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MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

AGRICULTURAL DEVELOPMENT AND ADVISORY SERVICE

ALTERNATIVE GLASSHOUSE VEGETABLE CROPS

HOLLAND

J T ASHDOWN

Report of Visit Sponsored by the Horticultural Development Council

CONTENTS

ITINERARY

Monday, 6 June	Travel Wolverhampton - Harwich Harwich - Hook of Holland night ferry.
Tuesday, 7 June	Visit to Delft Westerlee Auction. Naaldwijk Experimental Station. G Welles - discussion of experimental results and statistics. J C Bakker - sweet pepper environment. J van de Wijnboom - advisory services. Tour of Minor Crop Experiments.
Wednesday, 8 June	Visit to Experimental Garden at Westmaas. Visit to Barendrecht Auction. Naaldwijk Experimental Station K Buitelaar - melons. R H Maaswinkel - aubergines. P M Ramakers - biological control in sweet pepper.
Thursday, 9 June	Visit to sweet pepper, radish, courgette and melon growers with: L van der Burg S van Holsteijn of the Naaldwijk consultancy. Visit to sweet pepper growers with: A C van der Hout of Enza Zaden. Hook of Holland - Harwich night ferry.
Friday, 10 June	Travel Harwich - Wolverhampton.

OBJECTIVES OF THE VISIT

To study new developments in research and in the Dutch glasshouse industry relating to the production of four minor edible crops namely sweet pepper, melon, aubergine and radish.

The visit was structured to include discussions with appropriate research workers and advisory staff and visits to a variety of production units. Time was also allowed to examine some of the final products on the auctions.

SUMMARY OF FINDINGS

Despite the fact that for the first time the throughput of ornamentals at the auctions has exceeded glasshouse edible crops the Dutch protected vegetable industry is in good health.

Production of the major glasshouse vegetables is relatively stable but some newer crops particularly sweet peppers are expanding to meet strong market demand. Although new crops are continuously being sought it is felt that the future lies in monocrop production either of a single crop eg peppers or aubergines or by successional crops eg AYR radish or lettuce. The development of the technology for sweet pepper monocropping is the outstanding success in this field.

The report describes aspects of sweet pepper production including new varieties, biological pest control, aspects of fruit quality and the problem of flushes of fruit in early planted crops.

A rockwool system of production has been developed for aubergine growing which extends the season of production however the market for this crop is more limited although it continues to expand and substantial quantities are exported to England.

Strong competition from Spain and Italy has limited the production period and profitability of the melon crop but the move to cultivate Charentais types instead of the more usual Ogens could lead to new markets.

Radish production on AYR specialist nurseries has seen steady expansion in recent years. Exports to the UK have almost doubled between 1984 and 1987. Provided a sandy soil and adequate capital for mechanisation are available modest expansion of UK production seems feasible.

Other crops referred to in the report include courgette, French beans and Pepino.

TECHNICAL NARRATIVE

VISIT TO DELFT WESTERLEE

This auction is the second largest in the Westland dealing with glasshouse vegetables, the largest being Westland North. It has a turnover of some 400 million Guilders each year. The auction specialises in a wide range of glasshouse vegetable crops and a number were examined.

Mini-cucumbers - this is a new crop produced for export largely by 2 growers. They are packed in 2-layer boxes. The premium size are packed 20 to a box and weigh 150-200 g each but a smaller size is packed 24 to the box.

Chinese cabbage - there is an all the year round demand for this crop but glasshouse production is restricted to the spring. Only Japanese round types are grown and these require even watering and cool growing conditions to avoid problems of internal browning.

Radish production continues to expand and there are about 1000 hectares of cropped area each year in Holland. Production is all the year round where 7 crops per year can be grown. The main production is of circular red types but we also saw red/white varieties for the French market and a white finger shaped type referred to as "icicle radish".

Paksoi was being marketed in 6 kg wooden boxes with counts of 9 or 14 per box. This was considered easy to grow and showing some expansion potential.

Fennel is produced only on a limited basis and expansion is thought to be unlikely due to its long growing period.

Kohlrabi was being grown to a high standard and was felt to have some potential as a glasshouse crop if the market could be expanded.

Cherry tomatoes were being marketed in 250 g rigid plastic punnets 9 of which were placed in a Dutch tomato tray. These were generally smaller than English "cherries" but were achieving a price about 3 times that of ordinary tomatoes on the auctions. The main variety grown is Avita (de Ruyter).

Sweet peppers were present on the auction in even larger quantities than 2 years ago. Red and green vie for being the most popular colours. A purple pepper is grown for export to the US and fetches up to 3 times the price of the equivalent green pepper. New colours include the orange variety Ariane but so far this variety has a poor shelf life. Brown is the latest addition to the colour range.

DISCUSSIONS AT NAALDWIJK

It was generally thought that there was a better future for glasshouse crops producing fruit rather than leafy vegetables. In the search for new species a good deal of scepticism was shown in relation to Babaco although a new apple-like fruit from Israel the Feijoa seemed a possibility although none had yet been grown.

Sweet Pepper

Although still a problem blossom end rot (BER) was regarded as less serious than fruit cracking although more severe than in the tomato. Environment was regarded as the most important factor in its control.

Fruit quality of peppers was judged to be of particular importance and it is recommended that greater emphasis be given to this in the UK experimental programme. One aspect of quality is shelf life which has been found to vary not only between varieties and types but also from one nursery to another. Shelf life is decreased with higher conductivities in the growing medium. The latter is the opposite to findings with the tomato and seems to relate to the need for turgidity in the skin of the fruit. Aspects of fruit quality which are assessed include wall thickness, fruit shape, fruit firmness, freedom from defects, and more recently flavour assessment by a special "tasting panel".

One problem referred to as "Stips" consists of black spots occurring on the outside of the fruit (but occasionally internally in the case of Delphin) which is thought to be due to an excess of calcium in the tissue. As with gold speckle in tomatoes it is seen particularly in the autumn and is thought to be caused by the deposition of calcium oxalate crystals in the cells of the skin which physically damage the cell walls. The problem is reduced by maintaining higher conductivity levels.

It has been found that the sweet pepper will accept 3 times the level of solution conductivity in rockwool that it will accept in soil and that in rockwool there is no difference in yield between 2000 and 4000 micro Siemans. In order to reduce the problem of fruit skin cracking it is recommended that in rockwool crops conductivity of 3000 to 3500 micro Siemans is maintained from the end of April onwards - UK experience would suggest some increase in BER would arise inevitably above 3500 micro Siemans.

Some cost saving is being achieved in rockwool crops by using small strips of rockwool rather than full slabs but these are placed in gullies but still watered to run-off rather than re-cycled.

NFT is considered too risky due to the possibility of root disease infection particularly Fusarium Wilt. A series of experiments are in progress to examine alternative means of sterilising the nutrient solution in re-circulating systems. One method involves a heat exchanger which heats up all the solution to a temperature of 85°C every 24 hours in order to sterilise it each day. Alternative methods being looked at include "ultra filtration" and micro filtration.

For several years experiments have been carried out at Naaldwijk into the effects of alternative temperature regimes and humidities on the sweet pepper crop. In previous years night temperatures as low as 12°C have been applied in combination with day temperatures of 25°C falling to 23°C with no loss of total yield though with some delay.

In 1987 an experiment was carried out which involved a variety of day/night temperature combinations on an October sown pepper crop. Day temperatures ranged from 16-28°C and night settings from 15-21°C. It was concluded that the effect of altering the differential between day and night temperatures was of minor importance in relation to plant growth and yield but that there was a definite optimum 24 hour mean temperature. This 24 hour optimum was found to be in the region of 21°C.

A further experiment looked at the effects of day and night time humidity on growth and fruit production in peppers. It was found that neither vegetative growth nor early or final yields were significantly affected by humidity by day, night or over the full 24 hours, but the mean fruit weight was increased by high humidity at night.

Fruit cracking is the major fruit quality problem and appears to be caused by rapid swelling of the fruit at a late stage in its development. At this late stage the skin loses much of its elasticity. This fruit expansion can occur particularly after a number of heavy picks in the first flush of fruit. Using a microscope it was found that as in tomatoes it was possible to see cracks about 6-7 weeks after fruit set. Fruit cracking is certainly worst in early sown crops.

Fruit setting appears to be highly dependent on day temperature being inhibited by temperatures below 17°C and also above 25°C. The optimum temperature was thought to be 21-22°C. High day time humidity also helps the flowers to set.

In the pepper there is a strong photosynthate source/sink relationship ie when the plant has set a certain number of fruit further setting is almost impossible to encourage regardless of environmental or other conditions until the "sink" has been removed normally by picking.

It was confirmed that Californian thrips (western flower thrips) were a serious problem on the sweet pepper flowers but biological control techniques were under development.

Biological Control in Sweet Peppers

Good control of 2-spotted spider mite has been achieved using Phytoseiulus but since problems have occurred with Thrips. Tarsonemid mite was less of a problem than in previous years.

Development work is continuing using Amblyseius cucumeris which has been found to be effective against Thrips. It can easily be mass produced and can be introduced into sweet pepper without the presence of the pest as it appears to survive on the pollen produced by the flowers from March onwards. However there are difficulties in observing the predator in view of its small size and microscopic examination is required.

1988 Experiments at Naaldwijk

One problem with sweet peppers is the tendency for early planted crops to produce flushes of fruit which with many growers planting at the same time in December can cause fluctuations in price. Also when crops flush there is known to be an increase in cracking of subsequent fruit following heavy picks. An experiment has therefore been set up to look at means of improving pollination so that a steady proportion of flowers can be set thereby avoiding flushes. The following treatments were used:-

1. Vibrating flowers using an electric bee 3 times per week.

2. Use of the hormone Tomatoen, this is aimed at changing the photosynthate source/sink balance.

3. Fruit thinning.

No results are yet available.

A second experiment compared alternative methods of plant raising in relation to the effects on final yield. The following treatments were applied:-

1. Propagation in high temperatures.

2. Propagation in high temperatures with supplementary lighting.

3. Propagation in low temperatures.

4. Propagation in low temperatures with supplementary lighting.

The sowing date of each treatment was carefully timed so that all the plants reached planting stage ie first flower open on about the same date. No yield differences between the treatments have been recorded so far.

AUBERGINE

There are some 85 hectares of this crop in Holland of which 70-80% is grown in rockwool. Rockwool gives better control of crop growth resulting in improved setting of the early crop and higher total yields.

Yields from a rockwool crop are typically about 30 kg/m^2 but can rise to 40 kg in the best crops. Such crops are planted at the end of December and harvested until the end of the following November. Similar production equipment in terms of glasshouses and heating equipment to that used for monocrop sweet peppers is required. The main variety is Dobrix (de Ruyter).

The aubergine is not a popular crop with many workers as some can develop allergies. Tip burn of the calyx can be a problem from the end of January to the end of March and the problem is worsened by low humidities for example when minimum pipe temperatures are being used when no thermal screen is present. It is thought that the problem may relate to deposition of calcium oxalate crystals in the sensitive cells of the calyx causing damage to the cell membranes.

As with peppers this species is trained up a vertical string to the wire and cannot be layered so varieties need to have only moderate vigour so as not to become excessively tall.

Botrytis is a common problem particularly on nurseries without pipe heating systems. The price structure tends to be good between January and May with some recovery in the autumn. Frequency of picking is every 5 days.

There are 2 training systems in use, one involving 2 stems and the other involving 3 stems per plant, each uses 4 rows per 3.2 m bay. The 2 stem method involves a spacing of 60 cm along the row with 80 cm between rows within the double. In the case of 3 stems the spacing is 70-75 cm in the row with the same spacing between rows. The 2 stem method seemed more reliable but had higher plant costs.

The standard temperature regime is 19°C night, 20°C day and ventilation at 23°C from planting onwards. The night temperature is often reduced to 18°C to improve setting of the first flowers.

Pollination is assisted by regular sprays of a mixture of 1 g Rovral plus 10 mls of Tomatoen (based on a gibberellic acid) in 1 litre of water and are discontinued from the beginning of May. These sprays are applied weekly. It was claimed that the gibberellic acid did not adversely affect quality.

White fly is the main pest problem and Vydate is applied once a week on rockwool throughout the season (presumably in the form of liquid Vydate). Biological control using Encarsia has been found ineffective as the pest multiplies much faster on this crop than tomato or pepper.

Two spotted spider mite is also a problem although Vydate gives good control, some effect is also achieved with Tork or a synthetic pyrethroid known as Kilumal.

Current experiments are aimed to look at mini aubergines aimed particularly at the markets in France, Turkey and Greece. The main seed source of these is Japan and a variety of colours are under investigation.

Fusarium wilt is a major problem on those nurseries growing in the soil as also is Verticillium wilt. Poor soil structure can also have a serious effect on root development.

Melons

There are approximately 60 hectares of this crop grown in Holland most of which are marketed between June and September. The Ogen type is the main one grown.

The earliest plantings are at the beginning of March but continue into June and the best prices are achieved in May, June and early July. Most of the crop is grown in the soil either unheated or with air heaters. About 4 or 5 growers grow in rockwool. Melons are often fitted into a rotation of other minor crops.

More recently interest has been shown in the French Charantais type which produces a small fruit weighing 500-700 g as opposed to the Ogen fruit typically of about 1 kg. The flavour of the Charantais type is extremely good and an early trial suggests that planting as early as the 10-15 February may be viable.

At present one grower grows 2 successive crops of Ogen melons per year taking the first flush of 3 or 4 fruits only before replanting. It should be possible to do this with 3 successive crops of Charantais, according to Ing Buitelaar.

A good rockwool crop should yield 5-6 fruit per plant in the first flush but only 4 fruit can be expected in the soil. Charantais fruit ripen fast and daily harvesting (7 days per week) is recommended. For this reason it was claimed that the Charantais is not likely to be used for export. It has red flesh of good flavour and is highly aromatic.

Typical temperatures from planting are 20°C night and day reducing to 17°C night and 18-19°C day after setting fruit. The lower temperature after setting is said to improve sugar content. The fruit takes 45-50 days to develop to maturity. Various plant arrangements are possible but 4 rows are normally planted in a 3.2 m wide glasshouse bay. When training, side shoots are removed from the first metre stem and the stem trained up a vertical string. Above 1 metre side shoots are stopped at 1 female flower each.

The range of diseases that affect the crop are identical to those affecting the cucumber and include Fusarium, Phomopsis, mildew, and Mycosphaerella.

Excessive vigour can be a problem during early growth and this can lead to serious Botrytis problems.

Essentially the melon is well suited to an air heated cropping cycle but does not have an adequate return to justify a pipe heating system. Typical auction returns are 2-3 Guilders per fruit up to mid-July after which the price normally collapses. For best results however the crop must be grown in rockwool.

Pepino

This crop was grown for the first time in Holland in 1986 and a good crop was grown achieving a yield of 15 kg per plant, however in 1988 problems of pest control were experienced and uneveness of growth. Plants have been raised from both seed and cuttings and at present plants raised from seed look more promising. A small variety trial was being grown in one of the glasshouses (perhaps 500 plants) and the problems of variability and pest control could clearly be seen, however fruit was being picked and the tallest plants had reached the wire at about 6 ft.

VISIT TO EXPERIMENTAL GARDEN WESTMAAS

The experimental garden at Westmaas is one of 5 in various parts of Holland. These experimental gardens carry out simple experimental work which relates particularly to the cropping in their locality but they are also used to demonstrate new technology. There was a single block of glass of about 1 hectare at Westmaas which was subdivided into 10 compartments some of which had pipe heating systems but others only direct fired heaters.

A crop of hot peppers variety Torito had been planted on the 19 April to demonstrate a simple training system where a single wire was stretched down the middle of each double row from which a loop of string was fastened round each plant. No attempt had been made to remove or stop the side shoots.

An earlier crop of hot peppers was being grown with the higher labour input system used for sweet peppers of a similar planting date ie taking 2 or 3 stems per plant each fastened to an individual string with side shoots stopped.

Westmaas is an established outdoor celery area with increasing emphasis on the American green types. A crop of various varieties of self-blanching celery had just been cleared from one of the compartments.

A demonstration crop "Cutting Celery" had just been cleared from one compartment. This is typically planted in August and the foliage is cut down 2 or 3 times a year to soil level starting with the first cut at the end of November and the last cut in May. This product was later seen on the auction and is marketed inbunches of slender green celery-like leaves which have a flavour similar to the self-blanching types. The main variety grown is Amsterdam Dark Green.

French beans were being grown, variety Helda in rockwool. The planting date was 14 January and the project involved an experiment to determine the importance of different volumes of rockwool in a conventional rockwool system watered up to 20 times per day giving 30% excess. Two plants were grown in each rockwool block and arranged as follows:-

1. Three blocks on a slab measuring 15 x 7.5 x 100 cm.

2. Two blocks on a slab measuring 15 x 7.5 x 30 cm.

3. One block on a slab measuring 15 x 7.5 x 10 cm.

Although yield results were not available no visible differences could be seen in growth habit between the different volumes.

In a separate experiment alternative conductivity levels had been used with a maximum of 8000 micro Siemans but amazingly this had no effect on either vigour or yield. A typical yield for such a planting date would be 5 kg/m^2 with a pulling out date around mid-July. Temperatures at planting are 20°C night, 22°C day which are reduced after establishment to 18°C night and 20°C day.

Auction ZHZ Barendrecht

This auction is smaller than Delft Westerlee with an annual turnover of 2.5 million Guilders.

The auction is also different in that some 80% of its throughput is for home consumption and for this reason is also a base for many distribution companies.

The auction also covers a wide variety of less common crops and many of these were seen including:-

Round and flat podded French beans.

Lollo Rosso lettuce.

Corn salad.

Glasshouse cauliflower.

Radish seedlings (Porcelaine).

VISIT TO SWEET PEPPER NURSERY - K VROMANT, NAALDWIJK

This is the nursery of a leading monocrop sweet pepper grower and was the site used for the evaluation of the mobile training wire system which proved to be ineffective.

The current crop had been sown on the 5 October and planted during the first week of December. It was expected to continue harvesting until the end of October. The main variety was Delphin grown primarily for red fruit but other varieties such as Ariane (orange) and Luteus (yellow) were being grown. Many growers in the Westland grow a range of different colours.

Plutona is still marginally more popular than Delphin as it tends to flush to a lesser extent and is less prone to fruit cracking.

Some of the rockwool slabs had been steamed and re-used. About 70% of pepper growers steam rockwool slabs for re-use at least twice. This is claimed to be easier for the sweet pepper as the presence of a large quantity of foliage at the end of the crop makes it possible to dry out the slabs easily. The slabs are then piled on pallets and sheeted over and steamed or a mobile steam container is brought to the nursery which will take 3 or 4 pallet loads of slabs at one time. New sleeves are available which are sealed at one end and once filled with the old slab they are usually sealed with tape at the other end.

A wire height of 2.8 m was thought to be close to the minimum for this crop which was already within $\frac{1}{2}$ m of the wire. Despite this however there is no need to stop as fruit load and the development of side shoots reduces growth rate considerably from this stage in the crop. Trimming is carried out every 3 weeks the aim being to encourage the development of fruit on short side shoots that are protected by the leaves and unlikely to snap off.

TMV is still a problem on some nurseries although not this one. The seed firms treat the seed with trisodium phosphate which sterilises the surface of the seeds but it is possible for the virus to reside within the seed. All workers therefore carry a small container with a sponge and skimmed milk powder in which they dip their hands between plants during the critical stage of planting to picking and then only between rows from the start of picking. Little TMV resistant material is available although some hybrids show a degree of tolerance.

The sweet pepper is very susceptible to the Western Flower Thrip however good control is being achieved in Holland using dichlorvos but this upsets the biological control programme for other pests.

Biological control is extremely successful on the sweet pepper. Phytoseiulus is used against Two Spotted Spider Mite. Encarsia is effective against white fly, Dachnusa is also effective against leaf miner. In the case of aphids natural enemies often keep the pest under control but where problems occur Pirimor is used without serious damage to the other biological systems.

Typical yields for a red/green pepper crop are 17 to 22 kg/m^2 and the average price for last year was 3.70 Guilders/kg. This results in a net output of 75 Guilders/m^2 compared with about 90 Guilders for a similar long season tomato crop. However the labour cost is 30% less than with a tomato.

Movable thermal screens are used universally for sweet pepper. Most are clear polythene which is changed annually but there is some interest in LS10 plus with a claimed life of 3-4 years. However, LS10 plus is unlikely to replace polythene as it costs about 2.5 Guilders/m^2 compared with 75 cents/m^2 polythene and by its second or third year accumulates dirt which inhibits light transmission and provides a home for pests and diseases.

HEATED COURGETTE PRODUCTION - WILFRED van LUIK, SOUTH WESTLAND

There are about 15 ha of heated courgettes grown in Holland. This nursery had about 2 ha. The crop was grown in rockwool and the variety was Storrs Green. This is the main variety in Holland although Elite (Pannevis) and Gold Rush (a yellow variety) are also grown.

The crop was planted in January and the final yield to when the crop is pulled out in July is expected to be about 15 fruits per plant.

Each plant is trained up a single extra strong polypropylene string to which the stem is tied once a week using fillis.

The plants were propagated in rockwool blocks and the temperatures from planting were 18°C night, 18°C day and when fruit production begins these are dropped to 15°C night and 17°C day. In summer fruit development is rapid.

Pollination is a problem because most flowers only open once and usually just for a few hours in the morning. Pollination using bees has been used but without success. Bees are thought to visit male flowers only and can transfer viruses. Pollination is carried out by hand using a camel hair brush on the end of a stick which is regularly dipped in the pollen from male flowers. This is carried out each morning as the female flowers only open for a day.

Two rows of plants are grown in each 3.2 m bay with a path underneath the ridge. A density of 0.8 plants/m^2 is achieved.

The fruit are packed in 2 size grades of 14 and 16 per tray weighing about 5.5 kg. Most nurseries do not have the facilities to weigh grade fruit although this would be preferred by the auctions.

Once the first crop has been removed in July a second crop is planted in early August and continued into November although this is far less profitable than the early crop. A yield of about 15 fruits per plant is achieved from this second crop if it is planted right at the beginning of August. The crop is very light sensitive and growth and fruit development diminish rapidly in the autumn.

Mildew is a major problem and is controlled using sprays of Nimrod. Two Spotted Spider Mite can also attack the plants and is difficult to control using biological control techniques said to be due to the hairy leaves. But generally few pests are a problem.

When growing in rockwool similar nutrition is applied to that for aubergine and the conductivity of about 4000 micro Siemans is used at planting reducing to 3000-3500 from the start of picking.

AYR RADISH NURSERY - LEO BOL, DELFT

The fine sandy soil on this nursery leant itself to specialist radish growing. Normally 7 crops were grown per year and the variety Saxa Nova (Pannevis) is used during the period 1 March to 1 October.

A specially designed pneumatic seeder costing about £20,000 is hired by this relatively small nursery (approximately 2 ha) for sowings up to 2 times per week. A density of about 260 seeds/m^2 is used.

Only the red varieties are grown and are marketed washed complete with their top leaves for the German market but topped and packed in cone shaped polythene sleeves for the UK market.

The soil is sterilised once a year in August using Vapam and this is followed by a heavy flooding to remove all surplus fertilisers. Typically a base fertiliser of 5-7 kg/m^2 20:6:9 is applied before each crop but in summer only liquid feeding us used. Liquid feeding is applied from 5 days after sowing ie as soon as the seedlings are visible. The duration of summer crops can be as little as 20 days. An example production programme is attached at Appendix II and seeding rates at Appendix III.

MELON PRODUCTION - H.van DOORNEs' GRAVENZANDE

On this nursery melons were grown in the soil using the double v method of training. Plants are grown in a single row about 14 ins apart each side of the gutter and alternate plants are trained vertically or diagonally in towards the ridge. The path is under the ridge. The rows either side of the gutter are about 2 ft 6 ins apart. The type of melon was Ogen and variety Panogen. Beehives were in place in the glasshouse and hive bees were actively pollinating the crop.

Irrigation was by means of an overhead spray line above the path. At the time of the visit the soil was very dry (sandy) and the humidity in the house was excessive due to limited ventilation facilities.

The fruit developed in a flush of about 3.5 fruits per plant. No flowers are allowed to set on the main stem itself but once the plants are about 1 m high side shoots are stopped at the first fruit. The main stem is stopped just above the wire which was at about 2.2 m.

Rovral was used for Botrytis control and Vydate liquid for Two Spotted Spider Mite and white fly. The temperature regime used was 17°C night and 23°C day.

Grafted plants were used on this nursery as protection against Phomophsis and Fusarium.

Melon Production - C. de Jong, s' Gravenzande

This was also a soil crop watered by overhead spray lines. The planting system involved 4 rows per 3.2 m span as in tomatoes with a double row under the ridge. The plants were trained vertically. A pipe heating system had recently been installed using narrow gauge 20 mm pipe with a loop in the middle of each double row with the facility to raise the pipe on chains as the crop grows.

The same vertical cordon training system was used whereby the plants are simply twisted around fillis which is tied to a wire at height of about 2 m.

Some leaf miner was evident.

The plants had been propagated in 7 cm peat blocks. A temperate regime of 21°C night and 23°C day was applied from planting reducing to 20°C night and 22°C day and finally by the beginning of June to 18°C night and 19°C day. This was the best looking crop of the 3 seen.

Melon Production - V van der Knapp, Honselersdijk

On this nursery there were 3 planting dates, 15 April, 1 May and 2 June. The total crop area was 13,500 m^2. The crop was being grown in a new glasshouse with 3½ m height to the gutters. The training system was the same as that at the previous nursery.

Three alternative methods of irrigation were in use namely high level spray lines, low level spray lines and drip irrigation using one drip per plant. It was considered that the drip irrigation system was superior.

To be successful at growing melons the right balance has to be struck between vigour and fruit setting. An excessively vigorous plant will not set fruit but one which is lacking in vigour will not be strong enough to develop the maximum number of 4 fruit in the first flush. A soil conductivity of 2000-2500 micro Siemans is the target at planting stage but a relatively strong liquid feed is given of between 5000 and 8000 micro Siemans.

Ogen melons must contain at least 8% sugar as this is an auction requirement, however Charantais contain considerably more sugar.

In these crops infections of Botrytis and Mycospaerella were clearly visible. This was thought to be due to the use of low night temperatures and the failure by the grower to remove male flowers and unwanted side shoots from the main stem leaf axils.

VISITS WITH ENZA REPRESENTATIVE - ARCO van der HOUT

Sweet Pepper Varieties

Delphin - this is second only in importance in Holland to Plutona and is valued for its shape and high total yield. However, it tends to be prone to skin cracking and also produces fruit in flushes. It has no resistance to TMV.

Element (E1820) is a new green/red variety which it is claimed is resistant to 3 strains of TMV P0, P1, and P2.

Madara (E1821) is a new green/red variety with the same TMV resisance as Element. Its fruit are usually 4 lobed and it is recommended for growing on rockwool.

Luteus is probably the most widely grown yellow variety in Holland but has no virus resistance.

Ariane (E1886) is the new orange variety which developed by accident as a sport of Luteus and is therefore similar in growth habit but tends to produce larger fruit but like Luteus is very prone to flushing.

Elea (E2355) is a new green/yellow variety with resistance to the 3 strains of TMV.

Inia (E844) is a green/yellow variety introduced for the first time in 1988

Visit to Nursery of Mr K Vromant

In addition to the main varieties described previously this grower was trying Element. He was not convinced that it was an improvement over Delphin but Enza claimed that it had less cracking than Delphin and a better shape than Plutona. The latter was certainly true. It was shorter jointed and less vigorous than Delphin and I was told that it required a higher temperature in the early stages after planting of about ½ to 1°C more than Delphin. It clearly set very easily but it tended to flush and produced fruit very close to the head of the plant.

Visit to Peter Vromant Nursery Naaldwijk

This nursery of about 1 ha specialised in the production of yellow peppers and grew Luteus as its main variety.

Elea was being grown as a trial amongst the Luteus. It was blocky in shape but had smaller fruit than Luteus, however it was claimed to have a yield advantage of about ½ to 1 kg/m^2 to the end of June over Luteus. It was a darker yellow than Luteus but not as dark as Ariane. Like Luteus it suffered very little from shoulder cracking but quite a number of mis-shapen fruit were evident.

On this nursery biological control was being practised for Spider Mite, and Thrip. The rockwool was being re-used and the steamed slabs were placed in a continuous sleeve which ran the whole length of the row. The grower claimed this to be a re-circulating system but each plant had an individual drip and there was little evidence of the necessary plumbing system to do this. It

seemed more likely that drainage occurred at the end of the troughs thereby only reducing the total amount of run-off. The grower stated that a new machine was shortly to become available at a price of about 40,000 Guilders for automatically re-sleeving sterilised rockwool using automated heat sealing.

Ariane showed more problems with fruit cracking clearly relating to its tendency to flush.

Visit to Nursery of Mr van Holsteyn s' Gravensande

Another specialist sweet pepper nursery of about 13,000 m^2 on which the main variety was Delgado. This is a less common variety in Holland but favoured by the grower because of its consistency in both setting and picking throughout the season - a clear advantage over Delphin. Although not experienced by this grower Delgado is said to suffer from a failure to ripen fully red during periods of very hot weather.

Madara was being trialed on a large scale in one of the glasshouse blocks. It was claimed to have less cracking and for the fruit to ripen rapidly from green to red. However some fruit were rather long and pointed but clearly setting is easy and it was claimed to be easier than in the case of Delphin. The yield so far compared well with Delgado particularly in the first 2 months of picking. This grower has suffered quite seriously from Blossom End Rot during April when there was a period of bright sunny weather with strong winds. This caused a sudden reduction in humidity and serious losses due to BER. Removal of the affected fruit caused the plants to be too vigorous and the crop was indeed some 30 or 40 cm taller than the comparable Delgado.

SUGGESTIONS FOR FURTHER RESEARCH AND DEVELOPMENT

In recent years ADAS R and D resources available for minor edible protected crops have been largely devoted to developing the technology for mono-crop sweet pepper production as this crop is regarded as having the greatest commercial potential for UK glasshouse growers. As a consequence a high proportion of this report relates to sweet peppers and a major part of the recommendations proposed for further experimental work.

There is little doubt that quality is the key to the success of sweet pepper growing in northern Europe. Yields at Stockbridge House EHS in 1987 and 1988 have been comparable with those achieved by good growers in Holland but in devising treatments for further experiment the various aspects of quality need to be recorded more fully. Specific proposals for further work on sweet peppers are:

1. Continuation of studies into optimum temperature regimes but related to growth stage, use of thermal screens and effects on humidity.

2. Research is required into the fundamental causes of fruit cracking and its relationship with flushes of fruit, temperature, humidity and solution conductivity.

3. Variety trials should include records of quality aspects eg wall thickness, shape, and cracking.

4. Effect on yield of growing different percentages of ripe fruit eg 20% red/80% green in comparison with 80% red/20% green.

5. Further development of growing media to look at reduced volumes and re-circulating systems.

There would be great benefit in co-operating with research workers at Naaldwijk in several aspects of this work.

The market for aubergines in the UK would appear to be expanding although clearly it is much smaller than that for peppers. Further data is required to assess the full home market potential. This crop could be viable as a mono-crop and an initial experiment to determine feasibility, yield potential etc of a long season hydroponic crop would be justified.

There is no doubt of the considerable size of the melon market in the UK but direct competition with the high volume imports of melons from Spain etc would not be economic. However, there is a place for a premium quality product with improved flavour and an investigation trial to assess the potential of the Charentais types would be worthwhile.

Demand is increasing for high quality protected radish but the precise requirements for soil type and expensive specialised equipment have lead to production being in the hands of a very small number of specialist growers. It seems unlikely that this situation will change significantly.

Experiments on training systems for longer season courgette production were carried out at Lee Valley EHS in the early 1980s but the increased demand for this product and the development of technology for extending the season suggests that a limited experimental programme should be resumed to evaluate yield potential, varieties and economic viability.

Pepino is one of the few recently introduced edible crops in Holland which is thought to be of interest to the market. Experiments should continue into training systems, alternative strains and pest control.

Paksoi is regarded as the most viable species in the Chinese vegetable group. We need to develop and improve basic cultural techniques in order that production under glass can be dovetailed with outdoor production.

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I would like to take this opportunity to thank the Horticultural Development Council for making my visit possible, the speed with which I received a positive response to my proposal was much appreciated.

My thanks are also due to my own management in giving me authorisation to proceed and the initiative of Reg Butters in seeking agreement with the HDC for sponsorship of overseas visits by ADAS Project Leaders.

Lastly I would like to record my gratitude to the researchers, advisers and growers in Holland who made me so welcome, in particular Gerard Welles the Co-ordinator for research on protected vegetable crops at Naaldwijk who organised most of my programme and who gave so freely of his time.

APPENDIX I

Statistics (Central Bureau of Auctions)

Sweet Pepper

Dutch Output and Exports

'000,000 kg

	Total Output	Total Exports
1983	43.6	32.9
1984	42.6	32.3
1985	48.8	37.6
1986	55.7	43.3
1987	63.1	49.4

Export Destinations of Dutch Peppers

'000,000 kg

	1983	1984	1985	1986	1987
W. Germany	14.5	12.6	11.3	15.2	18.0
England	7.8	8.3	10.8	11.5	12.2
U.S.A	0.6	1.3	3.3	4.1	5.1
Sweden	1.8	1.7	2.0	2.0	2.7
Finland	1.4	1.6	2.1	1.9	2.2
Other countries	6.8	6.8	8.1	8.6	9.2

Pattern of Monthly Exports to England

'000 kg

	1983	1984	1985	1986	1987
January	5	5	0	0	0
February	0	5	5	0	8
March	170	200	210	170	332
April	580	630	630	660	920
May	1,010	1,060	1,140	1,320	1,560
June	1,090	1,310	1,470	1,760	1,765
July	1,370	1,440	1,740	1,900	2,114
August	1,240	1,490	2,070	2,180	2,321
September	810	1,050	1,440	1,570	1,703
October	960	950	1,670	1,470	1,318
November	410	140	410	390	174
December	130	40	30	60	21

Aubergine

Dutch Output and Exports

'000 kg

	Total Output	Total Exports
1983	11,310	9,950
1984	11,100	10,050
1985	14,550	13,000
1986	18,230	16,660
1987	19,146	17,550

Export Destinations of Dutch Aubergines

'000 kg

	1983	1984	1985	1986	1987
W. Germany	4371	3814	4469	5531	6182
France	1756	2238	3016	4854	4926
England	2220	2477	3439	3721	3857
Belgium	669	609	787	900	841
Sweden	222	213	271	344	384
Other countries	712	699	1018	1310	1360

Melon

Dutch Output

	'000 fruit	Area planted Ha.
1983	3,630	
1984	4,230	
1985	2,570	53.8
1986	3,330	65.0
1987	2,730	61

Export Destinations of Dutch Melons

'000 kg

	1982	1983	1984	1985	1986	1987
W. Germany	320	360	460	300	290	285
England	195	300	330	200	210	205
Other Countries	-	28	38	49	49	56

Radish

Dutch Output and Exports

'000 kg

	Total Output	Total Exports
1983	106,800	86,500
1984	121,000	100,200
1985	124,800	100,400
1986	128,900	102.600
1987	130,700*	114,400*

*Up to October.

Export Destinations of Dutch Radish

'000 kg

	1983	1984	1985	1986	1987
W. Germany	18,857	20,905	19,463	17,739	20,268
England	1,528	2,086	2,714	2,842	2,896
France	767	1,353	1,383	2,901	2,824
Belgium	661	1,002	1,327	1,554	2,649
Sweden	532	672	735	817	981
Other countries	733	693	1,157	1,510	1,890

*Up to November.

APPENDIX II

Calendar of sowings for Glasshouse Radish

Sowing Date	Seed per m^2	Growing Period in weeks	Days	Pannevis varieties
1-4 January	300	10.0	(71)	
5-14 January	300	9.0	(64)	Rondar (SG491)
15-25 January	330	8.0	(56)	Rondar (SG491)
26 Jan-11 Febr.	350	7.5	(52)	
12-25 February	380	7.0	(49)	
26 Febr-March	380	6.5	(45)	
7-25 March	350	5.5	(40)	Saxa * Nova
26 March-8 April	340	5.0	(35)	Saxa * Nova
9-22 April	320	4.5	(32)	Saxa * Nova
23 April-6 May	300	4.0	(29)	Saxa * Nova
7-20 May	270	3.5	(26)	Saxa * Nova
21 May-3 June	260	3.0	(22)	Saxa * Nova
4=17 June	250	3.0	(21)	Saxa * Nova
18 June-1 July	250	3.0	(20)	Saxa * Nova
2-15 July	250	3.0	(21)	Saxa * Nova
16-29 July	250	3.5	(24)	Saxa * Nova
30 July-12 Aug	250	4.0	(28)	Saxa * Nova
13-26 August	250	4.5	(32)	Saxa * Nova
27 Aug-14 September	250	5.5	(38)	Saxa * Nova
15-23 September	260	6.0	(42)	Rondar (SG491)
24 Sept-7 Oct	260	6.5	(45)	Rondar (SG491)
8-18 October	260	7.0	(50)	Darkar (SG493)
19 Oct-4 Nov	260	9.5	(68)	
5-18 November	260	11.0	(77)	
19 Nov-2 Dec	260	12.5	(87)	
3-16 December	280	12.0	(83)	
17-31 December	290	11.0	(77)	

Source: Pannevis Seeds

APPENDIX III

Seed count per m^2

In row spacing	Number of rows per 3.20 m bay																	
	24	26	27	28	30	32	33	34	36	38	39	40	42	44	45	46	48	50
2.0	**375**	**406**	**422**	**438**	**469**	**500**	**516**	**531**	**563**	**594**	**609**	**625**	**656**	**688**	**703**	**719**	**750**	**781**
2.2	341	369	384	398	426	455	469	483	511	540	554	568	597	625	639	653	682	710
2.4	**313**	**339**	**352**	**365**	**391**	**417**	**430**	**443**	**469**	**495**	**508**	**521**	**547**	**573**	**586**	**599**	**625**	**651**
2.6	288	313	325	337	361	385	397	409	433	457	469	481	505	529	541	553	577	601
2.8	**268**	**290**	**301**	**312**	**335**	**357**	**368**	**379**	**402**	**424**	**435**	**446**	**469**	**491**	**502**	**513**	**536**	**558**
3.0	250	271	281	292	312	333	344	354	375	396	406	417	437	458	469	479	500	521
3.2	**234**	**254**	**264**	**273**	**293**	**312**	**322**	**332**	**352**	**371**	**381**	**391**	**410**	**430**	**439**	**449**	**469**	**488**
3.4	221	239	248	257	276	294	303	312	331	349	358	368	386	404	414	423	441	460
3.6	**208**	**226**	**234**	**243**	**260**	**278**	**286**	**295**	**312**	**330**	**339**	**347**	**365**	**382**	**391**	**399**	**417**	**434**
3.8	197	214	222	230	247	263	271	280	296	312	321	329	345	362	370	378	395	411
4.0	**187**	**203**	**211**	**219**	**234**	**250**	**258**	**266**	**281**	**297**	**305**	**312**	**328**	**344**	**352**	**359**	**357**	**391**
4.2	179	193	201	208	223	238	246	253	268	283	290	298	312	327	335	342	357	372
4.4	**170**	**185**	**192**	**199**	**213**	**227**	**234**	**241**	**256**	**270**	**277**	**284**	**198**	**312**	**320**	**327**	**341**	**355**
4.6	163	177	183	190	204	217	224	231	245	258	265	272	285	299	306	312	326	340
4.8	**156**	**169**	**176**	**182**	**195**	**208**	**215**	**221**	**234**	**247**	**254**	**260**	**273**	**286**	**293**	**269**	**312**	**326**
5.0	150	162	169	175	187	200	206	212	225	237	244	250	262	275	281	287	300	312
5.2	**144**	**156**	**162**	**168**	**180**	**192**	**198**	**204**	**216**	**228**	**234**	**240**	**252**	**264**	**270**	**276**	**288**	**300**
5.4	139	150	156	162	174	185	191	197	208	220	226	231	243	255	260	266	278	289
5.6	**134**	**145**	**151**	**156**	**167**	**179**	**184**	**190**	**201**	**212**	**218**	**223**	**234**	**246**	**251**	**257**	**268**	**279**
5.8	129	140	145	151	162	172	178	183	194	205	210	216	226	237	242	248	259	169
6.0	**125**	**135**	**141**	**146**	**156**	**167**	**172**	**177**	**187**	**198**	**203**	**208**	**219**	**229**	**234**	**240**	**250**	**260**
6.2	121	131	136	141	151	161	166	171	181	192	197	202	212	222	227	232	242	252
6.4	**117**	**127**	**132**	**137**	**146**	**156**	**161**	**166**	**176**	**186**	**190**	**195**	**205**	**215**	**220**	**225**	**234**	**244**
6.6	114	123	128	133	142	152	156	161	170	180	185	189	199	208	213	218	227	237
6.8	**110**	**119**	**124**	**129**	**138**	**147**	**152**	**156**	**165**	**175**	**179**	**184**	**193**	**202**	**207**	**211**	**221**	**230**
7.0	107	116	121	125	134	143	147	152	161	170	174	179	187	196	201	205	214	223
Between row spacing (cm's)	13.3	12.3	11.9	11.4	10.7	10.0	9.7	9.4	8.9	8.4	8.2	8.2	7.6	7.3	7.1	7.0	6.7	6.4

Source: Pannevis Seeds