AUSTRALIAN NUFFIELD FARMING SCHOLARS ASSOCIATION

REPORT OF VISIT TO THE UNITED KINGDOM

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(Tasmanian Scholar 1988)

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Australian Nuffield Farming Scholars Association.

Report on a study tour of the United Kingdom, Italy and Holland to study Business Management and Vegetable Seed Production.

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"Daisy Bank"
Richmond. 7025
Tasmania.

Acknowledgements

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TASMANIAN DEPARTMENT OF AGRICULTURE

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The Director of the Tasmanian Department of Agriculture, Dr. Allen Smith.

In the U.K.

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In Holland -

Jos Huizer and family of Jos Huizer Zaden B.V. Rijsood, for their hospitality and assistance in studying the vegetable seed industry.
The General Netherlands Inspection Service of Vegetable and Flower Seeds. (N.A.K.G.)

Obviously, leaving home and the farm for 6 months puts much strain on those left behind. My thanks to my wife Dinky and children and my parents and employee.

INDEX.

The Worshipful Company of Farmers' 38th Course in Farm Business management - 10th January - 30th January, 1988. This course is held at the Centre for European Agricultural Studies, Wye College, University of London, Ashford, Kent.

Outline of Course.

The aim of the course is to create a greater understanding of the factors and techniques involved in managing a business. They cover six main aspects.

1. Agricultural Policy - examination and study of the impact and future implications of the C.A.P. (Common Agricultural Policy) for farming in the U.K.

2. Farm Business Planning - was concerned with techniques of analysing and planning which can help in the making of decisions. The determining of objectives as a prelude to the formation of plans was emphasised.

3. Management Accounting and Finance - dealt with the collection and use of financial and physical information essential for effective decisions and controlling the outcome and progress of farm plans. It also involved business investments and tax planning.

4. Marketing - covered understanding and developing the forces which effect marketing strategy and tactics for certain farm products. The problems of using market research were also discussed.

5. Personel Management - examined the behaviour, thinking and values of people acting individually and in groups, and the problems of obtaining understanding and co-operation. Also discussed was the selection and training of personel.

6. General Environment - various aspects of the general economic and social environment within which the agricultural industry operates were discussed.

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1. Common Agricultural Policy (C.A.P.)

Objectives - a) Support incomes
b) Improve productivity
c) Increase stability
d) Security of supplies
e) Aid balance of payments

f) Price to consumers
g) Rural social objectives
h) Rural environmental objectives
i) International objectives

With these objectives in mind, the C.A.P. can be seen to have been fairly successful with the main exception being - 'price to consumers' - if the aim is to keep the prices low. EEC consumers spend 22% of their income on food, beverages and tobacco. This figure is understandable, considering the average farm holding, with the exception of Spain and Portugal, is 17.1 hectares.
Because of the urban crowding, the maintenance of small rural holdings is seen as very important. The C.A.P. would in fact be more aptly named 'The Common Social Policy' - at a price.
The expenditure on the C.A.P. represents 63% of the total EEC budget of 36 billion E.C.U. (European Currency Unit). (1 ECU = Aus $1.42)

2. Farm Business Planning. Procedures for orderly thinking about risky decisions.

i) A decision is when a choice must be made from amongst a number of actions. Factors that make a decision difficult are unknown consequences, conflicting consequences and complexity. The emphasis was on situations where the consequences were largely unknown.

ii) Structure of risky decisions. There are two conventional methods of analysing risky decisions.

a) The pay-off matrix.
Acts (or strategies)
Events (or states)
Outcomes (or pay-offs)

Examples - 'to spray or not to spray'
- highly simplified in many cases.
- only a single choice
- can still expose the risks in a dramatic way
- concepts of dominance; pure verses mixed actions.

b) The decision tree.
Setting out the consequences of decisions in terms of yet more decisions whose consequences should be taken into

account at the start.

Examples - the more complicated spraying decision
- land purchases and interest rates
- act nodes, event nodes.
- aim is to spell out future choices dependent upon current outcomes. Decisions interlinked over time.
- any tree must be a simplification of reality or the important factors may get submerged in detail, so simplify and specify.

Theory suggests that the rational decision-maker chooses on the basis of:

a) his beliefs about the relative likelihoods of the various events, ie - his subjective probabilities of the events.

b) his preference for the values of the outcomes, ie - his attitudes to the risks on offer.

iii) Subjective probabilities of events (S.P.)
- probabilities are usually expressed as a % of likelihood of occurrence
- getting people to express their S.P.'s
- getting 'experts' to express S.P.'s allows them to express doubts and uncertainties.
- using S.P.'s in pay-off matrices and decision trees
- expected money value as a criterion for choice
- problems with expected money values as a criterion.

iv) Attitudes to risks on offer.
- attitudes can make the decision-maker indifferent between a risk and a gamble. Decision-makers can be classified into several catergories : risk averters
risk indifferent
risk preference.
- categorisation of an individual may depend upon assets and age, etc.

v) Implications of Risk

a) For managers.
- get used to making decisions with less-than-perfect knowledge.
- remember to weigh the costs and benefits of extra information.
- when risk is important
- spell out the outcomes in terms of poor, average and good.
- attach probabilities to the events causing the risk.

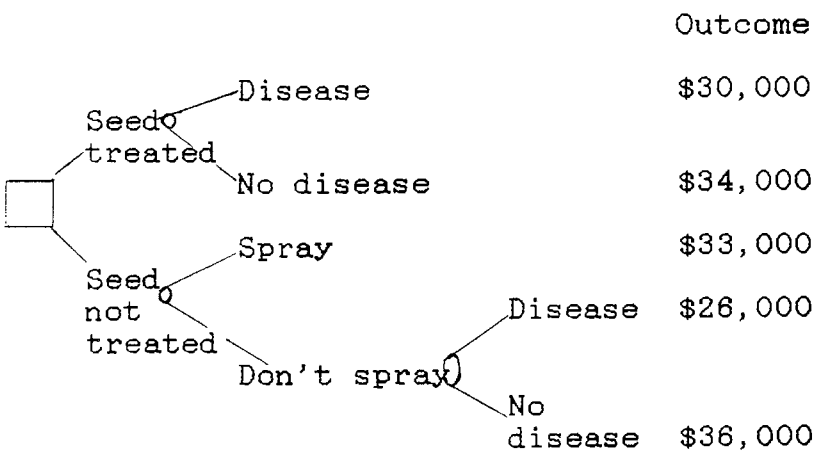
- for technical questions use 'experts', but : do not ask or expect your information-providers to make the decision for you (ie. separate the assignment of probabilities from the taking of the decision.)

b) For advisors.
- explain the consequences of a range of outcomes for each possible action
- be prepared to give probability estimates
- be aware that clients are likly to differ in their attitudes to risk
- in your own interest avoid making the decisiion for the client.

The Pay-off Matrix - to spray or not against a disease of wheat.

Actions	Events (Risk) Disease occurs	No disease
Spray	$33,000	$33,000
Don't spray	$26,000	$36,000

The Decision Tree - as above, but with added possibility of seed treatment.



3. Management Accounting and Finance

- relates to the use of accounts for analysis and

planning.

i) Complete Cost Accounting (Enterprise Costing)
Allocation of all costs, as well as outputs, to individual enterprises. Many problems both in theory and practice : joint costs, arbitrary allocations, ignores complementary and supplementary relationships, opportunity cost of resources used, treats all costs as though 'variable', time-consuming, troublesome and costly, (many extra records to keep and to analyse). Therefore it is very little used.

ii) Accounts Analysis.
Consider the 'whole farm' as a business, efficiency factors and inter-farm comparisons.
The accounts are adjusted to put farms on similar financial basis (solely for comparative purposes).
Management and investment incomes (rental value of owned land).
Analysis of ouputs (yield and system) and costs.
Drawbacks.
a) Limited usefulness of comparative standards, eg. how representative is the size, accuracy of data. Little use if above average.
b) Limited data for planning. May reveal weaknesses, but is sufficient date provided to indicate what specific action is required to remedy them?
Extra data on enterprise outputs and 'variable' costs essential for budgeting.

iii) Gross Margin Analysis.
Midway between i) and ii) above: allocates all outputs, but only some (the variable) costs.
Gross Margin of an enterprise = Output - Variable Costs.
The G.M. model assumes a given 'fixed' cost structure re amount of regular labour, machinery and buildings available.
Variable costs (seed, spray, ferts, etc.) must -
a) be specific to one enterprise only.
b) vary in proportion to the number of hectares or head (ie. the scale of the enterprise.)

Fixed costs comprise regular labour, power and machinery and general overheads, plus rent, interest charges and ownership expenses where applicable.

Main Variable Costs comprise seed, fertilizer, sprays, plus such casual labour and contract work that satisfy the

two criteria (a and b) above. Also concentrates on veterinary expenses for livestock.

Use of Gross Margins.

A. Analyses. Comparison with standards = check on ent. performance. (Variations in yields, prices and other variable costs and stocking rate.)
Fixed costs : little extra offered compared with Accounts Analysis.

B. Planning. Its main contribution.

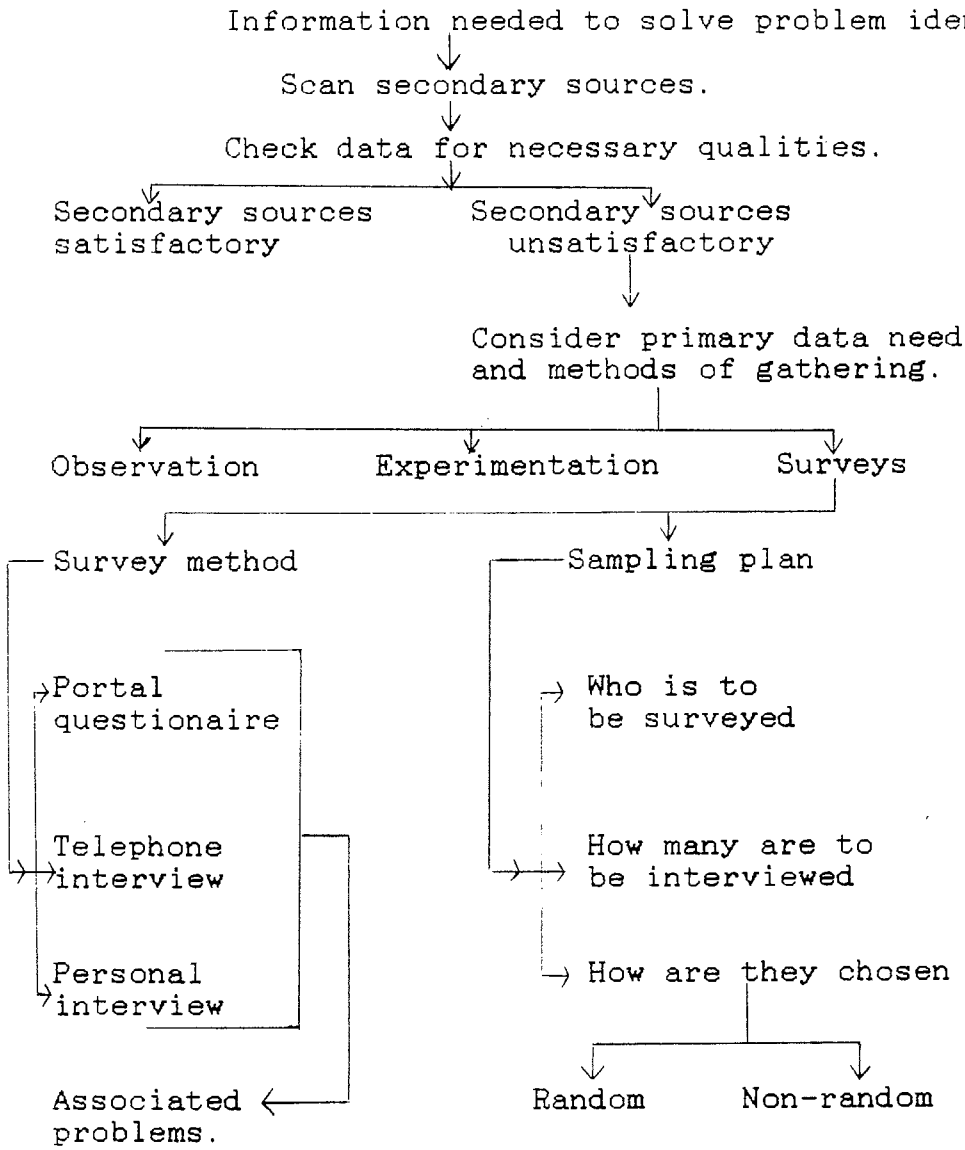
Possible Misuse of Gross Margins.
a) Not a profit figure and should never be thus interpreted in comparing enterprises.
b) Variable cost items can vary between farms,(especially regular v. casual labour, and own machinery v. contractors.)
c) Both output and variable costs per hectare or per head may alter if substantial changes are made in the enterprise mix.
d) Similarly with 'fixed costs': big jumps can occur in 'integer' costs with substantial enterprise changes. There are thus in fact three types of cost - variable, fixed and integer. (eg. regular labour, depreciation on buildings and machinery.)
e) Fixed costs should never be allocated on a flat rate (per hectare) basis to calculate the net profits of the enterprises, (with rare exceptions). Even though this may be of limited value for considering desirable changes in the enterprise mix.
f) This is because the Gross Margin is only one feature of an enterprise even though important. You must also consider soil type, total and seasonal demands for the fixed inputs, supplementary and complementary relationships and capital/cash flow aspects.

4. Marketing - defined as the process of planning and executing.

Marketing objectives.
i) Product - all important, using market research to define consumer needs.
ii) Product line - variety, packaging, safety and ease of opening,
iii) Advertising - creating awareness of product, often based on trials and distributor recommendations.

iv) Sales promotion - to boost share within a market.
v) Price - set after consideration of costs, what level the market will stand and the state of the competition.
vi) Distribution - establish a reliable network and can be combined with promotional activities.
vii) Sales force - well versed in product line.

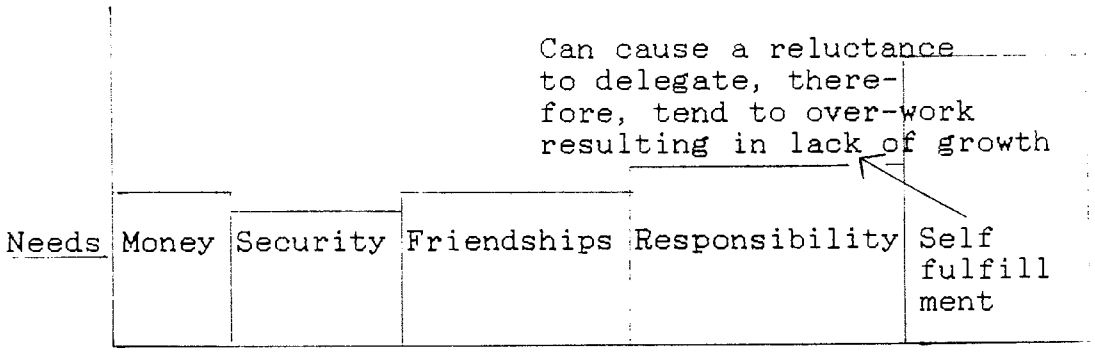
Information gathering methods in marketing research.



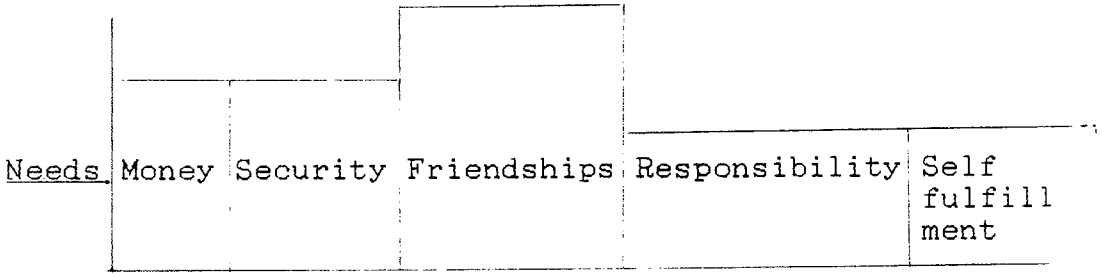
5. Personnel Management.

The main factors required for motivation and business growth are :

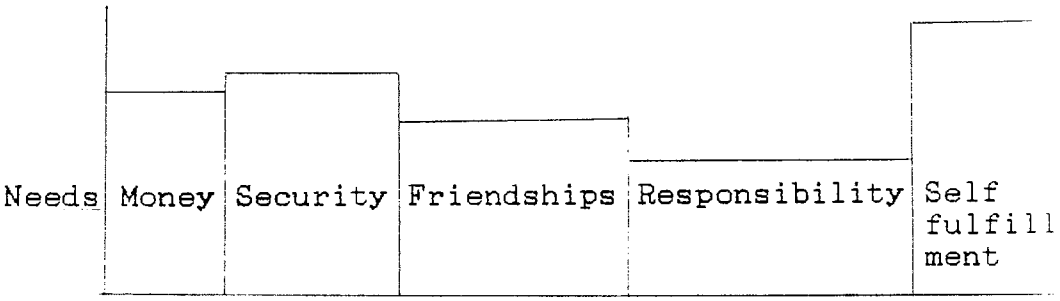
i) Money
ii) Security - if sole motivator, can lead to stagnation.
iii) Friendships - creates a happy environment.
iv) Responsibility - can be a strong stimulant
v) Self-fulfillment - will often forego high pay and benefits for self-fulfillment.



Average small business owner.



Average employee (Industry)



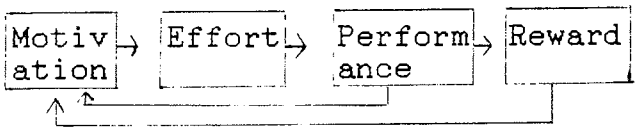
Average agricultural employee

Low Motivation

1. Promotes poor performance
2. Low out-put
3. Inefficiency
4. Absenteeism
5. High turnover of staff
6. Inflexability - not adaptable - unco-operative
7. High (time) costs in supervision.
   (6 and 7 apply more in agriculture.)

Setting appropriate rewards.

Why put in effort if little is to be gained. Money is not the only reward.



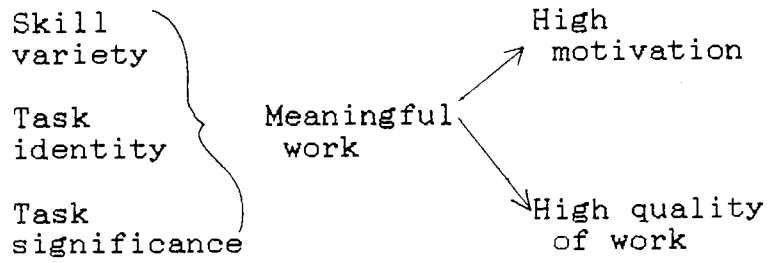
Make employees aware that their effort and performance affect business results.

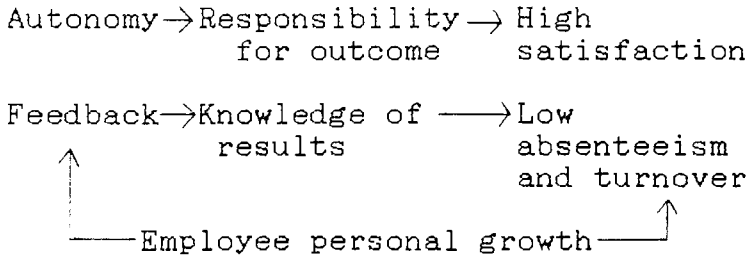
Adequate job design.

Core components of a job.

1. Skill variety
2. Task identity
3. Task significance (importance.)
4. Autonomy (independence)
5. Feedback.

If jobs are high in above features -





Styles of Management

1. Autocratic - old style, issuing of instructions, little discussion of objectives/problems. Motivation through wages. Little trust. Can be useful with young/inexperienced staff.
Among creative employees, this can lead to -
i) low morale and motivation
ii) low trust
iii) lack of inovation
iv) inflexibility
v) poor company performance.

2. Laissez faire - casual with no structure. Employees are left alone with no leadership or direction and feedback is very low.
This can lead to -
i) low performance
ii) low morale and motivation
iii) lack of control and direction.

3. Open participative - currently the more favoured style of management. It concentrates on employee development, trust, selecting means to goals, praising and feedback on performance.
Advantages of above -
i) Highly motivated staff
ii) Reduced overhead costs
iii) Less management costs (time)

Satisfiers and Dissatisfiers.

A. Satisfiers.

i) Achievement in the job.
eg. Successful completion of work, solving problems and being vindicated.

ii) Recognition of achievements in the job.
ie. Acknowledgement by others by means of words and deeds that they recognise achievement/

iii) Work itself.
ie. The actual performance of the job.

iv) Responsibility.
eg. Being made responsible for the work of others or being given different responsibilities.

v) Advancement.
ie. Promotion and changed status.

B. Dissatisfiers.

i) Company policy and administration.
eg. the effects of formal organisation, authority and communications questions and personel policies.

ii) Supervision - technical.
ie. The competence and fairness of managers in the professional capacities.

iii) Salary.
ie. Increases and decreses, actual or expected.

iv) Interpersonal relations - supervision.
ie. non-professional relationships with managers.

v) Working conditions.
ie. Physical surroundings, amount of work, work facilities.

6. General Environment.

This section covered the social and economic environment, in which farmers are finding it increasingly difficult to operate.

Because there are large urban populations close to most farming areas, the activities and practices of farmers are being more closely scrutinised. There is more widespread knowledge of the food surpluses and the resulting cost to taxpayers.

The environmental movement is gaining considerable strength and is calling for such things as set-a-side, where land is managed, but not farmed. Increased levels of nitrogen in ground water, as well as surpluses have

strengthened their position. Farmers are starting to be seen as a threat to the environment.

Reasons for conservation of habitat and animal life.

i) Native plants (and some animals) are seen as a source of gene stock, eg. Native grasses are repressed by high nitrogen levels.
ii) Control of pollution - fertiliser and herbicide/pesticide residues.
iii) Recreation purposes - bush walking. The Ramblers are very well organised and make sure that most public rural footpaths are used regularly and sign posted.

Set-a-side - already used in some EEC countries, eg. Germany. To eliminate surplus, a price cut of about 30% would be required. Legislators could use conservation as a reason to justify payments to farmers in order to remove land from production.

Payments may range from Aus $70 to Aus $500 per hectare, depending on the value of the land - related to particular enterprises (grazing or arable) and the amount of management by farmers, eg. slashing. The scheme would be voluntary and payments high enough to encourage farmers to participate.

Agreements would specify any restrictions, eg. stocking rates, fertiliser levels and timing of any management tasks. A minimum area of 20% would apply, with no maximum envisaged. The main target would be cereals, plus other surplus commodities.

Farmer opinions on its effectiveness and desirability are divided. Some see setting-a-side headlands as a plus. Normally, headlands yield less in an arable situation because of compaction from machinery turning - so their over all yield would decrease little. The set-a-side headland would provide a solid area to turn and the payment would make up for any revenue shortfall.

This summary of the Farm Business Management Course is but a brief outline of some of the subject matter involved. Practical exercises, case studies and 'business games' within the group played an important role. Sessions started at 9.00 am and finished at 5.30 pm. with an after dinner speaker and assignments later in the evening.

Meeting 21 other farmers of a similar age from Britain, France, Germany and Austria was both interesting and of great benefit to me later during my tour.

I would like to extend my sincere thanks to the

Australian Nuffield Farming Scholars Association and The Worshipful Company of Farmers for the chance to participate in the 38th Course.

Finally, thank you to the lecturers and staff of Wye College for a very informative and enjoyable three weeks.

Cruciferae

This group contains the brassicas such as cabbage, cauliflower, brussel sprouts, broccoli, chinese cabbage, turnip and mustard. The seed production methods are very similar, so not all will be covered in detail.

Soil Type

A fairly heavy, well drained fertile soil is best for brassica seed crops, but will grow on a variety of soils.

Nutrition and pH

The pH of the soil (which should not have grown a cruciferous crop during the previous three years) should be 6.0 - 6.5. Acid conditions can affect the availability of micro-nutrients, such as molybdenum.

The N.P.K. ratio applied varies between areas, but the general recommendation is 1:2:2. High nitrogen levels result in soft plants. Top dressings of N are applied in spring to replace that which is leached out during winter. Late spring dressings of N may produce an excess of vegative growth, which will in turn delay harvest. Deficiencies of molybdenum, boron and manganese can be rectified with dressings or spray.

Irrigation

Little work has been done on irrigation levels with seed yield in mind. Most research has dealt purely with the vegative stage to increase the amount of foliage. Water stress can have the effect of increasing the thickness of the waxy cuticle and produces plants with a blue-green coloration which can make roguing more difficult. The most important stages for seed production are at flowering, through to final pod fill.

The main method of irrigation seen during my tour, was with pipes and sprinklers. Hard hose travelling irrigators were just starting to appear on some of the larger farms.

Cross-Pollination - between cruciferous crops.

Group I

Brassica oleracea	Brussel sprout Fodder Kale Cabbage Cauliflower Sprouting broccoli Kohl rabi Calabrese	Cross-pollinate readily with each other

Group II

Brassica chinensis	Chinese cabbage	
Brassica napus	Swede, Swede rape, Rape Kale	Cross pollinate to some extent.
Brassica rapa	Turnip, Turnip rape.	
Brassica juncea	Brown mustard	Will cross pollinate.
Brassica nigria	Black mustard	

Group III

Sinapis alba	White mustard	Will not cross-pollinate with each other or with any of the other kinds.
Sinapis arvensis	Charlock	
Raphanus sativus	Fodder radish	
	Garden radish	

Isolation

Most authorities consider it important to have a greater recommended distance (up to 1,500m) between types of B.oleracea, eg. cabbage and cauliflowers, than between different cultivars of the same type, eg. two cabbage cultivars (up to 1,000m).

Sowing and Spacing

Cabbage, cauliflower, broccoli and brussel sprouts are generally raised in seed beds and planted out. In Italy, most were bare rooted transplants, while in Holland, most popular were the square peat blocks with the use of 'v' shaped speedlings increasisng. In Britain, many favour the Hassy Tray over speedlings. It is plastic and a more rounded shape, but tends to promote root spiralling if held too long. In the south east of England, a large number of cabbage and broccoli open-pollinated crops were direct seeded. These direct drilled crops may be sown in 50cm rows, spaced at 10cm, at a depth of 12-20mm. Dressing the seed with the fungicide, iprodine, is recommended to control the seed-borne infection of Alternaria brassicicola (dark leaf spot) at crop establishment.

Transplants are sown at such a density, as to allow roguing and cultivation and to minimise weed competition.

The density also depends on the vigour of the cultivar. In Britain the recommended spacings are 45 to 60cm square, depending on the cultivar, with good results being obtained planting in rows, 90cm apart and 30cm between plants, which keeps weed competition to a minimum and allows for maximum cultivation.

In Italy, the row spacing was 70-80cm. This spacing applied to the vast majority of seed crops, to allow for cultivatin and roguing. Alterations were made to the spacing within rows to suit the terminal size of the plant. This ranged from 30cm to 60cm in most brassica crops. Radish and turnip spacing within rows was 5-10cm.

Some producers earth-up cabbage and sprout plants after they are established. This aids weed control and helps prevent the plants from falling over when they are heavier.

Sowing (transplanting and drilling) is timed so that the cultivar receives sufficient vernalisation (if required) and for the plants to survive hard winter weather and to seed in suitable harvest conditions.

Bolting

When producing seed from a hard hearted cabbage, it is necessary to incise the mature head after checking for trueness to type. This is to allow the flower stalk to emerge unhindered by tightly folded leaves. If this is not done, the stalk may emerge distorted, or instead, secondary stalks may emerge from beneath the head. These secondaries tend to be prone to wind damage. In Holland, when grown under glass, the heads can be removed for the fresh market and the seed obtained from the secondaries.

When it is necessary to incise the head, the most popular way is to make two cuts in the form of a cross, taking care not to damage the growing point below.

With brussel sprouts, the terminal growing points are removed after final roguing. This encourages the development of flowering shoots from lateral buds (sprouts) thereby increasisng total seed yield and uniformity of seed maturity.

Weed Control

Brassica seed crops, drilled or transplanted, are spaced widely enough to allow tractor hoeing. The 'stale seed bed' technique is often employed. This involves preparing a seed bed ten or more days before drilling/planting and spraying any emerged weeds with diquat and paraquat before sowing.

The chemicals listed below are approved for use in the U.K. but may not be approved or available in Australia, eg Lasso (Alachlor) and Tok E-25 (Nitropen).

Pre-drilling.

Avadex BW (Tri-allate) Incorporated for wild oat and grass control.
Tecane (TCA) Applied at least 7 days prior to drilling for couch, cereals, wild oat and grasses.
Treflan (Trifluralin) Incorporated within 14 days of sowing for annual broad leaf control.

Pre-emergence.

Ramrod (Propachlor) Applied post drilling to control annual weeds.
Butisan S (Metzachlor) Applied from drilling up until crop seed chits. This treatment must be followed with a post-emergence application after the crop has reached the fully expanded cotyledon stage.
Tok E-25 (Nitropen) Applied within 3 days of drilling for annual broad leaf control.
Lasso (Alachlor) Similar to Ramrod, but more residual.

Post-emergence.

Brasoran 50 WP (Aziprotryne) Applied at crop 3 true leaf stage for control of grass and some broad leaf weeds.
Carbetamex (Carbetamide) Apply when crop has 4 true leaves. Controls grasses, cereals and wild oats.
Semeron 25 WP (Desmetryne) at 3 true leaf stage for broad leaved weeds.
Herbon Somon (Sodium monochloroacetate) at 2-4 leaf stage for large range of annual weeds.
Kerb 50W (Propyzamide) after 3 leaf stage for the control of annual grasses and chickweed.
Ramrod (Propachlor) from 4 leaf stage for germinating annual weeds.

Pre and post-transplanting

Avadex BW (Tri-allate) incorporated pre-planting.
Treflan (Trifluralin) incorporate within 14 days of transplanting.
Tecane (TCA) incorporate at least 7 days before transplanting.
Delozin S (Chlorthal-dimethyl/methazol) before weed emergence for annual weeds.
Ramrod (Propachlor) before weed emergence.
Brasoran 50 WP (Aziprotryne) when crop has 3 or more true leaves.

Carbetamex (Carbetamide) after crop establishment.
Semeron 25 WP (Desmetryne) 2-3 weeks after transplanting.
Herbon Somon (Sodium monochloroacetate) 7-10 days after transplanting.
Kerb 50W (Propyzamide) for spring cabbages only after transplants have started to grow.

Pests

Flea Beetle (Phyllotetra spp) damages seedlings by eating the cotyledon leaves or the seedling before emergence. Treating the seed with gamma-HCH gives effective control. If attack occurs post-emergence or post-transplanting, further applications can be used.

Pollen Beetle (Meligethes spp) is blue-black in colour and starts to attack the seed crop at green bud. They eat the flower parts, causing the 'blind' stalk symptom without any pod development. Spraying with gamma-HCH, malathion, phosalone or endosulfan is recommended when populations exceed 15 beetles per plant at the green to early yellow bud stage. Once flowers are open it is too late to spray and bees are put at considerable risk.

Seed Weevil (Ceutorhynchus assimilis) can be more serious than the pollen beetle, as it attacks later. It is grey with the typical weevil proboscis and lays its eggs in the pods. The hatching larvae then eat the developing seeds. One or two per plant are worth controlling. Control is achieved at the end of flowering using the same chemicals as for the pollen beetle. The insecticide kills the newly emerged larvae and at this stage there is least danger of killing bees. The chemical phosalone is approved for both ground and aerial application.

Cabbage Root Fly (Erioischia brassicae) larvae attack the crop at all stages, but plants are usually killed in the seed bed or soon after transplanting. The larvae which feed on the cabbage root tissue must be eradicated. Many strains are resistant to organochlorine insecticides and most insecticides now used are organophosphorus. These may be applied to the seed bed in liquid or granule form. The most common method I saw was using a metred granule hopper on the drill or transplanter.

Aphids. Possibly the best known brassica pest, but often hard to control due to its ability to lodge deep inside the foliage of the plant, rendering contact sprays ineffective. As aphid infestations are most common in warmer weather, most damage occurs when plants are seedlings or at flowering. At other than flowering, a systemic aphicide is very effective as contact between spray and aphid is not necessary. At flowering this would be too

harmful to bees, therefore a contact insecticide should be used. Pyrethrin based formulations are particularly safe to use at flowering, especially if applied early morning or late evening. Some of the many chemicals used are Aldicarb, Chlorpyrifos, Demeton-S-methyl, Dimethoate, Disulfoton and Pyrethrins.

Infestations of aphids can also introduce numerous types of disease. Bee keepers should be warned several days in advance of any spraying, so that hives can be closed on the day of treatment.

Birds and Grazing Animals - treat with aluminium ammonium sulphate.

Diseases.

Canker (Leptosphaeria maculans) is often referred to as black leg and is very widespread on many brassica crops. It is seed borne and causes the development of light brown leaf spots and eventually brown/purplish cankers on the stem. This fungus may also infect the pods. The disease can be reduced by cultural measures such as rotation, isolatin and crop hygiene : infected brassica crop debris, after harvest, should be burnt or chopped and buried by ploughing.

Plants grown from seed should be raised from disease free seeds. In the U.K. seed can be tested by the Official Seed Testing Station at Cambridge. Chemical treatments such as benomyl + thiram or thiabendazole have given useful control.

Dark Leaf Spot (Alternaria brassicicola) causes blackening of stems and pods in addition to a leaf spot and the disease can seriously reduce the yield and particularly the germination percentage. Since there is a cycle of infection which begins with the sowing of infected seed that establishes the disease in the crop, seed treatment prior to drilling, and of the crop before and after cutting is recommended. Control in the seed is by iprodine (Rovral) For control in the growing crop, the same chemical may be applied at the end of flowering as soon as the majority of pods have formed, followed by two applications at intervals of 3 weeks. As spore production occurs while crops are in a swathe, it is important to isolate crops as much as possible, thereby reducing the risk of air-borne spores infecting other crops.

Black Rot (x Campestris)
Lesions are 'V' shaped with black veins and surrounded by pronounced yellowing. The pathogen is present in host vascular bundles and during fruit development may invade the xylem of the funicules and siliques. The pathogen survives from season to season as a seed-borne viroculum. It does not survive in soil for more than 60 days and is capable of surviving in old leaves for no more than 2 years. Cruciferaceae weeds can act as hosts.

Hot water soaks (for seed) have been shown to eliminate the pathogen and are generally recommended.

Cabbage only - 25 minutes at 50o C.
Other crucifers - 15 minutes at 50oC.

Club Root (Plasmodiophora brassicae), is the most widespread and destructive desease of brassicae. It is not seed borne but can remain alive in infected fields for many years. Its presence is first indicated by wilting of the plants, the roots of which are covered in galls. It can be transmitted on machinery or through manure from animals fed on infected land. Diseased transplanting material can also transmit the disease. Liming may help to reduce the effects where the soil is infected to a low degree.

The fungus needs temperatures in excess of 20oC to be active in invading the root system. For drilled crops no fungicide treatment is available but for transplanted crops the National Vegetable Research Station (U.K.) recommend that roots should be dipped in a suspension of calomel in methyl cellulose or a suspension of benlate in water.

Powdery Mildew (Erysiple cruciferarum) It is commonly found on brassicas in the autumn and winter. The disease causes large white mycelial patches to develop on foliage, stems and hearts. Following cold weather the mycelium may turn black. The pathogen can penetrate into cabbage hearts. The causal agent is an airborne fungus which invades the upper surface layers, living mainly on the surface itself. The disease is unlikely to be seed-borne. Infection may result in yield depression and reduction in cold tolerance. Application of fluotrimazole (Persulon) before the fungus develops can give some control. Crop rotation and debris removal will also help.

Downy Mildew (Erysiple brassicae) is soil-borne and can infect the young plants through the roots, whence it invades the plant systemically for a short period. It then sporulates on the cotyledons, and spores carry infection to neighbouring plants. The foliage of diseased seedlings becomes speckled with yellow, and on the under surface of

the leaves, white downy patches of the fungus can be seen. Badly infected seedlings may be stunted or killed.

Symptoms on mature plants are ill-defined yellowish brown areas between the main veins on the under surfaces on which a white downy mould appears in moist weather. Severly affected leaves become yellow and die while soft rot organisms may attack the plant secondarily. Generous ventilation helps control the fungus. A top dressing of nitrogen may help seedlings outgrow the disease. Chemicals effective against downy mildew are chlorothalonil, copper hydroxide, dichlofluanid, maneb + zinc, propamocarb hydrochloride.

Soft Rot (Erwinia carotora) may cause considerable damage. The soft internal tissues of the stem may disintegrate, reducing it to a bad-smelling slimy mass. The margins of the leaves may also rot. Seed production may be completely prevented. Soft rot often accompanies mineral deficiency symptoms. Potassium deficiency or an imbalance of potassium and other essential chemicals may cause marginal leaf scorching. Boron deficiency may be followed by swelling and internal splitting of the stem and softening of the tissues. An imbalance in the levels of nitrogen and potash can lead to hollow stem. Soft rots are also common where an excess of farmyard manure is applied on poorly drained land.

Ring Spot (Mycosphaerella brassicicola) is found during wet weather in winter. It is commonest where there is insufficient crop rotation. More or less circular spots, up to 1cm in diameter, are formed on the foliage, stems and seed pods, and are most abundant on the outer and lower leaves. The surface of these spots are dotted over with minute black fruiting pustules of the fungus arranged in concentric rings. Diseased leaves become yellow and wither prematurely. The fungus may infect the seeds, but the importance of seed infection is not known. The chief sources of infection are the remains of diseased tissue persisting in the soil. Control is best by rotation, isolation and crop hygiene and the chemicals, benomyl and chlorothalonil.

Light Leaf Spot (Cylindrosporum concentricum - previously known as Gleosporium concentricum) shows initially similar to herbicide damage, some leaves appearing scorched, which spreads to other leaves. Under moist conditions, fruiting bodies erupt on the host foliage in concentric white rings. The infection is spread by water splash from plant to plant and will move on to the flowering

stems causing them to collapse. Chemicals of the benomyl type can be used to control the pathogen. Rotation and crop hygiene are also important.

Cauliflower Mosaic Virus and Turnip Mosaic Virus can cause damage in the above as well as cabbage. They produce similar symptoms ranging from a mottle, areas lighter yellow and darker green than normal, so arranged to give a mosaic pattern to necrotic spots on leaves. The disease is aphid transmitted and control is by isolation, rotation and crop hygiene. Spraying against aphids will also limit the spread of the disease.

Harvesting.

The crop is ready for cutting when the mid-stem pods have seeds which are light brown in colour. Hybrid and some open-pollinated crops are cut by hand and placed in windrows or on sheets to continue drying before threshing. Cutting prematurely results in uneven, poor coloured and shrivelled seed, whilst cutting too late brings the risk of seed loss through shattering. Ideally, seed should be harvested at a moisture content between 12 and 16%.

Some open-pollinated crops such as chinese cabbage and turnip are cut and windrowed on a high stubble using a swather. A vertical side knife enables tangled crops to be cut more easily. Depending on weather conditions, drying takes one to two weeks. The crop is threshed by picking up the swathes with a combine. In Italy, with its more reliable harvest conditions, direct combining is possible, as it is in Australia.

Brassica seeds split very easily and it is therefore important to use a relatively slow drum speed, not normally exceeding 700rpm. Faster speeds may be required if the material is not very brittle. Split seeds can be removed from a seed-lot by a spiral separator.

Seed Yield.

Varies from one area to another and also depends on the type.

Cabbage	700kg/H
Cauliflower	400kg/H
Brussel sprouts	600kg/H
Kohlrabi	700kg/H
Turnip	2,000kg/H av.
Swede	1,500kg/H av.

These yields can be halved if only one parent of a hybrid seed crop is harvested. In Italy, a hybrid red cabbage

yielded 800kg/H, both lines being harvested. A direct combined turnip crop yielded 2000kg/H. Approximately 10% of this would be lost with cleaning.

Storage and drying.

Damp brassica seed loses viability very quickly and drying facilities must be available to reduce the moisture within one hour of harvesting if required. It should not be stored in bags above 10% moisture or in bulk above 8%. Seed with low moisture content will tolerate a higher temperature than that with a high moisture content and it is advisable to start drying at a low temperature and gradually raise the air temperature as the seed loses its moisture. But the temperature should never exceed 38oC as indicated in the following figures; for complete safety the temperature controls should be set 2-3o below these maxima.

Drying Air Temp	Moisture Content
Not exceeding 38oC	10 - 18%
Not exceeding 28oC	18-20%

Because of these temperature limits, batch or storage dryers are more suitable than the continuous-flow type. Of the batch methods, in-sack driers are convenient for small lots, particularly if there is any risk of contamination with other seeds. Seed depth in on-floor dryers should be about half that for larger seeds to allow for the higher resistance of brassica seed to air flow. If a high volume of air is used, then little heat is required to dry seed.

Germination.

The minimum germination prescribed in the Vegetable Seeds Regulations (1979) is 75%. Contracting merchants, however, are more likely to require a germination in excess of the EEC minimum. This is usually 85% with detail below.

	Germination %	Specific Gravity
Cabbage	85	98
Cauliflower	80	98
Kohl Rabi	85	98
Turnip	85	98
Radish	82	97

	Vigor	Germination
Kohl Rabi	3	10
Turnip	3	10
Cauliflower	4	12
Cabbage	4	12

Mustard(brown)	6	12
Mustard(white)	3	10
Rape & Radish	4	9

Time allowed in days, to measure the percentage of high vigor seed and the total number of days allowed for seed to reach standard germination rates are shown above.

Radish (Raphanus sativus)

The main type from which seed is commercially produced is R.sativus var. radicula.

Soil and nutrients.

A pH between 5.5 and 6.8 is suitable. The general N.P.K. ratio is 1:3:4 although a lower amount of K is applied where there are satisfactory residues.

Isolation.

The recommended distance is 1,000m, although in some countries the distance between commercial seed stocks of similar cultivar may be less.

Sowing.

The 'root to seed' system is used for basic seed production where root selection is needed.

The 'seed to seed' system is used for final multiplication where inspections of the mature root are not considered necessary.

Rates of up to 6kg/ha are used, the rows are 50 to 90cm apart with 5 to 15cm between plants in the row. In Italy the crops I saw usually had spacings of 70cm and 8 to 10cm respectively.

Pollination.

The flowers are cross pollinated by bees and some other insects. One of the few crops I saw where it was considered important to suppliment the existing bee and insect population was a Japanese radish. Twelve bee hives had been placed around a 5.5 ha crop.

Harvesting.

The seed pods become brown and parchment-like when the seeds are near maturity. Pods do not shatter readily and it is therefore better to harvest under very dry conditions if a combine is to be used. A standard swather is used if the crop is to be cut prior to threshing. The drum speed should be 500-600 rpm.

Yield.

1,000kg/ha is usual although double this can be achieved. A European forcing type which was very expensive (because of extensive selection in the field before flowering) yielded 800kg/ha. This was grown in Italy and the seed was destined

for glass house production.

Pests and Diseases.

Are the same as the other brassicas.

Chenopodiaceae.

The main genera in this family are beetroot, spinach beet, chard and spinach. I saw many crops of spinach in Holland, Italy and some in the U.K. I only saw beetroot in Italy.

Spinach (Spinacea oleracea)

Spinach cultivars are usually classified according to seed type (round or prickly) and leaf shape.

Isolation

Pollination is mainly by wind. Isolation distance is usually 1,000m. This may be extended for hybrids, depending on the species of neighbouring crops.

Nutrition.

The optimum pH is 6.0-6.8. Depending on soil type, the general N.P.K. recommendation is 1:2:2. Supplementary dressings of N are applied before and after bolting. Excess N may cause lodging after flowering commences.

Sowing.

The usual rate is 6kg/ha, in rows 45-60cm apart. Depth is 2-3cm.

Flowering.

Spinach is a typical long-day plant. Flowering occurs in unvernalised plants but is hastened by previous chilling. Populations of spinach are composed of plants which are either male, female or hermaphrodite. Male plants tend to flower before female plants. Male plants produce fewer and smaller leaves than females before flowering.

Roguing.

1. Before main flowering, remove non-rosetting and early flowering males and plants not true to type.

2. When flowering has commenced, as for stage 1. Also removed are plants showing signs of specific pathogens, eg. Downy mildew and Mosaic.

Hybrids.

The male/female ratio can range from 2:6 to 2:14. Roguing for hybrid seed production includes removing male

plants from female rows. This is usually done twice.

Harvesting.

In good weather conditions, the crop is harvested with a combine when the plants are dry and the majority of seeds are mature. This can lead to considerable loss, as the seed at the bottom ripens before the seed at the top of the plant. In other areas, the crop is cut and windrowed when the earliest seeds are mature. Cut plants must be left on sheets to avoid seed loss.

A drum speed of 700 rpm is recommended with concaves set fairly wide to minimise the amount of broken stalks. The threshing also breaks up the clusters of seeds. The 'prickly' spinach is more difficult to clean.

Seed Yield.

The average seed yield is approximately 800kg/ha, with some yields being double that. The hybrid yield is very similar to open-pollinated cultivars.

Pests and Diseases.

Aphids can be a problem, but are readily controlled with chemicals as is the Flea beetle.

The main disease is Spinach Wilt and is controlled by not growing on the same ground twice. Other diseases caused by seed-borne pathogens are Leaf Spot and Anthracnose.

Beetroot (Beta vulgaris)

Is generally grown for the production of its swollen roots and is popular in the Middle East, Europe and North America. Criteria for development and selection of the modern cultivars have been based on root shape and colour, and include globe-, cylindrical- and long-rooted types.

Most beetroot cultivars are multigerm (clusters of 2-5 seeds). Before precision drilling, these clusters need singling. Plant breeders have developed a few monogerm cultivars (single seeds) which makes drilling simpler.

Nutrition.

Beetroot requires a pH of between 6 and 6.8. Recommended seed bed fertilizer is N.P.K. at a ratio of 2:1:2, although some growers use a ratio of 1:1:2 with further N applied as a top dressing in the first season. Transplanted stecklings receive N at 50kg/ha in spring.

Boron deficiency should be watched for. The main symptoms are black cankerous areas on the root exterior and also between the concentric rings. Boron can be applied as sodium tetraborate (borax) at a rate of 1.5 to 2kg/ha.

Seed Production Methods.

Root to seed. Usually for the production of basic seed. Also preferred in some areas for final multiplication as it allows for roguing of roots.

Seed is sown at a rate of 10-15kg/ha in rows 40-50cm apart during summer in Europe. The roots are lifted and rogued in autumn when approximately 3cm in diameter before frost damage occurs. The roots are stored in sheds or in the field in clamps or pits. Shed storage is more suitable as the ideal temperature of 4-5oC with relative humidity at 80-90%, being achieved. The roots are re-planted in spring.

Seed to Seed. In areas free of severe frosts, the seed to seed system is used. A sowing rate of 12kg/ha in August/September will produce enough stecklings to plant up to 4 ha. A four row bed system 110cm wide is used, with 25-30cm between rows. Optimum plant density is 200/m2. The roots are transplanted in early spring in rows 60cm apart and 45-60cm between plants.

Flowering.

The beetroot is a quantitative long-day biennial with a cold requirement for flower initiation. The flowers emerge relatively early in spring. Some producers 'top' this, claiming an increased yield by concentrating the seed maturity period, thus reducing losses from shattering.

Isolation.

Being wind pollinated, at least 1,000m between different cultivars is required. In some parts of the U.S.A., 3,000m is stipulated.

Harvesting.

This can be difficult to judge, but like many crops, when the first (or in this case the lower) seeds are about to shed, the crop is ready to cut. This is done with a swather, or for small lots, by hand. The windrows usually have to be turned before they are ready to thresh. Low drum speed and wide concave settings are required when threshing.

Yield.

1,000kg/ha is considered a satisfactory yield, but can be higher. In Italy, a crop I saw was expected to yield 3,000kg/ha.

Diseases.

Alternaria, leaf spot, powdery mildew, downy mildew and black leg.

Pests.
Aphids and flea beetles.

Umbelliferae.

The four main vegetables in this family are carrot, parsnip, parsley and celery.

Carrot (Daucus carota)

Carrot cultivars are normally classified to root shape, size and colour.

Isolation.
Because of the high possibility of cross-pollination, isolation distances for commercial seed crops should be no less than 800m and for basic seed, the distance should be about 1,600m. Because carrot crosses with wild carrot, care should be taken when choosing a site.

Nutrition.
Depending on soil type, the general recommendation is N.P.K. at a ratio of 1:2:2.

Sowing.
As with other root vegetables, seed is grown by two methods - seed to seed and root to seed. Seed to seed is most common for multiplication with root to seed being used mainly for basic seed production, where being able to rogue the roots is important or where the soil is too heavy for successful seed germination. In Italy, most of the carrot crops seen were in heavy soil on hillsides. The small stecklings were transplanted in September in 70cm rows, with 25cm between roots. This allowed for some loss over winter. Harvest was in August.
With seed to seed, drilling was done in July-early August, in rows 50-90cm apart using a rate of 2-3kg/ha.

Flowering.
There is a distinct order of flowering which relates to umbel position. The first umbel to flower is called the primary umbel which is terminal to the main stalk. Branches from the main stalk form secondary umbels, and branches from these form tertiary umbels. There is, therefore, a wide range of flowering time and seed maturity on each plant. Some cultivars require a cold period to initiate flowering

and some do not.

If other crop species are flowering nearby, it has been found to be advantageous to place bee hives next to the carrot crop, because, while bees are efficient pollinators of carrot, they usually prefer the other crops.

Roguing. (Seed to Seed)

Plants bolting early and those with untypical foliage characters should be removed. Roguing for desirable root characteristics is only possible with root to seed production.

Hybrids.

Most of the crops I saw were for F1 hybrid seed. Usually 2 pollinator rows per 6 female rows was the ratio. The row spacing of 70cm was convenient for some inter-row cultivation and to make the removal of the male pollinator easier.

Harvesting.

The crop is cut when seed on the primary umbels starts to drop. Small lots are cut by hand but most is cut and windrowed mechanically. This is best done in the morning when the dew is on the head to reduce seed loss. When dry, a combine harvester is used. Again, this should be done when the material is not too brittle, because as well as losing seed, small particles of stalk, etc. in the sample will make subsequent seed cleaning a lengthy operation.

Seed Yield.

Open-pollinated crops in temperate regions yield 600 to 700kg/ha. Hybrid crops yield somewhat less - 500kg/ha. Because hybrids have smaller petals, there is reduced insect activity.

Disease and Pests.

The main diseases are Black root rot, Botrytis and Sclerotinia controlled by benomyl (dip). Blight controlled by copper hydroxide and Powdery mildew contolled by triadimefon.

Pests to watch for are aphids, carrot fly, cut-worms and nematods.

Parsnip (Pastinaca sativa).

Production of parsnip seed is very similar to that of carrot. Because the seed is large, flat and light, it is harder to harvest and clean, but as parsnip produces large quantities of nectar, it is much more readily pollinated.

Isolation.

Being attractive to bees and other insects at flowering, it is important to have good isolation - 1,000m.

Nutrition.

A pH of about 6.5 is required. N.P.K. at a ratio of 1:2:2 is recommended. A top dressing of N is often applied in spring.

Sowing.

Apart from a few small lots grown for root selection purposes, the crops I saw in the U.K. were grown seed to seed. The usual row spacing recommended is 1m with 60cm between plants within the rows. For this population, the sowing rate is 4kg/ha. Most crops I saw had row spacings of about 650cm to 750cm. Higher plant populations usually mean that a higher number of primary umbels will result. As with carrots, this is important for high seed vigor. The crop is sown from May to June. The root is fully developed by the end of the first season when the leaves die down. It flowers in the second year following vernalisation of the roots during winter. I saw one field where a cereal crop had been sown between the rows of parsnip and harvested before the parsnip started to bolt.

Flowering and Harvesting

Are similar to that of carrot.

Yield.

An average seed yield is 1,000kg/ha.

Pests and Diseases.

Are the same as for carrots.

Parsley. (Petroselinum crispum)

As with parsnip, parsley is a biennial and the seed crop is vernalised at the end of the first season. I saw parsley being grown in both the U.K. and Italy.

Isolation.

Parsley is cross pollinated by a variety of insects and the recommended isolation distances are 500m between cultivars of the same leaf type and 1000m between curled and smooth leaf cultivars.

Nutrition.

Parsley requires similar soil types and nutrients as carrot.

Sowing.

Most parsley is grown 'seed to seed', but in Italy I saw some transplanted crops. As with some other crops, the parsley was transplanted because on the hillsides the soil was heavy, making a suitable seed bed very hard to prepare. Row spacing was 80 to 90cm with 30cm between plants within the rows. This gives a plant population of about 40,000 to 50,000 plants per hectare. This population also applied to carrot and celery.

With 'seed to seed' production, the sowing rate was 3kg/ha in rows 56cm apart during July or August. Parsley seed takes up to 30 days to germinate in the field.

Flowering.

Similar to carrot. Here too, there is a trend to higher plant densities to reduce the time between seed maturity of successive umbels.

Harvesting.

As with carrot and parsnip, the seed can shatter easily resulting in high losses. The crop should be cut just before the primaries shatter. The crop is 1 to 2m tall by the time it finishes flowering and it is cut into windrows. A combine is used for large areas, but for small areas, the seed is separated by a stationary or mobile thresher. Later cleaning is done with an aspirated screen cleaner.

Yield.

The average is 800kg/ha.

Pests and Diseases.

Are the same as for carrot and parsnip. Herbicides used for the three crops are also the same.

Celery. (Apium graveolens)

I only saw two crops of celery, both of which were in Italy. One was a green celery, the other a white type. Growing celery is similar to the growing of carrots and parsnip and the same herbicides can be used. Celery is a biennial and requires low temperatures to vernalise.

Soil.

Celery is not very tolerant of acid soils and requires a pH of between 6.5 and 7.5. The N:P:K ratio is 1:2:4 and late dressings of N should be applied cautiously as it can increase the susceptibility to frost damage.

Sowing.

The two crops I saw were transplanted because of the

heavy soil conditions and the unavailability of irrigation. The farmer usually grows the seedlings for transplanting. This is done when the commercial market crop is planted which depends on the areas' climate. Transplanted spacings are 60cm rows with 30cm between plants.

For 'seed to seed' crops, sowing is done after mid-summer as with the umbelliferous root crops. This does not allow the roguing of plants which would bolt early in the first year of a normal two year crop. Adequate irrigation is required as germination can take up to three weeks, which is partly due to the presence of germination inhibitors in the seed.

Harvesting.

Very similar to that of the other umbelliferous crops - celery is very prone to shattering. The crop is windrowed and combined. For small lots, the seed will readily separate from the straw if cut and dried on a tarpaulin - especially under cover.

Yield.

The average seed yield is 500kg/ha. The green celery seen was expected to yield 700 to 800kg/ha and the white type 400 to 500kg/ha.

Pests.

Aphids, carrot fly, caterpillars, celery fly, cutworms, leaf miners and white fly.

Diseases.

Botrytis, downy mildew, phytophthora, pythium, sclerotinia and septoria.

Alliaceae.

This family includes onion, leek, Japanese bunching onion, chives, garlic and shallot. I saw onion and leek in both the U.K. and Italy and Japanese bunching onion in Italy.

Onion (Allium cepa L)

Isolation.

A minimum of 1,000m is recommended. Some countries have zones in which only cultivars of the one bulb colour can be grown.

Soil.

A pH of 6.0 to 6.8 is satisfactory. Recommended N:P:K

ratio is 1:2:2.

Sowing.

With 'seed to seed', sowing takes place from mid-summer to early autumn. The plants have to reach sufficient size for vernalisation. Seeding rate is 4 to 5kg/ha in rows 70cm apart, although this can be reduced to less than 30cm if sufficient irrigation is available. Roguing of 'off types' takes place prior to bolting. Japanese bunching onion in Italy was grown mainly 'seed to seed'. It was sown in August and harvested in early June. The row spacing was 70cm.

With 'bulb to seed' in Italy, the seed was sown in beds at 6kg/ha in February and the bulbs were lifted in August. After curing and sorting, the bulbs are replanted in September. In areas with harsh winters, the bulbs are stored and re-planted the following season. The bulbs are re-planted in furrows 70 to 100cm apart.

Flowering and Pollination.

The vernalisation period to initiate flowering varies according to the cultivar. Bulbs stored until the following season require a storage temperature of 9-13oC. Those re-planted almost immediately and crops grown 'seed to seed' are vernalised in the field.

The duration of flowering on individual umbels is approximately four weeks and pollination is by bees and other insects. The usual ratio of male to female rows in a hybrid crop ranges from 1:4 to 1:8.

Harvesting.

Usually, onion seed heads are harvested by hand when 5% of capsules on the head have ripe (black) seed. When cutting, 10-20cm of stalk is taken with the head. In some areas, the total crop is cut in one sweep. In other areas, several selective harvests are made. This staggered cutting applies particularly to bunching onion because of its drawn out flowering. The heads are further dried on tarpaulins, either in the open or under cover, depending on local weather conditions.

A great deal of work is being done in some parts of the world, developing a means of mechanical harvesting. The most promising is the use of a combine with the threshing drum removed. Any ripe seed is collected and the heads containing immature seed pass through undamaged to be collected in trailers and taken to be dried.

Threshing can be carried out when the seeds can be rubbed from their capsules by hand. Concave settings and drum speed should be closely monitored so as not to damage

the seed. Onion seed is easily cracked. It is also important not to break too many of the former flower pedicles from the seed during cleaning. Cleaning is achieved by using air-screens and gravity tables. If high levels of flower pedicles remain, they can be removed by a magnetic separator or by flotation.

Yield.

The average yield is 1,000kg/ha for open-pollinated crops. Hybrid crops yield considerably less - 50 to 100kg/ha.

The Japanese bunching onion seen was expected to yield 500kg/ha.

Leek. (Allium ampeloprasum L.var porrum)

Very similar seed production methods as onion.

Soil.

A pH of 6.0 to 6.8 and an N:P:K ratio of 2:2:1 during seed bed preparation.

Sowing.

Both 'seed to seed' and 'root to seed' systems are used. Usually only 'root to seed' is used for basic seed production, but one commercial seed crop seen in Italy was transplanted because of the heavy soil.

With 'seed to seed' production, a seeding rate of 2-3kg/ha is used with row spacings of 30cm. Thinning to plant spacings of 5-10cn may be required.

With 'root to seed' production, seed is drilled in beds at 4-5kg/ha. in early spring. After eight to twelve weeks the seedlings are lifted (and graded if for basic seed production) when pencil thickness. They may be trimmed, then replanted 10cm deep, 8-10cm apart with 70cm between rows. The transplants are either planted by hand or machine.

Isolation, Flowering and Pollination.

As for onion.

Harvesting.

Crop is hand cut as for onions, but as leeks flower later than onions, problems with autumn weather may occur, resulting in the need for artificial drying.

Yield.

500-600kg/ha.

Pests and Diseases for onion and leek.

Pests - cutworms, onion fly, stem and bulb nematodes and thrips.

Diseases - botrytis, collar rot, damping off, downy mildew, neck rot, phytophthora, pythium, rhynchosporium, rust, seed-borne diseases and septoria.

Compositae.

The main member of this family is lettuce. I saw lettuce being grown in most countries, with much of the hybrid production being under glass in the U.K. and Holland. The only other Compositae seen was chicory in Italy. This is grown as a biennial and subsequently treated similarly to lettuce.

Lettuce (Lactuca sativa L.)

There are a great variety of lettuce cultivars distinguished by their colour and type of head.

Isolation.

Although a small percentage of cross-pollination has been observed, most authorities regard lettuce as self pollinating and a minimum of 2m between different cultivars is recommended.

There should be a gap of 3 years between seed crops on the same ground.

Nutrition.

The pH should be at least 6.0, with 6.5 being more desirable as lettuce is susceptible to calcium deficiency. N:P:K in the ratio of 3:2:2 is recommended. Nitrogen is important to seed yield and up to 80kg/ha can be applied. Too much N will result in an atypical head, making roguing for 'off types' difficult. Top dressings can be applied as a folia spray using urea.

Sowing.

The rows are 50-60cm apart using a seeding rate of 1.5 to 2kg/ha. Young plants are thinned to between 20-30cm. Transplants are planted 25cm apart with 50-60cn between rows.

Irrigation.

Adequate water is important to maximise seed yield, although most overhead irrigation is detrimental once seed has begun ripening, because the impact of water droplets can cause ripe seed to fall. Late watering can also encourage weed growth which can make harvesting difficult.

Flowering.

Most cultivars are day-neutral (summer types) or long-day types which are usually used for winter greenhouse production. Some cultivars developed recently are intermediate.

The inflorescence of lettuce, which is called a capitulum, contains about 24 individual florets which are highly developed in favour of self pollination.

Roguing.

There are 3 main times for roguing - the 4-6 leaf stage, at heading and after bolting has commenced. With commercial crops, roguing usually only takes place at the time of heading.

Bolting.

Cultivars of lettuce with tight hearts often experience trouble with stalk emergence. This can result in a distorted stalk resulting in reduced seed yield. Delayed bolting can also lead to increased exposure to pathogens, such as botrytis. Several methods can be used to overcome this problem. They include de-heading, slashing or quartering, taking care not to damage the unexposed growing point. Correct timing is therefore very important.

Growth-regulating chemicals (Gibberellic acid) have been used to promote early bolting, thus avoiding the problems associated with stalk emergence.

Harvesting.

As with parsnip and carrot, lettuce seed ripening is staggered and deciding when to cut the crop is difficult. General practice is to cut and windrow when 50% of the seed heads are ready on a typical sample plant. After up to 5 days drying in the windrow, a combine is used to thresh the crop.

Cleaning.

Initial cleaning is done with an air-screen machine and further flower stem particle removal can be accomplished using a disc separator or an indent cylinder.

Yield.

A satisfactory yield under good conditions is considered to be from 0.5 to 1 tonne per ha.

Diseases.

Big vein, botrytis, damping off, downy mildew, rhizoctonia and sclerotinia.

Pests.

Aphids, (which can transmit the seed-borne lettuce mosaic virus), caterpillars, cut worms and white fly.

Leguminosae.

Members of this family include peas and beans - dwarf, French, green, snap, runner and broad bean.

Peas. (Pisum sativum L.)

These are usually classified as being either white flowered or purple flowered. The white flowered types are generally for human consumption. Semi-leafless varieties are gaining popularity.

Isolation.

Peas are self-pollinated. This occurs in the late bud stage before the flower is completely open. The recommended distance between varieties ranges from 2 metres to 20 metres. This is mainly to prevent contamination during harvesting.

Four years is generally accepted as being the interval between crops to prevent the build up of fungal diseases.

Nutrition.

Peas prefer a pH of between 5.5 - 6.5. Depending on the soil nutrient status, specialist pea seed producers tend to use a N:P:K ratio of 3:1:2. Work by Browning and George (1981) has indicated that increased seed yield can be obtained with relatively high N and P levels. In Italy, nitrogen is seen as being very important for growing peas. The recommendation was 60-70 units applied at sowing and another 60-70 units after emergence, but before the 3 node stage.

However, seed from the higher nitrogen regimes were found to be less vigorous when subjected to the conductivity test (P.G.R.O. 1978)

Sowing.

The seed bed should be loose to allow for the seed to be sown 5-7cm deep, which after rolling will be 2-4cm deep.

Peas are intolerant of plough pens and water logging. Dry soils limit crop development and wet soils may be conducive to some soil-borne diseases. Peas should be sown as early in the spring as soil conditions allow.

A population target of 75-100 plants per m2 depending

on type, is ideal and plants should be distributed evenly. Narrow rows (12cm) results in the crop being more competitive against weeds and helps to make harvesting easier.

Irrigation.

The most critical stage when adequate water is required is during flowering. Because of the length of time it takes to water a large area, irrigatin should commence as soon as flowers are seen. Irrigation prior to flowering only affects the amount of haulm produced and should not be necessary, except in very arid areas. Moisture deficits during pod swell will also affect yield.

Roguing.

For commercial seed production, crops may be rogued during flowering. For basic seed production, plants should be rogued when approximately 15cm high, at flowering and when the pods have filled.

Harvesting.

Most harvesting is now done by direct combining. Moisture content should be 14% or less. If drying facilities are available, peas may be harvested with a moisture content of up to 24%. If a crop has to be desiccated because of the presence of green weeds, spraying can be done when the crop foliage starts to die back and turn yellow as long as the seed has a moisture content of no more than 40%.

Drum speed should be low with a wide concave clearance, especially if the moisture content is below 14% as mechanical damage to the testa will result in low germination.

Drying and Storage.

Seed which has been harvested at a moisture content of 24% or less should be dried at a temperature between 38o and 43oC.

When storing peas for a period of at least six months, a moisture level of 14-15% should be maintained. If seed is to be over-yeared, then a storage temperature of 10oC and a moisture content of less than 14% is necessary.

Yield.

The average yield of pea seed is approximately 2,000kg/ha. This varies with variety and time of sowing.

Fungal Diseases.

Fusarium Wilt - soil-borne infection is the main source

and it usually occurs before flowering. The plant becomes desiccated from the base upwards. Most cultivars are resistant to the commonest form of wilt.

Fusarium Foot Rot - also soil-borne and usually occurs after flowering. The roots and stem base turn brown or black. Infection is favoured by wet conditions early in the season followed by high temperatures later. After withering of the lower leaves the plants die, usually in well defined patches. There is no resistance to foot rot, but good growing conditions and 4-5 year intervals between legume crops should lessen the effects should it occur.

Foot Rot, Leaf and Pod Spot - they may be seed-borne or carried over on plant debris and are likely to be most severe in wet seasons. The three fungi are closely related : Ascochyta pisi, Mycosphaerella pinodes and Phoma medicaginis var pinodella. All cause brown or purplish leaf and pod spots and sometimes similar lesions on the stem. Infected seeds can give rise to seedlings showing symptoms and establish the disease in the crop or, in some cases, the seedlings may be killed by a severe foot rot. Control is by using a 4-5 year rotation, burning infected debris and treating seed with benomyl and thiram.

Black Root Rot - caused by Theilaviopsis basicola. Symptoms are similar to those of Fusarium foot rot and occurs mainly after lime application or in limestone districts. Control measures are similar to those for the other soil-borne diseases.

Downy Mildew - caused by Peronospora viciae. An attack gives rise to a greyish growth on the under surfaces of the foliage. Tendrils, flowers and pods may be affected if severe. Infection is thought to be from resting spores which can survive for several years in the soil. Diseased pods often have few or no healthy seeds. Control is by burning debris and allowing 4 years between crops. Some new chemicals may be effective.

Grey Mould - Botrytis cinerea causes rotting of leaves, stems, flowers and pods. A grey fluffy growth may be associated with such attacks.

Powdery Mildew - Erysiphe polygoni covers leaves and pods with a white powdery growth. The disease is favoured by humid weather and crops are most at risk late in the season. It can be controlled with the systemic fungicide triadimefon.

Stem Rot - Sclerotinia sclerotiorum causes rotting and collapse of stems and is favoured by high humidity. The black resting bodies (sclerotia) can survive for years in the soil. Burning infected debris and a long rotation is recommended for control.

Virus Diseases.

These are not usually of economic significance. Common pea mosaic virus, pea enatin mosaic virus, pea leaf roll and pe streak are all transmitted by the pea aphid.

Pea early browning virus is transmitted by nematodes in the soil.

Physiological Disorders.

Marsh Spot - is due to manganese deficiency and causes yellowing around leaf margins and betwen veins. If uncorrected, seeds develop with a brown spot in the centre. Affected seeds may fail to germinate or produce malformed plants. Control is normally achieved with a folia application of manganese sulphate or including it in a base dressing of 40-100kg/ha where a deficiency is known.

Broad Bean (Vica fala L)

4,000 to 5,000 hectares of broad beans are grown annually in the United Kingdom. The Processors and Growers Research Organisation (P.G.R.O.) began research on these in 1963.

Varieties can be divided into two groups; white flowered which may be used for both canning and quick-freezing, and those with coloured flowers which can only be used for quick-freezing. Coloured flowers indicate the presence of leucoanthocyanins, which give the beans a brownish discolouration upon canning or cooking.

Isolation.

Some cross pollination can occur - up to 30%, so a minimum of 300m is recommended between varieties.

Nutrition.

A pH of 6.5 is recommended. The ratio of N:P:K should be 1:1:1

Sowing.

A plant population of 18 per square metre is recommended. At this density, plants will be about 13cm apart in 40cm rows. This is approximately 150kg per ha. An 'open' seed bed is preferable to a fine overworked one. As with peas, seed should be sown deep enough to allow the use of pre-emergence herbicides.

Due to the large size of the seed, few drills can be used successfully. Two which are suitable and give precision spacing of the seed are the Stanhay 'Jumbo' and the Ferrag Fahse 'Mono-air'.

Harvesting.

In Europe, small seed lots are cut by hand or mown by machine. In wetter areas, the crop is bundled as stooking is necessary. This is done when the pods have lost their sponginess.

Larger areas are harvested direct when completely dry. If too much shattering occurs, it is advisable to combine in the evening or early morning when some moisture is in the pod. Drum speed should be low with a wide concave clearance. Care should be taken to match the reel speed to the ground speed as excessive reel speed will shatter the pods before the stem is cut.

Yield.

Average yield is 1,500 to 2,000 kg per ha.

Pests.

The mainpest is the black aphid (aphis fabae). Control is by systemic or contact insecticides. Care should be taken, particularly with systemic formulations, not to harm bees. Aphid control will contain leaf roll virus.

Diseases.

Chocolate spot (botrytis spp.) is the most common fungus disease of broad beans. Reddish chocolate-brown spots are produced on leaves and pods and streaks often appear on the stems. Two species of the fungus can be involved, the most aggressive being Botrytis fabae which eventually causes blackening of the pods. The disease is most likely to be troublesome in conditions of high humidity, so good drainage and ventilation are useful. Vigorous crops because of a good supply of phosphate and potash are less likely to be heavily attacked.

Preventative sprays of benomyl or carbendazim will help prevent losses. They should be applied before heavy infection, preferably before flowering. A follow up spray may be necessary 14 days later if conditions remain wet and humid.

Downy Mildew (Peronospora viciae) also results in loss. Sprays of Fosetyl aluminium made at early flowering and repeated 7 days later will control the disease.

Disorders.

Marsh Spot - same as for peas.

French Bean (Phaseolus vulgaris L.)

They are often referred to as snap, green, kidney, haricot and dwarf bean. The majority are bush types. The species is an important crop for processing, the immature green pods are canned or frozen and the dried seeds are used for baked beans.

Nutrition.

French beans grow successfully in soils with a pH of between 5.5 and 6.5. The general N:P:K ratio applied during seed bed preparation is 1:2:2.

Sowing.

Seed should be sown in late spring when the danger of frost has passed. The sowing rate is 100kg/ha for bush types, depending on the seed size of the cultivar. Rows are 45 - 90cm apart.

Flowering.

Most cultivars are day-neutral, although there are some short-day cultivars. The flowers are self-compatible and are predominantly self-pollinated, although some cross pollination occurs. Higher insect activity leads to a greater degree of cross-pollination.

Isolation.

Usually 50m is required between different cultivars for final seed multiplication and 150m for basic seed production.

Roguing.

As with most crops, roguing takes place before flowering, at flowering and at pod form. Off types, early and late plants are removed.

Harvesting.

Bush types are considered to be ready for harvest when the earliest pods are dry and the remainder of the pods have turned yellow. Under good growing conditions the flowers tend to set until relatively late in the season. This leads to a loss from shattering of the earliest seeds if harvest is delayed. It has been found that there is a reduction of about 350kg/ha in harvested seed when the crop was cut before the earliest pods were fully mature.

The plants are either cut and placed in windrows for further drying before combining or threshing. In hotter areas, the standing crop is harvested direct. Care should

be taken to avoid mechanical damage to the seeds as they are very susceptible to cotyledon cracking. Drum speed should be 250-350 rpm with a concave clearance of 12-20cm. The seeds moisture content should not be too low or excessive mechanical damage occurs.

Yield.

Seed yield appears to range from 1,500 to 3,000 kg/ha.

Diseases and the chemicals for their contol.

Downy Mildew	captan+fosetyl-aluminium+thiabendazole.
Ascochyta	As above.
Botrytis	benomyl, carbendazim, vinclozolin.
Anthracnose	carbendazim
Fusarium	drazoxolon

Pre-sowing Seed Treatments.

There are several pre-sowing treatments which are used for vegetable seeds.

Pelleting.

Pelleting makes the drilling of small or awkwardly shaped seed easier. Individual seeds are encased in an inert material such as montmorillonite clay which may also contain the necessary chemicals for the seeds protection. Although the pellet is hard enough to allow mechanical handling, it breaks down on contact with soil moisture. Pelleting is usually done by specialist companies.

Coating.

Seed coating is a technique by which additives such as pesticides, nutrients or nitrifying bacteria are applied to the seed. The coating conforms to the individual seeds shape and does not usually change the seeds size.

Seed Priming and Fluid Drilling.

The priming of the seed is a pre-sowing treatment which aims to have all seeds in a given lot on the 'brink' of germination prior to sowing. While an initial seed-lot may contain a population of seeds with differing potential durations of germination, eg. carrot, the technique of priming will ensure that each seed has reached the same stage of germination prior to sowing.

Priming involves the hydration of seeds in an osmotic solution that permits the preliminary process of germination, but not the final phase of radicle emergence. The seeds are sown surface-dried after a period of storage.

Fluid drilling involves germinating seed in a tank of aerated water which is maintained at the correct temperature. The seed is ready for sowing when the first radicles are 1-3 mm long.

The germinated seeds are then blended into a gel so that each seed is separate from the next in a random suspension. This gel is a carrier which enables the germinated seed to be sown without damage.

The fluid drill pumps the gel and seed mixture into a small furrow in the ground either as a continuous stream or in clumps.

Bee Behaviour.

Bees play a very important role in the pollination of many vegetable seed crops. Bees do not move at random over a seed plot, but in collecting food restrict themselves to a particular part which is mostly only a few square metres in size. The bees also prefer to work within rows instead of across them. A distance of 50-80cm between hybrid parent plants may decrease the percentage of crossing.

After each flight the bees return to this part of the crop. In the course of the flowering period they will seach a somewhat larger region, but this has no consequence for pollination, as investigations have shown that the bees, after the night, no longer carry viable pollen on them. Other insects visiting flowers are also known to be attached to one location.

Only where insufficient food is available will insects cover larger distances, as in the case of small seed plots, such as are used in breeding. Even then, the contamination at greater distances decreases regularly. Since bees can fly several kms, contamination can occur at greater distances also.

Even with large plots, bees may wander, especially at the beginning and towards the end of flowering when nectar and pollen production is less. The number of bees and other insects working the plot will affect this as well.

Because bees prefer to work a small area, intensive pollination by the adjacent plants has been found to occur. This has also been noticed with crops pollinated by wind.

If 2 populations (as in hybrids) have to pollinate each other as intensively as possible, they should be planted in alternate rows or groups of alternate rows for the best result.

Regulatory Laws and Organisations.

Seed growing countries have a range of laws and bodies to help maintain high standards of vegetable seed. Here are two examples. One mainly to protect a seed multiplication industry (Italy), and the other to maintain a high standard of variety breeding and seed marketing (Holland).

In the seed growing areas of Italy, companies meet several times a year to decide which type will be grown where. If they can't reach agreement a government official will act as an arbitrator. He represents the Seed Law which was legislated 8-10 years ago. This enables a high concentration of vegetable seed growing in neighbouring districts. There are 12 seed companies in Cesena alone. Some of the regulations to prevent contamination include the right to destroy a crop if it is grown out of area. If offending material (in flower) is in a private garden, the gardnener is given seed in return for removing it. The gardener can be forced to remove it if he refuses the seed offer. Company field officers also have the right to enter private property in order to pull offending flowering plants.

The General Netherlands Inspection Service for Vegetable and Flower Seeds. (N.A.K.G.)

Vegetable Seeds.

The Netherlands has about 50 firms occupied with the production of vegetable seeds. These firms, the selection firms, are affiliated to the N.A.K.G. Half of these firms are specialised in breeding new varieties (breeding firms). Owing to this intensive breeding each year some 250 to 300 new vegetable varieties become available for the ultimate user.

The N.A.K.G. registers the selection firms for each crop and it also registers the varieties that are being maintained by these firms. Regular checks on the maintenance of the varieties for which the selection firms are registered are carried out by sampling the available stock seed. Annually some 2500 samples of stock seed are sown and evaluated for this purpose on the trial plots of the N.A.K.G. at Roelofarendsveen. Next to this the selection firms are regualrly visited by the inspectors. During these visits they collect information about the maintenance of the existing varieties and the breeding work of the new varieties.

The inspectors of the N.A.K.G. subject all fields for the production of stock seed in the Netherlands to a first inspection. The remaining seed growing fields are fields

for the production of standard seed. These standard seed parcels are inspected at random. After harvesting the yield of the standard seed fields is delivered to the ultimate users. The total area of vegetable seed crops in the Netherlands covers about 2000 ha annually.

Vegetable seed lots which have been multiplied abroad from Dutch stock seed can be sampled on entry into the Netherlands at the request of the seed firm or on the initiative of the N.A.K.G. About 500 of these so-called import seed lots are sampled annually for a test on the germination capacity, the trueness to variety and varietal purity. Together with samples sent in by the firms, part of these are tested for trueness to variety and varietal purity in winter by means of assessment of young plants grown under artificial light (about 400 samples a year).

The inspectors take at random samples of the lots of vegetable seed marketed by the seed firms. This so-called post control serves to see to it that the lots are provided with labels (or an overprint) stating the exact data such as species, variety, lot number and season of packing. These samplings take place on seed production firms and on the premises of domestic wholesale traders, canning factories, plant propagation firms, market gardeners, packers and retailers. Annually some 5000 vegetable seed lots are sampled in this way. All samples are tested for germination capacity at the laboratory of the N.A.K.G. at Roelofarendsveen. Some 2000 samples are also sown on the trial field for asseesment for varietal trueness and purity.

The N.A.K.G. also has the right to publically repremand a company, remove an official of a company or place an inspector in the company if there is evidence of mal-practice. It can also expell a company from N.A.K.G. membership, which prevents the company from trading in the seed industry.

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