	Plant Fresh Weight (g)
CONVENTIONAL				
P_2O_5 only in compost	6.9	0.32	0.064	0.50
ORGANIC				
Bonemeal only in compost	6.9	0.30	0.074	0.48
CONVENTIONAL				
P_2O_5 + N in compost	10.9	0.63	0.114	1.17
ORGANIC				
Bonemeal and Hoof & Horn in compost	8.8	0.56	0.110	0.81

At the first transplanting date, the plants grown in compost which originally contained fertiliser nitrogen, whether from organic or non-organic sources, were much more vigorous and grew more rapidly than the plants which were fertilised solely by liquid feeding. At harvest, the treatments with nitrogen incorporated into the compost yielded more spears than the treatments which supplied all nitrogen by liquid feeding. The addition of hoof and horn to the compost appeared to increase marketable yields, although a significant ($p>0.05$) difference was not measured.

At the second transplanting date, two weeks later, the plants grown in compost which originally contained fertiliser nitrogen, whether from organic or non-organic sources, were becoming 'leggy' in comparison with the plants which received their nitrogen by liquid feeding. As a result, the liquid-fed plants were more suitable for transplanting. The 'leggy' plants recovered quickly, however, after transplanting and, at harvest, no significant ($p>0.05$) differences were found between the treatments. The plants which grew in the composts amended by hoof and horn matured slightly earlier than the plants of the other treatments.

TABLE 7

Calabrese transplant raising systems: vigour scores (means and standard errors)*

Treatment	Assessment Dates **				
	29 June	13 July	27 July	10 August	25 August
Planting Date 14 June 1990					
CONVENTIONAL - P_2O_5 only in compost	4.0	5.7	7.7	7.3	7.0
ORGANIC - Bonemeal only in compost	3.3	5.7	7.0	7.0	7.3
CONVENTIONAL - P_2O_5 + N in compost	5.0	6.3	8.0	8.0	7.7
ORGANIC - Bonemeal and Hoof & Horn in compost	6.0	7.3	8.7	8.3	8.0
Planting Date 29 June 1990					
CONVENTIONAL - P_2O_5 only in compost	-	6.7	5.7	6.7	7.7
ORGANIC - Bonemeal only in compost	-	6.0	5.3	6.3	7.3
CONVENTIONAL - P_2O_5 + N in compost	-	7.0	7.3	7.0	6.7
ORGANIC - Bonemeal and Hoof & Horn in compost	-	6.3	7.0	7.3	8.0
SE	0.37 (6 df)	0.46 (14 df)	0.37 (14 df)	0.39 (14 df)	0.40 (14 df)

*Vigour Scores 0 = Poor Vigour
10 = Highly Vigorous

**Assessed weekly; results shown in Table are every 2 weeks

TABLE 8

Calabrese transplant raising systems: spear development and yields (means and standard errors)*

Treatment	Days to 50% harvest	Total no. Spears/plant	Marketable no. Spears/plant	Marketable yield (kg/m^2)
<u>Planting Date</u> 14 June 1990				
CONVENTIONAL - $P_2 0_5$ only in compost	87	0.7	0.5	0.37
ORGANIC - Bonemeal only in compost	90	0.8	0.5	0.40
CONVENTIONAL - $P_2 0_5$ + N in compost				
ORGANIC - Bonemeal and Hoof & Horn in compost	87	1.2	0.8	0.45
<u>Planting Date</u> 29 June 1990				
CONVENTIONAL - $P_2 0_5$ only in compost	77	0.8	0.5	0.45
ORGANIC - Bonemeal only in compost	77	0.8	0.4	0.40
CONVENTIONAL - $P_2 0_5$ + N in compost	75	0.9	0.7	0.40
ORGANIC - Bonemeal and Hoof & Horn in compost	72	0.8	0.5	0.43
SE (14 df)	2.1	0.07	0.07	0.059

TABLE 9

Calabrese transplant raising systems: spear quality characteristics (means and standard errors)

Treatment	Head Quality Score*	Defects: Senescent (%)	Defects: Loose (%)	Defects: Immature (%)
Planting Date 14 June 1990				
CONVENTIONAL - $P_2 0_5$ only in compost	5.1	6.0	5.7	21.7
ORGANIC - Bonemeal only in compost	5.2	7.3	2.0	25.3
CONVENTIONAL - $P_2 0_5$ + N in compost	5.2	7.3	5.7	23.7
ORGANIC - Bonemeal and Hoof & Horn in compost	4.9	8.7	4.0	23.3
Planting Date 29 June 1990				
CONVENTIONAL - $P_2 0_5$ only in compost	5.7	0.0	1.0	36.3
ORGANIC - Bonemeal only in compost	6.6	2.0	3.0	40.0
CONVENTIONAL - $P_2 0_5$ + N in compost	4.8	2.7	3.3	16.3
ORGANIC - Bonemeal and Hoof & Horn in compost	5.9	3.3	5.3	27.3
SE (14 df)	0.64	3.93	1.53	5.14

*Quality Score: 0 = Poor
10 = Excellent

TABLE 10

Calabrese transplant raising systems: plant growth characteristics at final harvest (means and standard errors)*

Treatment	Plant Height (cm)	Plant Leaf No.	Plant Weight (Kg.)
Planting Date 14 June 1990			
CONVENTIONAL - $P_2 0_5$ only in compost	35	19	1.0
ORGANIC - Bonemeal only in compost	34	21	1.2
CONVENTIONAL - $P_2 0_5$ + N in compost	36	18	0.7
ORGANIC - Bonemeal and Hoof & Horn in compost	36	19	0.9
Planting Date 29 June 1990			
CONVENTIONAL - $P_2 0_5$ only in compost	32	21	0.8
ORGANIC - Bonemeal only in compost	32	20	0.8
CONVENTIONAL - $P_2 0_5$ + N in compost	32	18	0.5
ORGANIC - Bonemeal and Hoof & Horn in compost	32	19	0.8
SE (14 df)	1.5	0.7	0.13

*Recorded after final harvest on 18 October 1990
Means of 5 plants
Leaf numbers over 5cm
Plant weights excluding roots

Discussion

Calabrese transplants were produced to a good standard using organic fertilisers. These transplants grew to produce yields similar to conventionally raised transplants. The major difficulty experienced in simulating conventional transplant raising systems using organic fertilisers was the lack of control of plant growth which is possible with the inorganic salts of potassium and nitrogen. To produce strong transplants in a relatively short period of time, an organic source of fertiliser nitrogen, such as hoof and horn, had to be added to the compost mix. If planting was delayed, nitrogen continued to be released from the hoof and horn and the plants tended to become 'leggy'. When no fertiliser nitrogen was added to the compost, liquid feeds of dried blood produced only slow and hard growth which was difficult to maintain. If serious nutritional deficiencies or imbalances occurred, they were virtually impossible to correct using only organic fertilisers.

Much more work is needed to produce reliable systems for raising transplants organically in modular trays with small cells. The variable nature and release characteristics of many organic fertilisers may be major problems. Standard organic fertilisers are needed to supply nutrients at rates matching plant needs which will vary depending on species, variety, and plant environment.

[M. Sutton : Scottish Agricultural College (Edinburgh)]

NITROGEN RATES X SOURCES FOR CALABRESE
NITROGEN RATES X SOURCES FOR BRUSSEL SPROUTS

Objective

To assess different types of organic fertiliser as sources of nitrogen for two, high nitrogen-demanding vegetable brassicas, one a short season crop (calabrese), the other a long-season crop (Brussel sprouts).

Method

Experimental details, including layout and treatments, are given in Appendices 8 and 9. Each of the three types of organic fertiliser - meat and bone meal, poultry manure, farmyard manure - was incorporated into the soil before transplanting at two rates equivalent to applying 150kg and 300kg of inorganic nitrogen/hectare. The yields of calabrese spears and Brussel sprout buttons were measured at harvest.

Results and Discussion

The effects of the organic fertilisers on the experimental plot yields of calabrese spears and Brussels sprout buttons are shown in Tables 11 and 12, respectively. In both crops, the highest yields were produced with meat and bone meal: the higher rate of fertiliser increased the total weights of calabrese spears and Brussels sprout buttons by 100% and 35% respectively over untreated. None of the differences in crop yields between the two application rates of the same fertiliser was significant ($p>0.05$). Perhaps the most surprising result of this experiment was that

TABLE 11 **Nitrogen rates x sources for calabrese: spear yields (means and least significant differences)**

Treatment	Inorganic nitrogen equivalent/hectare (kg)	Total No. spears	Total spear weight (kg)
Untreated	-	41.3	2.61
Meat and bone meal	150	40.8	4.15
Meat and bone meal	300	37.8	5.26
Poultry manure	150	42.0	3.49
Poultry manure	300	41.5	3.76
Farmyard manure	150	41.0	3.64
Farmyard manure	300	41.5	4.86
LSDp = 0.05		3.60	0.666

TABLE 12 **Nitrogen rates x sources for Brussels sprouts: button yields (means and least significant differences)**

Treatment	Inorganic nitrogen equivalent/ hectare (kg)	Marketable button wt. (kg)	Unmarketable button wt. (kg)	Total button wt. (kg)
Untreated	-	7.63	1.07	8.95
Meat and bone meal	150	9.40	1.47	10.86
Meat and bone meal	300	10.53	1.15	11.68
Poultry manure	150	7.88	2.00	9.86
Poultry manure	300	8.65	1.70	10.35
Farmyard manure	150	9.03	1.23	10.25
Farmyard manure	300	9.13	1.85	10.85
LSDp = 0.05		1.481	0.950	1.595

poultry manure, commonly regarded as a good source of readily available nitrogen, did not lead to higher crop yields than meat and bone meal.

[W. Fordyce : Scottish Agricultural College (Edinburgh)]

PRE-PLANTING TECHNIQUES FOR WEED MANAGEMENT ON CALABRESE

Introduction

The management of weeds in organically grown brassicas can be a considerable problem if appropriate rotations, mulches and cultivation techniques are not used. The stale seedbed technique is a useful approach to weed management because it reduces the likely germination of weeds during the early growth stages of a crop. Before sowing a crop, a seedbed is prepared and left to permit weed seed germination to occur; following germination, this first flush of weed growth is destroyed, usually mechanically but occasionally thermally (e.g. with some organically grown carrot crops); and, then, the crop is sown immediately thereafter. Stale seedbed techniques have, however, their limitations: in particular, not all weed species will germinate at the time the seedbed is made because different species react differently to soil temperature with new species emerging in response to soil warming in the spring.

In comparison with stale seedbeds, mulches may raise the soil temperature quicker in the spring and, as a result, encourage earlier emergence of weeds.

Objective

To assess weed management in calabrese by stale seedbeds and clear and black polythene sheets used as pre-planting, seedbed mulches.

Method

Experimental details, including layout and treatments, are given in Appendix 10. On 2 dates, the weeds present were identified and the proportion of the soil surface covered by weed plants (so called % ground cover) was assessed: 29 June, 1 day after transplanting and 13 August, between 6 and 7 weeks after transplanting. Crop vigour was assessed subjectively throughout the growing season on a scale 1 (low) to 10(high) and the calabrese spears were harvested on 7 occasions, starting 4 September and finishing 19 October.

Results

The effect of the treatments on the weeds present on 29 June and 13 August as well as the proportions of the soil surface covered by weed plants on these dates is shown in Table 13. Considerable growth of weeds had occurred by 29 June under all the clear polythene sheet treatments. By comparison, little or no weed growth had

TABLE 13 **Pre-planting techniques for weed management on calabrese: weeds present and % ground cover on 29 June, 1 day after transplanting, and on 13 August, between 6 and 7 weeks after transplanting.**

Treatment	29 June		13 August	
	Weeds present	% ground cover	Weeds present	% ground cover
Stale seedbed for 10 weeks pre-planting	Annual meadowgrass, Redshank, Charlock, Chickweed*, Corn spurrey*, Scentless mayweed, Fat hen*, Couchgrass, Knotgrass, Hemp-nettle	100	Knotgrass*, Chickweed*, Couchgrass*, Scentless mayweed*, Annual meadowgrass, Corn spurrey, Shepherd's purse, Redshank, Fat hen	42
Black polythene as a soil cover for 8 weeks pre-planting	Couchgrass	3	Scentless mayweed*, Fat hen, Shepherd's purse, Chickweed, Annual meadowgrass, Couchgrass, Hemp-nettle, Knotgrass, Redshank, Corn spurrey	28
Black polythene as a soil cover for 4 weeks pre-planting	None	0	Scentless mayweed*, Chickweed, Knotgrass, Annual meadowgrass, Shepherd's purse, Corn spurrey, Redshank, Fat hen, Couchgrass, Sow thistle	25
Black polythene as a soil cover for 2 weeks pre-planting	Couchgrass	0	Scentless mayweed*, Couchgrass*, Corn spurrey*, Fat hen, Knotgrass, Groundsel, Shepherd's purse, Redshank, Chickweed	38
Clear polythene as a soil cover for 8 weeks pre-planting	Knotgrass*, Redshank*, Couchgrass*, Annual meadowgrass*, Fat hen, Chickweed, Corn spurrey, Sow thistle, Scentless mayweed, Dock, Shepherd's purse	97	Knotgrass*, Couchgrass*, Scentless mayweed, Shepherd's purse, Corn spurrey, Annual meadowgrass, Redshank, Chickweed, Groundsel, Fat hen	60
Clear polythene as a soil cover for 4 weeks pre-planting	Fat hen*, Knotgrass*, Couchgrass*, Shepherd's purse, Chickweed, Redshank, Corn spurrey, Annual meadowgrass, Scentless mayweed	60	Scentless mayweed*, Annual meadowgrass*, Dock, Couchgrass*, Knotgrass, Shepherd's purse, Redshank, Hemp-nettle, Chickweed, Corn spurrey	63
Clear polythene as a soil cover for 2 weeks pre-planting	Fat hen*, Knotgrass* Redshank* Annual meadowgrass, Couchgrass, Scentless mayweed, Corn spurrey, Chickweed, Sow thistle, Dock, Potato, Oilseed rape	47	Scentless mayweed*, Annual meadowgrass*, Chickweed, Fat hen, Couchgrass, Dock, Knotgrass, Redshank, Shepherd's purse, Potato, Corn spurrey, Charlock, Sow-thistle	85

* most dominant species

TABLE 13 (continued)

Latin names of weed species:

Annual meadowgrass	*Poa annua*
Redshank	*Polygonum persicaria*
Charlock	*Sinapis arvensis*
Chickweed	*Stellaria media*
Corn spurrey	*Spergula arvensis*
Scentless mayweed	*Tripleurospemum inodorum*
Fat hen	*Chenopodium album*
Couchgrass	*Elymus repens*
Knotgrass	*Polygonum aviculare*
Hemp-nettle	*Galeopsis tetrahit*
Shepherd's purse	*Capsella bursa-pastoris*
Sow thistle	*Sonchus arvensis*
Dock	*Rumex obtusifolius*
Potato	*Solanum tuberosum*
Oilseed rape	*Brassica napus*
Groundsel	*Senecio vulgaris*

occurred by the same date under the black polythene sheets. Weed growth was considerable, however, by 29 June in the stale seedbed treatment. Similar results to 29 June were obtained on 13 August: the best and the worst treatments were, respectively, black and clear polythene sheets with the stale seedbed technique giving an intermediate response.

The growth rate of the calabrese crop throughout the 1990 season was more vigorous with the black polythene treatments than with either the clear polythene or stale seedbed treatments. There was a tendency for the growth of the plants in both black and clear polythene treatments to be more vigorous with the 2 and 4 week pre-planting periods than with the 8 week pre-planting period.

The effect of the treatments on the marketable yields and numbers of calabrese spears is shown in Table 14. Black polythene treatments yielded better than clear polythene treatments. Within the black polythene and the clear polythene groups of treatments, there appeared to be a similar pattern of yield responses i.e. the 2-and 4-week treatments gave higher yields than the 8-week treatment. The stale seedbed treatment gave higher yields than either of the 8-week polythene treatments. The highest yields were measured in the 2-and 4-week black polythene treatments.

TABLE 14 **Pre-planting techniques for weed management on calabrese: marketable yields and numbers of species (means and least significant differences)**

Treatment	Yield		Spear number	
	kg/plant	t/ha**	/plot	thousand/ha
Stale seedbed for 10 weeks pre-planting	0.65	1.08	15.7	26.17
Black polythene as a soil cover for 8 weeks pre-planting	0.43	0.72	11.2	18.67
Black polythene as a soil cover for 4 weeks pre-planting	1.02	1.70	21.0	35.0
Black polythene as a soil cover for 2 weeks pre-planting	0.89	1.48	17.0	28.33
Clear polythene as a soil cover for 8 weeks pre-planting	0.42	0.70	10.7	17.83
Clear polythene as a soil cover for 4 weeks pre-planting	0.76	1.26	14.2	23.67
Clear polythene as a soil cover for 2 weeks pre-planting	0.68	1.13	11.2	18.67
LSDp = 0.05	0.60*		-	

*statistical analysis not robust because of 'missing plots'

** good average yield is 5.5t/ha

Discussion

Black polythene probably prevented germination of some weeds, while others died-back on emergence owing to lack of light. Consequently, when the polythene covers were removed, there was little weed growth apart from couchgrass (Elymus repens). Surprisingly, this technique worked well after only 2 weeks ground cover. Of interest, black polythene reduced weed growth for the whole of the season which may have arisen from depletion of the weed seed-bank, and an otherwise undisturbed soil surface or, possibly, consolidation of the undisturbed surface, reducing germination. Surface disturbance, which occurred with removal of the weeds from the other treatments, probably encouraged the later weed growth which appeared in these treatments.

Crop vigour improvement must arise, in part, from lack of direct weed competition. The speed with which the crop grew when black polythene had been used may have arisen, however, from improved soil warming and, possibly, greater soil moisture retention. Both of these effects could have affected nutrient supplies. Equally, however, the different crop vigours observed between clear and black polythene and stale seedbed treatments may in part have arisen from moisture and nutrient depletion due to vigorous, early, weed growth. Continuing high vigour when black polythene was used may then have arisen from a lack of later weed growth and competition, as well as vigorous, early growth. Of interest, crop vigour and yields tended to be lower when black polythene was used for 8 weeks than for 2-and 4-weeks. Soil micro-organism activity may have reduced nutrient supply under polythene laid down for longer than shorter periods.

The high crop vigour from use of black polythene was reflected in total yields, i.e. the 2-and 4-week treatments gave higher yields than the 8-week treatment and the 4-week treatment gave a higher yield than the 2-week treatment. It is possible that 2-and 4-week soil covers sufficiently reduced later weed competition, improved soil moisture and nutrient supplies and warmed the soil, whereas an 8-week cover caused deleterious changes to occur in the soil.

The advantages of the use of black polythene pre-planting over traditional stale seed-bed or clear polythene are obvious, but timing of soil cover is important. The length of time of soil covers requires further examination for different periods of the year, and for different cropping regimes. The factors that lead to improved crop vigour, and to the fall-off in vigour following extended periods of ground cover, warrant further examination.

[D.H.K. Davies : Scottish Agricultural College (Edinburgh)]

WEED MULCHES ON CALABRESE
WEED MULCHES ON BRUSSELS SPROUTS

Objective

To assess some mulching techniques for management of weeds in short season (calabrese) and long season (Brussels sprouts) brassica row crops.

Method

Experimental details, including layout and treatments, are given in Appendices 11 and 12. On 3 July, approximately 7 weeks after transplanting, the weeds present were identified and the proportion of the soil surface covered by weed plants (so called % ground cover) was assessed. Crop vigour was assessed subjectively throughout the growing season on a scale 1(low) to 10(high). Calabrese spears were harvested on 25 and 27 July and Brussels sprout buttons were harvested on 17 and 18 October.

Results

The effect of the treatments on the weeds present on 3 July as well as the proportions of the soil surface covered by weed plants on the date is shown in Table 15.

TABLE 15 **Weed mulches on calabrese and Brussels sprouts: weeds present and % ground cover on 3 July, approximately 7 weeks after transplanting**

Treatment	Weeds present *	% Ground cover
No mulch	Redshank, Knotgrass, Fat hen, Chickweed	95
Sown ryegrass	Redshank, Knotgrass, Fat hen, Chickweed	95
Bark	Redshank, Knotgrass, Fumitory	17
'Hortopaper'	Redshank, Fat hen, Chickweed	9
Black polythene	Redshank, Knotgrass	1

* most dominant species

Latin names of weed species:

Redshank	-	<u>Polygonum persicaria</u>
Knotgrass	-	<u>Polygonum aviculare</u>
Fat hen	-	<u>Chenopodium album</u>
Chickweed	-	<u>Stellaria media</u>
Fumitory	-	<u>Fumaria officinalis</u>

TABLE 16 **Weed mulches on calabrese and Brussels sprouts: marketable yields of calabrese spears (means and least significant differences)**

Treatment	Yield	
	kg/plot	t/ha*
No mulch	0.83	1.5
Sown ryegrass	0.77	0.8
Bark	2.63	4.8
'Hortopaper'	3.63	6.6
Black polythene	4.93	9.0
LSDp = 0.05	1.537	

* good average yield is 5.5 t/ha

Weed growth was suppressed most by 'Hortopaper' and black polythene treatments. The bark treatment permitted the emergence of a few weeds to occur, but, in general, weed suppression was good. Fumitory (Fumaria officinalis) occurred more frequently in the bark treatment, but chickweed (Stellaria media) was suppressed. Weeds were not suppressed at all by ryegrass mulch.

Calabrese planted into black polythene showed far greater vigour throughout the growing season than plants in other mulches. Plants in 'Hortopaper' and bark showed similar degrees of vigour despite higher weed incidence in bark.

Brussels sprouts planted into black polythene initially showed greater vigour than plants in 'Hortopaper' but, later in the season, plants in 'Hortopaper' were slightly more vigorous. Plant growth and development were poor in bark, and very poor in ryegrass or with no mulch.

TABLE 17 **Weed mulches on calabrese and Brussels sprouts: marketable yields of Brussels sprout buttons (means and least significant differences) and proportion of marketable to unmarketable sprout buttons.**

Treatment	Yield		%	
	kg/plot	t/ha*	Marketable	Unmarketable
No mulch	0.83	7.8	51.6	48.4
Sown ryegrass	0.77	9.1	64.9	35.1
Bark	2.73	3.6	73.3	26.7
'Hortopaper'	6.62	10.5	86.9	13.1
Black polythene	8.92	12.8	79.0	21.0
LSDp = 0.05	0.815			

* good average yield is 11.75 t/ha

Calabrese plants growing in black polythene gave significantly ($p<0.05$) higher yields than no mulch, sown ryegrass and bark treatments (Table 16). Brussels sprout plants growing in black polythene gave significantly ($p<0.05$) higher yields than all other treatments (Table 17). Yields of calabrese spears and Brussels sprout buttons were very poor in no mulch and sown ryegrass treatments. The yield of sprout buttons in the bark mulch was also very poor. Although not as high as the yields of plants growing in black polythene, the crop yields in 'Hortopaper' were good. One interesting observation which was made with the 'Hortopaper' mulch treatment was that the proportion of marketable Brussels sprout buttons was greater from plants growing in 'Hortopaper' than from plants growing in black polythene. This difference of quality in favour of 'Hortopaper' was more than compensated, however, by the greater yields of the plants growing in black polythene.

Discussion

The benefits of black polythene mulches for weed suppression are evident. 'Hortopaper' mulch has also given excellent suppression of weeds and the use of bark as a weed mulch has some potential.

The crop yield results suggest that black polythene is giving benefits that cannot be fully explained by weed suppression only. The initial, improved vigour of the crops growing in black polythene over the crops growing in 'Hortopaper' and the other mulches must contribute to the differences in final yields. Interestingly, the vigour of Brussels sprout plants growing in 'Hortopaper' was similar, if not greater, than the vigour of plants growing in black polythene later in the season, but this difference in vigour did not affect final yields, although it may have improved the proportion of the crop that was marketable. Calabrese plants in bark mulch grew as vigorously as plants in 'Hortopaper', but yields were much lower. Brussels sprout plants grew poorly in bark. The reasons for the poor growth of plants in bark are unknown but may, in part, arise from slightly increased weed growth as well as other influences not evaluated in the experiment. The use of barks other than pine forest bark which was used in the experiment could be examined along with other natural mulches such as straw.

The growing and cutting of ryegrass before transplanting the crop was clearly an unsuccessful weed management technique. The grass competed too much with the crop and did not give adequate suppression of weeds. Instead of sowing ryegrass only, the initial idea had been to sow a ryegrass/clover mixture during the previous year when the clover may have contributed to soil fertility at the same time as suppressing weeds. The management of the vegetative growth of the ryegrass after planting of a crop is expected to be too difficult, however, in practice to warrant further evaluation.

[D.H.K. Davies : Scottish Agricultural College (Edinburgh)]

CABBAGE PEST MANAGEMENT

Objective

To assess a range of novel treatments for suppression of aphid and caterpillar pests of cabbages.

Method

Experimental details, including layout and treatments, are given in Appendix 13. All treatments (except untreated and fabric cover) were applied regularly every 2-3 weeks from 6 July (5 weeks after transplanting) until 8 October (18-19 weeks after transplanting).

Aphid and caterpillar infestations were assessed every 2-3 weeks from 27 July (8 weeks after transplanting) until 5 October (18 weeks after transplanting) : the proportion of plants infested by each pest and the degree of damage from caterpillars. As the degree of infestation by each pest during 1990 was low, the plants were not harvested but were allowed to continue their growth beyond a marketable condition to express maximum pest incidences.

Results and Discussion

The effect of the treatments on the incidence of aphids on the cabbages is shown in Table 18 (caterpillar numbers and associated plant damage were too low to permit statistically meaningful treatment of the data).

TABLE 18

Cabbage pest management : proportions of plants infested with aphids during 1990 (means and least significant differences).

Treatments	Dates				
	27 July	10 Aug.	27 Aug.	18 Sept.	5 Oct.
Untreated	0.23	0.24	0.26	0.11	0.08
Fabric cover	0.09	0.13	0.07	0.07	0.07
Seaweed extract	0.15	0.27	0.23	0.08	0.08
Bacillus thuringiensis	0.19	0.27	0.21	0.06	0.05
Derris	0.20	0.21	0.22	0.10	0.09
Fatty acids	0.18	0.32	0.21	0.07	0.05
LSDp = 0.05	0.127	0.125	0.129	0.065	0.050

The fabric cover was the only treatment to decrease significantly ($p<0.05$) the proportions of plants infested with aphids. It decreased the aphid infestation of the cabbages on 27 July and 27 August. Perhaps the most surprising result was the lack of effect of the fatty acids treatment which is a commercial product sold specifically for the suppression of aphids. As derris and Bacillus thuringiensis are both recognised to be caterpillar-specific treatments, their lack of effect on aphids was not surprising. The seaweed extract would not be expected to exert any direct effect on aphid populations, but would, rather, be expected to exert an indirect effect by enabling plants to sustain or withstand aphid attacks. As the experiment was not harvested for marketable yields of cabbage heads, this potential, indirect effect of seaweed extract was not measured.

The use of fabric cover for pest management on vegetable brassicas has been demonstrated by McKinlay (1987;1990). The cover appears to restrict access to plants by flying insects. Although floating mulches consisting of fabric covers may be a reasonably practicable solution to the problem of managing migrant insect pests on organically grown brassica crops, several drawbacks remain. Slug and weed problems may be increased and a reduced crop yield may be caused by reduced photosynthetically active radiation on plants: McKinlay (1990) observed an increased incidence of slug damage on cabbage plants covered with fabric. Although this effect was not statistically ($p>0.05$) significant, slugs must remain a threat to plants growing under fabric cover floating mulches. Perhaps metaldehyde-impregnated paper tapes, etc. will provide a solution to the slug problem. So far as weeds are concerned, their growth can be suppressed by the use of mulches (see page 31). Recent studies at the Edinburgh School of Agriculture (by Souwerbren and McKinlay, unpublished) suggest that the reduction in photosynthetically active radiation on cabbage plants caused by floating mulches may not lead to reduced yield because the plants exhibit compensatory growth.

An interesting observation arising from the experiment was the relatively constant proportion of cabbage plants infested with aphids in the fabric cover treatment in comparison with the fluctuating proportions of infested plants in the other treatments. This effect in favour of the floating mulch could be important when considering marketability of produce.

[R.G. McKinlay : Scottish Agricultural College (Edinburgh)]

POTATO EXPERIMENTS

POTATO VARIETY X SEED RATES
POTATOES FOR BAKING.

Introduction

Potato tuber specifications for pre-packing vary according to outlets but, in general, high quality tubers in the size grade 45/50-65mm (65-90mm for baking potatoes) are required free from diseases and defects. Harvesting of potatoes earlier than usual may be important both to attain tuber quality standards and to avoid potentially large yield losses arising from blight (Phytophthora infestans) occurring later in the growing season.

Objective

To examine ways of maximising tuber yields relatively early in the growing season to facilitate early harvesting. One experiment was done with potatoes for pre-packing, examining variety (i.e. maturity group) x seed rate interactions; and another experiment was done with potatoes for baking, examining seed rates only (with one variety).

Method

Experimental details, including layouts and treatments for both experiments, are given in Appendices 14 and 15. The degree to which potato plants were covering the soil surface (so-called % ground cover) was assessed throughout the growing season (8 June to 3 August). Following harvest, the tubers were weighed for yield, counted, and graded for size and incidences of diseases and defects.

Results: Potato variety x seed rates.

Emergence and early growth of varieties, Estima, Maris Bard and Pentland Squire, were generally good. The most prevalent diseases were stem canker (Rhizoctonia solani) and blackleg (Erwinia carotovora var. atroseptica) with Estima being the variety worst affected by blackleg. All varieties had reached 50% ground cover by the end of June. No variety reached 100% ground cover : Estima, Maris Bard and Pentland Squire reached maximum ground covers of 90%, 75% and 90%, respectively; and Estima and Maris Bard began to senesce at the beginning of August. No significant ($p>0.05$) differences were measured in ground cover between treatments.

The effects of potato variety, seed rate and haulm destruction dates on tuber yields and numbers are shown in Tables 19 and 20 respectively. Increasing planting density (i.e. seed rate) generally increased tuber yields in the 25-45mm size grade, particularly at the first haulm destruction date. Yields in the 25-45mm size grade decreased between the two haulm destruction dates as tubers increased in bulk with time and, as a result, were graded larger at the later haulm destruction date. No significant ($p>0.05$) effect of planting density on either tuber yield in the size grade, >45mm, or total tuber yield was measured although the yield of tubers graded >45mm as well as the total yield of tubers did tend to be smallest at the lowest seed rate.

TABLE 19 **Potato variety x seed rates : tuber yields (t/ha) (means and standard errors of differences)**

Varieties	Seed rates	Haulm destruction dates					
		Size grades					
		25-45mm		>45mm		Totals	
		29/7	31/8	29/7	31/8	29/7	31/8
Estima	Recommended	6.8	4.1	25.2	34.9	31.4	39.2
	Recommended + 15%	7.8	3.5	23.2	32.9	30.4	35.7
	Recommended - 15%	3.7	3.3	24.0	31.4	30.1	35.7
Maris Bard	Recommended	4.8	4.3	19.3	27.6	23.7	32.0
	Recommended + 15%	6.7	4.4	18.6	30.2	24.9	34.8
	Recommended - 15%	3.4	3.3	16.8	30.1	20.3	31.1
Pentland Squire	Recommended	5.5	3.6	21.3	40.7	26.9	44.4
	Recommended +15%	5.0	3.3	25.2	34.2	25.9	40.4
	Recommended - 15%	4.1	2.4	21.3	37.8	25.7	42.5
SED		0.73	0.73	3.02	3.02	3.15	3.15

Variety and haulm destruction date (with or without interaction) had significant ($p<0.05$) effects on the yield of tubers graded >45mm and total tuber yield. In terms of total tuber yield (i.e. mean of all seed rates), Estima outyielded Pentland Squire by 4.4 t/ha and Maris Bard by 7.1 t/ha at the first haulm destruction date. At the second haulm destruction date, Pentland Squire outyielded Estima by 5.4 t/ha and Maris Bard by 10.1 t/ha. In the pre-packing grades (>45mm), Estima produced 2.2 t/ha and 6.0 t/ha more tuber yield than Pentland Squire and MarisBard respectively at the first haulm destruction date. At the second haulm destruction date, Pentland Squire produced 6.3 t/ha and 10.1 t/ha more tuber yield than Estima and Maris Bard, respectively.

Variety and seed rate had significant ($p>0.05$) effects on tuber numbers. At the first haulm destruction date, Estima produced greater numbers of tubers/ha than Pentland Squire and Maris Bard but Pentland Squire produced greatest number of tubers/ha at the second haulm destruction date. In general, increasing planting density increased tuber number.

TABLE 20

Potato variety x seed rates : tuber numbers ('000/ha) (means and standard errors of differences)

Varieties	Seed rates	Haulm destruction dates	
		29/7/90	31/8/90
Estima	Recommended	339	321
	Recommended + 15%	380	369
	Recommended - 15%	274	359
Maris Bard	Recommended	245	265
	Recommended + 15%	280	302
	Recommended - 15%	211	256
Pentland Squire	Recommended	316	408
	Recommended + 15%	321	359
	Recommended - 15%	267	325
SED		46.2	46.2

Assessment of the quality of tubers graded 45-65mm at the first haulm destruction date revealed that 30% of the tubers (by weight) of Maris Bard had defects and failed to meet pre-packing quality standards. Common scab (Streptomyces scabies) was the major cause of rejection. Estima had the smallest proportion of defects at the first haulm destruction date. At the second haulm destruction date, extensive growth cracks in the tubers of all three varieties increased, generally, the proportions of defects with the largest and smallest proportions being associated with Maris Bard and Pentland Squire, respectively.

The tuber yields and numbers in the potatoes for baking experiment are given in Table 21. The lower seed rate produced more yield than the higher seed rate in the 65-90mm size grade, but the difference in yields was not statistically ($p>0.05$) significant. As a proportion of total yield, the lower seed rate produced 11.6% more yield than the higher seed rate in the 65-90mm size grade. In terms of tuber numbers, the lower seed rate produced 6,000 more tubers/ha than the higher seed rate in the 65-90mm size grade. Assessment of the quality of tubers in the 65-90mm size grade revealed that 63.6% were marketable.

TABLE 21

Potatoes for baking : tuber yields (t/ha) and numbers ('000/ha)
(means and standard errors of differences)

Seed rates	Yields			Numbers	
	Size grades			Size grade	
	45-65mm	65-90mm	Total	65-90mm	Total
Recommended	20.2	9.7	33.5	28	271
Recommended - 15%	16.2	12.3	31.1	34	227
SED	1.88	2.24	3.04	6.0	22.2

Discussion

Organic potato producers aiming to maximise tuber yields for pre-packing, and aiming to harvest at the end of August/early September, should consider growing a second early variety rather than a first early or maincrop variety. The relatively early bulking rate of second early varieties will help to ensure that an acceptable yield will be achieved by this harvest date and allows earlier harvesting which is important for producing clean, defect-and disease-free tubers. First early and maincrop varieties will both tend to produce lower yields than second early varieties by the end of August/early September. The yield advantage gained by extending the season to grow a later bulking, maincrop variety needs to be carefully weighed up against the risk of blight and a decrease in quality associated with later harvests.

To maximise potato tuber yields for general pre-packing, adjustments of +/-15% to seed rate recommendations for conventionally grown crops seem unwarranted for organically grown crops. However, to maximise tuber yields of baking potatoes (65-90mm) for harvesting in September, a reduction of 15% to the recommended baking potato seed rate is probably worthwhile. This reduction in seed rate requires, perhaps, further investigation especially at weedy sites where the reduction in ground cover associated with lower seed rates may reduce the ability of potato crops to suppress weed growth.

[S. Bowen : Scottish Agricultural College (Edinburgh)]

POTATO BLACKLEG MANAGEMENT

Objective

To grow stocks of potatoes (cv Maris Bard) contaminated with different numbers of Erwinia carotovora var. atroseptica(Eca), the causal agent of the bacterial disease blackleg, and to record the amount of disease in the crops and the yield of tubers at harvest. In addition, some of the stock with the highest level of Eca contamination was treated with a biological control agent (antagonistic bacteria) to test its effectiveness.

Method

Experimental details, including trial layout, are given in Appendix 16. The biological control agent comprised antagonistic bacteria suspended in peat; the peat mixture was coated onto the tubers at planting. Crop emergence and incidence of disease were recorded at weekly intervals throughout the growing season. The experiment was harvested on 29 August and crop yields were recorded. The potatoes were graded into size classes >65mm, 45-65mm, 25-45mm and <25mm. The weight and number of potatoes in each size grade were recorded.

Results

Crop emergence in the various treatments is shown in Table 22.

TABLE 22 Potato blackleg management: crop emergence (%)

Treatment	Bacterial numbers on seed tuber stock	Assessment dates		
		1 June	8 June	15 June
A	low	84.3	92.0	99.3
B	↓	81.7	89.7	98.7
C	↓	84.3	92.3	99.5
D	↓	90.3	97.3	99.7
E	high	57.1	80.0	92.3
F	high + biological control agent	52.5	75.2	91.7
SED (24 df)		3.42	2.64	1.53

Treatments A-D emerged significantly ($p<0.05$) earlier and had consistently higher emergence throughout the experiment than treatments E or F. Treatment B emerged significantly ($p<0.05$) slower than treatment D.

The incidence of disease in the various treatments is shown in Table 23. Disease was recorded as the percentage of plants per plot with blackened stems.

TABLE 23 Potato blackleg management: disease incidence (%)

Treatment	Bacterial numbers on seed tuber stock	Assessment dates						
		26 June	2 July	10 July	17 July	25 July	1 Aug	6Aug
A	low	0.00	0.33	0.67	1.17	2.17	3.83	5.00
B	|	0.00	0.17	0.17	1.17	0.33	0.33	0.67
C	|	0.00	0.00	0.00	0.00	0.33	0.33	1.33
D	|	0.00	0.00	0.17	1.00	3.67	6.00	7.17
E	high	0.42	1.53	3.71	9.83	22.16	27.50	30.50
F	high + biological control agent	0.50	2.33	4.33	9.83	23.50	29.30	32.50
SED(24df)		0.24	0.44	0.74	0.79	1.67	1.56	1.42

Treatments E and F had consistently higher incidence of disease than the other treatments. The biological control treatment had no effect on disease reduction in the crop.

Tuber yields and numbers are shown in Table 24.

TABLE 24 Potato blackleg management : tuber yields (t/ha) and numbers (000's/ha)

Treatment	Bacterial numbers on seed tuber stock	Yield	Number
A	low	33.16	338.6
B	↓	33.02	299.6
C	↓	33.61	329.4
D	↓	35.29	345.2
E	high	27.26	250.1
F	high + biological control agent	24.04	247.7
SED(24 df)		1.76	18.9

Treatments E and F had significantly ($p<0.05$) lower yields than the other treatments.

Weights and numbers of tubers x size classes are shown in Tables 25 and 26 respectively.

TABLE 25 Potato blackleg management : Weights of tubers (t/ha) x size classes

Treatment	Bacterial numbers on seed tuber stock	Tuber size class			
		> 65mm	45-65mm	25-45mm	<25mm
A	low	1.70	22.40	8.49	0.17
B	↓	2.73	23.86	6.06	0.17
C	↓	2.18	23.16	7.51	0.18
D	↓	1.80	25.42	7.49	0.18
E	high	1.33	18.48	6.71	0.17
F	high + biological control agent	1.14	15.67	6.30	0.17
SED (24 df)		0.55	1.71	0.72	0.03

TABLE 26 **Potato blackleg management : numbers of tubers (000's/ha) x size classes**

Treatment		Tuber size class		
		> 65mm	45-65mm	25-45mm
A	low	6.0	168.4	164.1
B	|	8.7	169.6	121.3
C	|	7.3	173.3	148.8
D	↓	5.7	193.9	145.6
E	high	4.5	112.5	133.1
F	high & biological control agent	3.5	119.2	125.0
SED (24 df)		1.81	16.44	13.80

In general, treatments E and F had lower tuber yields in all size classes.

Treatments B-D had significantly ($p<0.05$) greater tuber yields in the 45-65mm size class than treatments A, E and F; treatments A, C and D had significantly ($p<0.05$) greater yields than treatments B, E and F in the 25-45mm size class; and treatment B had a significantly ($p<0.05$) greater yield in the > 65mm size class than treatments E and F.

The numbers of tubers in treatments E and F were generally lower than for the other treatments.

Discussion

The results are consistent with other studies on the correlation of the numbers of Eca per tuber and the subsequent expression of blackleg disease symptoms in the crop. As expected, treatment E, with a bacterial tuber count of $\log_{10}5.65$, had a high incidence of disease. The biological control agent had no effect in this experiment, although disease pressure was obviously high. The incidence of disease in treatments A and D was slightly higher than expected: tuber bacterial counts of $\log_{10}2.0$ are usually thought to have a low risk of developing into blackleg disease in the crop.

[J. Chard: Scottish Agricultural College (Edinburgh)]

POTATO BLIGHT MANAGEMENT

Objective

To test a range of possible programmes for management of potato blight (Phytophthora infestans) infection.

Method

Experimental details, including layout, dates of treatments and application rates are given in Appendix 17.

The effect of the programmes on foliar blight infection was recorded during the growing season. The tubers harvested from each treatment were graded according to size and the weight and the number of tubers in each size category were also recorded. A sample of tubers from each treatment was assessed for blight infection.

Results

The effect of the experimental programmes on the incidence of blight infecting potato leaves is shown in Table 27.

TABLE 27 **Potato blight management : % foliar blight (means and standard errors of differences)**

Treatment	21 August	29 August	4 September
Untreated	1.3	23	83
Bordeaux mixture (at first blight warning)	0.0	3	25
Bordeaux mixture (when crop first meets in row)	0.1	1	21
Bordeaux mixture (plus early haulm destruction)	0.1	Haulm removed	Haulm removed
Bordeaux mixture (plus haulm removal)	0.1	3	24
Waterglass	0.1	8	78
Bacillus bacterium	0.1	14	76
Herb extract (extract of thyme)	1.3	23	85
'Ledax Bio'	0.1	29	86
SED	0.8	8.62	6.29

On 21 August, low incidences of blight infection were detected on the lower leaves. The treatments were probably protecting only the upper leaves and not penetrating to the affected leaves. On 29 August, all treatments comprising Bordeaux mixture (except treatment incorporating early haulm destruction which occurred on 24 August) had significantly ($p<0.05$) less foliar blight infection than untreated. Of the other treatments, waterglass and *Bacillus* bacterium look most promising. The herb extract and 'Ledax Bio' treatments had similar incidences of foliar blight infection to untreated. On 4 September, the Bordeaux mixture treatments continued to give the best reduction in the incidence of foliar blight infection. The waterglass and *Bacillus* treatments continued to perform marginally better than the herb extract and 'Ledax Bio' treatments.

The effect of the experimental programmes on tuber yield and numbers is shown in Table 28.

TABLE 28 **Potato blight management : tuber yield (t/ha) and number ('000/ha) (means and standard errors of differences).**

Treatment	Yield	Number
Untreated	42.52	390
Bordeaux mixture (at first blight warning)	39.67	388
Bordeaux mixture (when crop first meets in row)	34.90	357
Bordeaux mixture (plus early haulm destruction)	33.27	370
Bordeaux mixture (plus haulm removal)	42.23	386
Waterglass	40.77	422
Bacillus bacterium	38.31	398
Herb extract (extract of thyme)	41.02	407
'Ledax Bio'	37.90	354
SED	2.25	15

No treatment yielded significantly ($p<0.05$) better than untreated but the yield from Bordeaux mixture (plus early haulm destruction) was significantly ($p<0.05$) reduced.

The effect of the experimental programmes on tuber yield and numbers x three size grades is shown in Tables 29 and 30.

TABLE 29 **Potato blight management : tuber yield (t/ha) x three size grades (means and standard errors of differences)**

Treatment	Tuber size grades >65mm	45-65mm	25-45mm
Untreated	7.7	28.7	5.9
Bordeaux mixture (at first blight warning)	8.0	25.2	6.2
Bordeaux mixture (when crop first meets in row)	6.1	22.4	6.1
Bordeaux mixture (plus early haulm destruction)	2.5	23.6	6.9
Bordeaux mixture (plus haulm removal)	7.9	28.2	5.9
Waterglass	3.5	29.7	7.3
Bacillus bacterium	3.8	27.2	7.0
Herb extract (extract of thyme)	6.2	27.7	6.8
'Ledax Bio'	5.6	26.9	5.2
SED	1.4	2.1	0.8

TABLE 30 **Potato blight management : Tuber numbers ('000/ha) x three size grades (means and standard errors of differences)**

Treatment	Tuber size grades >65mm	45-65mm	25-45mm
Untreated	27	226	137
Bordeaux mixture (at first blight warning)	29	205	154
Bordeaux mixture (when crop first meets in row)	22	185	150
Bordeaux mixture (plus early haulm destruction)	9	197	163
Bordeaux mixture (plus haulm removal)	27	221	137
Waterglass	12	244	167
Bacillus bacterium	14	227	157
Herb extract (extract of thyme)	21	227	160
'Ledax Bio'	19	216	119
SED	4	16	19

The yield reduction in Bordeaux mixture (plus early haulm destruction) was caused mostly by a reduced number of tubers in the 65mm+ grade.

Tuber blight infection, was detected in two treatments only (*Bacillus* bacterium and 'Ledax Bio') at low incidences (1% and 0.5%, respectively).

Discussion

Of the range of programmes tested for management of potato blight infection, treatments comprising Bordeaux mixture were most effective at reducing the incidence of foliar infection. Despite this, the tuber yields of these treatments were similar to untreated tuber yields, and there was no increase in the number of tubers greater than 65mm. Early haulm destruction substantially reduced yield because of a reduction in the number of large tubers.

Of the other treatments, waterglass appears to be the most promising, and the *Bacillus* treatment is also worth testing again. The herb extract and 'Ledax Bio' treatments appeared to have little effect.

[S. Oxley, J. Chard : Scottish Agricultural College (Edinburgh)]

POTATO BLIGHT RESISTANT CULTIVARS (with Scottish Crop Research Institute)

Objective

Five cultivars and two clones of potatoes, bred at the Scottish Crop Research Institute and selected for resistance to foliar and tuber blight (Phytophthora infestans) infections, were tested in the field for differential expression of disease and compared with five common cultivars.

Method

Experimental details, including layout and varieties used, are given in Appendix 18. In the dry season of 1990, no foliar blight infection was recorded in the experiment, but tubers were inoculated with the blight pathogen immediately after harvest to compare the resistance of the various genotypes. Resistance was scored subjectively using a 1-9 scale of increasing resistance.

TABLE 31 **Potato blight resistant cultivars: scores of tuber blight infection of blight-resistant genotypes and control cultivars (means and standard error)**

	Score *
Control cultivars	
Cara	6.2
Desiree	4.8
Maris Piper	3.0
Pentland Crown	3.7
Bintje	2.2
Blight resistant genotypes	
Stirling	8.0
Teena	7.0
Brodick	6.2
Torridon	5.5
Shelagh	5.0
13740(4)	6.5
12492(6)	4.5
S.E.	**0.37**

* 1 = low degree of resistance
9 = high degree of resistance

Results

The resistance to tuber blight infection of the blight-resistant genotypes and control cultivars tested is shown in Table 31.

Conclusion

Tuber resistance to blight infection was good in all genotypes except 12492(6) which was more susceptible than expected. Stirling and Teena were particularly resistant. Further testing under conditions of high disease pressure is needed to demonstrate their full potential.

[G. Mackay, R. Wastie : Scottish Crop Research Institute (Dundee)]

PESTS AND DISEASES X NITROGEN ON POTATOES (study funded by the Scottish Office Agriculture and Fisheries Department)

Background

The extent and rate of supply of nitrogen are two of the principal factors limiting organic crop production. Inputs of nitrogen to the organic system are often made by the addition of organic manures, particularly composted farmyard manure. The release of nitrogen from such manures is effected by soil micro-organisms, the activity of which is limited by a wide variety of environmental factors: pH, temperature, water availability, supply of other nutrients, etc. A possible slow release of nitrogen from organic manures, associated with cool spring temperatures, may be a limiting factor in the production of spring sown or planted organic crops, especially in Scotland. The timing of nitrogen release from manure and the availability of manure nitrogen to crops having different nitrogen demands and uptake patterns are not known.

Objective

To investigate (i) the timing of nitrogen release from organic manures like farmyard manure and the availability of manure nitrogen to crops having different nitrogen demands and uptake patterns [spring barley (see page 61) and potatoes] and (ii) the effect of manure nitrogen on pest and disease incidences on the growing crop and, in the case of potatoes, the harvested tubers.

Method

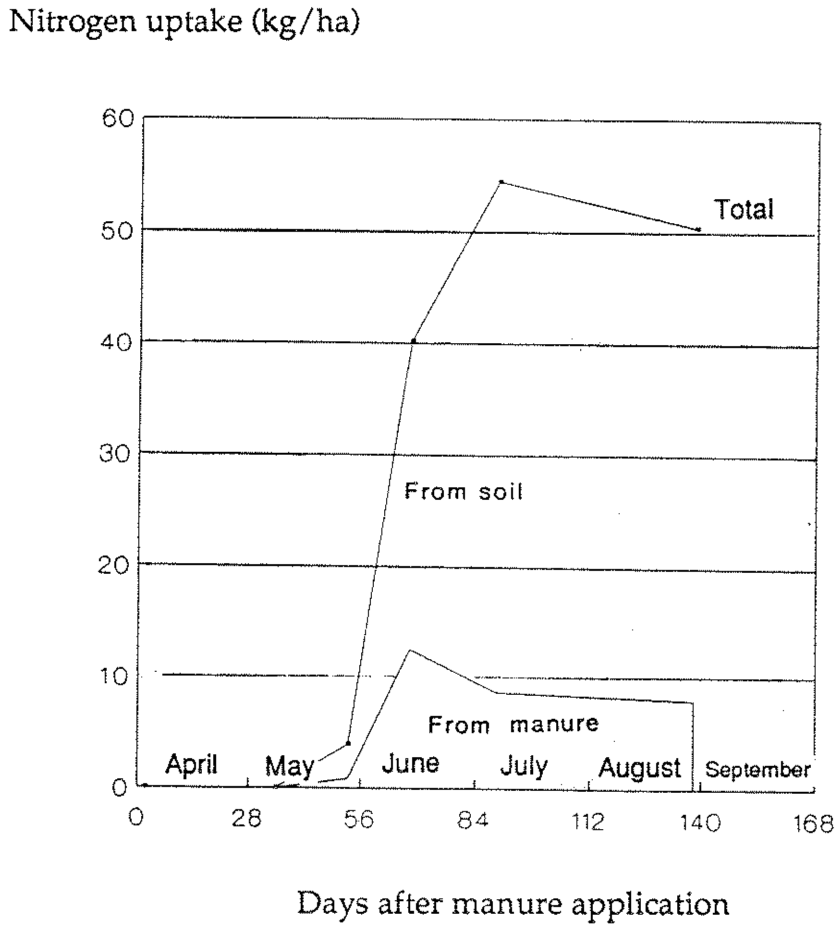
Experimental details, including layout and treatments, are given in Appendix 19. The experiment included small microplots where the manure applied had been treated with nitrogen enriched in the isotope N-15. This technique enabled plant uptake of nitrogen from the manure to be monitored. Potato stem samples were taken throughout the season from both plots and microplots until the end of August (a total of 4 cuts) and a sample of tubers was taken, just before harvest, at the end of September. The efficiency of uptake by plants of manure nitrogen can be calculated either from the difference in total nitrogen uptake on manured and unmanured plots at harvest or from the N-15 data obtained from the microplot plant samples. The amount of nitrogen supplied by the manure can be related to the total amount of nitrogen in the applied manure to give an estimate of the efficiency of recovery of nitrogen by plants from the manure.

The incidences of pests and diseases were monitored both in the growing crop and on harvested tubers.

Results and Discussion

Plant Yield and Nitrogen Content: The potato stems showed a sigmoid (S-shaped) response curve for nitrogen uptake with time (Fig.1)

Figure 1. **Uptake of nitrogen by potatoes during 1990**



The tubers formed a major 'sink' for nitrogen. The decline in nitrogen uptake by the stems during July and August would have been more than compensated for by tuber uptake of nitrogen, estimated as having begun in mid-July. For the potato plant as a whole, nitrogen uptake continued to increase through July and August only levelling out as the tubers reach maturity just before harvest. Stem nitrogen declined during July and August as leaves senesced and some translocation began to the tubers.

The potato tuber yields obtained from the various treatments are shown in Table 32.

TABLE 32 **Pests and diseases x nitrogen on potatoes : tuber yields (t/ha) (means)**

Treatment	Tuber Yield
Manure	50.91
Manure + Ferment	54.58
Ferment	49.72
Untreated	49.39

The farmyard manure treatments increased tuber yields slightly compared to the treatments which received no manure. Biodynamic ferment appears also to have slightly increased yields.

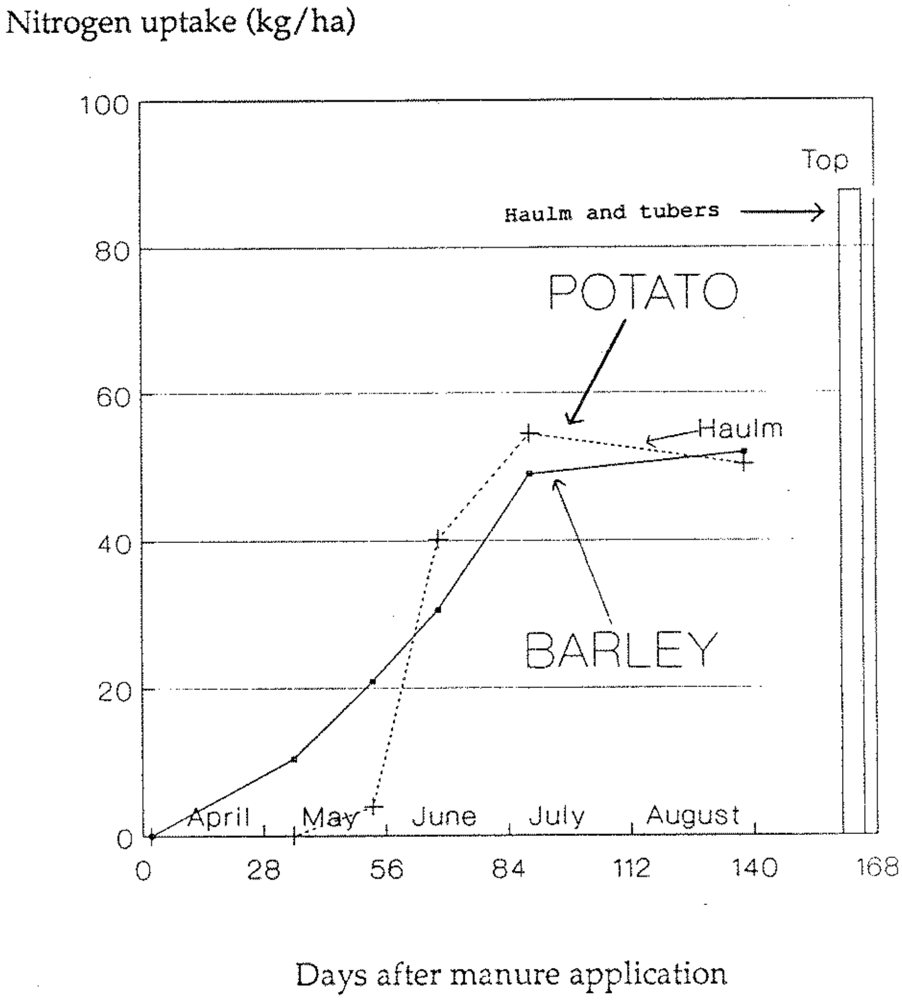
Manure Nitrogen Efficiency and N-15 Results : Using the N-15 data, the total nitrogen uptake of the potatoes can be divided into 2 pools, one derived from the labelled manure, the other derived from sources in the soil (Fig. 2).

The plant uptake of manure nitrogen occurred mainly early in the season and then levelled off. This response may indicate that the growth-promoting effect of manure is principally during the first few weeks after application, and once inorganic nitrogen and other easily released nitrogen has been taken up, there is little further uptake from the manure. The proportion of plant nitrogen derived from the manure declined through the season. A large proportion of the plant nitrogen was derived from the turnover of the soil organic matter, possibly supplemented by a residue from the application of manure during the previous autumn.

Although there was a general decline in the proportion of plant nitrogen derived from the manure through the growing season, there was a large uptake of manure nitrogen during the early part of stem extension, probably linked to the rapid growth of the stolons below ground and the expansion of the rooting system.

Soil derived nitrogen still supplied, however, the majority of the nitrogen requirements during stem extension. While the stems were expanding, there seemed to be a transfer of nitrogen from the stems to the newly initiated tubers which showed as a marked drop in the amount of manure-derived nitrogen in the stems.

Figure 2. Uptake of nitrogen by potatoes and barley during 1990



Effect of Treatments on Pests and Diseases

The incidence of diseases on the potatoes was low to non-existent [e.g. blackleg (Erwinia carotovora var. atroseptica), blight (Phytophthora infestans), black scurf (Rhizoctonia solani), powdery scab (Spongospora subterranea)] and, as a result, treatment differences were not apparent. A trend appeared to exist, however, towards a greater incidence of common scab (Streptomyces sp.) on tubers harvested from plants treated with biodynamic ferments.

The effects of the treatments on aphid numbers are shown in Table 33.

TABLE 33: Pests and disease x nitrogen on potatoes : aphid numbers [means (transformed by $\sqrt{x + 0.5}$) and least significant differences] (a) potato aphid (Macrosiphum euphorbiae); and (b) peach potato aphid (Myzus persicae)

Treatments	Dates: 14 June* Total	14 June* Wingless nymphs	20 June Total	20 June Wingless nymphs	4 July Total	4 July Wingless nymphs	11 July Total	11 July Wingless nymphs	25 July Total	25 July Wingless nymphs	7 Aug Total	7 Aug Wingless nymphs	21 Aug. Total	21 Aug. Wingless nymphs
(a)														
Manure	2.5	2.3	1.4	1.4	3.9	3.7	4.6	4.3	9.5	8.5	3.6	3.0	1.9	1.8
Manure + Ferment	0.7	0.7	1.8	1.6	4.0	3.8	4.8	4.6	9.6	8.7	2.9	2.5	1.6	1.5
Ferment	0.7	0.7	1.4	1.4	3.4	3.3	4.6	4.4	8.7	7.9	2.9	2.6	1.0	1.0
Untreated	1.9	1.6	1.4	1.3	3.2	3.1	5.0	4.9	9.3	8.4	3.5	3.3	1.7	1.6
LSDp = 0.05	0.59	0.52	0.84	0.78	1.85	1.91	1.36	1.16	3.07	2.96	1.08	0.96	0.82	0.82
(b)														
Manure	0.8	0.8	1.3	1.2	1.7	1.7	2.2	1.9	5.0	3.9	1.9	1.2	0.8	0.8
Manure + Ferment	0.7	0.7	0.8	0.8	1.4	1.2	2.1	1.7	4.3	3.5	2.1	1.7	1.2	1.1
Ferment	0.7	0.7	0.8	0.8	1.0	1.0	1.8	1.7	3.9	3.4	1.7	1.5	1.2	1.1
Untreated	0.8	0.7	1.1	1.0	1.2	1.0	2.6	2.3	4.9	3.7	1.8	1.6	1.3	1.2
LSDp = 0.05	0.24	0.21	0.51	0.41	1.15	1.00	0.67	0.55	2.04	2.14	0.75	0.63	0.67	0.58

* whole plant assessments; 3-leaf assessments (ie upper, middle, lower leaves) at other dates

The manure appeared to be having little or no effect on aphid numbers, except wingless nymphs on 14 June when manure significantly ($p<0.05$) increased nymph numbers over untreated. No substantive evidence exists from the experiment to support hypothesis that manure (in this case farmyard manure) applied in increasing quantities to plants will lead to increased pest (in this case, aphid) problems in contrast to the conventional situation where increasing artificial nitrogen fertilizer can lead to increasing problems from pests (and diseases). Biodynamic ferment appeared to be having an effect on aphid numbers. Manure + ferment and ferment treatments significantly ($p<0.05$) decreased total and wingless nymph numbers of M. euphorbiae on 14 June; ferment treatment significantly ($p<0.05$) reduced total and wingless nymph numbers of M. persicae on 11 July; and manure + ferment treatment significantly ($p<0.05$) decreased wingless nymph numbers of M.persicae on 11 July (all compared to untreated).

[R. McKinlay : Scottish Agricultural College (Edinburgh)
R. Rees : Scottish Agricultural College (Edinburgh)
D. Atkinson : Scottish Agricultural College (Aberdeen)
K. Ritz : Scottish Agricultural College (Dundee)]

POTATO APHID MANAGEMENT

Objective

To assess a number of novel treatments for the management of aphids on potatoes.

Method

Experimental details, including layout and treatments, are given in Appendix 20. Aphid numbers and types were assessed on potatoes by the 3-leaf sampling method (Anscombe, 1948) on 4 occasions throughout the season (4 and 18 July, 1 and 14 August). The fabric cover treatment was included in the experimental comparison more because it is known to prevent very efficiently aphid infestation of crop plants (McKinlay, 1987; 1990) than because it represents a commercially practicable solution to aphid management on a crop with considerable vegetative growth, such as potatoes.

Results and Discussion

The numbers of peach-potato and potato aphids found on potato plants in each treatment during 1990 are given in Table 34.

TABLE 34 **Potato Aphid Management : aphid numbers [means (transformed by $\sqrt{x+0.5}$) and least significant differences] (a) peach-potato aphid (Myzus persicae) (b) potato aphid (Macrosiphum euphorbiae)**

Treatments	Dates							
	4 July		18 July		1 August		14 August	
	Total	Wingless nymphs	Total	Wingless nymphs	Total	Wingless nymphs	Total	Wingless nymphs
(a)								
Untreated	1.0	0.8	2.6	2.3	2.0	1.7	1.1	1.1
Fabric cover	1.1	1.1	2.5	2.4	2.3	2.1	0.8	0.8
Green polythene	0.8	0.8	2.5	2.1	2.8	2.3	1.3	1.2
Fatty acids	1.3	1.2	2.7	2.2	2.4	2.0	1.4	1.2
Seaweed extract	1.1	1.0	2.8	2.2	2.8	2.3	1.3	1.1
LSDp = 0.05	0.36	0.32	0.88	0.82	0.81	0.73	0.48	0.39
(b)								
Untreated	3.0	2.9	6.2	5.6	3.2	2.9	1.4	1.3
Fabric cover	2.2	2.0	5.5	5.1	4.8	4.1	1.3	1.2
Green polythene	2.7	2.5	6.6	6.1	5.7	4.8	1.8	1.5
Fatty acids	2.1	1.9	5.8	5.3	3.7	3.1	1.3	1.1
Seaweed extract	2.6	2.4	7.3	6.8	4.5	4.0	1.5	1.4
LSDp = 0.05	0.79	0.85	2.12	1.95	1.02	0.99	0.48	0.39

On 1 August, green polythene and seaweed extract treatments significantly ($p<0.05$) increased the total numbers of peach-potato aphids compared with untreated. The fatty acid treatment significantly ($p<0.05$) increased the numbers of wingless nymphs of the peach-potato aphid on 4 July. The mean number of peach-potato aphids on plants treated with fatty acids tended to be greater than untreated on all dates (except wingless nymphs on 18 July). No treatment, including fabric cover, significantly ($p<0.05$) reduced peach-potato aphid numbers.

On 1 August, green polythene and seaweed extract treatments significantly ($p<0.05$) increased the total numbers and the wingless nymph numbers of potato aphids compared with untreated. The fabric cover and fatty acid treatments significantly ($p<0.05$) reduced the total numbers and the wingless numbers of potato aphids on 4 July; total numbers and wingless nymph numbers of potato aphids were also significantly ($p<0.05$) reduced by the fabric cover treatment on 1 August. The only treatments to reduce significantly ($p<0.05$) the numbers of potato aphids were the fabric cover and the fatty acids.

In conclusion, the fabric cover and the fatty acids treatment could be useful to growers trying to suppress aphid numbers on potatoes. As these treatments reduced the numbers of aphids more likely to be found at the top (potato aphids) than at the base (peach-potato aphids) of plants, they are likely to be more useful to growers of maincrop potatoes, concerned with maximising yields, than to growers of seed potatoes, concerned with minimising aphid-borne virus spread.

[R.G. McKinlay : Scottish Agricultural College (Edinburgh)]

BIO-DYNAMIC SEED TUBER TREATMENT ON POTATOES

Background

The biodynamic treatment, 'SPS Microbial', contains extracts of selected wild plants, garlic and onion. It is apparently able to stimulate root growth and reduce fungal attack.

Objective

To assess the effect of the use of 'SPS Microbial' seed treatment on the growth and development of potatoes.

Method

Experimental details, including layout and treatments, are given in Appendix 21. One half of the potato seed tubers used in the experiment was allowed to soak in a 1% solution of 'SPS Microbial' for 20 minutes prior to planting. Crop emergence and vigour were recorded throughout the growing season. Total tuber yields and yields per size class were recorded at harvest. The harvested tubers from treated and untreated plots were assessed and graded for quality. As the tuber grading assessment was done on an unreplicated basis, the results should be treated with caution.

Results

No differences in crop emergence or vigour were observed between treated and untreated plots.

The effect of the bio-dynamic seed tuber treatment on potato tuber yields is shown in Table 35.

TABLE 35 Bio-dynamic seed tuber treatment on potatoes : total tuber yields (t/ha) (means)

Treatment	Yield
Untreated	47.9
Bio-dynamic seed tuber treatment	45.5

The bio-dynamic seed tuber treatment would appear to have slightly depressed yields .

The effect of the bio-dynamic seed tuber treatment on potato tuber yields in 3 size grades is shown in Table 36.

TABLE 36 Bio-dynamic seed tuber treatment on potatoes : tuber yields (t/ha) x size grade (means)

Treatment	Tuber size grade		
	> 65mm	45-65mm	25-45mm
Untreated	9.2	31.6	5.9
SPS microbial seed treatment	7.0	31.2	6.35

The bio-dynamic seed tuber treatment would appear to be depressing tuber yields in the >65mm size grade. Potato tubers in this size grade are generally unmarketable owing to their large size.

The effect of the bio-dynamic seed tuber treatment on potato quality is shown below.

Untreated:	91.5% of potato tubers accepted onto grading plant. After washing, 78.3% of tubers accepted for pre-packing.
Bio-dynamic seed tuber treatment:	92.9% of potato tubers accepted onto grading plant. After washing, 92.6% of tubers accepted for pre-packing.

As little or no difference between treatments emerged until after washing, the bio-dynamic seed tuber treatment may have produced tubers which had fewer blemishes and better skin quality.

Discussion

The bio-dynamic seed tuber treatment appeared to depress potato tuber yields slightly compared to untreated. This depression in yield was, however, mainly in the >65mm size grade and many tubers of this size are unmarketable (except perhaps for baking) because they are just too big. The bio-dynamic seed tuber treatment may improve tuber quality and result in a greater proportion of the tubers being accepted for pre-packing, although these results should be treated with caution. Further work needs to be carried out on the use of the bio-dynamic treatment.

[J. Anderson: Farm Future]

MYCORRHIZA ON POTATOES (with Agricultural Genetics Company)

Background

Mycorrhizal fungi aid phosphate uptake by plant roots. Phosphorus is a very important nutrient in potato production.

Objective

To investigate the use of a mycorrhizal inoculum in organic potato production.

Method

Experimental details, including layout and treatments, are given in Appendix 22. The effect of the treatments on plant vigour was recorded throughout the growing season. Total tuber yields and yields per size class were recorded at harvest.

Results

No differences between treatments in plant vigour were recorded during the growing season.

The effect of the treatments on harvested tuber yield and number is shown in Table 37.

TABLE 37 **Mycorrhiza on Potatoes : tuber yield (t/ha) and number ('000/ha) (means and standard errors of differences)**

Treatment	Yield	Number
Untreated	42.97	420.81
Mycorrhiza	44.34	456.29
SED (6 df)	4.16	38.59

The effect of the treatments on harvested tuber yield and number in different size grades is shown in Tables 38 and 39, respectively.

TABLE 38 **Mycorrhiza on Potatoes : tuber yields (t/ha) x size class (means and standard errors of differences)**

Treatment	Tuber size class > 65mm	45-65mm	25-45mm	< 25mm
Untreated	6.23	28.62	6.48	0.27
Mycorrhiza	4.95	30.17	7.70	0.23
SED (6 df)	1.11	1.98	1.69	0.12

TABLE 39 **Mycorrhiza on Potatoes : tuber number ('000/ha) x size class (means and standard errors of differences)**

Treatment	Tuber size class > 65mm	45-65 mm	25-45mm
Untreated	23.52	237.36	159.94
Mycorrhiza	19.01	254.99	182.28
SED	4.20	16.69	22.28

Discussion

No significant ($p<0.05$) differences in harvested tuber yields were found between treatments, although the mycorrhizal treatment appeared to increase yields slightly compared to untreated.

[J. Chard: Scottish Agricultural College (Edinburgh)]

PESTS AND DISEASES X NITROGEN ON SPRING BARLEY (study funded by Scottish Office Agriculture and Fisheries Department)

Background and Objective **(see page 48)**

Method

Experimental details, including layout and treatments, are given in Appendix 23. The experiment included small microplots where the manure applied had been treated with nitrogen enriched in the isotope N-15. Plant samples were taken throughout the season from main plots and microplots (a total of 5 cuts). The incidences of pests and diseases were monitored in the growing crop. Soil samples were taken before sowing and throughout the growing season to 30cm depth and cores to 1m depth were taken in the micro plots after harvest.

Results and Discussion

Plant yield and Nitrogen content : At harvest, the barley grain yield was not high (between 2-4 tonnes/ha), but the yields of heads and straw were higher in the plots which had received manure. In the earlier cuts, no significant ($p>0.05$) differences were found between treatments in plant, straw or ear weights (Table 40), although manured plots tended to show greater mean yields. The low grain yields and large variability of the data (NB. LSD's, Table 40) reflect reasonably severe and non-uniform grazing of the experiment by rabbits in May and June 1990. The data have therefore to be interpreted with caution. The ear to straw ratio (measured in terms of dry mass) was significantly ($p<0.05$) lower at harvest on 28 August 1990 in the manured plots (mean = 1.62) than the untreated plots (mean = 2.29; Table 40): manured plots give rise to proportionately more straw than untreated plots.

TABLE 40 **Pests and diseases x nitrogen on spring barley : plant, straw and ear dry weights (kg/ha) (means and least significant differences)**

Treatment	Date and Plant Sample						
	17/5/9	4/6/90	19/6/90	5/7/90		28/8/90	
	Whole plant*	Whole plant*	Whole plant*	Ear	Straw	Ear	Straw
Manure	19.63	79.25	249.52	111.36	410.20	323.40	200.01
Untreated	22.43	73.10	208.54	94.68	327.80	249.60	112.11
$LSD_p = 0.05$	17.77	105.41	317.05	120.12	331.66	134.04	74.75

* above ground

At the first cut, the nitrogen concentration in the plant shoots differed significantly ($p<0.05$) between treatments and was significantly ($p<0.05$) correlated with nitrogen uptake by the plants. This effect is probably due to the immediate increase in the inorganic pool of nitrogen in the soil as a result of adding the manure and the subsequent uptake of this nitrogen by the plants.

Manure Nitrogen Efficiency And N-15 Results: Like potatoes, the total nitrogen uptake by the barley can be divided into a portion derived from the labelled manure and the remainder designated soil nitrogen (Figs. 1 and 2; pages 49 and 51 respectively).

The amount of plant nitrogen derived from the manure declined through the season from 47.4% to 13.75%. A large proportion of the plant nitrogen was derived from the soil organic matter, possibly supplemented by a residual effect from the application of manure during the preceding autumn. In the barley plants at harvest, 13.75% of the plant nitrogen was derived from the manure.

The manure applied contained 2.75%N and, hence, the application rate of nitrogen was approximately 137kgN/ha. The recovery of nitrogen from the manure was 4.89%, ie about 5% of the nitrogen in the manure was used by the crop. For soil nitrogen, assuming 2500kgN/ha, 1.8% was used on average by the barley crop.

Barley has a high demand for nitrogen early in the growing season, when soil temperatures are lower and does not use manure or soil nitrogen as efficiently as potatoes (see Pests and Diseases x Nitrogen on potatoes, page 49).

Measurement of total available nitrogen in the soils under potatoes or barley following the 1990 harvest indicated little difference between soils that received either no manure or manure (Table 41) suggesting that the nitrogen remained unavailable to the plant as organic nitrogen or that all mineralised nitrogen was used

TABLE 41 **Pests and diseases x nitrogen on spring barley and potatoes: total available nitrogen (mg/kg) (means and least significant differences)**

Treatments	Crop and Soil depth (cm)			
	Barley		Potatoes	
	0-3	0-20	0-3	0-20
Manure	8.5	9.4	-	7.3
Untreated	8.2	9.0	-	7.1
LSDp = 0.05	2.1	1.5	-	0.3

by the crop or lost by, for example, leaching. There were, however, differences between soils cropped with potatoes or barley (Table 42). The barley soil was more variable than the potato soil.

TABLE 42 Pests and diseases x nitrogen on spring barley : numbers of rose-grain aphids (means transformed by $\sqrt{x + 0.5}$ and least significant differences)

Treatments	Dates and Aphid life stage															
	29 May		6 June		14 June		20 June		4 July		11 July		25 July		7 August	
	Total	Wingless nymphs	Total	Wingless nymphs	Total	Wingless nymphs	Total	Wingless nymphs	Total	Wingless nymphs	Total	Wingless nymphs	Total	Wingless nymphs	Total	Wingless nymphs
Manure	1.31	1.31	1.48	1.28	1.06	1.06	1.89	1.82	5.79	5.36	10.59	9.98	8.67	7.78	0.71	0.71
Untreated	1.19	1.13	1.10	1.10	1.46	1.28	2.49	2.47	6.05	5.70	9.03	8.44	8.06	7.10	0.84	0.84
LSD = 0.05	1.08	0.89	0.73	0.95	1.47	1.32	3.87	3.69	0.83	0.79	1.13	1.22	5.61	5.49	0.41	0.41

Effect of treatments on pests and diseases: The incidence of diseases on the barley was very low [eg. powdery mildew (Erysiphe graminis), leaf blotch (Rhynchosporium secalis)] and, as a result, treatment differences were not apparent.

Aphids were assessed approximately every 10 days from 23 May until 21 August. Three aphid species were assessed: rose-grain aphid (Metopolophium dirhodum), grain aphid (Sitobion avenae) and bird-cherry aphid (Rhopalosiphum padi)). The effects of the treatments on the rose-grain aphid, numerically the most dominant species during 1990, are shown in Table 41. The aphid numbers peaked on or around 11 July when significantly ($p<0.05$) more were found on manure treated plants than on untreated plants, both total aphids and wingless nymphs. Some evidence exists, then, to support the hypothesis that manure (in this case, farmyard manure) applied in increasing quantities to plants will lead to increased pest (in this case, aphid) problems. Taken together, the aphid results of the potato (see page 49) and barley experiments lend support to this hypothesis.

Soil microbiology: A spring application of manure had no effect on the size or activity of the soil microbial biomass, on the quantity of nitrogen in the biomass or on the soil nematode population size. The effects of the spring application of manure may have been largely masked by a large application of manure across the field site during the preceding autumn. Soil respiration rates and numbers of nematodes were increased by growing plants. Halfway through the growing season, the population of nematodes was composed of approximately 50% microbial-feeding types. Quantities of microbial biomass carbon were increased in planted soils but to a lesser extent than soil respiration rates and nematode numbers. Microbial nitrogen was not influenced by the presence of growing plants. Quantities of nitrogen in the microbial biomass showed distinct maxima in midsummer, a pattern also observed in conventional arable systems. The increases in activity of microbes and their predators observed in soils growing barley plants indicate that the cycling of nutrients supporting the soil microcosm is influenced by growing plants.

[R. McKinlay: Scottish Agricultural College (Edinburgh)
R. Rees : Scottish Agricultural College (Edinburgh)
D. Atkinson: Scottish Agricultural College (Aberdeen)
K. Ritz : Scottish Crop Research Institute (Dundee)]

CHAPTER 3

ANIMAL PRODUCTION

GRASS

Clover is the cornerstone of the organic ley, and the seed mixtures sown at Jamesfield farm in 1989 and 1990 contained a high proportion of white clover (Trifolium repens) and a small proportion of red clover (T. pratense). The clovers were sown with a 50:50 diploid-tetraploid blend of perennial ryegrass (Lolium perenne) varieties, the tetraploids to encourage the spread of clover through their more open growth habit in comparison with the diploids. The herbs, chicory (Cichorium intybus), ribwort plantain (Plantago spp.) and yarrow (Achillea millefolium), were also included for their high mineral content and deep rooting ability.

Despite the absence of artificial nitrogen fertilizer on soils that had moderate phosphate and potash status, a good stand of grass and clover established. A 20 hectare field, sown in early September 1989, had the following number of sown plants established and percent establishment in November 1989:

Measures of establishment	Perennial ryegrass	Timothy*	White clover	Red clover
Plants/m^2	1380	60	390	44
% establishment	70	8	57	33

* Phleum pratense

Broad-leaved weeds - mainly chickweed (Stellaria media), daynettle (Galeopsis tetrahit), red deadnettle (Lamium purpureum), shepherd's purse (Capsella bursa-pastoris), and dock (Rumex obtusifolius) - averaged 18% ground cover. Few of the herbs appeared to have germinated.

After a mild winter, estimates of ground cover in the 20 hectare field on 2 April 1990, showed a fairly heavy infestation of weeds, mostly chickweed and shepherd's purse. The degree of weed infestation fell markedly over the grazing season and white clover increased markedly.

Month	% ground cover Perennial ryegrass	Timothy	White clover	Red clover	Unsown species	Bare grnd.
April	38	8	17	3	24	10
Oct.	39	1	46	9	trace	4

Of the herbs sown around the headland in this field, only 2 chicory plants/m^2, a trace of plantain and no yarrow plants were recorded in October 1990. Overwintering of Merino sheep and late spring growth in the absence of artificial nitrogen fertilizer combined to cause a spring shortage of grass/clover grazing, and delayed cattle turnout until 17 May 1990. The sparsity of grazing at this time also led to an underestimate of the grazing potential of the increasingly clover-dominant sward. Under-grazing of the field is reflected in the sward heights which should, ideally, fall in the range, 8-10 cm, from May onwards:

April	May	June	July	August	Sept.	Oct.
5.9	12.2	19.3	20.4*	15.3	20.4	14.5

*Cut for silage 17 July 1990

A measure of net herbage production in the 20 hectare hield was made from 12 enclosure cages sampled monthly from 17 May to 31 October 1990. A total production of 7130kg dry matter/hectare was measured, comprising 23% perennial ryegrass, 1% Timothy, 55% white clover, 7% red clover and 14% unsown species. None of the latter was recorded in the last 3 months. A production level of 7130kg dry matter/hectare is equivalent to a grass sward treated with 150kg artificial nitrogen fertilizer/hectare.

During 1990, the 20 hectare field produced a first-cut of silage in June, and smaller cuts, surplus to grazing requirements, in July and August. All cuts were big-bale-wrapped without an additive and made excellent silages, despite the high clover contents (44% of the dry matter content at 18 June cut).

Month	Dry matter (g/kg)	Ph	Ammonium nitrogen (gNH_3-N/kg total)	Crude protein (g/kg dry matter)	Digestibility value (%)	Metabolisable energy (Megajoules/ kg dry matter)
June	231	4.3	78	160	72.7	11.6
July	315	4.7	102	193	70.1	11.6
eAugust	435	4.7	105	234	76.7	12.3
<u>Key:</u>	low<300 high>300	low<4 high>5	low<100 high>150	low<130 high>180	low<60 high>70	low<10 high>11

The first cut produced a modest 10.7 tonnes of silage/hectare, about half the yield of a normal crop.

A second field, 7 hectares in area, was sown in May 1990 with 'Dula' oats for arable silage. Dry conditions delayed growth and the silage crop cut in late August had a heavy infestation of fat hen (Chenopodium album). The big-baled silage was well epreserved, however, with a high protein content but a low metabolisable energy:

Dry matter (g/kg)	pH	Ammonium Nitrogen (gNH_3-N/ kg total)	Crude protein (g/kg dry matter)	Digestibility value (%)	Metabolisable energy (Megajoules/ kg dry matter
404	4.8	66	172	61.4	9.8

After cutting, the field was divided into 5 paddocks for rotational grazing by the Merino sheep. In October 1990, the sward composition (% ground cover) was as follows:

Perennial ryegrass	Timothy	White clover	Red clover	Chicory	Plan-tain	Unsown species	Bare ground
46	4	13	11	7	1	16	2

The chicory and ribwort plantain were well established throughout the field, achieving an average of 27 and 9 plants/m^2, respectively.

[G. Swift: Scottish Agricultural College (Edinburgh)]

BEEF

Background

The primary objective of the beef system at Jamesfield farm is to build up soil fertility for subsequent organic crops. This aim is achieved by providing a grass/clover break in the rotation and by the production of farmyard manure when the cattle are housed over the winter period. All the dung produced over the winter is spread onto the arable/vegetable land.

The beef enterprise is based on finishing weaned, organic suckled calves with the objective of providing 2 finished animals every 2 weeks. The carcasses are then sold at the rate of one per week through a Safeway plc supermarket in Edinburgh. All animals are closely monitored to evaluate the seasonal premium required for organic beef so that producers can achieve a similar 'net margin per head' throughout the year. This information is essential if supermarkets are going to be guaranteed continuity of supply and producers guaranteed similar profit margins per head over the year.

Standards

The cattle are being produced under the Soil Association standards:

- All animals are purchased as suckled calves from registered organic farms;
- The system endeavours to make maximum use of homegrown feeds, in particular, grazing and silage from high clover swards.
- The animals are slaughtered at an approved Soil Association slaughterhouse.

Target slaughter criteria are based on Safeway plc carcass specification of:

Carcass weight:	244-318 kg
Conformation:	R or better
Fat class:	3 or 4L
Eye muscle area:	Minimum 6405 cm^2
Age:	16-24 months

To achieve these carcass weights requires slaughter weights of between 450 and 580 kg liveweight.

Progress Report

The target - to produce 2 finished organic cattle a fortnight - has been achieved, commencing mid-May 1990. With a second field of organic grass coming into production in the autumn of 1990, output of finished, organic animals has increased to 7 per month. This output is made up of an initial kill of 3 cattle early in the month and 4 cattle at the end of the month.

The 2 main problems encountered in initiating the programme were:

1) Lack of resources.

2) Sourcing organically registered suckled calves.

Initial Lack of Resources

At the start of the project in the autumn 1989, there were no organic pastures available on the farm and, as a consequence, no supplies of homegrown organic forage for wintering stock. Cattle purchased during the first winter had to be fed, therefore, entirely on purchased feed comprising of organic cereal straw, organic oats/barley, full fat soya bean meal and dried seaweed. To achieve the required levels of animal performance (around 0.6 kg./head/day for cattle being turned out to grass in the spring of 1990 and around 0.9kg/head/day for cattle being slaughtered out of the buildings in May, 1990) required a high level of concentrate feeding which had to be purchased in competition with the organic malting barley market or the organic oat market for human consumption. Premiums in excess of £50/tonne had to be paid. As a consequence, initial purchases of organic suckled calves (November, 1989 and March, 1990) left negative margins of around £100/head, largely as a result of excessive winter feed costs.

With the successful establishment of 20 hectares of organic high clover pasture with a further 7 hectares becoming available in the autumn of 1990, ample, high quality organic winter feed in terms of big bale silage was produced for the winter of 1991. This silage has had a two-fold benefit in reducing winter feed costs; first, by being cheaply produced at around £15/tonne (£5 contribution to reseeding costs and £10 contractor's charges for cutting, baling and bagging); and, secondly, in producing a high quality roughage (see Tables on pages 65 and 66), significantly reducing the amount of cereal supplementation required. Cereals still have to be purchased at prevailing market prices. As a consequence, daily winter feed costs in the region of 60 p/head/day during 1990/91 winter compare with an excess of 100 p/head/day for the previous winter feeding period.

Overall feed costs per head have been further reduced with subsequent groups of purchased cattle being grazed for a proportion of their lifetime. Daily costs for grazing are in the region of only 25 p/head with a major proportion of these costs being accounted for by the use of purchased organic straw being fed *ad libitum* throughout the summer grazing period to minimise the risk of bloat.

Sourcing Organic Suckled Calves

The second major problem encountered was sourcing of weaned, suckled calves registered as organic by the Soil Association. At the start of the project, the Soil Association was the only organic licensing body functioning in the UK. As a consequence, for the cattle produced from the project to be sold under an organic label, they had to be fully registered with the Soil Association. Hence, suckled calves could be purchased only from suckler herds registered as organic by the Soil Association.

(Initially, the project intended to apply UKROFS standards which would have allowed 'conventional suckled calves' to be purchased providing that they were kept for a minimum of 6 months within the organic unit at Jamesfield farm. Owing to the delay in establishing a national registration scheme based on UKROFS standards, the project would not have been able to meet the initial slaughter dates and, hence, animals could not have been sold under an organic label).

While there are currently almost 20 organic suckler herds in Scotland registered with the Soil Association, in practice only 2 herds are suitable for supplying weaned, organic, suckled calves to the project. The remaining herds either finish their suckled calves themselves or are too small (less than 20 cows/herd) to supply sufficient uniform calves in terms of sex and breeding.

At the start of the project, the situation was further confounded by the largest herd (approximately 150 cows) keeping its bull calves. Hence, the only cattle available from this herd were heifers. Nevertheless, now contacts have been established, the difficulties in purchasing organic suckled calves have diminished but are still severely restricting in terms of breed, sex and age/liveweight at sale.

Continuity of Supply of Finished Animals

In order to achieve a premium for organic beef, supplies to the consumer must be maintained throughout the year. The complication to management (such as differential feeding of small groups of cattle to achieve the required slaughter pattern) required to achieve this objective has not been significant, providing groups of suckled calves can be purchased at a range of liveweights and, hence, a range of expected dates of reaching slaughter condition. For example, over most of the summer grazing season, the majority of the cattle were grazed in one group but, owing to a range in liveweight at turnout, sex and breed type, problems in achieving continuity of finished animals were not great, with the exception of late autumn when a proportion of slaughtered heifers was overfat (4H or more). Similarly, although cattle are housed over the winter in small groups of around 5 per pen, differences in feeding have been minimal varying by no more than 1 kg of concentrates/head/day.

Conclusions

1) The project has clearly identified the importance of careful planning to give an integrated move from conventional to organic production. In the case of the project, the importance of careful planning has been most marked for feed supplies (for both winter and summer) and for sourcing suitable supplies of organic suckled calves. The latter problem would be eliminated by using UKROFS standards for which a registration system is now established in the UK and as more people move into organic production with suckler herds selling weaned calves.

   On the marketing side, the project has been fortunate in its association with Safeway plc to market all cattle produced at an agreed premium. However, the ability of organic producers to guarantee supplies throughout the year would remove one of the major obstacles to marketing organic beef at a premium.

2) The expected problems in terms of the level of management required to guarantee "consistent" supplies of cattle throughout the year have not materialised. Where adequate supplies of suitable, weaned, suckled calves are available, particularly in terms of their purchase weight, an individual producer would appear to be able to guarantee continuity of supplies, all be it on a small scale.

3) Providing high clover swards can be established to maintain forage production per hectare and a proportion of organic cereals is included in the rotation, there would appear to be little difficulty or major increased cost in the production of organic beef, compared to current conventional systems of production.

[B. Lowman: Scottish Agricultural College (Edinburgh)]

ANIMAL HEALTH

The objectives behind the livestock stocking policy at the Organic Farming Centre, Jamesfield farm have been discussed elsewhere (Jamesfield farm Open Day handout), but the implications for livestock health of these decisions were significant.

Cattle

All cattle were store animals, often forward stores, derived from organic units on the Soil Association register. All were weaned suckler calves, either heifers or stots following a season at grass with their dam. The health consequences of such purchases were that health problems of the neonatal and young calf were avoided. These include common problems such as infective scours (Rotavirus infection, Coronavirus, Cryptosporidia, Salmonellosis) digestive disorders (milk scour, milk bloat) and respiratory problems (Respiratory Syncitial Virus infection, pasteurellosis). Following a season at grass with their dam, the weaned calves were likely to have acquired a degree of protective immunity to lungworm and gastro-intestinal worms. Experiences through this first year confirmed these health predictions.

Sheep

The presence of sheep on the farm also provided a useful contribution to the health of both cattle and sheep. Their contribution was as follows:

- they precluded a species monoculture system reducing the build-up of parasitic and infectious agents specific to certain species of livestock

- the use of sheep in the grazing management of the pasture increased the nutritive value of the grazing for cattle.

As with the cattle, the Merino wethers were not expected to suffer problems from neonatal diseases and had acquired a degree of gut worm resistance.

Routine Monitoring

Cattle

On arrival at the farm, blood samples were taken from a selection of calves for a metabolic profile examination.

Calves Nos. 128-139 were sampled on 8 March 1990. Mean values with standard deviations for the 12 animals are detailed in the following Table:

Sampling date No. bled	8/3/90 12 animals	16/3/90 15 animals	28/6/90 12 animals	25/10/90 9 animals
GSHPx (Iu/ml cells)	6.1 ± 2.5	13.9 ± 4.6	68.9 ± 13.2	22.67 ± 5.4
Cu (umol/l)	12.0 ± 1.5	10.9 ± 1.9	10.13 ± 1.58	8.24 ± 1.7
Glucose (mmol/l)	4.18 ± 0.3	3.9 ± 0.21	-	-
BHBA (mmol/l)	0.08 ± 0.05	0.22 ± 0.07	-	0.48 ± 0.17
Ca (mmol/l)	2.23 ± 0.06	2.26 ± 0.1	2.39 ± 0.11	2.45 ± 0.08
Mg (mmol/l)	0.91 ± 0.08	0.85 ± 0.05	0.87 ± 0.04	1.11 ± 0.04
Phos (mmol/l)	1.9 ± 0.08	2.7 ± 0.32	3.28 ± 0.29	2.71 ± 0.42
TP (g/l)	68.0 ± 2.9	63.5 ± 3.9	74.7 ± 4.9	72.47 ± 6.0
Ab (g/l)	35.0 ± 1.4	33.1 ± 2.7	35.2 ± 2.33	30.94 ± 3.9
Glob (g/l)	32.9 ± 2.3	30.5 ± 2.6	-	-
Pepsinogen (Iu/l)	-	1.37 ± 0.6	0.75 ± 0.18	1.41 ± 0.19
Urea (mmol/l)	1.7 ± 0.3	1.5 ± 0.25	-	4.72 ± 0.74
Hapto (g/l)	-	-	0.06 ± 0.62	-

Energy and protein status of the calves was good although blood urea levels were marginally low. However, as total protein and albumin were adequate, there would appear to have been no problem with protein synthesis and the urea levels were considered to be indicative of winter feeding. Major mineral status was also good. Trace element status was of concern, for although copper levels were adequate, blood selenium levels as indicated by glutathione peroxidase values were very low. Normal values of above 23 units/ml cells are desirable. There was no indication of clinical abnormalities arising from this biochemical finding and apart from ensuring that each animal received 113-170g seaweed meal per head per day in the feed, no further action was taken.

On 16 March 1990, a second group of calves numbered 1-15 was sampled (see Table).

The findings in this group were similar to the findings in the previous group with the following variations. The selenium status fell into the low marginal category instead of the deficient category of the previous group. The interpretive ranges we use are:

>7	Iu/ml cells - deficient
7-15	Iu/ml cells - low marginal
15-23	Iu/ml cells - marginal
>23	Iu/ml cells - adequate

The serum pepsinogen values in the group (not examined in previous group) showed a burden of <u>Ostertagia</u> species worms within the normal range for a grazing animal. This finding confirmed the expectation that worm infection had been acquired to enable a degree of protective immunity to have been established without evidence of clinical parasitic gastro-enteritis (PGE).

On 28 June 1990, a third group of calves was blood sampled for metabolic examination. Animal numbers were No.7 and 613-638 - twelve animals being involved (see Table).

Notice the adequate selenium status in these calves and the low serum pepsinogen levels. The possibility of intercurrent bacterial infection in these calves was checked by examining for acute phase proteins. The haptoglobin figures indicated that no infection was present at the time of sampling.

On 25 October 1990, a sample of the cattle that had been at grass all summer was bled for profile examination. Animal numbers G1-G11 (G8 and G10 were excluded) were in the sample. The results of the nine animals' samples were as shown. Of significance was the rise of selenium status as indicated by the GSHPx levels to the bottom of the adequate category, a rise in blood urea values reflecting the non-protein nitrogen utilisation from herbage and serum pepsinogen levels indicating a worm burden of a size to be expected from clinically normal grazing cattle - a highly acceptable profile pattern for animals of this type after a period of grass.

Clinical signs requiring attention

Cattle

Angleberries

On arrival in Spring 1990, a few of the heifers had large angleberries around the udder and teats. Slight traumatic injury had occurred to these warts causing the animal some discomfort. Treatment using a combination of herbal and homoeopathic remedies was used.

> Homoeopathic remedy: *Thuja occidentalis* 30c was used 2 x weekly after 1 week increasing the potency to 200c.
>
> Herbal remedies: The warts were bathed with the cut surface of a lemon twice weekly, green forage in the form of cabbages was added to the ration to provide additional sulphur and the seaweed content of the ration was increased to 227g per head per day to provide extra iodine.

The response to treatment was variable but the warts had regressed or dropped off by turnout.

Stiff gait

At turnout, a number of the well grown animals appeared stiff with an uneasy gait. None, however, became recumbent or exhibited myoglobinuria. There was some concern, in view of the low selenium status in some of these animals, for an outbreak of nutritional muscular dystrophy or paralytic myoglobinuria. Examination of blood samples from affected calves revealed creatinine phosphokinase (CPK) values of >1000 Iu/ml ruling out a degenerative muscular disorder. No treatment was administered. Within 2 weeks the stiffness had abated.

Bloat

During mid-summer, as the clover content of the sward was substantial, a significant proportion of the herd showed evidence of rumenal distension. The severity of the distension was never great enough to require intervention to relieve the bloat and all animals expelled the gas without assistance. As a preventive, however, a 1 inch layer of arachis oil was applied to the surface of the water troughs daily to reduce the surface tension of the rumenal contents. The effect of such action appeared beneficial.

Sudden death

Two animals were found dead in the field, one on Thursday, 6 September and the second a week later on 13 September 1990. These animals were from a batch which had been recently brought on to the farm from an organic hill farm.

On necropsy, there was moderate distension of the rumen with early fatty degeneration of the liver in the first animal and congestion of the lungs with petechial and ecchymotic haemorrhage in the trachea, larynx, epicardial fat and beneath the parietal pleura in the second. Extensive microbial, chemical and toxicological examinations failed to reveal any significant findings.

Specific cause of death in these two animals could not be determined. Circumstantial evidence was suggestive of a metabolic imbalance - the animals had recently arrived on the farm with a sudden feed change from hill grazing to lush, high clover content lowland pasture. The haemorrhagic changes resemble those seen in hypomagnesaemia/hypocalcaemia and although not pathognomonic are suggestive of metabolic imbalance.

Lice

Over the housing period at the end of the grazing season, a build up of ectoparasites occurred. Treatment with Derris powder was used and only one course of treatment was required to bring the parasites under control.

Lameness

Following housing, one animal exhibited severe lameness. There had been a leg injury as no foot lameness was present. Rinking and competition for food probably resulted in leg injury. The animal was penned separately and rested and recovered uneventfully.

Sheep

Mycotic dermatitis

Soon after arrival on the farm, matting of the fleece and some scab formation were noted in 3-6 animals. *Dermatophilus congolense* was demonstrated on microscopical examination of fleece samples. Three animals were severely affected, were housed to avoid the heavy persistent rain that was falling at the time, were shorn and the lesions dressed with Oxytetracycline spray together with parenteral penicillin.

Remaining sheep with matted fleece but no skin scabbing were dressed with an aluminium sulphate/potash alum powder. The infection was controlled.

Headfly

In June/July, headfly problems became severe and dipping with a Bayticol dip failed to control the infestation. A spot-on insecticide containing a pyrethroid was used topically and was a considerable improvement.

Orf

A group of gimmers and wether hoggs was introduced from Kirkton Farm to control prolific grass/clover growth. Soon after arrival, it was noticed that a number of animals were lame. Examination showed lesions resembling contagious pustular dermatitis between the clits and up the legs. Lesions were open and bleeding and laboratory examination confirmed orf infection by electron-microscopy. Treatment with an ointment prepared from lard, petroleum jelly and sodium hypochlorite powder to form a malleable paste was applied to the lesions. The lesions responded well to this therapy.

Sudden deaths

Over the year, three sheep deaths occurred. Necropsy on these carcases failed to reveal cause of death. One animal had a moderate worm burden but in an animal in moderate to good condition this finding was not considered significant.

Summary

The health status of the stock was good, with no evidence of epidemic disease in spite of no use of clostridial vaccination or routine anthelmintic. Losses in both cattle and sheep were commonly associated with recently introduced animals occurring within a few weeks of arrival on the farm. The problem of introduced conditions associated with the stress of change in environment, feed change and altered stockmanship may all have contributed to these minor health difficulties.

[G. Halliday: Scottish Agricultural College (Aberdeen)]

CHAPTER 4

ENVIRONMENTAL MONITORING

PRELIMINARY SURVEY OF EARTHWORMS

Earthworms and Agriculture

Earthworms have a major role in the breakdown of plant material in the soil and the release of nitrogen compounds for assimilation by plants. Studies have shown both the beneficial actions of earthworms in soils, and the agricultural practices that pose threats to earthworms, such as ploughing, applications of certain pesticides, fungicides, herbicides and fertilisers, and stubble burning. But there is still a need to establish which organic agricultural techniques allow maximum growth of earthworm populations and permit high populations to be maintained, and whether earthworm activities can improve the yields and quality of crops and livestock.

Sampling

Potassium permanganate solution (which is permitted on 'Organic' status farmland) was the expellent chosen for sampling. This chemical irritates earthworms, which are collected as they emerge from the soil, enabling fields to be sampled easily and relatively quickly. The solution, prepared by adding 1.5g $KMn0_4$ crystals per litre water, was applied at a rate of approximately 2 litres to each 0.5 m^2 quadrat of soil; there were 4 replicates at each site.

To ensure that the earthworms collected are representative of all species present in the fields, sampling with chemical expellents must be restricted to periods when the soil temperature is between 5-10°C and also moist throughout the profile. The 4 sites were sampled between 30 October - 5 November, when the soil was moist and topsoil temperatures exceeded 5°C.

The earthworms were preserved in 4% formaldehyde solution; their biomass was recorded within 7 days (Gerard and Hay, 1979). Identification and nomenclature were based on Sims and Gerard (1985).

Four sites were sampled on Jamesfield and Balgonie farms, 3 on Jamesfield farm (organic), one on Balgonie farm (conventional).

Results and Discussion

The main characteristics of the 4 sites sampled on Jamesfield and Balgonie farms and the results of the earthworm survey are given in the following Table.

Earthworm species	Number of earthworms at each of four sites (from 4 0.5 sq.m. quadrats/site) 1*	2*	3*	4**	TOTAL
Lumbricus spp.					
L. terrestris	1	13	1	0	15
L. rubellus	22	13	35	0	70
L. castaneum	0	0	6	7	13
Aporrectodea spp.					
A. longa	28	76	38	1	143
A. caliginosa	38	98	79	8	223
A. rosea	8	7	14	13	42
Allolobophora spp.					
A. chlorotica	26	0	0	0	26
					532
Number of worms	123	207	173	29	
Mass (g)	47.28	141.97	88.44	6.82	
Biomass/worm (g)	0.38	0.69	0.49	0.21	
Soil type	Carpow	Carpow	Carey	Carey	
'Organic' years	60 +	1	1	none	
Crop	Swedes	Grass	Grass	Ploughed	
Date sampled	30 Oct	31 Oct	30 Oct	5 Nov	
Soil temp. (°C)	6	6	6	7	

*organic **conventional

All of the earthworms extracted belong to the 7 commonest species found in British agricultural land (Gerard, 1964). These species can be divided into 2 distinct groups:

1) Lumbricus species, which are active throughout the year, and perform a valuable function by foraging on the soil surface for old leaves, dung, and other decaying vegetation which may be pulled into the soil; and

2) Aporrectodea and Allolobophora species, which are inactive during warm, dry periods and move to deeper soil in cold weather; they feed only on fragments of plant material within the soil.

Both groups contribute to soil fertility, but unless conditions are favourable for the development of very high earthworm populations, it is likely that most of the beneficial effects are noticeable only over long periods.

In agricultural land, many factors and practices may influence the size and structure of earthworm populations. This preliminary survey was conducted to study the distribution of earthworm species and abundance in relation to different soil types and cropping practice.

Typically, Aporrectodea caliginosa and Allolobophora chlorotica are co-dominant in arable farmland (Gerard and Hay, 1979), but at Jamesfield farm, A. chlorotica was extracted from only one quadrat (at Site 1), and more sampling is required to determine whether it has a patchy distribution on the farm or is truly scarce in these fields.

A. caliginosa and A. longa were co-dominant species at Sites 1-3, with Lumbricus rubellus nearly as abundant as A. longa at Sites 1 and 3. Very few earthworms were extracted from Site 4 (the only non-'organic' site); 45% of these were the minor species Aporrectodea rosea.

Comparison between the samples indicates that the 3 'organically farmed' fields have higher populations and greater biomass of earthworms, as well as higher average biomass per worm, than the non-'organic' field. These differences, however, may also have resulted from the effects of factors other than past cropping practice that influence earthworm populations.

Further examination of the results shows that samples from the grass field (Sites 2 and 3) had the highest numbers and greatest biomass, especially from Site 2, on the Carpow soil series. Unexpectedly, Site 1, after 60 years of 'organic' farming appeared to be less important as an influence than other factors, which may include crops grown or cultivation practices.

Sites 3 and 4 were both on Carey soil series yet earthworm populations were vastly different. This result suggests that differences in soil series can be a less important factor than cropping and cultivation practices.

This preliminary survey has demonstrated that Jamesfield farm in association with a neighbouring conventional farm could provide useful information for guidelines on the effect of management practices on earthworms. A sampling programme for monitoring changes in earthworm populations under different treatments could measure which 'organic' conversion methods are most beneficial to earthworms.

In addition, there would be great practical value in studying high earthworm populations to assess whether their soil fertility activities could be specifically associated with improved yield or quality of organically grown crops and livestock.

Conclusions

All of the earthworms collected in the survey belong to the 7 species commonly found in agricultural land in Britain.

Earthworms were more abundant, had greater biomass and average biomass per earthworm at the 3 sites converted to the 'organic' method of farming, than in the one site treated with synthetic fertilisers and pesticides; but many factors may be responsible for this difference. Interpretation of the survey results is difficult, although examination of the results indicates that certain cropping and cultivation practices may have overridden the expected effects of soil series.

Any further surveys should be directed at research subjects which might provide practical advice for 'organic' farmers. Two major questions to be answered are:

1) Which combinations of 'organic' treatments encourage the development of high populations of earthworms?

2) Under which 'organic' conditions can earthworms increase the yield and improve the quality of farm produce?

[B.M. Gerard: Scottish Agricultural College (Edinburgh)]

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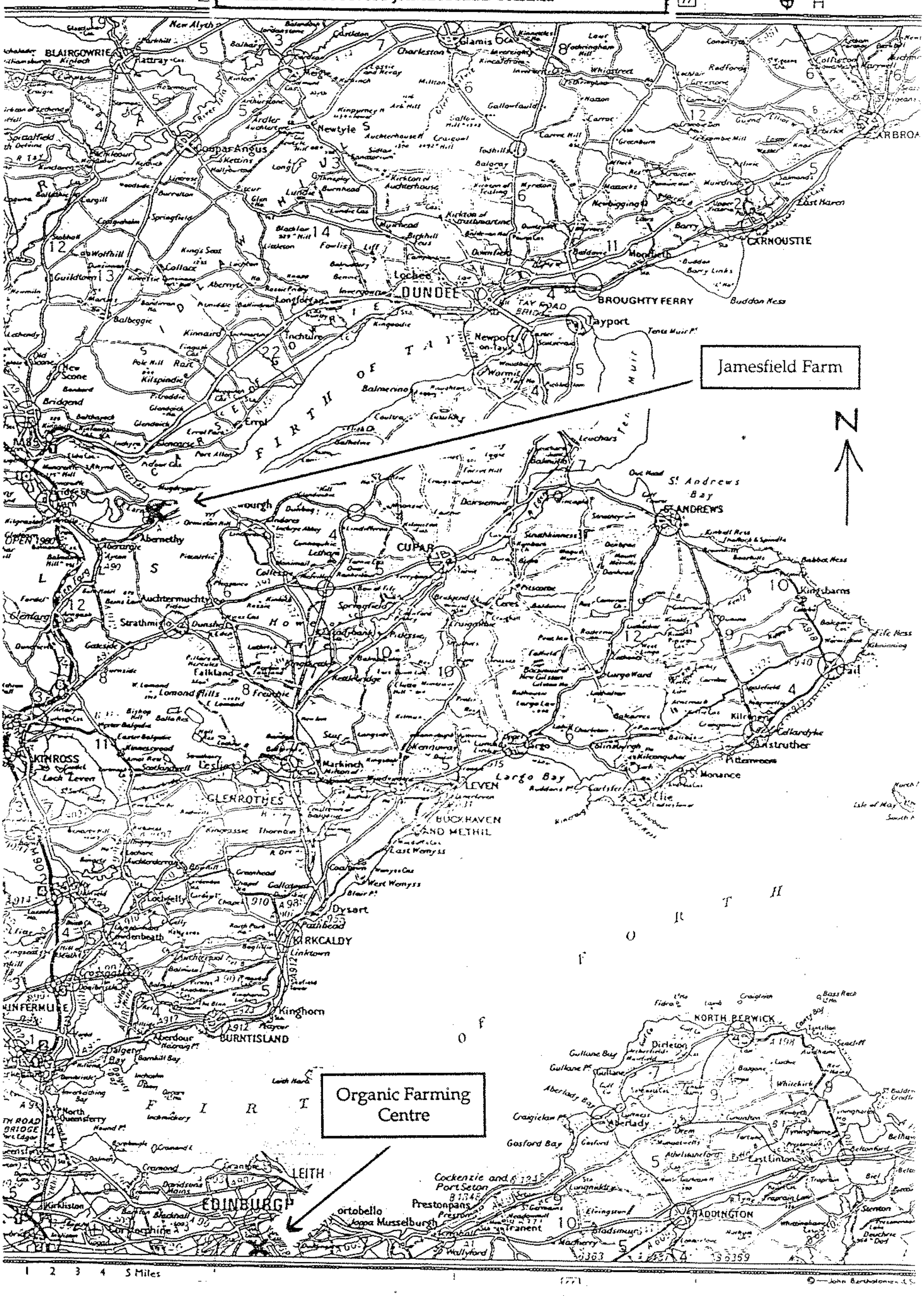
Appendix 1

MAP OF SCOTLAND TO SHOW LOCATION OF ORGANIC FARMING CENTRE'S MANAGEMENT AND ADMINISTRATION IN EDINBURGH AND FIELD STATION AT JAMESFIELD FARM.



SITE DETAILS : JAMESFIELD

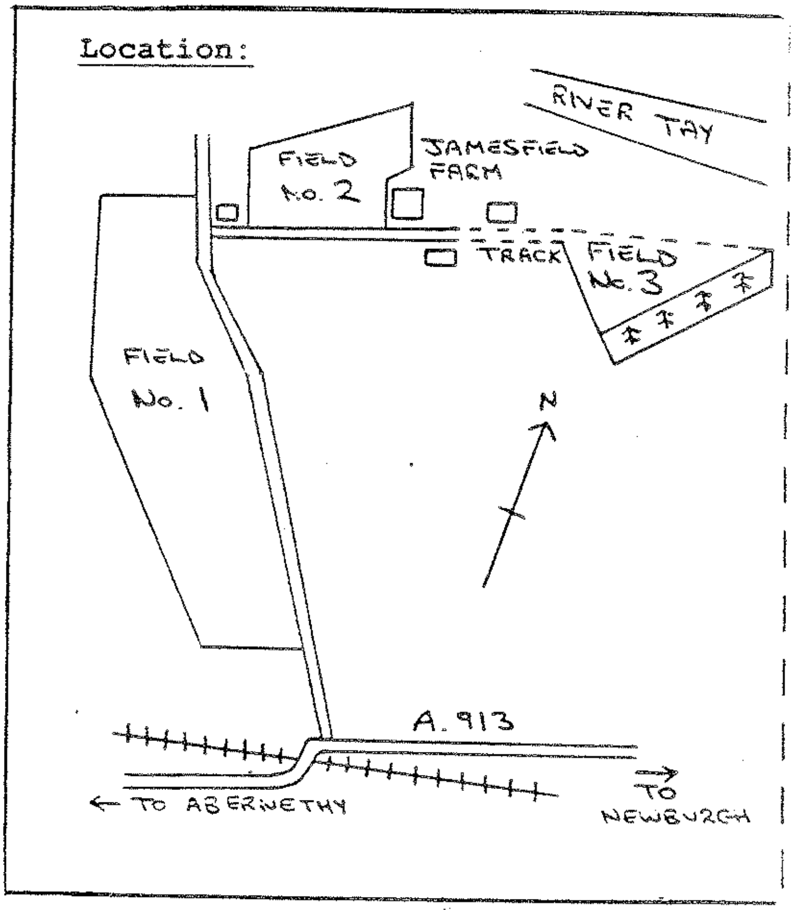
Grid Ref:	T 205183
Elevation:	15m
Soil Series:	Carpow/Carey
Soil Type:	Sandy Loam
Previously Cropping: (Livestock Field)	86 - Barley 87 - Oilseed Rape 88 - Wheat 89 - Barley
Soil Analysis: (Livestock Field)	pH - 6.1 P - High K - Moderate Mg - Moderate

Derived organic matter - 8%

Previous Cropping: (Cropping Field)	86 - Oats 87 - Grass 88 - Cabbage/ Barley 89 - Oats
Soil Analysis: (Cropping Field)	pH - 6.6 P - High K - Moderate Mg - Moderate S - Moderate Mn - Very low Cu - Moderate B - Low

Derived organic matter - 6%

Annual rainfall:	760mm
Mean Air Temperature:	8.3°C
Annual Sunshine Hours:	1321

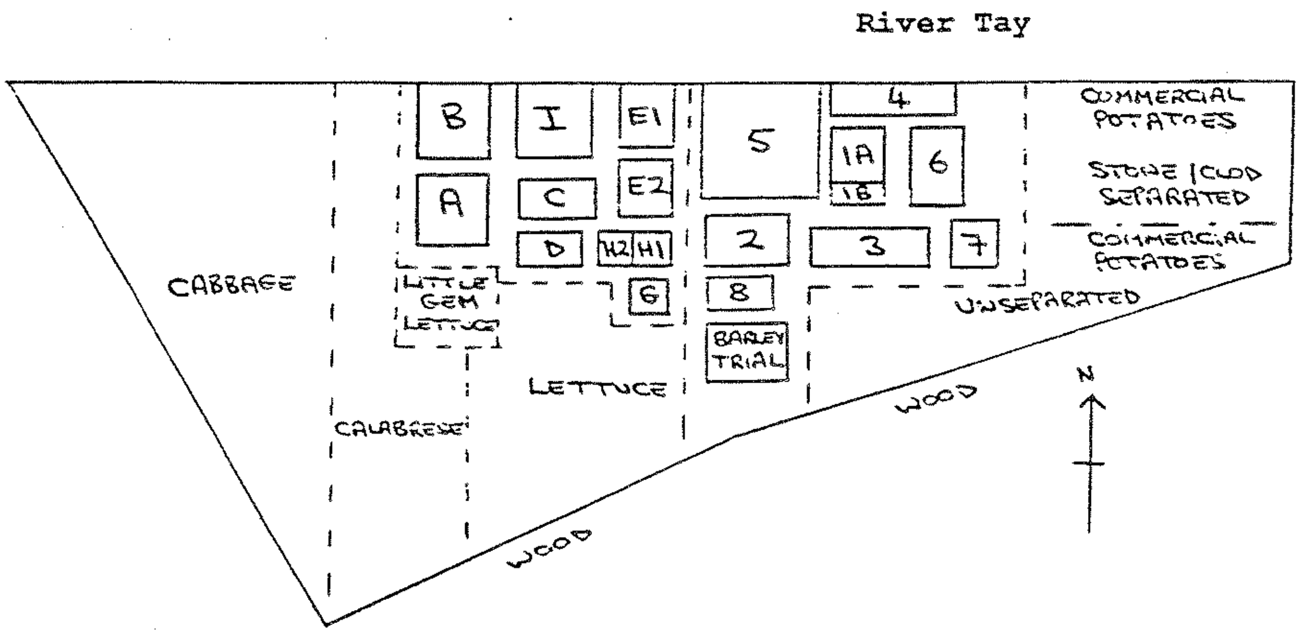


Key to Organic Farming Centre Fields:

Field No 1: (Livestock field)	Sheep/Cattle Grazing & Silage Conservation
Field No 2:	Arable Silage Conservation
Field No 3: (Cropping field)	Crop Experiments & Commercial Cropping

Appendix 3

FIELD LAYOUT OF CROP EXPERIMENTS AT JAMESFIELD



VEGETABLE PRODUCTION - BRASSICA AND POTATO EXPERIMENTS

Key To Brassica Experiments:

A	-	CALABRESE DISEASE MANAGEMENT
B	-	CABBAGE DISEASE MANAGEMENT
C	-	CALABRESE VARIETIES
D	-	CALABRESE TRANSPLANT RAISING SYSTEMS
E1	-	NITROGEN RATES X SOURCES FOR CALABRESE
E2	-	NITROGEN RATES X SOURCES FOR BRUSSEL SPROUTS
G	-	PRE-PLANTING TECHNIQUES FOR WEED MANAGEMENT ON CALABRESE
H1	-	WEED MULCHES ON CALABRESE
H2	-	WEED MULCHES ON BRUSSEL SPROUTS
I	-	CABBAGE PEST MANAGEMENT

Key To Potato Experiments:

1A	-	VARIETY X SEED RATES
1B	-	POTATOES FOR BAKING
2	-	BLACKLEG MANAGEMENT
3	-	BLIGHT MANAGEMENT
4	-	BLIGHT RESISTANT CULTIVARS
5	-	PESTS AND DISEASES X NITROGEN
6	-	APHID MANAGEMENT
7	-	BIO-DYNAMIC SEED TUBER TREATMENT
8	-	MYCORRHIZA

CALABRESE DISEASE MANAGEMENT

LAYOUT:

									Replicate
B 1	A 2	C 3	D 4	H 5	G 6	F 7	E 8	J 9	I
H 10	F 11	B 12	J 13	G 14	C 15	A 16	E 17	D 18	II
A 19	H 20	G 21	B 22	E 23	C 24	F 25	D 26	J 29	III
H 28	G 29	C 30	F 31	E 32	J 33	A 34	D 35	B 36	IV

N ↑

TREATMENTS:

A - UNTREATED
B - HERB EXTRACT (Oil of Marjoram; 5ml/l + 0.5% NuFilm P wetter)
C - WATERGLASS (1.1 kg/ha)
D - EQUISETUM (1.4 kg/ha)
E - *BACILLUS* BACTERIUM (400 l culture/ha + Ashlade adjuvant oil)
F - SULPHUR (5 l/ha)
G - BORDEAUX MIXTURE (3 kg/ha, reduced later to 1.5 kg/ha)
H - BICARBONATE OF SODA (10 g/l + 0.5% NuFilm P wetter)
J - 'BIO-S' (6 g/l + 0.5% NuFilm P wetter)

EXPERIMENTAL DETAILS:

Fertiliser: 50 t/ha Farmyard Manure

Weed Management: Black Polythene

Date Planted: 28/6/90

Plot Size: 4 Rows x 5m

Row Width: 60cm

Plant Spacing: 20cm

Variety: Corvet

No. of Treatments: 9

No. of Replicates: 4

No. of Plots: 36

Experimental Design: Randomised Block

Water rate: 200 l/ha (all treatments, except E)

Treatment dates: from 27/7/90 at 12-15 day intervals until 25/9/90 inclusive.

CABBAGE DISEASE MANAGEMENT

LAYOUT:

									Replicate
D 1	C 2	F 3	E 4	G 5	H 6	B 7	A 8	J 9	I
F 10	G 11	B 12	D 13	C 14	E 15	J 16	A 17	H 18	II
D 19	C 20	A 21	H 22	E 23	J 24	G 25	B 26	F 27	III
E 28	A 29	C 30	D 31	J 32	B 33	F 34	G 35	H 36	IV

N

TREATMENTS:

A - UNTREATED
B - HERB EXTRACT (Oil of Thyme; 0.5 l/ha + 0.5% NuFilm P wetter)
C - EQUISETUM (1.4 kg/ha)
D - *BACILLUS* BACTERIUM (440 l culture/ha + Ashlade adjuvant oil)
E - SULPHUR (5 l/ha)
F - BORDEAUX MIXTURE (3 kg/ha)
G - BICARBONATE OF SODA (10 g/l + 0.5% NuFilm P wetter)
H - 'BIO-S' (6 g/l + 0.5% NuFilm P wetter)
J - 'LEDAX BIO' (2 l/ha)

EXPERIMETAL DETAILS:

Fertiliser: 50 t/ha Farmyard Manure
Weed Management: Black Polythene
Date Planted: 22/6/90
Plot Size: 4 Rows x 5m
Row Width: 60cm
Plant Spacing: 30cm
Variety: Slawdena

No. of Treatments: 9
No. of Replicates: 4
No. of Plots: 36
Experimental Design: Randomised Block
Water rate: 200 l/ha (all treatments, except D)
Treatment dates: from 27/7/90 at 12-15 day intervals until 19/10/90 inclusive

CALABRESE VARIETIES

LAYOUT:

Replicate

GUARD ROWS

I	D 1	J 2	A 3	F 4	K 5	B 6	L 7	H 8	E 9	G 10	C 11
II	B 12	J 13	K 14	D 15	E 16	C 17	G 18	L 19	A 20	F 21	H 22
III	E 23	G 24	B 25	A 26	D 27	F 28	H 29	C 30	J 31	K 32	L 33

GUARD ROWS

N

VARIETIES:

A - CORVET
B - SKIFF
C - SHOGUN
D - MARATHON
E - SAMURAI
F - CARAVEL
G - HI-CALIBUR
H - LANCELOT
J - SUMASUN
K - COASTER
L - NEPTUNE

EXPERIMENTAL DETAILS:

Fertiliser: 50 t/ha Farmyard Manure

Weed Management: Black Polythene

Date Planted: 10/7/90

Plot Size: 1.8 x 3m

Row Width: 60

Plant Spacing: 20cm

No. of Varieties: 11

No. of Replicates: 3

No. of Plots: 33

Experimental Design: Randomised Block

CALABRESE TRANSPLANT RAISING SYSTEMS

LAYOUT:

GUARD ROWS

								Replicate
3A 1	1A 2	4B 3	2A 4	2B 5	1B 6	3B 7	4A 8	I
3B 9	2A 10	1B 11	3A 12	4B 13	4A 14	1A 15	2B 16	II
4B 17	1A 18	2A 19	1B 20	3B 21	2B 22	4A 23	3A 24	III

GUARD ROWS

N ↑

TREATMENTS:

1 CONVENTIONAL: P_20_5 in Compost (2.25kg single superphosphate (20%P_20_5)/m^3 sphagnum peat)
$N + K_20$ Liquid Feed (smmonium and potassium nitrates to concentration 90:0:120 ppm $N:P_20_5:K_20$)

2 ORGANIC: Bonemeal in Compost (2.65kg steamed bonemeal (17%P_20_5)/m^3 sphagnum peat)
Seaweed + Dried Blood Liquid Feed (68ml 'Maxicrop natural seaweed extract' + 6.9g dried blood (13%N)/10 l water)

3 CONVENTIONAL: $N + P_20_5$ in Compost (400g ammonium nitrate (34.5% N)+ 2.25kg single superphosphate (20% P_20_5)/m^3 sphagnum peat)
$N + K_20$ Liquid Feed (ammonium and potassium nitrates to concentration 50:0:120 ppm $N:P_20_5:K_20$)

4 ORGANIC: Bonemeal + Hoof and Horn Compost (1kg hoof + horn (13% N) + 2.65kg steamed bonemeal (17%P_20_5)/m^3 sphagnum peat)
Seaweed + Dried Blood Liquid Feed (68ml 'Maxicrop natural seaweed extract' + 3.8g dried blood (13%N)/10 l water)

EXPERIMENTAL DETAILS:

Fertiliser:	50 t/ha Farmyard Manure	**Variety:**	Corvet
Weed Management:	Black Polythene	**No of Treatments:**	4
Dates planted:	- 14/6/90 - 29/6/90	**No of Replicates:**	3
Plot Size:	1.8 x 3m	**No of Plots:**	24
Row Width:	60cm	**Experimental Design:**	Randomised Block

NITROGEN RATES x SOURCES FOR CALABRESE

LAYOUT:

							Replicate
D 1	A 2	C 3	F 4	G 5	E 6	B 7	I
B 8	G 9	A 10	D 11	C 12	F 13	E 14	II
F 15	C 16	B 17	G 18	A 19	E 20	D 21	III
D 22	F 23	G 24	E 25	B 26	A 27	C 28	IV

N ↑

TREATMENTS:

A - UNTREATED
B - 2.8 t/ha MEAT AND BONE MEAL (8.73% N)
C - 5.6 t/ha MEAT AND BONE MEAL (8.73% N)
D - 13.6 t/ha POULTRY MANURE (1.1% N)
E - 27.1 t/ha POULTRY MANURE (1.1% N)
F - 75 t/ha FARMYARD MANURE (0.1% N)
G - 150 t/ha FARMYARD MANURE (0.1% N)

All treatments incorporated into soil pre-planting.

EXPERIMENTAL DETAILS:

Weed Management:	Hand Hoeing	**Variety:**	Corvet
Date Planted:	19/6/90	**No of Treatments:**	7
Plot Size:	1.8 x 3m	**No of Replicates:**	4
Row Width:	60cm	**No of Plots:**	28
Plant Spacing:	20cm	**Experimental Design:**	Randomised Block

NITROGEN RATES X SOURCES FOR BRUSSEL SPROUTS

LAYOUT:

							Replicate
D 1	C 2	G 3	F 4	A 5	E 6	B 7	I
F 8	E 9	A 10	B 11	C 12	D 13	G 14	II
A 15	G 16	C 17	D 18	F 19	B 20	E 21	III
B 22	F 23	E 24	G 25	D 26	C 27	A 28	IV

N ↑

TREATMENTS:

A	-	UNTREATED
B	-	3 t/ha MEAT AND BONE MEAL (8.73% N)
C	-	5.8 t/ha MEAT AND BONE MEAL (8.73% N)
D	-	13.6 t/ha POULTRY MANURE (1.1% N)
E	-	27.1 t/ha POULTRY MANURE (1.1% N)
F	-	75 t/ha FARMYARD MANURE (0.1% N)
G	-	150 t/ha FARMYARD MANURE (0.1% N)

All treatments incorporated into soil pre-planting.

EXPERIMENTAL DETAILS:

Weed Management:	Hand Hoeing	**Variety:**	Golfer
Date Planted:	15/5/90	**No of Treatments:**	7
Plot Size:	1.8m x 2.4m	**No of Replicates:**	4
Row Width:	60cm	**No of Plots:**	28
Plant Spacing:	60cm	**Experimental Design:** Randomised Block	

PRE-PLANTING TECHNIQUES FOR WEED MANAGEMENT ON CALABRESE

LAYOUT:

B2 1	C2 2	B1 3	C1 4	B3 5	A1 6	C2 7
B1 8	C1 9	A1 10	C2 11	B3 12	C3 13	C1 14
B2 15	C3 16	B3 17	C3 18	A1 19	B2 20	B1 21

N ↑

TREATMENTS:

A1 - STALE SEEDBED FOR 10 WEEKS PRE-PLANTING
B1 - BLACK POLYTHENE AS A SOIL COVER FOR 8 WEEKS PRE-PLANTING
B2 - BLACK POLYTHENE AS A SOIL COVER FOR 4 WEEKS PRE-PLANTING
B3 - BLACK POLYTHENE AS A SOIL COVER FOR 2 WEEKS PRE-PLANTING
C1 - CLEAR POLYTHENE AS A SOIL COVER FOR 8 WEEKS PRE-PLANTING
C2 - CLEAR POLYTHENE AS A SOIL COVER FOR 4 WEEKS PRE-PLANTING
C3 - CLEAR POLYTHENE AS A SOIL COVER FOR 2 WEEKS PRE-PLANTING

All Polythene removed and ground cleared of emerged weeds before planting.

EXPERIMENTAL DETAILS:

Fertiliser: 50 t/ha Farmyard Manure

Date Planted: 28/6/90

Plot Size: 1.8 x 3m

Row Width: 60cm

Plant Spacing: 20cm

Variety: Corvet

No of Treatments: 7

No of Replicates: 3

No of Plots: 21

Experimental Design: Randomised Complete Block

WEED MULCHES ON CALABRESE

LAYOUT:

M3 1	M1 2	M3 3	M2 4	M0 5
M1 6	M4 7	M0 8	M4 9	M2 10
M0 1	M1 12	M4 13	M3 14	M2 15

N

TREATMENTS:

M0 - NO MULCH
M1 - SOWN RYEGRASS
M2 - BARK
M3 - 'HORTOPAPER'
M4 - BLACK POLYTHENE

EXPERIMENTAL DETAILS:

Fertiliser:	50 t/ha Farmyard Manure	**Variety:**	Corvet
Date Planted:	16/5/90	**No of Treatments:**	5
Plot Size:	1.8 x 3m	**No of Replicates:**	3
Row Width:	60cm	**No of Plots:**	15
Plant Spacing:	20cm	**Experimental Design:**	Randomised Complete Block

WEED MULCHES ON BRUSSEL SPROUTS

LAYOUT:

M0 1	M3 2	M2 3	M4 4	M0 5
M1 6	M2 7	M3 8	M1 9	M0 10
M4 11	M3 12	M1 13	M2 14	M4 15

N ↑

TREATMENTS:

MO	-	NO MULCH
M1	-	SOWN RYEGRASS
M2	-	BARK
M3	-	'HORTOPAPER'
M4	-	BLACK POLYTHENE

EXPERIMENTAL DETAILS:

Fertiliser:	50 t/ha Farmyard Manure	**Variety:**	Golfer
Date Planted:	19/5/90	**No of Treatments:**	5
Plot Size:	1.8 x 3m	**No of Replicates:**	3
Row Width:	60cm	**No of Plots:**	15
Plant Spacing:	60cm	**Experimental Design:**	Randomised Complete Block

CABBAGE PEST MANAGEMENT

LAYOUT:

Replicate III

I	C 1	D 2	E 3	F 13	B 14	E 15	D 25	A 26	B 27	V
	A 4	F 5	B 6	A 16	C 17	D 18	E 28	F 29	C 30	
	B 7	C 8	A 9	E 19	B 20	A 21	D 31	E 32	F 33	
II	D 10	E 11	F 12	C 22	F 23	D 24	A 34	C 35	B 36	VI

IV

N ↑

TREATMENTS:

A - UNTREATED
B - FABRIC COVER ('Agryl P17'; Polycrop Growing Systems, Suffolk IP1 5AP)
C - SEAWEED EXTRACT
D - *BACILLUS THURINGIENSIS*
E - DERRIS
F - FATTY ACIDS

EXPERIMENTAL DETAILS:

Fertiliser: 50 t/ha Farmyard Manure

Weed Management: Black Polythene

DatePlanted: 31/5/90

Plot Size: 2.4 x 5m

Row Width: 60cm

Plant Spacing: 30cm

Variety: Stonehead

No of Treatments: 6

No of Replicates: 6

No of Plots: 36

Experimental Design: Randomised Block

Treatment dates: from 6/7/90 at 2-3 week intervals until 8/10/90

POTATO VARIETY X SEED RATES

LAYOUT:

Replicate N <-----

I	E2 1	E1 2	E3 3	E2 4	E3 5	E1 6	M2 7	M1 8	M3 9	M1 10	M2 11	M3 12	P2 13	P3 14	P1 15	P2 16	P1 17	P3 18
II	M3 19	M2 20	M1 21	M3 22	M2 23	M1 24	P1 25	P3 26	P2 27	P2 28	P3 29	P1 30	E1 31	E2 32	E3 33	E3 34	E2 35	E1 36
III	P3 37	P2 38	P1 39	P3 40	P1 41	P2 42	M3 43	M1 44	M2 45	M1 46	M2 47	M3 48	E2 49	E1 50	E3 51	E3 52	E2 53	E1 54
IV	M3 55	M2 56	M1 57	M2 58	M3 59	M1 60	E1 61	E3 62	E2 63	E3 64	E2 65	E1 66	P1 67	P2 68	P3 69	P2 70	P3 71	P1 72

H1 H2 H1 H2 H1 H2

TREATMENTS:

Varieties:-

E = ESTIMA (first early)
M = MARIS BARD (second early)
P = PENTLAND SQUIRE (maincrop)

Seed Rates:-

1 = RECOMMENDED RATE
2 = RECOMMENDED RATE + 15%
3 = RECOMMENDED RATE - 15%

Varieties	Seed Rates (t/ha) 1	2	3
Estima	3.4	3.9	2.9
Maris Bard	2.9	3.4	2.5
Pentland Squire	3.8	4.4	3.2

Haulm destruction:- H1=LATE JULY
H2=LATE AUGUST

EXPERIMENTAL DETAILS:

Fertilizer: 50t/ha Farmyard Manure

Weed Management: Harrowing down/ 'Rolling Cultivator' and re-ridging

Disease Management: 2-3 applications of Bordeaux mixture (dependent on blight) warning periods)

Date Planted: 30/4/90

Plot Size: 4 drills x 7m

Drill Width: 85cm

No of Varieties: 3

Haulm Destruction Dates: H1 - 29/7/90, H2 - 31/8/90

No. of Seed Rates: 3

No. of Replicates: 4

No. of Plots: 72

Experimental Design: Randomised Block

Harvest Dates: H1 3/9/90
H2 26/9/90

POTATOES FOR BAKING

LAYOUT:

Replicate N <-----

Replicate			Replicate
I	B1 1	B1 2	IV
	B2 3	B2 4	
	B1 5	B1 6	
II	B2 17	B2 8	III

TREATMENTS:

Seed Rates:-

B1 = RECOMMENDED RATE (2.9 t/ha)
B2 = RECOMMENDED RATE - 15% (2.4 t/ha)

EXPERIMENTAL DETAILS:

Fertilizer:	50 t/ha Farmyard Manure	Drill Width:	85cm
Weed Management:	Harrowing down/ 'Rolling Cultivator' and re-ridging	Variety:	Estima
		No of Seed Rates:	2
Disease Management:	2-3 applications of Bordeaux mixture (dependent on blight warning periods)	Haulm Destruction date:	21/8/90
		No of Replicates:	4
Date Planted:	30/4/90	No. of Plots:	8
Plot Size:	4 drills x 7m	Experimental design:	Regular
		Harvest Date:	21/9/90

POTATO BLACKLEG MANAGEMENT

LAYOUT:

Replicate N <----

Replicate							Replicate
I	B 1	D 2	A 3	F 19	C 20	B 21	IV
	C 4	E 5	F 6	E 22	A 23	D 24	
II	F 7	E 8	B 9	C 25	F 26	B 27	V
	C 10	D 11	A 12	A 28	D 29	E 30	
III	B 13	E 14	D 15	B 31	D 32	C 33	VI
	A 16	C 17	F 18	E 34	F 35	A 36	

TREATMENTS:

Bacterial numbers on Seed Tuber Stock ($\log_{10}$/tuber ± standard error)

A = 2.15 0.19
B = none detected
C = 2.21 0.37
D = 2.01 0.04
E = 5.65 0.24
F = 5.65 0.24 + TREATED WITH *BACILLUS* BACTERIUM

EXPERIMENTAL DETAILS:

Fertilizer: 50 t/ha Farmyard Manure

Weed Management: Harrowing down/ 'Rolling Cultivator' and re-ridging

Disease Control: 2-3 applications of Bordeaux mixture (dependent on blight warning periods)

Dates Planted: 25 & 26/4/90

Plot Size: 4 drills x 7.5m

Variety: Maris Bard

Drill Width: 85cm

Seed Spacing: 30cm

No. of Plots: 36

No. of Replicates: 6

No. of Treatments: 6

Experimental Design: Randomised Block

POTATO BLIGHT MANAGEMENT

LAYOUT:

N <----

D 9	H 18	J 27	J 36
J 8	B 17	E 26	D 35
G 7	C 16	H 25	A 34
B 6	E 15	B 24	B 33
C 5	A 14	A 23	H 32
H 4	F 13	D 22	E 31
A 3	D 12	C 21	G 30
F 2	J 11	G 20	C 29
E 1	G 10	F 19	F 28
I	II	III	IV Replicate

Treatments:

A - UNTREATED
B - BORDEAUX MIXTURE (at first blight warning) (5kg/ha)
C - BORDEAUX MIXTURE (when crop first meets in row)(5kg/ha)
D - BORDEAUX MIXTURE (plus early haulm destruction) (5kg/ha)
E - BORDEAUX MIXTURE (plus haulm removal) (5kg/ha)
F - WATERGLASS (Sodium Silicate)
G - *BACILLUS* BACTERIUM
H - HERB EXTRACT (extract of thyme)
J - 'LEDAX BIO'

EXPERIMENTAL DETAILS:

Fertilizer: 50 t/ha Farmyard Manure (30t/ha Autumn 1989, 20t/ha Spring 1990)

Weed Management: Harrowing down/'Rolling Cultivator' and re-ridging

Date Planted: 24/4/90

Date Harvested: 9/10/90

Plot Size: 4 drills x 7.5m

Drill Width: 85cm

Seed Spacing: 37.5cm

Treatment dates: from 25 June (when crop first met in rows), every 2 weeks thereafter; except treatment B which commenced 29 June (at first blight warning).

Haulm destruction dates: 24 August (treatment D); 7 September 1990

Harvest date: 9 October

Variety: Cara

No. of Plots: 36

No. of Replicates: 4

No. of Treatments: 9

Experimental Design: Randomised Block

POTATO BLIGHT RESISTANT VARIETIES
(with Scottish Crop Research Institute)

LAYOUT: N <———

K 12	M 24	F 36	D 48
L 11	F 23	J 35	J 47
A 10	L 22	G 34	M 46
B 9	K 21	B 33	G 45
C 8	J 20	K 32	C 44
F 7	C 19	D 31	F 43
G 6	E 18	L 30	H 42
D 5	A 17	H 29	E 41
E 4	D 16	M 28	A 40
M 3	B 15	E 27	K 39
H 2	H 14	A 26	B 38
J 1	G 13	C 25	L 37
I	II	III	IV

Replicate

Treatments:

A - CARA
B - MARIS PIPER
C - PENTLAND CROWN
D - DESIREE
E - BINTJE
F - TEENA
G - SHELAGH
H - TORRIDON
J - BRODICK
K - 12492(6)
L - STIRLING
M - 13740(4)

EXPERIMENTAL DETAILS:

Fertilizer: 50 t/ha Farmyard Manure (30t/ha Autumn 1989, 20t/ha Spring 1990)

Weed Management: Harrowing down/ 'Rolling Cultivator' and re-ridging.

Date Planted: 30/4/90

Plot Size: 2 drills x 10 tubers (20 tuber blocks)

Drill Width: 85cm

No. of Varieties: 12

No. of Replicates: 4

No. of Plots: 48

Experimental Design: Randomised Block

Appendix 19

PESTS AND DISEASES X NITROGEN ON POTATOES

LAYOUT:

N <——

C 4	D 8	❑ A 12	B 16
❑ A 3	B 7	C 11	D 15
D 2	C 6	B 10	❑ A 14
B 1	❑ A 5	D 9	C 13

Key:- ❑ represents a microplot for measurement of soil nitrogen (microplot area = 3 x 2.5m)

Replicate	I	II	III	IV

TREATMENTS:

A - 20 t/ha Farmyard Manure applied in Spring

B - 20 t/ha Farmyard Manure applied in Spring + Bio-dynamic Ferment (Preparation 500 + 501)

C - No Farmyard Manure applied in Spring + Bio-dynamic Ferment (Preparation 500 + 501)

D - No Farmyard Manure applied in Spring

EXPERIMENTAL DETAILS:

Fertilizer:	30 t/ha Farmyard Manure applied to all plots in autumn (October 1989) Spring application of Farmyard manure applied 10 April 1990	**Plot Size:**	20 x 20m
		Variety:	Cara
Weed Management:	Harrowing down/ 'Rolling Cultivator' and Disc Weeder/Ridger	**Seed Spacing:**	37.5cm
		No. of Treatments:	4
Date Planted:	2/5/90	**No. of Replicates:**	4
Date Harvested:	16,17,19/10/90	**No. of Plots:**	16
Haulm Destruction:	31/8/90	**Experimental Design:**	Randomised Block
Drill Width:	85cm		

POTATO APHID MANAGEMENT

LAYOUT:

N <———

Replicate										
IV	D 31	B 32	E 33	C 34	A 35	J 36	F 37	G 38	A 39	H 40
III	A 21	G 22	H 23	F 24	B 25	C 26	D 27	J 28	E 29	A 30
II	A 11	F 12	C 13	H 14	G 15	B 16	J 17	E 18	A 19	D 20
I	E 1	H 2	A 3	B 4	A 5	F 6	C 7	D 8	G 9	J 10

TREATMENTS:

A - UNTREATED
B - FABRIC COVER
C - GREEN POLYTHENE
D - FATTY ACIDS (2 l/ha in 200l water/ha)
E - SEAWEED EXTRACT (2.5 l/ha in 200l water/ha)
F - FABRIC COVER
G - GREEN POLYTHENE
H - FATTY ACIDS (2 l/ha in 200l water/ha)
J - SEAWEED EXTRACT (2.5 l/ha in 200l water/ha)

EXPERIMENTAL DETAILS:

Fertilizer: 50 t/ha Farmyard Manure

Weed Management: Harrowing down/ 'Rolling Cultivator' disc weeder/ridger

Disease Management: 2-3 applications of Bordeaux mixture (dependent on blight warning periods).

Date Planted: 2/5/90

Plot Size: 8 drills x 8m

Drill Width: 85cm

Variety: Cara

Seed Spacing: 37.5cm

No. of Treatments: 9

No. of Replicates: 4

No. of Plots: 40
(2 untreated plots to each replicate)

Experimental Design: Randomised Block

BIO-DYNAMIC SEED TUBER TREATMENT ON POTATOES

LAYOUT:

N <———

	A 2	B 4	A 6	B 8
	B 1	A 3	B 5	A 7
Replicate	I	II	III	IV

TREATMENTS:

A - UNTREATED

B - SEED TUBERS TREATED WITH 'SPS MICROBIAL' (potatoes were placed in a seed bath and allowed to soak in a 1% solution of SPS microbial for 20 minutes).

EXPERIMENTAL DETAILS:

Fertilizer:	50 t/ha Farmyard Manure (30t/ha Autumn 1989 20t/ha Spring 1990)	Variety:	Cara
Weed Management:	Harrowing down/ 'Rolling Cultivator' and disc weeder/ridger	Seed Spacing:	37.5cm
Date Planted:	2/5/90		
Haulm destruction:	31/8/90	No. of Treatments:	2
Date harvested:	1/10/90	No. of Replicates:	4
Plot Size:	6 drills x 10m	No. of Plots:	8
Drill Width:	85cm	Experimental design:	Regular

MYCORRHIZA ON POTATOES
(with Agricultural Genetics Company)

LAYOUT:

N <——

Replicate		
IV	A 7	B 8
III	B 5	A 6
II	A 3	B 4
I	B 1	A 2

TREATMENTS:

A - UNTREATED

B - MYCORRHIZA PLACED BESIDE SEED TUBERS

EXPERIMENTAL DETAILS:

Fertilizer:	50 t/ha Farmyard Manure	**Drill Width:**	85cm
Weed Management:	Harrowing down/ 'Rolling Cultivator' and re-ridging	**Variety:**	Cara
		Seed Spacing:	37.5cm
Disease control:	2-3 applications of Bordeaux mixture (dependent on blight warning periods)	**No. of Treatments:**	2
		No. of Replicates:	4
Date Planted:	3/5/90	**No. of Plots:**	8
Plot Size:	4 drills x 8.5m	**Experimental design:**	Regular

PESTS AND DISEASES X NITROGEN ON SPRING BARLEY

LAYOUT:

Replicate

❑ A 1	B 2	❑ A 3	B 4	III	N ↑
B 5	❑ A 6	B 7	❑ A 8	IV	

Key:- ❑ represents a microplot for measurement of soil nitrogen (2 x 1.5m)

NB: Each main plot contained a yield plot for destructive sampling.

TREATMENTS:

A - 20 t/ha Farmyard Manure applied in Spring

B - No Farmyard Manure applied in Spring

EXPERIMENTAL DETAILS:

Fertilizer: 30 t/ha Farmyard Manure applied to all plots in October 1989
Spring application of Farmyard manure applied on 11 April 1990

Seed Rate: 250 kg/ha

Weed Management: 'Tearaway' weeder

No of Treatments: 2

Date Sown: 18/4/90

No of Replicates: 4

Plot Size: 10 x 10m

No of Plots: 8

Variety: Atem

Experimental design: Regular

EDINBURGH SCHOOL OF AGRICULTURE
UNIVERSITY OF EDINBURGH
CENTRE FOR HUMAN ECOLOGY

ORGANIC FARMING CENTRE

SECTION 2

MARKETING

Research Co-ordinator: Dr M. McGregor

SECTION 2

MARKETING

CONTENTS

CHAPTER 5

NON-ORGANIC FARMERS' PERCEPTIONS OF AND ATTITUDES TOWARDS ORGANIC FARMING

INTRODUCTION

Farmers are increasingly facing pressure from the EC, government and the public to reduce production and inputs. At the same time they are also being asked to conserve the environment and produce high quality food at a price the consumer is willing to pay. Organic farming is seen in some circles as providing the opportunity to meet these objectives. Market projections suggest that the organic food sector could grow from its current level of under 1% of produce sales, to between 5% and 15% of total UK food sales in the next 5 years (Henley Centre, 1989; Lampkin, 1989; Coopers & Lybrand Deloitte, 1991). Such estimates need to be treated with caution as supply will be a major constraint and a large number of non-organic farmers will be required to convert there farms to organic production.

The research described here addresses the extent to which non-organic farmers are aware of the principles and practices of organic farming; their attitudes towards it; and whether they have considered or would consider conversion. This was achieved by a series of ten focus group discussions which were carried out in 1990. A focus group involves discussion between a limited number of people selected on predetermined criteria. The specific purpose of the discussion is to obtain spontaneous reaction on a particular topic with the view of assessing knowledge, awareness and perceptions of, and attitudes towards that topic.

The ten discussion groups used in this research covered five farm types and locations in Scotland - Hill farms (Argyll); Dairy farms (Ayrshire); Lowground mixed farms (Aberdeenshire); Lowground arable farms (East Lothian); and LFA (less favoured area) with arable farms (Perthshire) - and the predetermined criteria were age and current farming practice. Two age groups (less than and greater than 35 years of age) were selected for each area and all participants were farming using non-organic methods. There were approximately eight farmers in each group.

The following specific areas were discussed in each of the focus groups;

- the consumers' view of farming,
- what it was that consumers really want,
- what they as farmers understood by the term organic,
- barriers to their adoption,
- the role of financial incentives in encouraging organic production, and
- sources of information.

CONSUMERS' VIEW OF FARMING

The view that emerged from all of the focus group discussions was that the public are misinformed about agriculture and the methods used in food production, and that the media were to blame for this. The lowground mixed farmers believed that biased media coverage has resulted in an anti-farming public who don't really understand agriculture and doubted, furthermore, whether or not the public really care as long as they continue to get plentiful supplies of cheap food.

However, opinions varied on whether farmers have a 'bad image'. At one extreme the hill farmers believed that farmers were seen as public enemies, polluting the countryside, misusing chemicals and fertilisers and producing allegedly contaminated food. While at the other the LFA with arable groups believed that farmers do not have a particularly bad image, and that the public do, in fact, have a lot of sympathy for the farming community, particularly with regard to the economic difficulties currently facing farmers.

> *farmers are public enemy number one, and the farming community has never been lower in public esteem.*

> (following a food scare) *that's how they learn what is happening what is happening the industry, they don't ever get the full story, nobody ever stands up and explains that it's not really like that.*

The dominant view among the lowground arable farmers was that consumers don't appreciate the problems inherent in food production and tend to take the supply of their food somewhat for granted. However, they felt that the public believe that farmers care quite well for the countryside although there is concern about issues such as the use of chemicals and the influence of the recent food quality scares (raised by the dairy farmers).

Increased public awareness of agricultural production methods is clearly desirable, but ideas on how this could be achieved were not forthcoming. The dairy, lowground mixed and the LFA with arable groups stressed the importance of waking up to this situation and taking positive action to improve the image of farming.

WHAT DO CONSUMERS REALLY WANT?

Consumers want cheap food. Quality, appearance, freshness, convenience, and health enhancement are also important to consumers who are increasingly health conscious and concerned about the environment. Processed foods, particularly meat products, were viewed as becoming less desirable. The hill farmers believed that complaints about food, particularly with regard to price, were the result of several decades of plentiful and cheap food. This was also the view of the dairy farmers, who added that organic farming and the increase in concern for the environment had been facilitated by over-production and abundant food supplies.

The lowground mixed farmers felt that those consumers with higher incomes could now afford to conscientiously select the 'right' sort of food to buy, while on the other hand the average consumer tended to look for an attractively packaged, cheap product. Similar views were expressed by the lowground arable groups who also emphasised the demand for uniform, good quality products, with the source country of such products not being of particular importance.

> *the ordinary housewife will go into the supermarket and will expect her food, without thinking about it, to be fresh and wholesome and uncontaminated. She just expects that, takes it for granted, until something comes up to make her think otherwise.*

Several groups stressed the power of the supermarkets in determining, or possibly dictating, what consumers buy. This had a negative effect in that the distance between the farmer and the consumer had increased making it more difficult for the producer to follow their produce past the farm gate.

> *a lot of the consumers don't really know what they want, and what they eat is what the supermarkets put down in front of them.*

The discussion was then targeted specifically at organic consumers. There was general agreement that in the past organic consumers have tended to be regarded as cranks, but they are now more readily accepted. Consumers of organic produce were thought to be people on higher incomes and the description 'yuppie' was used by both the hill and dairy farmers. The lowground arable farmers linked the increasing awareness of the importance of health with the purchase of organic produce. However they expressed some doubt as to the existence of reliable scientific evidence to substantiate the health benefits of eating organic produce as opposed to conventional produce.

> *they are terrified of all the things which are used in the production of food. They are scared it is going to damage their health. They are just anti-chemical, but they still demand the quality, and they don't appreciate that a lot of these chemicals are contributing to the quality and appearance of what they are buying.*

A number of farmers questioned whether consumers really understood what the term organic meant. This was supported by the views of the LFA with arable farmers who believed that organic consumers were actually demanding an image and were being encouraged in this by the media. The lowground mixed farmers perceived a link between those purchasing organic produce and the 'greens'. A view also emerged in some groups that those consumers who buy organic produce occasionally because of its perceived image were hypocritical - either organic produce is better for people and the environment or it isn't.

WHAT THEY AS FARMERS UNDERSTOOD BY THE TERM ORGANIC

The level of understanding of organic farming varied from group to group but all were aware of the basic requirements relating to the non-use of inorganic fertilisers, sprays and medicines. All were aware that a price premium exists for organic produce but had little idea of its magnitude. Similarly they were well informed about the need for a conversion period and that during the conversion period organic premium prices could not be obtained. However, few of the farmers were sure of the required length of the conversion period. A few farmers mentioned the existence of conservation grade and most knew of the Soil Association and/or Organic Farmers and Growers.

The dairy farmers appreciated the fundamental rules of organic farming, and saw organic farming as something which related to wider, ethical principles. Some had acquired more detailed knowledge, but this had merely served to confuse them and they viewed some of the rules as being rather strange and somewhat contradictory to their understanding of the principles behind organic farming. The restrictions on the use of current medicines were seen as potentially extremely problematic and they came to the conclusion that organic livestock production was almost a contradiction in terms.

The LFA with arable groups were quite well informed on the rules pertaining to organic agriculture, and were aware of some details relating to their own enterprises. Although problems were likely to result from the reduction in the use of sprays, there was a belief that alternatives to deal with such problems were available. With regard to crops (and particularly vegetables), a lower marketable percentage and a generally poorer quality product were anticipated, with the price premium unlikely to be great enough to compensate for the anticipated yield reduction.

BARRIERS TO ADOPTION

A commonly held belief by all groups was that organic farming was not suited to their particular farm type. The older lowground arable group also questioned the sustainability of organic farming systems. Many of the farmers believed that over the past few decades they had moved away from organic methods as a result of Government-fuelled encouragement to increase the production of cheap food. They were now too far removed from organic methods to wish, or believe it possible, to return to them. Any change in farming system must be justified by an equal and probably a higher return than that currently obtained.

> *organic farming is a gamble. I would love to try it but the message one tends to get is the yield is about half and the increase in price is about a third. At the moment I don't think the reward is there.*

The major problem mentioned by all groups was the financial viability and risk associated with a shift to organic farming but the perceptions were often different depending on farm type and age group. The lowground mixed groups stated that they readily accepted the principle of organic farming on a mixed farm providing the financial reward was sufficient. They expected that weed control and potential crop failure would be major obstacles to adoption. These farmers also felt that a shift to spring sown crops would be necessary although the younger age group were dubious of the likely success of organic spring barley and oats.

there are some clear handicaps, but the practical advantages of changing your system of production have to be rewarded and that is the area where people need to be satisfied. If the consumer was prepared to pay enough to make it more profitable, then we would certainly give it serious consideration.

The dairy farmers thought that farming organically would mean lower stocking rates and lower, more seasonal, milk output.

The lowground arable groups believed that a secure financial situation without borrowing would be required before farmers would be induced to think seriously about organic farming. The older age group were rather negative about organic farming than the younger group, although neither group believed that organic farming was suitable for their farm type. There was agreement that livestock were a crucial part of an organic production system but there were doubts raised as to whether the price premium would compensate for the expected loss in yield, widespread weed and disease problems and a large increase in manual labour.

The LFA with arable groups questioned whether organic farming is really attractive in financial terms. However there was a degree of uncertainty relating to both the likely situation after a farmer had been through the conversion period and also the adequacy of the organic price premium, particularly if, as expected, stocking rates had to be reduced. It was generally conceded that organic farming would be possible in their area providing the incentive was there, but believed that it would not necessarily fit into their current farming systems.

The question of maintaining animal health was raised by all groups; especially the difficulty of reconciling the legal requirements on animal health with the approach taken in organic farming. Many groups stressed the importance of conventional medicines in their farming systems and, in particular the preventive, routine medicines. Their experience had educated them of the need to move to *prevention rather than cure* whereas they felt that organic systems work the other way - something which they believed could not benefit the welfare of the animal. There was also concern about the efficacy of homoeopathic medicines and the perception that the organic organisations were continually moving the goal posts to suit themselves. The lowground mixed group questioned some of the rules relating to organic livestock, viewing this as a rather grey area.

The marketing of organic produce was of concern to many groups. The major problem that was raised by the hill farmers was the need to maintain the organic identity of the animal through the marketing chain. They were sceptical that a number of linked farms could be encouraged to work together to produce the final product. Such a linkage was highlighted as being important if they were to obtain an organic premium price at the store animal stage. Similar fears were also expressed by the dairy farmers who were worried about milk maintaining its organic status once it reached the dairy. It was felt that a single dairy would need to handle the organic milk, which meant that a number of producers in one area would need to produce organically. The establishment of co-operatives to target the larger outlets, to secure markets and establishing an appropriate image for their product was mentioned as a potential method of gaining effective marketing.

> *everything had been led towards maximum output, or rather optimum output, but now people are quite clear that they've got to produce something that will sell, and they will produce anything that will sell, whether its holiday apartments or food, as long as somebody is prepared to pay for it. Its a lovely kind of fairy story just to think of no fertiliser, no sprays, cows lying out among the buttercups, the dandelions, but I don't think in real life its extremely practical.*

Overall the feeling was that the future demand for organic produce was very limited and that if too many producers were to convert to organic farming a catastrophe of supply would occur. Although it was accepted that a definite market for organic produce exists and would continue to do so, a significant expansion of such a market was not anticipated. There was also concern expressed about the effectiveness of both policing organic agriculture and inspecting the final produce, especially with regard to organic production in other countries.

> *if too many people produce organically, they will be looking for us to turn on the tap within five or ten years because there won't be enough food.*

Livestock farmers were concerned about the supply of organic feed for animals. The hill farming groups discussed their reliance on bought-in concentrates and hay for winter feed. If adequate supplies of organic feed were not available, stock numbers would have to be reduced significantly. Similar concerns were also raised by the dairy farmers who thought they would have a problem of producing enough roughage to feed the cattle during the winter. They envisaged that either food would have to be bought-in (which was not regarded as ideal) or a much larger land area and even lower stocking rates would be necessary.

THE ROLE OF FINANCIAL INCENTIVES TO ENCOURAGE ORGANIC FARMING

It was clear from the discussion above that if any change was to occur in the farmer's methods of farming then this would first have to be justified by an equal, and probably higher (to compensate for the risk), return from the organic system. This then formed the basis against which further discussions about the role of financial incentives was set.

The focus group discussion pointed up a marked difference in attitude between the younger and older age groups. A financial incentive to convert to organic farming was more attractive to the older age groups whereas the younger farmers resisted any talk of new subsidies, preferring the market to determine the type and speed of change. The younger hill farming group demonstrated particular resistance to the idea of the introduction of a Government or EC financial incentive. They preferred to receive a realistic price for the final product than rely on such subsidies which would only worsen the feather-bedded image consumers have of farmers. However, the market led approach was thought to have some flaws as many thought that consumers would not be able to pay the true costs of food produced organically or that the demand for organic food was such that it would be able to support a larger production base, particularly in terms of sustaining the price premium.

A number of possible mechanisms were mentioned which could be used to encourage a greater adoption of organic farming. These ranged from a cash payment to compensate for anticipated lower stocking rates and returns (suggested by the older hill farmers) to the extension of the Environmentally Sensitive Area payments or a social subsidy for living in rural areas (suggested by the LFA with arable farmers), to the introduction of a tax on chemicals (suggested by the younger lowground mixed farmers).

> *The housewife must pay the cost of production of that foodstuff and for organic farming to survive the housewife must pay what it costs to produce it. I will take a subsidy for living in a remote part of Britain to keep the countryside correct, but I don't want a subsidy to produce the stuff. The whim of the politician can cut that subsidy tomorrow.*

Set-aside was mentioned in a number of the discussion groups as a means of converting to organic production. The younger group of lowground mixed farmers suggested that the money currently financing the set-aside scheme could be better used to promote organic farming and to assist farmers to convert. This would achieve two objectives; extensification and environmental. The younger lowground arable farmers did not see the necessity for a scheme to assist financially during conversion when set-aside already exists. They believed that if the set-aside scheme isn't currently tempting people to go organic, a similar scheme which specifically mentions the term organic is unlikely to be more effective.

SOURCES OF INFORMATION

A common factor in all of the focus groups was the belief that they did not have a real understanding of organic farming. There was variation in the level of knowledge already obtained and in their desire to obtain more information on the subject. For all of the groups the primary source of information to date was the farming press. Other media sources (including 'The Archers' radio programme) and occasional attendance at meetings at which organic farming had been discussed were also mentioned. Two farmers in the LFA with arable groups had read the organic standards and one of these had contacted the Soil Association with regard to information on registering.

The local advisory service (SAC) tended to be regarded as the obvious choice, if only as a starting point, for sources of further information. The importance of seeking information from as many sources as possible was also stressed with the ability to visit working organic units being seen as of particular use. A lack of independent financial information was noted and this type of information, perhaps in a gross margin format would be of particular interest as would general information on organic farming to remove their confusion especially over rules.

Information from the organic bodies, such as the Soil Association was regarded (almost without exception) as potentially biased and would be treated with caution. Such organisations were seen by most groups as extreme and were perceived to lack independence. The one exception to this view came from the LFA with arable farmers. They would readily approach the Soil Association for further information believing that, having been involved with organic farming for some time, the information they provide should be more accurate. They still stressed the need to seek information from a number of sources, preferably including 'someone who is actually doing it'.

CONCLUSIONS

This research has indicated that while there is a general understanding of organic farming in the non-organic sector there are still some underlying misconceptions and worries. The level of understanding was highest with the hill farmers who are currently closest to organic production practices and the younger age group. The level of understanding can be raised by provision of objective information on the implications of conversion to organic farming systems. Such awareness will be of use not only to those who eventually convert to organic farming but also to non-organic farmers who are currently being encouraged to reduce chemical inputs on their properties. The major areas where information is required are discussed below.

1. The research has shown that farmers believe that they have a 'bad or at least not a very good image', but no real action has been taken to date to improve this situation. The need for such action is recognised, but no clear ideas on how to approach the problem were forthcoming. This image is largely blamed on the

media. If such an image is to be turned around then a more positive image of farming must be portrayed in the media.

2. There is a lack of reliable information coming back to farmers concerning the changing patterns of consumers and their habits. This is illustrated by the rather narrow view that the farmers had of consumers who purchased organic products. The farmers however, quite correctly highlighted the lack of scientific evidence relating to the benefits, or otherwise, of eating organic as opposed to conventional produce.

3. It is clear from the responses on the barriers to adoption that there is an urgent need for independent verifiable information on the financial implications of conversion to organic farming as well as detailed knowledge in relation to specific crop and livestock enterprises. This should ideally come from a marriage between the organic bodies (such as the Organic Farming Centre, Soil Association and Elm Farm) and the non-organic bodies (such as the research institutes, Universities and agricultural colleges).

4. The rules governing organic farming production are poorly understood. Confusion is also being caused by lack of a consistent rule book which can be adopted through-out the UK. The advent of UKROFS may overcome this difficulty but a clearly presented set of standards which are enforceable would be of great help.

5. Farmers are still sceptical about whether organic farming is in fact financially viable and that the production risk associated with organic farming systems is in fact acceptable. This will not be changed quickly but the development of a series of demonstration properties would help allay some fears. These could be linked to research organisations or be private farmers.

6. Finally if organic farming is to be adopted on a wider scale than currently then the future farmers and advisers require appropriate training from the organic farming organisations, Universities and agricultural colleges. This is starting to occur but there are still only a limited number of institutions offering organic farming modules in their degree, diploma and certificate courses.

[L. Chadwick & M. McGregor: Scottish Agricultural College (Edinburgh)]

References

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CHAPTER 6

CONSUMER ATTITUDES TO, AND AWARENESS OF, ORGANIC PRODUCE IN THE UNITED KINGDOM

BACKGROUND

Consumer attitudes to food purchasing have undoubtedly changed considerably in the last 5 years as a result of increasing wealth, but the food scares of 1989 and 1990 in the UK have heightened consumer awareness of the food that they purchase. They have created a significant move in public opinion away from blind acceptance of low priced food. Consumers are now looking for commodities which are not only competitively priced, but safe, and more importantly free from agrochemical residues. The consequence of these changes is that the organic food sector has expanded considerably over this period with estimates indicating that growth has been almost threefold since 1987 (albeit from a very small base); and likely to do so again in the next 5 years. As a result demand is currently growing faster than supply.

There have been reports suggesting that the organic food sector could grow from its current level of under 1% of produce sales, to between 5% and 15% of total UK food sales in the next 5 years (Henley Centre, 1989; Hill, 1986; Lampkin, 1989). Such estimates need to be treated with some caution as supply will be the major constraint. If such targets are to be reached the current high levels of imports (mainly from Israel, North America, Western Europe, and North Africa) will in the short term need to be maintained, and care will need to be taken to ensure that high quality standards are met and the authenticity of the product is maintained. If this doesn't occur then the rate of growth will definitely be slower.

Associated with the anticipated increase in demand is a growing public perception that by paying a little more, an approved product can be obtained. There is no reason to suggest that this trend is not likely to continue. In fact the current shortage of supply is also helping to force up the price of organically produced food, by an average of 88% over conventionally grown fruit and vegetables. But it is the premium that consumers are willing to pay for organically grown produce which is of importance and the viability of producing such food at such premiums. Estimates from consumer interview surveys suggest that a large number of consumers are willing to pay premiums of between 5% and 20% (Dent, 1988; Dixon and Holmes, 1987; Henley Centre, 1989; EFRC, 1988; NFU, 1988; Lampkin, 1989) but such studies lack the rigour of the market place. The only realistic way that such estimates can be accurately made is by in-store testing of consumer response to differing price premiums.

Of interest from a marketing perspective is the link between organic consumers and their attitudes to the environment. A recent report (MINTEL, 1989) found that 27% of the adult population purposefully avoids products which damage the environment, use too much energy, cause unnecessary waste, involve cruelty to animals or adversely affect other countries. Such people, who can be categorised as predominantly young, married with children, middle class and living in the SE of England were also found to be prepared to pay at least 25% extra for goods which met this specification. An even larger group - 75% - would be prepared to accept price premiums of the order of 5%. Such results mirror those found for consumers willingness to pay such premiums for organic produce.

The rapid growth being experienced in organic sector has also meant that many organic products have been poorly marketed; especially with regard to presentation, packaging and advertising. A number of recent studies have alluded to the fact that packaging is inappropriate, found low recognition of symbols and a poor image of organic produce in general (Hill, 1986; Brighton, et al, 1989; Murdy, 1989). However, a further feature of the developing organic food sector is its rapid change from a craft industry, serving local areas, to a mainstream industry, strongly influenced by the multiples. Safeway plc (one of the top five supermarket multiples in the UK) for instance have been marketing organic food since 1981 and have supplied organic produce to all of their stores since 1985. This is where the major expansion will occur in the future as at present such outlets account for 60% of organic food sales in the UK. This, coupled with a more professional approach to marketing by the emerging grower co-operatives will undoubtedly help to expand the market.

This report describes the results of consumer research studies which have looked at consumer perceptions of, and requirements for organic produce. It reports on the results of a series of consumer discussion groups of regular, occasional and non-purchasers of organic produce carried out in early 1990 in the United Kingdom and consumer profiling analysis carried out in late 1989.

RESEARCH OBJECTIVES

The objectives of this research were as follows:

1. To understand the meaning to the customer of the terms "organic" and "green" and their relationship to each other.

2. To determine possible platforms for increasing sales of organic produce; products; presentation; packaging and labelling); promotion; processing; and price

3. To feed the results into future organic research and development work to be carried out by the Organic Farming Centre.

METHODOLOGY

Quantitative Analysis of Green and Organic Attitudes

The objectives of this component of the research were to identify and understand how consumers can be segmented in terms of green and organic attitudes. To meet this objective a specific survey of UK consumer attitudes was commissioned by Safeway plc in October 1989. The research was conducted by the National Market Research Agency (NMRA). The sample of 2000 consumers was broadly representative of the UK as a whole, although there was some bias towards the South of England.

Using selected data from the consumer survey, principal components analysis (PCA) and cluster analysis, consumers were segmented into specific types. Information was then analysed by these segments or clusters to determine how they differ either demographically or in their shopping attitudes and behaviour.

The aim of the PCA was to reduce a set of 12 attitude variables (shown in Table 43) to a smaller number of underlying factors which essentially summarise the key dimensions which discriminate between the survey respondents.

TABLE 43: Key attitude variables used in the Principal Components Analysis.

Importance in choosing where to shop -

1. range of organically produced foods.
2. range of environmentally friendly products.
3. range of health foods.

Agree/disagree with the following statements -

4. I am always looking for foods with natural ingredients or that are organically grown.
5. I try to buy environmentally friendly products as often as possible.
6. I read labels on food packets because I am concerned about ingredients or additives.
7. I am concerned about the environment.
8. I am much more aware of what affects people's health nowadays and as a result have changed my family's eating habits.
9. I am concerned for the welfare of animals.
10. I would rather buy foods that tastes good regardless of their nutritional value.
11. A vegetarian diet is a healthier way to live.
12. I don't eat meat because I am concerned for the welfare of animals.

The three main discriminators or factors to emerge from the 12 attitude variables were:

Factor one	-	green and organic attitudes
Factor two	-	health and nutrition awareness
Factor three	-	vegetarian and concern for animal welfare

Each factor is made up as a combination of the 12 input variables. Using these factors it was possible to segment consumers into a series of cluster groups. The reclustering produced five cluster groups. Cluster group 1, which is only 5.6 per cent of the population, includes those most interested in organics and green issues, while cluster group 2, with 7.5 per cent of the population, includes those for whom organics have more of an appeal from a status viewpoint. Therefore cluster groups 1 and 2 are most relevant at the moment - they are the purchasers of organic produce and tend to have green attitudes. Cluster groups 3,4 and 5 are those consumers who are either on the fringe of, or indifferent, to "green" and are not organic purchasers.

Table 44 shows that the first of the three factors (green and organic attitudes) is the most important and a useful indicator of the degree to which respondents are concerned on both green and organic issues. Thus a low score on factor one indicates high concern. Factor two relates to awareness of health and nutrition. A low score indicates that a consumer does not read food labels and is less concerned with nutritional content and more concerned with taste. Factor three discriminates on vegetarian issues and concern for animals. A low score equates with sympathy for these issues. Factor three also discriminates between clusters one and two. Thus there is a tendency for those most concerned about organic and environmental issues to be vegetarian.

TABLE 44: Summary of consumer segmentation into cluster groups

Cluster	Unweighted proportion of respondents	Mean scores on PCA number		
		factor 1	factor 2	factor 3
1	5.6%	-4.2	-0.6	-1.4
2	7.5%	-2.5	-0.7	1.2
3	31.5%	-0.8	0.8	-0.1
4	25.6%	0.0	-0.6	0.3
5	29.7%	2.3	0.0	-0.2

NB Cluster group two is the most green and aware of organics.

Qualitative Study of Consumer Attitudes

A total of six consumer discussion group meetings were conducted. All meetings lasted approximately one and a half hours and were recorded, apart from consumer discussion groups 3 and 4. All groups were composed of women selected from the

ABC1 social grade and contained a mix of respondents with/without children and working/not working outside the home. Details of the structure of each of the discussion groups are presented in Table 45.

TABLE 45: Summary of the location, timing and respondent profiles of the consumer discussion groups.

	Consumer Discussion Group No.					
	1	2	3	4	5	6
	Young Interested	Old Interested	Young Committed	Old Non-users	Old Committed	Young Non-users
Date	05-December-1989		12-February-1990		15-March-1990	
Location	Ginger Focus Studios Acton, London W3		Croyden London		The Grange Edinburgh	
Respondents Age	25-45	45-65	25-45	45-65	45-65	25-45
Organic buying habits	Purchase at least once per month		Regular buyers	Non-users but also non-rejectors	Purchase at least once per week	Non-users but also non-rejectors
Social Class	ABC1					
Other	Female housewives Mix of children - no children at home Mix of working - not working outside home					
Interviewer	Wendy Hayward Qualitative Consultants				Dr Nick Lilwall The Scottish Agriculture College	

RESULTS

Attitude to "green"/organics

Over 85 per cent of the consumers were classed as either "on the fringe" or "indifferent" to "green". Although only just over 13 per cent of those in the survey were either "very green" or "interested green", almost 50 per cent of the total agreed with the statement "I am always looking for foods with natural ingredients or that are organically grown" - the key factor being "natural ingredients" rather than "organically grown".

The results of the consumer discussion groups also showed that the link between organic purchasers and "green" concern is, in general, indirect, although it is stronger for the regular purchasers than the occasional purchasers. In the occasional purchaser groups, it was only the minority who were most knowledgeable about organic farming who made a link between the lack of chemicals used in organic farming and a broader environmental benefit (less damage to the soil, no chemicals leaching into the rivers etc). It is the personal, inner or family-directed health benefit which is the initial motivation, with environmental concerns, where they exist, providing strong support.

Understanding of the term "organic" varied considerably between the consumer discussion groups. The regular purchasers knew that organic farming meant that no chemical additives, just "natural" additives, could be used and that there was a need for the soil to be "purged" of unnatural substances before organic farming could begin. They appreciated the more labour-intensive, lower-output, and higher-waste-aspects of organic farming and therefore appreciated (and to an extent accepted) the price premium generally charged for organic produce.

The occasional purchasers were less confident in their knowledge and understanding of the term "organic" and very few understood the processes, requirements or standards involved or the full implications of organic farming. The absence of chemical additives and the use of naturally derived additives (such as manure) were the primary consumer discussion points of these consumers who saw organic as a simple low technology process, drawing an analogy with the way "homegrown" vegetables would be produced. They tended to see themselves as "spreading the word" with regard to organics and such produce generally retained the status of a "treat".

A much more vague impression of organic farming came, in general, from the non-users. Although being aware of the basic principle of avoiding chemical additives, they were not aware of further details of organic production, conversion, standards and so on. This group therefore had no understanding of the reason for the price premium and rejected its validity, particularly if it was substantial, for example more than 50 per cent. These non-users still regarded organics as out of the mainstream.

Looking for organically grown/environmentally friendly produce

Concern for the environment was the most important reason given for buying environmentally friendly products. The statement "they are healthier" which was most popular with the "very green" group, declined with attitude to "green", and was in fact the least important factor for the "indifferent" group. When asked about willingness to increase purchases of environmentally friendly products, price was certainly important for all groups. Equally as important or even more so for the "very green" and "interested green" groups, was easier availability. In comparison, it would appear that official endorsement of certain products would have much less impact.

TABLE 46: Differences between cluster groups buying habits with respect to those looking for organically grown and environmentally friendly products.

	CLUSTER					
% AGREE	1	2	3	4	5	Pop^n
I buy environmentally friendly products because:						
I'm concerned about the environment	85	79	77	65	27	60
I feel I should	35	34	34	35	20	30
They are healthier	47	37	31	28	7	25
They are just as good as standard products	24	15	20	19	13	18
I would consider buying environmentally friendly products more often if:						
They were more easily available	64	53	44	42	24	40
They weren't so expensive	48	53	61	55	51	55
There was an official endorsement of what I should buy	30	17	20	15	15	18

It would seem, from the consumer discussion groups, that for many organic consumers there is a difference between motivations for buying organic produce (direct concern for oneself and one's family) and for buying environmentally friendly products (concern for the wider environment, with an indirect benefit for oneself and one's family). Even if the relationship between environmental concerns and healthy eating is not direct, it does seem that those in the vanguard of environmental concerns will also be amongst those who are more committed to healthy eating.

Reasons for buying

For the "very green" and "interested green" groups, product availability is rated most highly, followed by price, whereas for the other groups price is clearly the most important factor in the decision to increase purchases of organic produce. The availability of self-selection for fruit and vegetables, and finding organically grown foods all across the shop were the next most important factors, while increasing the convenience factor and the availability of larger pack sizes did not rate highly.

TABLE 47: Differences between cluster groups preferences, and reasons, for buying more organically grown foods.

% AGREE	CLUSTER 1	2	3	4	5	Pop^n
I prefer organically grown foods and would buy more if:						
The price was lower	69	51	68	60	37	56
Products were more easily available	73	60	45	39	17	38
Fruit & veg were available for self-selection	50	43	39	37	19	34
I could find them all across the shop	56	42	32	30	14	29
They were more convenient to use	10	11	7	9	6	8
They were available in larger pack sizes	7	7	6	6	2	5
% population	5.6	7.5	31.5	25.6	29.7	

In the consumer discussion groups, too, it was apparent that price is a real issue, and as long as there is a substantial premium for organics this will limit some consumers' purchasing and keep others out of the sector altogether. Occasional purchasers gave price as the principal reason for not buying more regularly. The views of these particular consumers seem to go deeper than an easy rationalisation. Evidence from the committed users shows that there seem to be quite accurate impressions of the price difference between organic and non-organic produce, and, although price was less important for this group, the consumers did not, in general, have an unlimited propensity to pay. Where there is strong commitment to health and/or environmental values (and the family/household budget has some room for manoeuvre), organics can be seen as offering real value in terms of goodness, purity and taste. Non-users felt that the price premium over non-organic produce could not be justified and expressed doubt as to whether the benefits of organic produce were as significant or as genuine as claimed.

Organic Demographic Profiles

The following demographic profile - of an organic purchaser - was obtained from the quantitative research:

* very green tend not to be working and more middle aged
* more likely to be in single/two person households
* higher level of education
* higher AB profile
* less likely to own microwave
* very green, tend to be vegetarian and concerned about animal welfare

Those involved in the consumer discussion groups saw organic consumers as those with a positive attitude to and awareness of; healthy eating; the environment; the pleasures of food; positive aspirational image; active, energetic lifestyle; and likely to be women. While the non-users identified typical purchasers as; vegetarian; cranky; and people with health problems.

Consumer Shopping Habits

The "very green" and "interested green" groups made more frequent use of health food shops, fishmongers and delicatessens/specialist food shops. The general pattern is that the frequency of visits to these shops declines as interest in "green" declines. The pattern for regular purchasing in butchers' shops and convenience stores is not so clearly defined, with the indifferent to green group the most likely to use convenience stores. The majority of those surveyed used the greengrocer/market at least 2-3 times per week.

In the consumer discussion groups there was enthusiasm to purchase organic produce from non-supermarket sources. It was felt that these non-supermarket sources (for example greengrocers and health food shops) could provide a more personal service, and possibly lower prices. Supermarkets were seen to some extent as "jumping on a bandwagon" to improve their image, and the non-supermarket sources had the appeal of a more genuine (and generally closer to 100 per cent) commitment to organics as well as a lesser degree of financial motivation.

TABLE 48: **Differences between cluster groups showing the types of shops used.**

% AGREE	CLUSTER 1	2	3	4	5
Use fishmonger at least once a week	35	36	28	27	20
Use butcher 2-3 times per week or more	34	38	26	32	25
Use greengrocer/market at least 2-3 times per week	51	53	47	43	38
Use delicatessen/specialist food shop at least once a week	37	26	23	21	14
Use convenience stores at least 4-6 times per week	12	10	8	14	16
Use health food shops at least once a week	28	18	9	4	2

DISCUSSION

The consumers in the organic produce market with the greatest understanding and awareness of the term "organic" and what it involves also have a strong and genuine commitment to environmental issues and healthy eating. These consumers also expect an equally strong commitment from retailers. For instance, they look for biodegradable packaging and expect its use in supermarkets. They would however like to see self-selection of produce, but understand that this entails problems for the multiples, for example with regard to the difficulty in distinguishing between organic and conventional produce for the purposes of weighing and pricing at the check-out. Produce availability is also a key factor and this group would often like to increase their purchases of organic produce, but are prevented from doing so (or at least restricted) by limited availability. These consumers are willing to pay a premium price for organic produce and have sufficient understanding of organic farming to accept that there is often a genuine need to charge a premium price. However, although their buying patterns for organic produce are generally not restrained by their household budget they do have price limits.

Those consumers who have less understanding of the term "organic" and are less environmentally aware form another category in Table 49. The provision of further information in the area of understanding what "organic" means together with some sort of "environmental" education would be of particular benefit to this category. These consumers see organic produce as being beneficial from the point of view of their interest in healthy eating. Price is more important to this group, who would tend to respond to price reductions by increasing their consumption of organic products. Self-selection of products is seen as desirable but there is a low level of understanding of organic production systems and therefore some doubt as to the validity of the price premiums involved. Consumers who purchase organic produce because they believe that it "tastes better" than its non-organic equivalent form a third category. Although other groups include taste as an important benefit, this group for whom taste is the primary motivation, are a minority.

The final category (indifferent group in Table 49) consists of those who do not purchase organic produce. This group could be influenced and possibly encouraged to purchase by using, for example, price promotions/reductions - if the price premium were smaller organics could be "a gesture". Generally this group has a more superficial attitude to healthy eating.

TABLE 49: Consumer viewpoints - conclusions from qualitative and quantitative research

	VERY GREEN	IN THE MIDDLE	INDIFFERENT
PRICE			
	least concerned	organics too expensive	use price to justify not buying and project negative attitudes
	need some premium to justify "organic"		
ENVIRONMENT			
	concerned about global issues and animal welfare	centred on benefits to self	not an issue .. ..yet?
AVAILABILITY			
	key issue want to buy more need help to find organics in store	encouragement required need reasons to buy	non-issue
SELF SELECTION			
	important - matches ideal of "natural" but.. understand problems for multiples	less understanding of supermarket constraints	
	appreciate biodegradable packaging now	prefer loose	prefer loose

From the marketing viewpoint of the supermarkets, organic produce can be seen as an appropriate and important part of a "green" supermarket, although the evidence shows that only a minority of consumers make a direct connection between organic and green issues. Supermarkets are generally not regarded as being truly committed to organics, and action such as increased stocking levels, better labelling and information would be likely to benefit sales. Consumers also have an image of infrequent deliveries of organic produce to supermarkets. Self-selection clearly produces difficulties for the multiples, but packaging is generally accepted by the organic consumers - providing it is biodegradable and it could be used more advantageously as an effective and credible carrier of information.

Bodies such as the Soil Association who are involved in organic validation and whose symbols appear on the packaging of organic produce appear to have had little impact on consumers. Awareness of such bodies is, in fact, very low. Although a few of the consumers involved in the consumer discussion groups had heard of bodies such as the Soil Association, recognition of any of the symbols used by such bodies on packaging etc was almost non-existent. Clearly there is scope here for further education of the consumer. Another posibility is that the supermarkets offer a guarantee of organic integrity.

Price is certainly a key issue for all categories of consumer, whether regular, occasional or non-purchasers of organic produce.

In terms of marketing opportunities 15 per cent of the respondent base involved in the consumer research could be said to be truly green - they have already been convinced by the organic argument. It is now the middle ground that offers the most potential for new organic purchasers and it is their movement across into the "green" group that needs to be tracked.

CONCLUSIONS

The conclusions that can be drawn from both studies are as follows:

1. The consumers in the organic produce market with the greatest understanding and awareness of the term "organic" and what it involves also have a strong and genuine commitment to environmental issues and healthy eating.

    a. They also expect an equally strong commitment from retailers and look for, and expect, retailers to use biodegradable packaging.

    b. These consumers would like to see self-selection of produce, but understand that this entails problems for the multiples, for example with regard to the difficulty in distinguishing between organic and conventional produce for the purposes of weighing and pricing at the check-out.

    c. Produce availability is also a key factor. This group of consumers would like to increase their purchases of organic produce but are prevented from doing so (or at least restricted) by limited availability.

    d. As a group they are willing to pay a premium price for organic produce and have sufficient understanding of organic farming to accept that there is often a genuine need to charge a premium price. Although their buying patterns for organic produce are generally not restrained by their household budget, they do have price limits.

2. Those consumers who have less understanding of the term "organic" and are less environmentally aware form another category.

    a. These consumers see organic produce as being beneficial from the point of view of their interest in healthy eating.

    b. Price is more important to this group, who would tend to respond to price reductions by increasing their consumption of organic products.

    c. Self-selection of products is again seen as desirable but there is a lesser degree of appreciation of organic farming systems and therefore some doubt as to the validity of the price premiums involved.

    d. The provision of further information on the organic production process together with environmental educational material would be of particular benefit to this category.

3. Consumers who purchase organic produce because they believe that it tastes better than its non-organic equivalent form a third category. Although other groups include taste as an important benefit, this group, for whom taste is the primary motivation, form a small percentage of consumers.

4. The final category consists of those who do not purchase organic produce. This group could be influenced and possibly encouraged to purchase organic food if it cost less. Generally this group has a more superficial attitude to healthy eating.

5. From the marketing viewpoint of the supermarkets, organic produce can be seen as an appropriate and important part of a "green" supermarket, although the evidence shows that only a minority of consumers make a direct connection between organic and green issues.

6. Supermarkets are generally not regarded as being truly committed to organics by all groups and action such as increased stocking levels, quicker turnover of produce, and better labelling and information may benefit sales.

7. Bodies such as the Soil Association which are involved in organic validation and whose symbols appear on the packaging of organic produce appear to have had little impact on consumers. Awareness of such bodies is, in fact, very low. Although a few of the consumers involved in the consumer discussion groups had heard of bodies such as the Soil Association, recognition of any of the symbols used by such bodies on packaging etc was almost non-existent. Clearly there is scope here for further education and it has been suggested that, as the consumers trust the supermarkets, there may be scope for the supermarkets themselves to offer a "guarantee" of organic integrity.

FUTURE RESEARCH

The research programme has taken the data from its first phase as the basis for setting the objectives of the second phase. The second phase of the research involves testing two hypotheses in-store. The first hypothesis is that consumer demand is price responsive and if the differential between conventional and organic produce is reduced then demand will increase. The second hypothesis is that making consumers more aware of organic produce in-store and providing some education material will increase demand.

This research is being carried out in twenty supermarkets in the Safeway chain. Ten are being used as controls and 5 each are being used as test-beds for price elasticity and merchandising research. All stores have the same range of organic produce on hand and this involves a full range of vegetables.

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EDINBURGH SCHOOL OF AGRICULTURE
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CENTRE FOR HUMAN ECOLOGY

ORGANIC FARMING CENTRE

SECTION 3

INFORMATION AND TRAINING

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SECTION 3

INFORMATION AND TRAINING

CONTENTS

CHAPTER 7

ELECTRONIC INFORMATION SYSTEMS

ORGANIC FARMING INFORMATION SYSTEM - OFIS

INTRODUCTION

As a result of discussions with the European Commission, it became clear that the creation of the Organic Farming Centre represented an opportunity to develop an electronic information system as a part of the Commission's "agricultural informatics" interests, using hypertext and eventually multi-media applications.

This was set within the context of the current usage of information technology, which is seen as being of value to specialists within the academic, commercial and industrial sectors, but of little value or meaning to the ordinary farmer and agricultural industry worker.

It was clear that there was a large gap to be bridged, and that the only way to do this was to design a system which was simple to use and provided such a breadth of pertinent information that it was perceived as being useful enough to break through the inertia associated with learning about computers and information technology.

DESIGN CRITERIA

When considering the creation of such a system, it is useful to be able to visualise the information flows as they exist within the industry. These can be mirrored within an electronic framework, and other resources accessible only to computer systems can then be added to enhance these flows. In addition, there would be some aspects in which electronic systems could be of great value, and others where they would be of only marginal value.

In designing this system, it was clear that to be "limited" to the organic sector was an asset: it is still a small sector, but all aspects of the industry are represented. Therefore, there is a "finite" body of information to provide, and this makes the creation of the system more manageable.

There are several types of information, and each requires its own form of dissemination. The Organic Farming Information System (OFIS) recognises this, and is able to provide a range of dissemination options. For example, some information should be held centrally and disseminated in a controlled way, sometimes only to selected people or organisations, either free or at a change. This centralised and hierarchic provision of information has its place, for example where commercial research organisations sell their results. An industry also needs to be able to communicate within itself, and this is normally carried out by newsletters and trade magazines. OFIS needs to provide both of these options for the dissemination of a wide range of types of information.

It would be wrong, therefore, to conceptualise a system which aimed at accumulating as much information as possible and providing it electronically. That would imply limiting the system to the thinking associated with 19th century technology. The opportunities presented by information technology span a wider horizon.

OFIS has been designed to enable a range of "types of information dissemination" within an open framework which describes the industry sectors. It will be used throughout the industry, and therefore provides an opportunity for an industry (and it could be any industry) to communicate within itself in an entirely new way.

The notion of an open framework is important - one of the principals of OFIS is that it should when ever possible be decentralised and encourage users to take responsibility for the development of the system to meet their own requirements, rather than having a rigid pattern laid down upon them.

OFIS therefore enables a dynamic interaction to take place between:

1) Industry sectors and topics:
   research and development
   information and advice
   training and education
   production
   marketing and business management.

2) Types of information:
   on-line conferences
   edited conferences
   relevant documents
   bibliographies.

3) Additional relevant resources:
   databases
   expert systems etc

4) Multi-media:
   text
   graphics
   interactive video.

TARGET SUBSCRIBERS

OFIS recognises that face to face communication is of immense importance, particularly in the agricultural industry. It is therefore intended to serve as a "decision support and information system", one step removed from the farmer/customer. It will therefore increase the value of the service offered by, for example, an advisor or a co-operative to farmers, and be a worthwhile investment for such organisations.

It is also aimed at these organisations rather that at individual farmers because they will in all likelihood have the necessary hardware available, and therefore the initial investment would be minimal.

Subscribers to OFIS would not all get the same package of resources: these can be added to suit budgets and needs. For example, training and advisory staff would require a different set of resources to a marketing executive, although both sectors would benefit from participating in the core system.

Hypertext, a novel computer technology, enables information system designers to create bodies of information that are, in a sense, 3D rather that the conventional 2D of the printed page. Topics are linked together so that a user can browse through topics as they wish, moving to specific areas for more detail. Hypertext programmes also allow a designer to make "transparent" links between different types of computer programme, such as databases, spreadsheets, expert systems and communication packages.

The key element of OFIS is that its open design invites contributions and suggestions from users. User communications and access to resident and on-line resources have prompted the phrase "value added conferencing environment". The industry will be able to enrich its own internal discussion very substantially, and this will strengthen its development.

OFIS will go on to an on-line pilot test in 1991, and further development work will be carried out. This will lead to a European pilot project in due course.

DEVELOPMENT PROGRAMME 1990

The development of OFIS was carried out through a 6-month contract with the University of Strathclyde Department of Information Science. This had been suggested by the European Commission, as the Department was seen as one of the European leaders in hypertext systems.

The form of OFIS evolved steadily through the contract period, which ran from June to December, and only reached its final conceptualization in the final month. Thus the main achievement of the contract was the development of the idea of a "value-added conferencing environment" and OFIS's open framework design and construction. This is recognised as breaking new ground within the realm of information science and justifies the time and effort put into the project.

CONTENTS

OFIS is operated using a computer selection device called a 'mouse' which enables the user to 'point' to a topic and 'click' the mouse to select a particular item. When the programme is switched on, the following screens appear:

FIRST SCREEN

INDEX OF ORGANIC FARMING AND INDUSTRY SUPPORT:

PLEASE CLICK ON A TOPIC:

Organic Farming Standards
Permitted Lists
Farm Planning
Farm Fertility
Crop Production
Livestock Production
Food Quality
Packing and Distribution
Research And Development
Advice and Information
Training and Education
Marketing
Economics
Machinery
Literature

There is a control panel under this index which is made up of:

Go to, Find, Glossary, Resources, System overview, Help, Exit.

Every index item, when clicked, will offer a range of format options:

SCREEN TWO

These are:

On-line conference
Edited conference
Relevant documents
Bibliography

Under these format option screens is another control panel containing the following options:

Index, Browse other formats, Go to, Find Glossary, Resources, System overview, Help, Exit.
The on-line conferences and edited conferences both have the same 'expanded index'.

Users will be able to move around the system as they wish, looking at current on-line conferences, looking through a range of edited conferences, or browsing through a range of formats within the same subject.

'Relevant documents' are short technical documents, specific to the topic in question, that have been scanned into the system and placed into a hypertext form.

The Bibliography, which is again specific to the topic in question, contains references and abstracts in a hypertext form.

The system is designed to bring maximum flexibility into computer based communications, and to make the process as transparent as possible for the user.

This will result in reducing the 'critical mass' of users necessary to break through the inertia associated with electronic communications systems.

It will also break down the perception that a person either does have access to computer based information or is excluded. With OFIS, or other developments of the concept, users can access the information base through a number of ways:

* On-line access provides the opportunity to read and contribute directly to on-line conferences on any topic.

* Edited conferences are the edited highlights of the on-line conferences. These are downloaded onto up dated floppy disks and mailed to subscribers for automatic downloading into their hard disks. Over time, a valuable information base is built up within an easily accessible hypertext framework.

The thinking behind the on-line and edited conference framework is that there are two ways of providing information:

i through a centralised database which holds all information that is perceived as being useful,

ii providing an open framework within which an industry or sector can build up an information base through a new dimension of communication opportunities.

OFIS is built around the second of these two options.

Subscribers can gain access to all the information in a number of ways:

* Through a full on-line participation.

* By subscribing to the off-line version which holds up-to-date edited conferences and both resident and remote resources.

* Through subscribing to the published hard copy print outs of edited conferences.

* Whichever type of involvement they choose, users will be able to input data in a number of ways:

- directly through on-line conferences.

- by telephone, fax or mail and through a second party which has an on-line subscription.

- by telephone, fax or mail and through the system manager.

The whole system is built within an easy to use hypertext programme, 'Guide', which is available to both IBM and Apple systems, and enables transparent access to different parts of the same document, other documents or other applications. These other applications can be either based on the subscriber's hard disk - 'Resident Resources', or on other remote computers - 'Remote Resources'.

In either case, the subscriber chooses what resident and remote resources serve their purpose; different industry sectors will require different resources. For example, agricultural advisors may require crop variety expert systems to assist in variety choice, whereas a marketing cooperative would have greater needs for a producer and consumer database.

Subscribers will be able to build up a suite of both on-line and resident resources to suit their needs and budgets.

REPORT BY THE DEPARTMENT OF INFORMATION SCIENCE UNIVERSITY OF STRATHCLYDE

In its report on the initial development of OFIS, the Department of Information Science made the following observation on the project.

INTRODUCTION

The Organic Farming Information Service is a hypertext prototype for a pan-European resource on organic farming. It has been developed by the Department of Information Science at the University of Strathclyde with the Organic Farming Centre, as part of its 2 year programme to promote organic farming.

The potential clients for such a system need to both access and publish material: farmers must be catered for, but also a host of wider industry interests, such as funding bodies, suppliers, distributors, educators. Its main potential clients are researchers, advisors, producer groups, cooperatives, wholesalers and retailers. A comprehensive system must offer the following:

* easy access to sources of Information in a range of formats and media
* easy input mechanisms for those who wish to announce or publish
* easy transition to other applications (spreadsheets, expert systems, databases)

* a platform which can be supported by mainstream technologies (PC, Mac) without major investment by clients
* flexibility in terms of systems management with some degree of local autonomy.

HYPERTEXT

Hypertext ("non-sequential reading and writing with free user movement") is a generic label for a new approach to information handling which allows great flexibility to both authors or producers and readers or consumers. Text (in any format or any medium, anything which has an owner on a system) is presented as chunks of material (of varying sizes) which are linked to form customised documents: the links may be specified by an author or editor, or may be made by users. Hypertext presentation can improve access and control in large scale technical documentation sets, especially in multimedia environments. The Department of Information Science at Strathclyde has experience in designing hypertext applications which demonstrate such capabilities.

HARDWARE

The prototype was developed on a 386 IBM compatible. Users will require a minimum platform for Windows, a 286 machine with at least 2M of RAM.

DESIGN

The team decided that full market research into the Information habits of the project's mixed clientele was neither practicable (within the time-constraints of the project) nor desirable (for a prototype). A few individuals held to be representative of potential client sectors were asked what they needed, which allowed the team to attempt a basic blueprint of user needs: up-to-date details of who and where to ask for information, on how to do things, and on how the system works (both in terms of navigation and of what it does when confronted with your task).

These user studies, scant though they were, did help the team to move away from a heavily menu-based approach to system design. The groundwork for indexing and classification in the organic farming domain has been done. The team felt, however, that a prototype intended to attract major funding from the EC must be more than a combination of features from existing systems. As a result, OFIS features control mechanics (icons or buttons surround each screen and offer help or transit options at any point in the user's encounter with the text) as much as subject headings. This means that diversity of function is highlighted as much as diversity of content.

The system in its present form offers a raft of generic headings from which the user can launch to other applications (speadsheets, expert systems), expanded subject domains, conferences or whatever. It does not supersede but complements established applications and allows more flexible transition between them, and in addition, greatly expands the frame of activity of users by linking from existing resources to new input (what may loosely be called informal publishing) presented through conferences, glosses and comments, current awareness.

OFIS, for example, in its present form, allows easy access to Agdex, the agricultural literature and abstracting service run by Edinburgh School of Agriculture; it allows the user to explore data from a model farming project in Lotus format, and it offers access to Greennet, and to conference facilities offered by the Network Services Agency, a British Telecom/Highlands & Islands Development Board sponsored network in the Highlands of Scotland. Ideally, the user leaves an existing point, explores a pocket of interest in another application, and returns to the point of exit without the tedium of entry and exit protocols. OFIS achieves this in transitions between Guide and dBase, or Guide and Lotus, though the link to NSA must be made more transparent.

AN APPRAISAL OF THE PRESENT OFIS PROTOTYPE

Any prototype technology seeking funds for further development must convince those who see it that it is different from what has gone before. It must offer either a quicker or more convenient way of doing what is already done, or new ways of doing things. The team feels that in terms of doing things better, or improving existing practice, OFIS will allow access to the wide range of materials presently accessed by potential users with a "one-stop-shopping" approach, which can eliminate current retrieval problems like

* geographical dispersion of databases, documentation etc
* lack of synoptic information about what is held where
* difficulties in locating truly current material (which escapes the formal publication system) on bulletin boards, E-mail etc
* material in different formats both within local systems (incompatible software) and remotely.

The system also offers improvements at a basic ergonomic level, by allowing authors and users to input and extract material with the minimum of inconvenience, or at least a level of inconvenience which makes the tradeoff with existing systems positive. The point and click technique, for example, offers access to concisely represented material which is displayed on screen in a consistent and obvious format (a combination of menu headings and icons). Guide also improves the lot of authors, by providing macros or standard formulae (for handling SGML mark-up for example) which minimise the difficulties of scripting and linking; it can also be adapted for automatic indexing of structured texts. The last 2 features are not demonstrated in the present prototype.

The OFIS prototype can also hold its ground as a demonstration of novelty, in addition to improvement on existing practice. Presentation in windows format allows users to juxtapose and visualise the connection between materials which are accessed; it allows them to rearrange material easily (and see a representation of their rearrangement) and thus have multiple points of view, or take different perspectives on what is offered. Because hypertext is premised on movement across texts by means of links, users, or authors, can backward and forward chain through material, and thus trace the background of documents, and their impact. Input can also be encouraged from individuals as they engage with text (subject, of course, to such editorial control as is necessary to prevent chaos), which may give other users guidance on the validity of material.

Such capabilities can have a radical impact on training. In addition to pointing users to Information on where they can find training, the system itself can become a virtual training ground, as novices can follow the path of more experienced users (and their comments) who have navigated relevant sections of the system. This will be especially relevant in the case of interactive video presentation, an area which has been enhanced by hypertext in other industrial sectors like medicine and the motor trade. Because of funding constraints, the present prototype does not demonstrate video linking.

OFIS also breaks new ground in terms of user guidance, by offering clear advice on where the user is and what the system is doing at any point in time. The present prototype only does this in a rudimentary way.

We would conclude that the present prototype will serve as an attractant for further funding, but that it is minimal and work must be done to realise its fuller potential. Some fattening can be achieved with minimal resource implications - input by a subject domain specialist into the existing headed sections (whose links have been scripted) for example, and the creation of specialist interest trails across different sets of material (to demonstrate its power as a training vehicle). But more convincing capabilities (keyword access to a growing document base, dynamic browsing, video access) will require both programming skill and hardware, which must be purchased.

CHAPTER 8

EDUCATION AND TRAINING

INTRODUCTION

The creation of the Organic Farming Centre represented a major opportunity for the development of education and training in organic farming. For the Centre's first year, this work was focussed in Scotland as part of the Organic Farming Centre's intention to develop a well balanced organic farming industry support service in one region, namely Scotland, prior to offering it to other European regions in 1991.

The existing education and training opportunities in the UK in early 1990 were confined to a series of 7 Agricultural Training Board courses and 8 block release courses at colleges located mainly in the Midlands and South of England, and in Wales. The Organic Farming Centre's mission was to implement an appropriate development programme within each sector of the organic farming industry. To that end, it has co-operated with Scottish Agricultural College (SAC) and Agricultural Training Board (Scotland) [ATB(S)] to create a range of educational and training opportunities.

The Organic Farming Centre's role in this process was as an initiator and catalyst, and as a guide in providing detailed subject outlines and structures. SAC and ATB(S) specialists were then able to contribute suitable material.

EDUCATION

During 1990, the Organic Farming Centre worked with SAC to create the first 5 nationally recognised and validated organic farming modules at HND level.

These are:

- Organic Farming Practice and Certification Schemes, and Conversion to Organic Production
- Organic Crop Production
- Organic Livestock Production
- Organic Forage Production and Utilization
- Organic Horticultural Production

The HND, a management level 3-year course which includes work place experience, is made up of 17 modules. The organic modules are available as an option in the third year. Most of the core modules in years 1 and 2 provide a sound agricultural foundation in all aspects of the industry and are applicable to both organic and conventional agriculture.

The Organic Farming Centre is confident that this proportion of modules throughout the HND will provide a potential organic farmer with a good foundation.

Each HND module is designed to be taught through a 40-hour period, and will be available to both HND students and external and mature students who wish to extend their knowledge base.

The HND in agriculture is taught at each of the 3 SAC sites, and each will be offering these organic farming modules. The course tutors at the 3 sites have had training in organic awareness which was carried out by the Organic Farming Centre (see below). This training was mandatory in order for the tutors to meet SCOTVEC requirements. Further courses for tutors and lecturers are planned for 1991.

TRAINING FOR EXTENSION SERVICES

The Organic Farming Centre was requested to present a course for Scottish Agricultural College extension officers and lecturers from the 3 Scottish sites, and other institutes, in September 1990. Potential tutors for the HND organic farming modules attended this course. The course brought together many specialists from within the UK, and a key lecture was given by Dr Jan Diek van Mansvelt from Wageningen University, The Netherlands. The 4-day course was well received and contained a practical session on designing the conversion of a college farm to organic production.

The open sessions included speakers from the Organic Farming Centre, Scottish Organic Producers Association, Organic Farmers and Growers (Scotland), Safeway plc, Scottish Agricultural College and other extension workers in the UK.

TRAINING

Organic farming is more climate sensitive than conventional agriculture, and to that end, training courses need to be designed to take account of specific regional characteristics.

As noted before, prior to the formation of the Organic Farming Centre, all UK training courses were designed to meet the needs of farmers in the south of the country. It was therefore clear that a new series of courses was needed to meet the needs of Scottish producers.

In 1990, the Organic Farming Centre designed and developed a series of training courses for organic farmers. These skill and technique based courses were formatted by the Agricultural Training Board (Scotland) and drew on expertise from SAC specialists and the experienced gained through the Organic Farming Centre's research work at Jamesfield farm. This collaboration had not occurred before in other agricultural sectors in Scotland. The courses are being promoted under the banner headline "Organic Farming - An Option For The 90s". The first series were individually entitled:

1) Considering the Conversion to Organic Production
2) Rotations and Soil Fertility
3) Organic Livestock Production
4) On-Farm Processing and Marketing Opportunities

These workshops have been run very successfully in Aberdeen and Dumfries. The leaflet gives an outline to the courses.

The courses have been promoted in association with SAC through a UK industry financed training initiative, PICKUP. This provides funding for piloting short courses.

Further workshops have been planned and are being promoted this year. These are:

1) Considering the conversion
2) Planning and financing the conversion
3) Rotations and soil fertility
4) Arable crops
5) Field scale vegetables
6) Manure management
7) Forage production
8) Livestock production
9) Marketing organic produce
10) Organics for the smallholder

Appendix 1

Why Organic Husbandry?

Farmers and growers who are considering organic production as a response to the increasing demand for natural produce, require information and training in these techniques.

For example, many hill and upland farmers could be producing organic livestock which would attract premium prices - but how often is this seen as an additional market opportunity?

The lowland farmer could start a carefully planned and phased conversion. This would provide a secure entry into a rapidly growing agricultural sector which carries attractive price premiums.

Experienced practitioners in the organic agricultural movement, specialists from within the Agricultural Training Board Scotland and the Scottish Agricultural College have co-operated with the Organic Farming Centre in the development of this series of one-day workshops.

A joint initiative from:

The Scottish Agricultural College

Agricultural Training Board SCOTLAND

Organic Farming Centre

The Organic Farming Centre is funded by: Safeway plc, Scottish Development Agency and Commission of the European Communities.

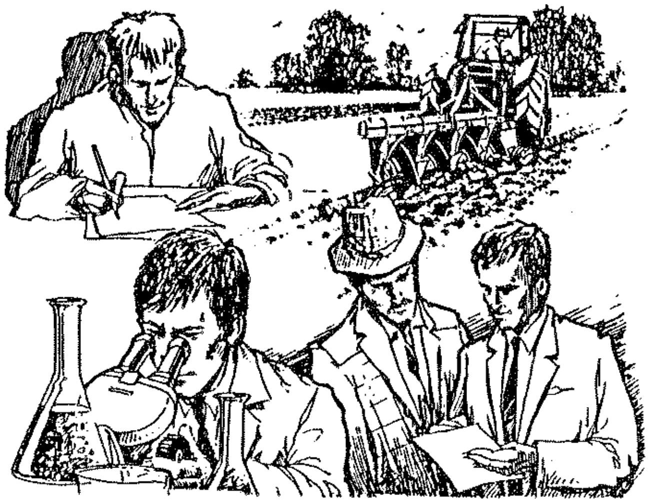
This series of workshops has been developed as part of the rural training initiative by the Scottish Agricultural College, to meet the needs of the farming industry.

For information on other training courses contact Rachel Jones at the address overleaf.

SAC PICKUP Project

ORGANIC FARMING

an option for the 90's



- *creating a balanced farm rotation*
- *promoting health within livestock and crops*
- *selling into an under-supplied market*

A series of one-day participative workshops on organic farming and marketing available throughout 1991-2

Enrol now as numbers are limited

Please send me information on the following workshop(s):-

- *Considering the Conversion* ☐
- *Planning and Finance the Conversion* ☐
- *Rotations and Soil Fertility* ☐
- *Arable Crops* ☐
- *Field Scale Vegetables* ☐
- *Manure Management* ☐
- *Forage Production* ☐
- *Livestock Production* ☐
- *Marketing Organic Produce* ☐
- *Organics for the Smallholder* ☐

Suggestions for other workshops:

....

....

Name: ....

....

Address: ....

....

....

Postcode: .... Tel: ....

Post to: Rachel Jones
FREEPOST
The Scottish Agricultural College Edinburgh
West Mains Road, Edinburgh EH9 0LS
Telephone: 031 667 1041

THE WORKSHOPS

1. *Considering the conversion*

* why convert?
* organic production standards
* understanding the principles
* market opportunities

2. *Planning and financing the conversion*

* financial implications
* assessing existing resources
* achieving change
* planning your own conversion

3. *Rotations and soil fertility*

* what is soil fertility?
* the importance of a rotation
* manures and nutrient cycling
* practical implications

4. *Arable crops*

* weeds and cultivation
* effect of rotation, cultivation and fertility
* choosing varieties

5. *Field scale vegetables*

* farm environment
* buying-in policy
* pest and disease control
* choosing varieties

6. *Manure management*

* why compost?
* alternatives to composting
* applying composts

7. *Forage production*

* species selection
* manuring
* conservation

8. *Livestock production*

* the importance of livestock in organic agriculture
* feeding to organic standards
* maintaining livestock health

9. *Marketing organic produce*

* marketing outlets
* successful on-farm sales
* working with supermarkets
* financial appraisal

10. *Organics for the smallholder*

* livestock
* horticulture
* appropriate machinery
* finance

THE FOLLOWING PAGES ARE EXTRACTS FROM THE FORMAL SUBMISSION TO SCOTVEC IN OCTOBER 1990

SUBMISSION OF A PROPOSAL TO THE SCOTTISH VOCATIONAL EDUCATION COUNCIL

FOR

ELECTIVE UNITS IN ORGANIC FOOD PRODUCTION

FOR INCLUSION IN THE HIGHER NATIONAL DIPLOMA IN AGRICULTURE

HIGHER NATIONAL DIPLOMA IN AGRICULTURE

Aims

The units presented in this document are designed to provide an introduction to organic food production and the problems of conversion to organic food production from conventional systems. The units also allow specialisation in organic techniques of arable and grassland production and horticulture.

The units are designed to fit within the framework of the present HNDA and will be available as electives in Part IV of the course.

Rationale

In recent years, the Scottish Agricultural College (SAC) has become increasingly involved in providing economic and technical advice to Scottish farmers on organic farming. The farmers are in part responding to increased consumer demand for organically produced food and in part because organic food production offers a potential for diversification in the face of declining subsidies for traditional produce. This sector has grown very rapidly and is still growing and may eventually account for about 10% of the food market. In response to this demand, SAC has since 1987 undertaken a major programme of organic research and development, and in collaboration with other educational and commercial interests, established the Organic Farming Centre at Jamesfield in Fife in 1989.

The increased contacts produced by this initiative within the organic sector showed a demand for formal education in the advanced level technical skills which were currently being developed in the sector. With the agreement of the other partners in the consortia, SAC, as the organisation primarily responsible for advanced technical training, undertook to develop appropriate units to be included in the new recently validated HNDA.

Draft proposals were prepared and the opinions of interested parties in the UK were sought on these proposals. The response was generally favourable and a request was made to SCOTVEC for validation.

Admission Arrangements

As detailed in Part 1 Submission of a Pilot Proposal to the Scottish Vocational Education Council for a Higher National Diploma in Agriculture. Revised version July 1989. Subsequently referred to as Part 1 Submission. pp2.

Mode of Attendance

As detailed in Part 1 Submission pp3.

Curriculum and Course Design

These units are designed to give either an introduction to organic farming or an introduction with a specialisation in arable, grassland or horticultural organic production. They will be available as elective choices to those completing entry requirements to Part IV of the HNDA course.

Professional/Industrial Bodies

A range of professional and industrial bodies were circulated with a questionnaire and a brief outline of these proposed units. The list of bodies contacted is Appendix A of this submission and the questionnaire and brief outline of units is Appendix B of this submission.

A resume of the comments made by responding bodies is presented as Appendix C of this submission.

In general, comments were favourable and the units presented in this submission take account of the suggestions made.

Teaching and Learning Methods

These are detailed in the unit descriptors.

Work Experience

A period of supervised work experience in general or organic agriculture is a prerequisite for entry to Part IV of the HNDA and hence to these electives. Exemption from the requirement for work experience can be granted on the same basis as for other Part IV elective units. The relevant conditions are detailed in the Part 1 Submission pp4 sect. 10(b).

Assessment Methods

The same assessment methods and regulations will apply to these units as to other Part IV elective units. They will be subject to the same internal quality control procedures and will be subject to scrutiny by the SCOTVEC appointed external assessor. The detail of all assessments is subject to approval by the external assessor before use. An assessment schedule which includes possible reassessments is prepared for each course programme to ensure that the load on students is realistic. Each student is allowed two attempts at each assessment, with a third attempt at the discretion of the Board of Studies and the approval of the External Course Assessor.

The Award of Merit

The general approach to the Award of Merit is laid down in para.14.2, pp6 of the Part 1 Submission. This will continue to be the basic standard for the Award of Merit within the HND Agriculture, but changes in the details of the Award of Merit within individual Units will continue to evolve in line with the guidance notes on the Award of Merit in Higher National Units, issued by SCOTVEC as part of its Advanced Courses Development Programme.

Any such changes in the methods of awarding merit will be made only with the prior approval of the SCOTVEC external assessor.

In view of the range and variety of assessments within the Units offered, each Unit coordinator and the Unit teaching team have the responsibility to devise their own system of awarding merit in their Unit within the guidelines of the Part 1 Submission and under the supervision of the SCOTVEC external assessor.

The majority of Units previously taught employ some form of the Merit Matrix approach and an example of this is given. This is particularly appropriate in Units with a high percentage of knowledge based and practical assessments. It is more difficult to apply in assessments designed to assess the higher cognitive skills.

The Unit management team consists of the year tutor, the Unit leader, and the Unit teaching team, and is directly responsible to the course Board of Studies for the running of each Unit.

The course Board of Studies at each centre is responsible for the management of the course at each centre. It is comprised of the teaching staff on the course at each centre plus the external course assessor and student representatives. The course Board of Studies at each centre reports to the Scottish Agricultural College Academic Board.

The Scottish Agricultural College Academic Board is responsible for the coordination of the course at the 3 teaching centres and is responsible for the direction of SAC teaching activities.

Each centre has a staff/student liaison committee which is responsible for ensuring that matters raised by the representatives of the student body, with a bearing on course teaching, are brought to the attention of the Board of Studies.

The SCOTVEC external assessor works directly with the chairman of the centre Board of STUDIES, but where necessary he can have direct access to Unit teaching teams and the SAC Academic Board.

Staff Development

To increase the numbers of staff with organic farming experience, a programme of staff training in organic food production has been organised starting with a 4 day residential course for college staff at Oatridge College on 10-14th September 1990. The programme is attached as Appendix E. This staff training programme, together with the core teaching team of experienced staff, will be sufficient to service these courses in the foreseeable future.

A full staff list of the Scottish Agricultural College is given in Part 1 Submission Appendix B1.

HIGHER NATIONAL UNIT SPECIFICATION

HIGHER NATIONAL UNIT TITLE: **Conversion to Organic Production**

OUTCOMES AND PERFORMANCE CRITERIA

OUTCOME 1

Appraise the viability of organic farming

PERFORMANCE CRITERIA:

(a) The assessment of the suitability of a farm for conversion is appropriate.

(b) The comparison of the overall profitability of organic versus conventional production for a given enterprise is accurate.

OUTCOME 2

Plan a conversion to an organic system

PERFORMANCE CRITERIA:

(a) The planning of the sequencing and timing of the conversion of a given farm is appropriate

(b) The estimation of conversion costs is correct

(c) The identification of the social effects associated with conversion are correct

HIGHER NATIONAL UNIT SPECIFICATION

HIGHER NATIONAL UNIT TITLE: **Organic Farming Principles and Certification Schemes**

OUTCOMES AND PERFORMANCE CRITERIA

OUTCOME 1

Explain the principles of organic farming

PERFORMANCE CRITERIA:

(a) Explanation of the principles of organic farming is concise and accurate

OUTCOME 2

Assess the place of organically produced food in the UK market

PERFORMANCE CRITERIA:

(a) Review of consumer interest in organic food is clear and accurate

(b) Review of the growth of the organic food market is clear and accurate

OUTCOME 3

Explain the role of organic symbols and certification schemes

PERFORMANCE CRITERIA:

(a) Explanation of the role of organic symbols and certification schemes is clear and accurate

(b) Explanation of the operation of one of the principal certification schemes is clear and accurate.

HIGHER NATIONAL UNIT SPECIFICATION

HIGHER NATIONAL UNIT TITLE: **Organic Livestock Production**

OUTCOMES AND PERFORMANCE CRITERIA

OUTCOME 1

Evaluate the implications of applying organic livestock production standards

PERFORMANCE CRITERIA:

(a) The practical implications of applying one of the principal certificate standards to a given livestock enterprise is correct.

OUTCOME 2

Review methods for promoting health of livestock in an organic system

PERFORMANCE CRITERIA:

(a) The appraisal of the principals and practices resulting in healthy, disease resistant organic livestock is correct.

(b) The description of husbandry and veterinary procedures required in the event of health breakdown is accurate.

OUTCOME 3

Plan a management system appropriate for organic livestock production.

PERFORMANCE CRITERIA:

(a) The planning and presentation of an appropriate organic livestock system for a given whole-farm situation is clear and concise.

HIGHER NATIONAL UNIT SPECIFICATION

HIGHER NATIONAL UNIT TITLE: **Organic forage production and utilisation**

OUTCOMES AND PERFORMANCE CRITERIA

OUTCOME 1

Select forage/fodder plants suitable for organic systems

PERFORMANCE CRITERIA:

(a) The review of the value of appropriate forage/fodder plants is accurate

(b) The design of an appropriate seed mixture for organic grassland is correct

OUTCOME 2

Plan the efficient production and utilisation of forage in an organic system

PERFORMANCE CRITERIA:

(a) The description of the procedures for establishment and maintenance of a mixed sward is accurate

(b) The description of an appropriate grazing management regime to provide clean grazing and efficient utilisation is correct

(c) The planning of the conservation and utilisation of winter forage is correct.

OUTCOME 3

Plan the efficient production and utilisation of selected arable fodder crops in an organic system

PERFORMANCE CRITERIA:

(a) The planning and presentation of an integral system for the production and utilisation of selected fodder crops is correct, clear and concise.

HIGHER NATIONAL UNIT SPECIFICATION

HIGHER NATIONAL UNIT TITLE: **Organic Crop Production**

OUTCOMES AND PERFORMANCE CRITERIA

OUTCOME 1

Review the standards for organic crop production.

PERFORMANCE CRITERIA:

(a) The description of the crop production standards of one of the principal certification schemes is accurate
(b) The evaluation of the opportunities and limitations of the standards is correct

OUTCOME 2

Describe techniques for optimising soil fertility and cropping potential

PERFORMANCE CRITERIA:

(a) The description of the role of rotations in organic systems is accurate
(b) The identification of the techniques for minimising nutrient loss and optimising soil structure and microbial activity in organic systems is correct
(c) The selection of permissible sources of nutrient inputs is correct

OUTCOME 3

Describe crop protection measures available to organic farmers.

PERFORMANCE CRITERION:

(a) The review of the permissible techniques for weed, pest and disease control is clear and accurate

OUTCOME 4

Plan the production of a selected organic crop.

PERFORMANCE CRITERION:

(a) The devising and presenting of a plan for the production of a specified crop on a given farm is clear and concise

HIGHER NATIONAL UNIT SPECIFICATION

HIGHER NATIONAL UNIT TITLE: **Organic Horticultural Production**

OUTCOMES AND PERFORMANCE CRITERIA

OUTCOME 1

Review the standards for organic horticultural production.

PERFORMANCE CRITERIA:

(a) The description of the horticultural standards of one of the principal certification schemes is accurate.
(b) The evaluation of the opportunities and limitations of the standards is correct.

OUTCOME 2

Describe techniques for optimising soil fertility.

PERFORMANCE CRITERIA:

(a) The identification of techniques for minimising nutrient loss and optimising soil structure and microbial activity is correct.
(b) The selection of permissible sources of nutrient input is correct.

OUTCOME 3

Describe crop protection measures available to organic vegetable growers.

PERFORMANCE CRITERION:

(a) The review of permissible techniques for weed, pest and disease control is clear and accurate.

OUTCOME 4

Plan organic horticultural production systems.

PERFORMANCE CRITERIA:

(a) The devision and presentation of an appropriate organic horticultural production system for a given outdoor site is clear and concise.
(b) The devision and presentation of an organic horticultural production system for a given protected site is clear and concise.