University of Reading
Department of
Agricultural Economics & Management

THE ROLE OF PLASTIC STRUCTURES IN HORTICULTURE

J. Rendell
R.L. Vaughan

Agricultural Enterprise Studies in England & Wales
Economic Report No 94

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FOREWORD

AGRICULTURAL ENTERPRISE STUDIES IN ENGLAND AND WALES

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

The departments in different regions of the country conduct joint studies of those enterprises in which they have a particular interest. This community of interest is recognised by issuing enterprise studies reports prepared and published by individual departments in a common series entitled "Agricultural Enterprise Studies in England and Wales".

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

PREFACE AND ACKNOWLEDGEMENTS

Previous reports in this series have dealt with individual horticultural crops. This report, however, breaks new ground in that it is concerned with the economics of crop production as a whole under walk-in plastic-covered tunnels and multispans.

Despite the multiplicity of crops grown and the relatively small areas involved, which in England and Wales together total little more than 300 hectares, a survey was considered justified because of the very rapid expansion of this type of production during a time when the horticultural sector as a whole has been under severe financial pressure.

The survey was designed to answer a number of general questions about the industry, the answers to which could not be obtained from official statistics. Census records show the areas of plastic, both heated and cold, on the holdings, but for individual protected crops no distinction is made between those grown under plastic and those under glass. This survey has also sought to establish the type or types of holding using plastic, why plastic was chosen in the first place, what it is used for, and when it was purchased and at what cost.

In addition published gross margin data on many of the crops commonly grown under plastic were lacking as indeed were data on the overall annual margins attained from the various possible combinations of crops. This survey has gone some way towards filling this gap.

This study was financed by the Ministry of Agriculture, Fisheries and Food and the fieldwork was carried out by the Universities of Cambridge, Exeter, London (Wye College), Manchester and Reading, the coordinating centre. This Department wishes to thank all cooperating growers who provided the basic information without which this report would not have been possible and colleagues at the aforementioned Universities who were responsible for collecting the data.

SUMMARY

1. The area of plastic tunnels and multispans in England and Wales increased from 99 hectares in 1973 to 315 hectares in 1983.

2. In any one year a significant proportion of this area is either not covered with plastic or if covered is not used for crop production.

3. The majority of growers chose plastic because the initial cost was less than for glass.

4. By far the greatest use of plastic cover is for tunnels with multispans accounting for only 18% of the total area.

5. The average cost of a tunnel is about £350 per 100 sq.m and replacement polythene is £53 (renewable every two and one half years).

6. Plastic cover is important for the production of hardy nursery stock but is also widely used for a range of vegetable crops and for strawberries.

7. The average annual output of crops grown under plastic in 1983 was £420 per 100 sq.m and the gross margin £288.

8. It is considered that crops produced under plastic are unlikely to be any more profitable than similar crops grown under glass.

9. Of the individual crops grown cucumbers and tomatoes yielded the highest gross margins at £294 and £292 per 100 sq.m respectively.

SECTION I

THE USE OF PLASTIC IN THE HORTICULTURAL INDUSTRY

(i) AREA OF PLASTIC AND GLASS IN ENGLAND AND WALES

Plastic is used in horticulture for many purposes some of which, such as mulching with black polythene, are becoming of considerable importance. This report, however, is restricted to the use of polythene for protecting growing plants, and more particularly with its use in walk-in tunnels and multispans. Low polythene tunnels as a substitute for glass cloches are not included in this report nor are they recorded in the glasshouse census of the Ministry of Agriculture, Fisheries and Food.

The typical walk-in tunnel is some 4.5 metres wide by 20 metres long and consists of a framework of metal hoops covered with a sheet of polythene drawn tautly over the framework and secured at the edges by burial in the ground.

Nationally, the area of walk-in tunnels and multispans covered by plastic or glass substitutes in England and Wales increased from 99 hectares in 1973 to no less than 315 hectares in 1983 (see Table 1), and this at a time when the area of glass increased scarcely at all. Of this total of 315 hectares little more than one-fifth had heating equipment, whereas three-quarters of all glasshouses were so equipped. It should be pointed out that possessing heating equipment does not necessarily mean that it is used.

Table 1. Area of plastic and of glass in England and Wales

YEAR	PLASTIC		GLASS		TOTAL	
	HEATED	UNHEATED	HEATED	UNHEATED	PLASTIC	ALL
	Ha.	Ha.	Ha.	Ha.	Ha.	Ha.
1973	23.22	75.40	1313.97	449.36	98.62	1861.95
1974	30.39	81.41	1326.93	438.54	111.80	1877.27
1975	37.12	107.34	1347.71	431.87	144.46	1924.04
1976	37.59	139.21	1408.58	433.66	176.80	2019.04
1977	48.32	175.36	1437.42	457.35	223.68	2118.45
1978	45.43	192.26	1403.21	455.78	237.69	2096.63
1979	52.50	208.31	1428.89	441.33	260.81	2131.03
1980	53.42	214.37	1436.39	441.22	267.79	2145.40
1981	58.41	227.37	1437.71	439.61	285.78	2163.10
1982	57.20	238.46	1413.53	441.06	295.66	2150.25
1983	64.32	250.71	1403.70	443.58	315.03	2162.28

Source: MAFF

(ii) GEOGRAPHICAL DISTRIBUTION

Plastic-covered tunnels and multispans are widely distributed throughout the country, but of the 3461 holdings recorded in the June 1981 glasshouse census as having this form of protection 48% were in the ten counties listed in Table 2, and these same counties accounted for 54% of the total area.

Table 2. Principal Counties with plastic cover in 1981

COUNTY	NUMBER OF HOLDINGS	AREA OF PLASTIC (Ha)
Hereford & Worcester	205	26.88
Hampshire & I.O.W.	174	22.86
Kent	216	20.12
West Sussex	141	18.93
Lincolnshire	226	11.39
Lancashire	145	11.35
Essex	150	10.94
Cambridgeshire	105	10.81
Norfolk	138	10.67
Cornwall	146	10.14

Source: MAFF

These ten counties include most of the important areas of the glasshouse industry such as West Sussex, Lancashire and Essex, and also counties such as Kent, Cornwall and the Fenland Counties of Lincolnshire, Cambridgeshire and Norfolk where the use of plastic is associated with the production of strawberries, hardy nursery stock and so on. Indeed of the 3461 holdings with walk-in plastic cover 838 (24%) were to be found on holdings with no glass.

SECTION II

CHARACTERISTICS OF THE SAMPLE

(i) RECRUITMENT

The sample was recruited from a randomly drawn list of all growers recording an area of plastic at the June 1981 glasshouse census, and co-operation of these growers was sought early in 1983. In all, 306 growers were approached in order to meet the target of 140 co-operators. Although at 46% this is an acceptable response rate, actual refusals comprised a mere 14%; the difference was accounted for by the inability of many growers to co-operate for a variety of reasons.

If all such reasons are included this represents no less than 40% of the total number and suggests that a significant proportion (up to 25%) of the 315 hectares of walk-in plastic recorded at the June 1983 census was not used for commercial crop production. Indeed, analysis of the use of plastic by those growers in the sample strengthens this view, as will be clear later.

The reasons for non-cooperation are in themselves of some interest as they indicate a high degree of instability within this sector of horticulture.

Table 3. Reasons for inability to cooperate

	No.
No tunnels left	37
Tunnels not covered during year	22
Unable to trace grower	16
"Other" reasons	47
	122

"Other" reasons include unsuitability, imminent retirement, use of the tunnels for purposes other than crop production, and production being non-commercial.

(ii) REASONS FOR CHOOSING PLASTIC

During the period 1972-1983 the horticultural industry witnessed a quiet revolution in the use of plastic walk-in tunnels and multispans in England and Wales.

The total area of this form of protection has more than trebled in the past decade and by 1983 plastic structures accounted for 15% of the total protected area in England and Wales. As has already been said, the growing importance of the use of these structures has taken place at a time of economic pressure on the industry. In order to be able to explain this trend, a short questionnaire was prepared listing probable reasons for choosing plastic and the 135 growers in the sample were asked to judge the importance to them of each of the five reasons set out below.

1) Because the initial cost for an equivalent area is less than for glass.
2) To grow low value protected crops.
3) Primarily to raise plants for use elsewhere on the holding.
4) To extend the season of crops already grown.
5) To produce crops that are unprofitable to grow in any other way.

Table 4. Reasons for choosing plastic

	QUESTION NUMBER				
RESPONSE	1	2	3	4	5
	Number of replies				
Very Important	107	25	18	25	24
Important	20	24	23	32	42
Not Important	8	86	94	78	69
Average Score	1.27	2.45	2.56	2.39	2.33

All of the 135 growers responded to the questionnaire and for every question there were three possible replies. In order to calculate the average score each reply was valued on a scale of 1 to 3, with "Very Important" scoring 1, "Important" 2 and "Not Important" 3. The lower the average score for each of the five reasons, therefore, the greater the importance of that reason.

That plastic cost less than an equivalent area of glass (Q1) was considered by almost 80% of the respondents to be a very important reason for choosing plastic. On the whole it was not felt that its use for growing low value protected crops (Q2) was important. In fact, over 60% clearly stated that it was unimportant. Less than a third of growers interviewed attributed any importance to plastic for raising plants for use elsewhere on the holding (Q3). With regard to extending the season of crops already grown (Q4), a majority had no strong feelings on this matter. Finally, opinion was evenly divided on the merits of producing crops in plastic structures that would otherwise be unprofitable to grow (Q5).

In addition, a number of interviewees advanced other reasons they considered had been very important when they made their decision to purchase tunnels or multispans. A summary of these reasons is given below.

Table 5. Other Reasons Classed As Very Important

Reasons Advanced	Number of replies
Protection from the weather (man & plants)	12
Ideal environment for hardy nursery stock	8
Extends the range of crops already grown	7
Can be erected on slopes	5
Simple to erect	5
Mobility	4
Cheap to maintain	3
Avoids planning problems	3

(iii) DISTRIBUTION OF THE SAMPLE

Answers to general questions about the holding were obtained from 135 growers, referred to subsequently as the sample. Results of an analysis of the distribution of the sample compared with England and Wales data in terms of location and area of plastic are set out in Table 6.

Table 6. Distribution by number of holdings and area of plastic

PROVINCE	NO. OF HOLDINGS		TOTAL AREA OF PLASTIC		AVERAGE AREA PER HOLDING	
	Sample	E & W	Sample	E & W	Sample	E & W
	%	%	%	%	sq.m	sq.m
Cambridge	24	22	19	21	663	835
Exeter	14	15	17	10	974	589
Manchester	14	14	10	12	584	741
Reading	27	29	33	35	995	1056
Wye	21	20	21	22	839	992
Overall	100	100	100	100	830	880

It is clear that although regionally the spread of holdings in the sample was satisfactory, which is to be expected as the sample was drawn from the national data on the basis of holding numbers in each Province, by total area the correlation was not so close. This is mainly because the average area of the sample holdings in the Exeter Province was above the national average for that region, whereas all other Provinces were below. However, overall the sample average of 830 sq. metres of walk-in protection per holding was not greatly different from the England and Wales average of 880 sq. metres. Indeed, if England and Wales as a whole is considered rather than only those counties included in the survey, then the average per holding drops to 826 sq. metres, which is virtually identical to the sample. Overall the sample was drawn from 80% of the total population and 84% of the total area of plastic.

(iv) HOLDING CLASSIFICATION

From information supplied about output it was possible to classify the holdings. The types identified were primarily "horticultural" or "non-horticultural"; the latter having less than 50% of total output derived from horticultural crops. Within the "horticultural" group hardy nursery stock holdings were separately distinguished and the remainder subdivided on the basis of holding area and the absence or otherwise of outdoor cropping. Details of numbers and of total area of walk-in plastic for each type of holding are given in the table below.

Table 7. Distribution of sample by holding type

HOLDING TYPE	NUMBER OF HOLDINGS	AREA OF PLASTIC	
		HEATED (Ha.)	UNHEATED (Ha.)
Horticultural:			
5Ha. or over	26	0.10	1.85
Under 5Ha. (glass or plastic only)	15	0.25	2.07
Under 5Ha. (other)	54	0.41	3.13
Hardy Nursery Stock	29	0.22	2.48
Non-horticultural	11	0.04	0.56
Total	135	1.02	10.09

The total area of plastic on the sample holdings totalled 11.11 hectares, of which 10.09 hectares were unheated and 1.02 hectares heated. The proportion of heated plastic in the sample is very much less than one would expect from the nationally published figures.

Table 8. Average holding area by type

HOLDING TYPE	PLASTIC		GLASS		OUTDOOR CROPS	TOTAL UTILISED AREA
	HEATED	UNHEATED	HEATED	UNHEATED		
	Average area per holding (ha)					
Horticultural:						
5Ha. or over	-	0.08	0.04	0.05	12.22	14.28
Under 5Ha. (glass or plastic only)	0.02	0.13	0.19	0.04	-	0.38
Under 5Ha.(other)	0.01	0.06	0.06	0:03	1.24	1.69
H.N.S.	0.01	0.07	0.07	0.02	4.27	5.29
Non-horticultural#	0.01	0.05	0.01	0.01	36.34	68.56

Excludes three small-scale holdings

For all types other than the "non-horticultural" the average area of plastic on the holding was less than the area of glass, and on average the total size of holdings was very small, being less than 15 hectares even for the "5 hectare or over" group. On the "Hardy Nursery Stock" holdings the area of hardy nursery stock averaged no less than 4.19 hectares out of a total of 4.27 hectares of outdoor crops; that is to say such holdings were highly specialised and used their walk-in plastic tunnels in a somewhat different way to other growers. Indeed, some of the tunnels were covered with plastic netting rather than polythene and a number were used for retail display purposes rather than for the actual production of crops. Only 16 of the 135 sample holdings had any livestock and seven of these were in the "non-horticultural" group.

(v) FINANCIAL RESULTS BY TYPE OF HOLDING

Table 9. Financial results by type of holding

TYPE	AVERAGE TOTAL OUTPUT £1000	TOTAL OUTPUT PER HECTARE £1000	TOTAL LABOUR COST AS % OF TOTAL OUTPUT
Horticultural:			
5Ha. or over	45	3.8	44
Under 5Ha. (glass or plastic only)	20	58.9	77
Under 5Ha. (other)	20	22.1	69
Hardy Nursery Stock	106	70.1	39
Non-horticultural#	89	1.3	28

Excludes three small-scale holdings

"Hardy Nursery Stock" holdings had on average not only the largest turnover but also the highest per hectare output. Non-horticultural holdings also had a high total output but this was associated with the lowest intensity of production which averaged only £1300 per hectare. Labour cost per £100 gross output in general rose with increasing intensity of production but the average for "Hardy Nursery Stock" holdings was very favourable in this respect; that is to say labour cost was less than one would expect for their intensity of production. This might be due to scale and/or to relatively better prices for their produce compared with the other types of holding.

(vi) AGE DISTRIBUTION OF PLASTIC ON THE HOLDING

All growers in the sample were asked to give details of the area of cover on their holding by year of erection or purchase. Data were collected for 85% of the total area of plastic in the survey. An analysis of the information obtained clearly shows the mid to late seventies to have been a boom period. In more recent years there has been a marked decline in the area of plastic tunnels and multispans purchased or erected annually by growers. An often repeated comment concerns low profitability and high capital cost. This cost price squeeze has forced some growers to rent out their plastic structures for a variety of non-horticultural purposes. This trend has featured strongly on the urban fringe of large towns and cities. During more profitable times a single crop could generate an output equivalent to the capital cost of the investment. However, this no longer remains the case and the consequences are clearly illustrated by the reduction in the areas of plastic structures erected in the early eighties.

Table 10. Area of Cover by Year of Erection or Purchase

Year of Erection or Purchase	Area in Sq.metres
1966	903
1968	1486
1969	263
1970	3566
1971	2915
1972	2339
1973	7614
1974	4785
1975	7765
1976	10121
1977	7842
1978	10902
1979	10904
1980	8633
1981	7498
1982	6721
1983	3006
No information	16582
TOTAL	113845

(vii) AREA OF COVER BY TYPE OF STRUCTURE

On examining the area of cover in relation to the type of structure it was found that tunnels accounted for over 80% of the total area. However, the average area for individual multispans at 819 sq.metres was greater than the 128 sq.metres average for tunnels.

Table 11. Area of Cover by Type of Structure

	No.	Area in Sq.metres	Average area in Sq.metres
Tunnels	732	93365	128
Multispans	25	20480	819
Total	757	113845	-

(viii) CAPITAL INVESTMENT

Data were collected on the investment in tunnels and multispans and the average cost was expressed per 100 sq.m. The data were not totally satisfactory as records for multispans were few and far between. However, the information obtained for tunnels proved to be far more reliable.

Table 12. Investment in Tunnels and Multispans

Year of Purchase	Tunnels		Multispans	
	No. of Records	Average Cost in £/100 Sq.m.	No. of Records	Average Cost in £/100 Sq.m.
1968	3	113	-	-
1969	2	121	-	-
1970	7	118	-	-
1971	7	102	-	-
1972	12	174	1	228
1973	17	144	1	334
1974	15	148	1	148
1975	26	179	2	108
1976	26	170	2	568
1977	26	202	2	255
1978	35	264	4	444
1979	34	292	1	358
1980	29	333	1	739
1981	17	325	1	327
1982	20	338	1	650
1983	9	377	1	615

It was found that in general a multispan structure cost more than an equivalent area of tunnel. This conclusion is based on a small sample but Ministry standards for 1981 bear this out.

Growers estimated that their tunnels would last at least seventeen years on average, but there is little to support this conclusion as even the oldest tunnels have not reached that age. On the other hand it is known that the framework can be so badly damaged by wind or snow that the tunnels have to be scrapped. The cost of tunnels more than trebled over the 15-year period 1968-1983. Nevertheless, plastic structures remain a viable economic proposition when compared with glass, even allowing for a shorter life-span and the need to replace the polythene frequently, because the initial capital cost of glass is approximately four times that of plastic.

Individually costs of replacement polythene were very variable due to the use of different gauges, the year when last renewed (1980 onwards) and the quantities purchased. However, analysis of the data showed that the average cost was £53.42 per 100 sq.m. and that the polythene has to be renewed every two and one half years or so; that is to say the cost is some £21 per 100 sq.m. per year.

Other equipment purchased for use under plastic included heaters (usually mobile paraffin burners), electrically-driven ventilating fans and irrigation lines. Twenty-nine growers provided data on heaters covering 53 tunnels or multispans at an average cost of £300 each, and 8 growers provided data on ventilation covering 25 tunnels at an average cost of £164 per tunnel.

(ix) THE USE OF TUNNELS AND MULTISPANS

Details of the use, if any, to which the tunnels and multispans were put, were collected for most of the sample holdings. The areas shown in Table 13 are annual areas for the given types of cropping and not the sum of the individual crops which might have been grown. If crops of more than one type were produced in any given structure during the year then they have been included under "mixture of types".

Table 13. Details of cropping (in sq.metres) 1983

TYPE OF CROP GROWN	TUNNELS	MULTISPANS
Hardy Nursery Stock, Bedding and Pot Plants	28207	2167
Vegetables	26915	5713
Strawberries	12355	-
Cut Flowers	7153	2495
Vegetable Plants	1442	-
Vines	1014	-
Mixture of types	7234	1489
Storage and/or Retail	923	-
Not used during year	3255	8100
Details not available	4867	516
TOTAL	93365	20480

Of the 8.9 hectares of tunnels and 2.0 hectares of multispans for which in 1983 cropping details were supplied no less than 10% of the area was not cropped during the year and a further 1% was used for storage and/or retail purposes. The use of plastic was particularly favoured for hardy nursery stock and bedding plants, for a variety of vegetables and for strawberries. Exclusive use for vegetable plant production was uncommon, although of course plant-raising is also included in the "mixture of types".

SECTION III

CROP COSTINGS

(i) ANNUAL RETURNS

One objective of this enquiry was to determine, if possible, the relative merits of different cropping programmes. However, with a very large number of actual crop combinations and an even larger number of theoretical possibilities it has proved very difficult to sort out profitable combinations. Also with relatively small sample numbers and only a single year's results available any conclusions reached should be treated with caution.

Table 14. Annual returns per 100 sq.m. in 1983

	All	Monocropping	Successional Cropping
Average Output (£)	420	314	482
Average Gross Margin (£)	288	214	331
Number of Records	128	47	81

As one might expect monocropping returned on average a lower output and gross margin than successional cropping and was less commonly practised. However, there were a surprising number of monocrops and growers often left their plastic structures lying idle for long periods of the year. Gross margins for different monocrops and for successional cropping systems are given in the next two tables, and these margins, which vary greatly in value, represent the annual contribution that these protected crops made towards the fixed costs of the business.

Table 15. Annual average gross margins from monocropping

Crop	Number of Records	Average Gross Margin (£) (per 100 sq.m.)
Chrysanthemums	7	333
Grapes	3	297
Cucumbers	4	242
Strawberries	16	216
Other Ornamentals	4	210
Tomatoes	5	180
"Summer" Vegetables	7	81

Annual gross margins for monocrops ranged from £333 per 100 sq.m. for chrysanthemums to only £81 for summer vegetables. The latter, comprising such crops as aubergines, courgettes and peppers, involved use of the plastic at very much below capacity; in all such cases it would have been possible to have grown a spring crop such as lettuce or radish before planting the summer crop. Nearly one quarter of all tomato and cucumber crops were monocropped and nearly half the chrysanthemums. Strawberries were mainly monocrops with only one quarter being grubbed after cropping and replaced with a short-term crop.

Multiple cropping proved very difficult to categorise. Certainly lettuce was the crop most widely grown in rotations. Indeed there were 6 records of successional cropping of lettuce alone with from 3 to 5 crops of lettuce in the year. The average annual gross margin for this type of cropping was £509 per 100 sq.m. with an average per crop of £204 per 100 sq.m.

Table 16. Average annual gross margins from multiple cropping

Crop Rotation	Number of Records	Average Gross Margin (£) (per 100 sq.m.)
Successional Lettuce (3 to 5 crops)	6	509
Lettuce-Summer Crop-Lettuce	4	458
Lettuce and Summer Crop	25	273

Lettuce followed by a summer vegetable crop such as peppers or courgettes followed by a further lettuce crop averaged somewhat less, while lettuce followed solely by a summer vegetable crop, the most common rotation of all, was lower again at only £273 per 100 sq. metres.

(ii) COSTINGS OF INDIVIDUAL CROPS

It should be borne in mind that individual crop returns do not necessarily reflect annual production margins, as such crops frequently form only part of the cropping programme.

Gross margins were calculated for 24 different crops that were encountered in the survey. In all a total of 261 returns were received but in the end only 180 were used to produce averages for 11 distinct crops. The remaining records consisted of only a small number of returns for each crop and hence were not considered viable for further investigation.

Gross margins were not obtained from hardy nursery stock producers as it was considered that their systems were too complex to be costed. In such systems plants are moved in and out of the tunnels at different stages of their growth and in small numbers, and setting a value on these plants both on entry to and on removal from the tunnels would have been extremely difficult and would have produced no very meaningful measure of output.

Table 17. Output, Costs and Gross Margins (per 100 sq.m.)

Crop	No. of Records	Yield	Output £	Variable Costs £	Gross Margin £
Chrysanthemums (aut. & winter)	16	-	369.7	105.0	264.7
Cucumbers	18	170 Doz.	382.0	87.6	294.4
Courgettes/Marrows	13	-	153.1	19.2	133.9
Lettuce-spring	46	113 Doz.	157.1	48.4	108.7
Lettuce-summer	9	103 Doz.	130.5	41.1	89.4
Lettuce-autumn & winter	15	120 Doz.	162.6	55.8	106.8
Peppers	11	361 Kgs.	183.7	67.9	115.8
Radish	9	96 Dz.B.	115.0	16.7	98.3
Strawberries-annual	11	109 Kgs.	257.4	78.1	179.3
Strawberries-two years or over	10	125 Kgs.	266.5	52.9	213.6
Tomatoes	22	674 Kgs.	220.5	65.9	154.6

The figures in Table 17 do not correspond with those presented in Table 15 as they are averages of all available records and include both monocrops and successional crops.

In costing the different crops certain conventions were adopted. Plants raised on the holding were included at an estimated cost of purchase. Also, for crops such as strawberries that lasted more than one crop year the cost of plants was apportioned over their expected life-span. Expenditure on items such as soil sterilants, herbicides and compost which would benefit succeeding crops was allocated to the costed crop on a proportional basis.

In Table 18 the crops are ranked in order of value of output per 100 sq.m. and the gross margins are expressed as a percentage of output.

Table 18. Output and Percentage Gross Margins (per 100 sq.m.)

Crop	Per 100 Square Metres	
	Output (£)	Gross Margin (% of output)
Cucumbers	382.0	77
Chrysanthemums	369.7	72
Strawberries-two years and over	266.5	80
Strawberries-annual	257.4	70
Tomatoes	220.5	70
Peppers	183.7	63
Lettuce-autumn & winter	162.6	66
Lettuce-spring	157.1	69
Courgettes	153.1	87
Lettuce-summer	130.5	68
Radish	115.0	85

The five leading crops in order of output remained the same when ranked in order of gross margin. Other crop gross margins, particularly that for peppers, did not agree so closely. Courgettes and radish were lowly placed in the output table but because of the low level of their variable costs, their gross margins at 87% and 85% respectively of output were among the highest.

Table 19. Variable Costs of Production (per 100 sq.m.)

Crop	Packing Materials	Plants	Ferts.	Crop Prot.	Heating Fuel	Other	Total
	£	£	£	£	£	£	£
Cucumbers	14.0	34.8	15.1	2.4	0.1	21.2	87.6
Chrysanthemums	16.7	58.4	4.0	5.6	-	20.3	105.0
Strawberries	11.2	10.5	4.5	5.9	14.2	6.6	52.9
Strawberries-annual	18.7	35.7	7.2	6.8	-	9.7	78.1
Tomatoes	9.0	36.2	6.2	3.5	-	11.0	65.9
Peppers	10.5	43.5	6.5	1.3	0.1	6.0	67.9
Lettuce-aut. & w.	21.9	20.7	2.4	0.8	2.5	7.5	55.8
Lettuce-spring	17.1	19.5	5.3	2.0	0.1	4.4	48.4
Courgettes	1.3	5.7	5.2	2.3	1.3	3.4	19.2
Lettuce-summer	15.3	17.5	1.7	0.9	-	5.7	41.1
Radish	4.5	7.5	1.2	-	-	3.5	16.7

The cost of plants was the main item of variable cost for most crops, the only exceptions being strawberries and autumn/winter lettuce. Packing materials were the next most expensive item with a range of from 7% to 39% of total variable costs. With the exception of cucumbers fertilisers and sprays were not significant items and heating fuel was only of importance for strawberries.

CONCLUSION

Although this investigation inquired into the use and cost of plastic walk-in structures and tunnels and the gross margins of the crops most frequently grown, no attempt was made to record the fixed costs of the businesses taking part, as in most cases the crops grown under plastic formed only a small part of the business as a whole. Indeed, if the average area of plastic for each type of holding, as shown in Table 8 but excluding hardy nursery stock, is multiplied by the average output per 100 sq.m. of £420 (Table 14) and expressed as a percentage of the average total output for that type, as set out in Table 9, it can be estimated that only for those holdings "under 5 ha. with glass or plastic only" was the proportion of total output from plastic of any significance (31.5%); next most important was "under 5 ha. with outdoor crops" at 12.2%.

For the average holding of "under 5 ha. with glass or plastic only" the total gross margin of the crops grown under plastic less depreciation of the structure and the annual share of the cost of renewing the plastic cover is £3400. However, calculations using the most recent FMS results for specialist glasshouse holdings to obtain details of fixed costs suggest that with an output from plastic of £6300 (average area of plastic times average output per unit area), labour would be some £3000 and "other fixed costs" £800, i.e. a total of £3800, so there is unlikely to be much, if any, profit for the average grower in producing crops in this way.

The last statement, however, should be read as a comment on the overall profitability of glasshouse growers operating on this scale, whatever the composition of their cropping, hardy nursery stock excepted. It was not a comment on the use of plastic structures as such, which for any individual grower could produce even more disappointing results. The gross margins in this report demonstrate that such methods of growing have a place. But the final result for any horticultural business depends on the many factors which affect the ultimate difference between the gross margins obtained from all of the crops grown (plastic-covered or otherwise) and all of the fixed costs incurred doing so.

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