FINAL REPORT YEAR 1 1994

Project No:	**FV/168**
Project Title:	**ANNUAL WEED CONTROL IN COURGETTES**
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Location of Project:	**A L Tozer, Pyports, Downside Bridge Road, Cobham, Surrey.**
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ADAS

HORTICULTURE DEVELOPMENT COUNCIL

COURGETTE WEED CONTROL

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AUTHENTICATION

The work summarised in this report was done under my supervision according to the procedures described, and is a true and accurate account of it.

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ADAS

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HORTICULTURE DEVELOPMENT COUNCIL

COURGETTE WEED CONTROL

1.0 APPLICATION

The purpose of this two year experiment was to test a number of potentially useful herbicides for both crop safety and weed control, and to compare these with untreated controls and with plastic mulch treatments, on a transplanted crop of courgettes.

Several of the herbicides tested in the first year were found to be sufficiently safe to warrant further testing, though others were too damaging to take forward. The successful treatments were investigated in the second year of the trial, with some ammendments to the rates of application or timing of sprays.

No herbicides are available for courgettes at present and none of those tested are approved for the crop or commercially usable. The trial was carried out under an Automatic Experimental Permit issued by the Pesticides Safety Directorate. At present therefore growers are unable to test for themselves on a commercially grown crop any of these treatments. It is possible that after further trials the best of the tested treatments may be the subject of an Off-label Approval application.

2.0 SUMMARY

2.1 Objectives

Courgettes and marrows have long presented problems of weed control. Chemical manufacturers have always considered the crop too small in area to spend money on development of herbicides. The recent loss of the one commercial product with recommendation for courgettes and marrows results in a complete lack of any herbicide for this crop.

Soil sterilisation and plastic mulching are alternatives but are more costly than most herbicide treatments used in horticulture. Herbicides are therefore a requirement for growing the crop in a cost-effective manner and without herbicides a reduction in crop area is a distinct possibility.

Doubts about the environmental safety of methyl bromide and high costs of sterilization generally, increase the need for herbicide treatments that can be used safely in this crop if production is not to reduce considerably.

The current arrangements for extension of uses of agrochemicals, the Off-Label Approval Regulations may allow approval of the best of the treatments tested in this trial. Harmonisation of approval regulations across the EC may also ease the situation in future years and allow the use of herbicides in the UK which are already approved for use by other EC Member States

2.2 Results

2.2.1 Crop Safety and Vigour.

Each treatment was scored for crop safety and vigour on a scale of 0-9, 9 being the equivalent of success, (no crop damage), 0 being the equivalent of failure, (crop loss).

In the first year treatments of Pyramin DF, Butisan S, Treflan and simazine were all consistently of lower crop vigour than the mean, with Pyramin being the most damaging and statistically significant, particularly on the three later dates. Some recovery took place on the treatments where damage was less severe but on the worst plots it carried over to the end of the trial.

The treatments which gave the highest vigour scores with least damage were Dacthal W75, Comodor 600, Flexidor 125, Ashlade Linuron FL, Kerb 50W and the treatment of black plastic mulch which gave the highest vigour score of all treatments.

TABLE 1 CROP VIGOUR YEAR ONE: 1994

Treatment	Date			
	22 June	29 June	6 July	13 July
Untreated	7.00	8.33	8.00	8.33
Dacthal W75	7.33	7.66	7.33	8.00
Pyramin DF *	4.66	2.33	1.66	1.66
Ramrod Flowable	7.33	5.00	5.66	6.66
Comodor 600	7.00	6.33	7.33	7.33
Flexidor 125	7.00	6.66	6.33	7.33
Linuron	7.66	7.33	6.66	7.00
Butisan S	5.00	3.66	4.00	5.00
Treflan	6.33	5.00	4.66	6.00
Simazine	6.00	3.66	3.33	5.00
Kerb 50W	7.66	7.66	7.66	7.66
Black plastic mulch	8.66	8.66	8.66	8.66
Control (hand-weeded)	8.33	8.66	8.00	8.66
Mean	6.92	6.23	6.10	6.71

In the second year of the trial the best treatments from the first year were tested again using rates as in the previous year and also at higher rates to test the treatments to the maximum. None of the treatments were totally damaging this year and there were few significant differences between treatments. Black plastic mulch was again the best treatment for crop vigour and was the one treatment which gave significantly better growth than most others, particularly towards the end of the trial period. The paper mulch which was tested for the first time this year was too fragile and tore at the edges thus giving variable results. Where it was not torn, however, crop vigour was high, though not as high as the black plastic mulch.

The safest chemical treatments in this year were Flexidor 125 and Linuron Flowable with Kerb 50W being only slightly less safe as was the lower rate of Dacthal W75. The higher rate of Dacthal W75 was too high and crop safety was compromised.

TABLE II. CROP VIGOUR YEAR TWO:-1995

Treatment	Date			
	13 June	21 June	27 June	4 July
Control (hand-weeded)	7.33	7.33	6.00	5.00
Dacthal W75 6kg/ha	5.67	4.67	4.67	4.00
Dacthal W75 9kg/ha	6.00	3.00	2.67	3.00
Kerb 50W 1kg/ha	6.67	6.67	6.00	4.67
Kerb 50W 1.5kg/ha	6.00	5.67	5.33	4.67
Flexidor 125 1.0 l/ha	6.67	7.33	6.33	6.33
Flexidor 125 2.0 l/ha	6.00	5.67	6.00	6.00
Comodor 600 3.5 l/ha	5.67	4.00	4.33	4.33
Comodor 600 3.5 l/ha pre-planting	5.67	5.33	4.67	4.00
Linuron Flowable 1.0 l/ha pre-planting	7.00	6.00	6.00	6.33
Linuron Flowable 2.o l/ha pre-planting	5.00	4.67	4.67	5.00
Treflan 1.7 l/ha pp incorporated	7.33	7.00	6.00	5.00
black plastic mulch	9.00	9.00	8.67	9.00
St Regis paper mulch	7.67	8.00	6.00	6.67
Mean	6.55	6.02	5.52	5.29

2.2.2 Weed Control

In the first year, at the first assessment a weed count was carried out on the whole plot area. For the second assessment a score of 0-9 was used, weed counts being impractical, with 0 being equivalent to weed freedom, 9 being being equivalent to full weed cover.

The trial was generally less weedy than expected as a result of the extreme dry weather, which reduced weed germination considerably. Nevertheless, there were consistent differences between treatments. The weed scores may be partly a product of the variation of vigour of the courgette plants and the effect of this on shading out weed germination and growth. This possibility is borne out by the results of Pyramin DF treatments, No 3, where fair weed control at the first assessment soon reduced and by the second assessment this was the weediest treatment. It also gave the lowest crop vigour and thus the competitive effect of the crop on weeds was much reduced.

TABLE III WEED SCORES / NUMBERS: 1994

Treatment	Weed Nos/plot	Weed Score
	6 June	13 July
Untreated	80.7	3.0
Dacthal W75	10.7	1.3
Pyramin DF	34.0	4.3
Ramrod Flowable	16.7	2.0
Comodor 600	39.3	1.7
Flexidor 125	7.7	2.0
Linuron	11.7	1.7
Butisan S	5.7	1.7
Treflan	12.3	2.0
Simazine	22.7	3.0
Kerb 50W	42.0	2.0
Black plastic mulch	0	0
Control (hand-weeded)	116.3	5.3
Mean	30.7	2.3

NB Note that the first assessment was weed count, the second, weed score so the two figures are not directly comparable, though they are related to each other.

In the second year weed scores were made on the same four dates as crop vigour on the same 0-9 scale as in the first year. The trial site was very much weedier than in the first year as a result of the greater rainfall at the beginning of the trial, though it again became very dry soon after planting.

As anticipated the two mulch treatments gave the best weed control with the black plastic mulch totally eradicating weed growth. Where the paper mulch had not torn this was also extremely effective but generally it was too fragile to be a practical proposition. The chemical treatments which gave the best weed control were Flexidor 125 and Linuron Flowable, both safe to the crop, with Dacthal W75 and Kerb 50W being less effective though still safe.

TABLE IV WEED SCORES 1995

Treatment	Date			
	13 June	21 June	27 June	4 July
Control (hand-weeded)	2.33	4.33	3.67	5.00
Dacthal W75 6kg/ha	2.00	4.33	3.00	3.33
Dacthal W75 9kg/ha	2.67	3.33	3.33	3.33
Kerb 50W 1kg/ha	2.33	4.33	3.67	3.33
Kerb 50W 1.5kg/ha	2.67	4.00	3.33	4.00
Flexidor 125 1.0 l/ha	1.00	0.67	1.00	1.33
Flexidor 125 2.0 l/ha	1.00	0.67	1.00	1.00
Comodor 600 3.5 l/ha	1.67	3.00	2.67	3.33
Comodor 600 3.5 l/ha pre-planting	2.00	3.33	2.33	3.33
Linuron Flowable 1.0 l/ha pre-planting	1.00	0.67	1.00	1.00
Linuron Flowable 2.o l/ha pre-planting	1.00	0	0.67	0.33
Treflan 1.7 l/ha pp incorporated	1.67	2.67	2.00	2.33
black plastic mulch	0	0	0	0
St Regis paper mulch	0	0	0	0
Mean	1.52	2.24	1.98	2.26

2.2.3 Yield

In the first year, flower numbers per plot were counted on 6 July, and yield as number of fruits, adjusted for fruit size, was taken on July 13. On all other assessment dates, (between 12 July and 25 July) the results relate to numbers of fruits from the first replicate only (ie not statistically valid nor analysed). Nevertheless the figures do give valid data in relation to the treatments, and were consistent from date to date. The yield data also follows closely that of crop vigour, with the most vigorous plots giving both the earliest and also highest yield.

TABLE V FLOWER No./CROP YIELD 1994

Treatment	FlowerNos per plot	Yield	Yield of Rep I
	6 July	13 July	12-25 July
Untreated	9.3	17.3	72
Dacthal W75	7.3	22.7	70
Pyramin DF	0	2.7	39
Ramrod Flowable	5.7	16.7	62
Comodor 600	6.3	19.0	72
Flexidor 125	5.7	18.0	77
Linuron	4.0	18.3	53
Butisan S	1.0	11.0	64
Treflan	3.3	23.3	58
Simazine	2.3	10.7	41
Kerb 50W	8.7	25.0	74
Black plastic mulch	14.0	20.0	87
Control (hand-weeded)	9.7	19.7	77
Mean	6.07	17.3	65.1

Flower numbers on July 6 are significantly lower from Pyramin DF than many other treatments and plastic mulching significantly higher than most others. All other differences are not significant.

Pyramin DF gave the lowest yield of fruit, significantly so by July 13 than all others except Butisan S and Simazine, though it was not possible to analyse the unreplicated data from the assessments of Rep 1 shown in the right hand column of the table above.

In the second year flower numbers were again recorded on 4 July 1995. Subsequently yield data was taken from Rep I only and could not be statistically analysed. The black plastic mulch again gave very good results, as did the St Regis paper mulch where it had not torn. The best chemical treatments were the higher rate of Kerb 50W, both Flexidor 125 rates and the lower rate of Dacthal W75. The higher rate of Dacthal W75 reduced yield. Marginal treatments were both Linuron Flowable rates, Comodor 600, and Treflan.

TABLE V FLOWER No./CROP YIELD 1995

Treatment	FlowerNos per plot	Yield of Rep I
	4 July	14 - 25 July
Control (hand-weeded)	17.3	67
Dacthal W75 6kg/ha	14.0	114
Dacthal W75 9kg/ha	4.7	83
Kerb 50W 1kg/ha	18.3	73
Kerb 50W 1.5kg/ha	14.7	143
Flexidor 125 1.0 l/ha	18.0	101
Flexidor 125 2.0 l/ha	16.3	124
Comodor 600 3.5 l/ha	4.3	102
Comodor 600 3.5 l/ha pre-planting	12.3	68
Linuron Flowable 1.0 l/ha pre-planting	20.3	93
Linuron Flowable 2.o l/ha pre-planting	19.3	71
Treflan 1.7 l/ha pp incorporated	18.0	82
black plastic mulch	21.7	115
St Regis paper mulch	16.7	63
Mean	15.42	92.79

3.0 ACTION POINTS FOR GROWERS

This trial has demonstrated the potential of a number of herbicide treatments for courgettes, which given approval, could be of use to commercial growers. Black plastic mulching has again proved itself to be a very effective treatment, not only for achieving weed control, but also for forwarding the growth and increasing the yield. This is certainly a factor which cannot be ignored in the crop, where earliness and early yield is needed for best returns, but early crops are most at risk from cold winds and cold soil conditions.

Before growers can attempt any of the chemical treatments tested here, approval must be sought from MAFF. This is most likely to be in the form of a specific off-label approval, and is likely to require residue data before it is granted. This is therefore not likely to be possible for at least two further seasons, but should certainly be borne in mind when considering the results of this trial.

4.0 BENEFITS

The availability of chemical weed control treatments will increase the flexibility of strategies for growers of courgettes, who at present must depend totally on either soil sterilisation or plastic mulching. Both treatments can undoubtedly be very successful, but are also considerably more costly than most herbicide treatments, and certainly more so than the treatments tested in this trial.

5.0 FURTHER ACTION SUGGESTED

The best treatments from this trial should be considered for applications for Off-label Approval and further trials of these treatments in greater detail should be continued to ensure results are repeatable.

HORTICULTURE DEVELOPMENT COUNCIL

HERBICIDES FOR ANNUAL WEED CONTROL IN COURGETTES AND MARROWS

6.0 Introduction

6.1 Courgettes and marrows have long presented a problem of weed control using herbicides. Chemical manufacturers have always considered the crop too small in area to warrant any time and money being spent on it, as evidenced by the lack of herbicides with recommendations. Enide (diphenamid) was the one commercial product with recommendation for courgettes and marrows, but the recent loss of this herbicide results in a complete lack of any product for this crop.

6.2 Soil sterilisation, plastic mulching, hand weeding and/or stale seed-beds are the only alternatives but are either much more costly or less effective than most herbicide treatments used in horticultural crops. The availability of herbicides is a requirement for growing the crop in a cost-effective manner. Without herbicides a reduction in crop area is a distinct possibility, with an increase in imported produce taking up the shortfall.

6.3 With no alternative herbicides available to the industry, soil sterilisation will become the only chemical means of achieving weed control. There are doubts regarding the long term future of methyl-bromide as a result of concerns about its environmental effects. The cost of this treatment is also extremely high and it can be applied only by licensed contractors, thereby reducing the flexibility possible for many growers. Basamid (dazomet), a granular soil sterilant, can also be used prior to drilling or planting the crop, but must be used well in advance to give time for the active gases to disperse from the soil. Cost of this treatment, as recommended, is also considerably higher than herbicides, though there may be potential for reducing rates and thereby costs.

6.4 Safe and cost-effective herbicide treatments will undoubtedly be less costly than soil sterilisation, and may allow the crop to be produced on a larger scale than is presently the case. Large areas of these crops are unlikely to be grown if very expensive treatments are required in order to control weeds. As a consequence, it is possible that these crops may be produced only on a very small scale where either hand weeding is feasible or the cost of sterilisation is acceptable.

6.5 Whilst it is unlikely that chemical manufacturers will be prepared to add courgettes or marrows to their product labels in the UK, the potential for off-label approvals is great. The harmonisation of approvals across the EC Member States may also improve the situation in legal terms, as products are placed on the Annex I list, and thereby become available in the UK if approved on these crops in other EC Member States.

6.6 Little work has been carried out on these crops in the past in the UK, and apart from this trial, none is underway at present. A trial carried out at Efford in 1987 showed the crop to be sensitive to the herbicides tested at that time, but the range of chemicals investigated was limited. Soil sterilisation was effective, but more work looking at reduced rates of products was deemed to be worthwhile.

6.7 This two year trial was to investigate the safety and cost-effectiveness of a range of treatments, including herbicides and plastic and paper mulches on courgettes and marrows.

7.0 MATERIALS AND METHODS

7.1 Design

Randomised block, three replicates.
Plots one bed width; one row of plants in the middle of each bed.
Plant spacing: 1.33m x 0.46m
Plot size: 1.33m x 7.5m ($10m^2$)

7.2 Records taken.

Crop safety score 0-9 scale
Weed count per plot.
Weed control score 0-9 scale
Estimate of yield by flower or fruit number.

7.3 Site

Messrs A L Tozer Ltd, Pyports, Downside Bridge Road, Cobham, Surrey, KT11 3EH.

7.4 Statistical analysis

An analysis of variance was carried out on the data obtained using the PC based "Minitab" computer programme.

7.5 Treatments: Year 1 1994

In the first year the following herbicides considered potentially safe to the crop following a literature search were included in the trial and compared with untreated and hand weeded controls.

TREATMENT	RATE/Ha PRODUCT	TIMING
1 Untreated		
2 Dacthal W75	6.0 kg	post-planting
3 Pyramin DF	2.5 kg	post-planting
4 Ramrod Flowable	9.0 litre	post-planting
5 Comodor 600	3.5 litre	post-planting
6 Flexidor 125	1.0 litre	post-planting
7 Ashlade Linuron FL	1.0 litre	pre-planting
8 Butisan S	1.5 litre	post-planting
9 Treflan	1.7 litre	incorporated
10 Simazine	1.0 kg	post-planting
11 Kerb 50W	1.0 kg	post-planting
12 Black plastic mulch		pre-planting
13 Control (hand-weeded)		

All treatments were applied just prior to or just following planting of courgette transplants. The plants were raised in peat compost in module trays of 104 cells and planted at the 2-3 leaf stage. All treatments were applied using a precision knapsack sprayer in water volumes equivalent to 600 l/ha.

7.6 Crop Diary: Year 1

19 May 1994	Crop sown in modules (104 trays). Cultivar Patriot
13 June 1994	Crop planted by hand.
13 June 1994	All treatments except Comodor 600 applied in very hot, dry, sunny conditions. Hand watered to aid establishment.
16 June 1994	Comodor 600 treatment applied. Weather hot, dry and sunny.
22 June 1994	Vigour assessment
29 June 1994	Vigour assessment
6 July 1994	Vigour, weed and flower number assessment
12 July 1994	First replicate yield assessment by Tozer staff members.
13 July 1994	Vigour, weed and yield assessment.
16-25 July 1994	Yield assessment of Rep I by Tozer staff members.

8.0 RESULTS YEAR 1 1994

8.1 Crop Safety

Each treatment was scored for crop safety on four separate occasions using a 0-9 score with 0 being equivalent to complete crop loss and 9 being equivalent to no crop damage.

FIGURE I: Crop vigour 22 June 1994

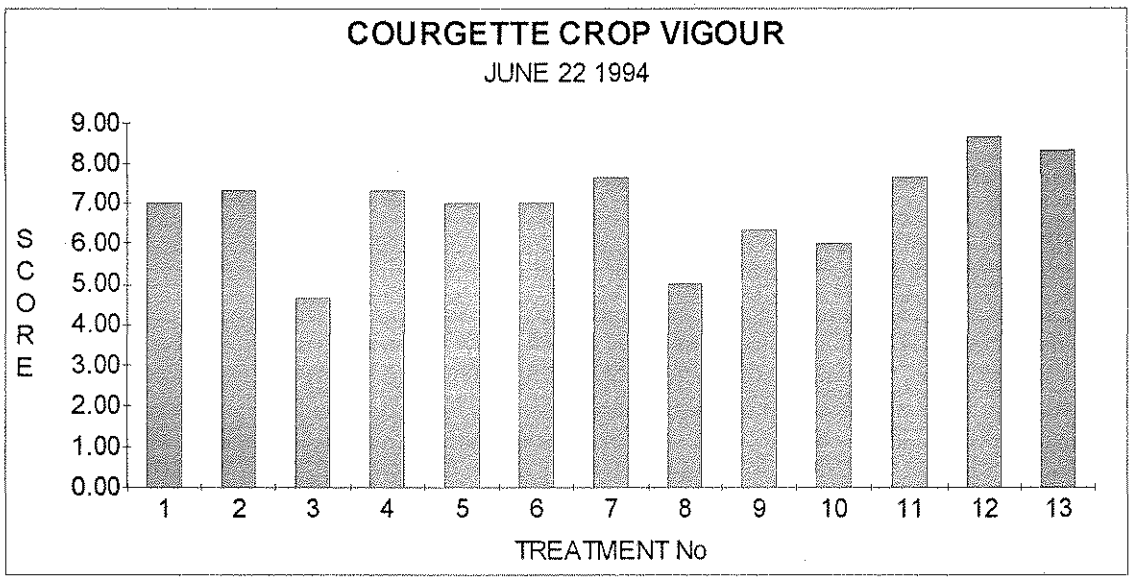


FIGURE II: Crop vigour 29 June 1994

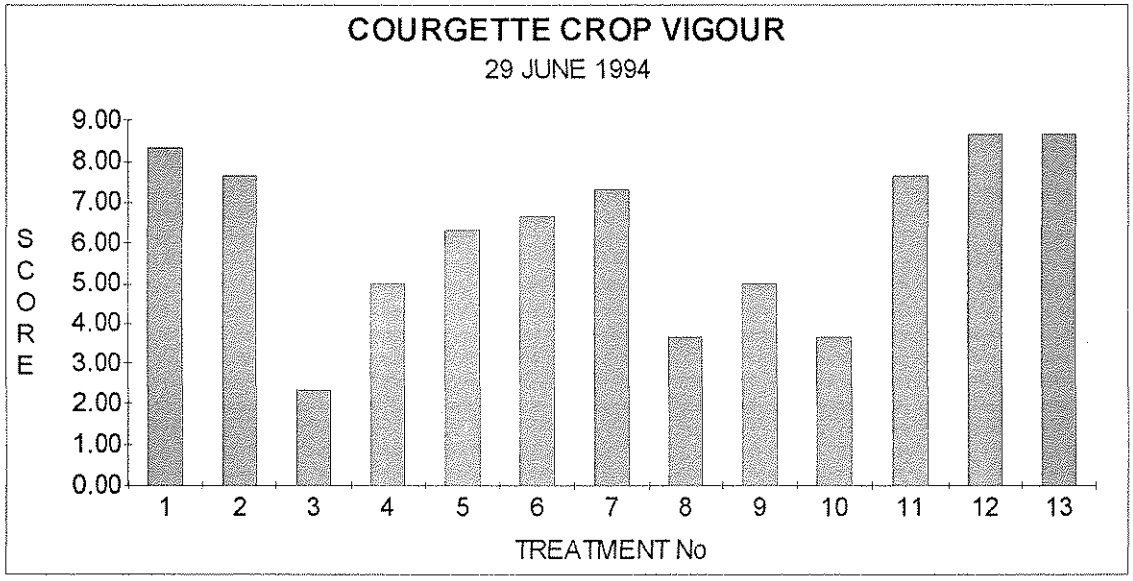


FIGURE III: Crop vigour 6 July 1994

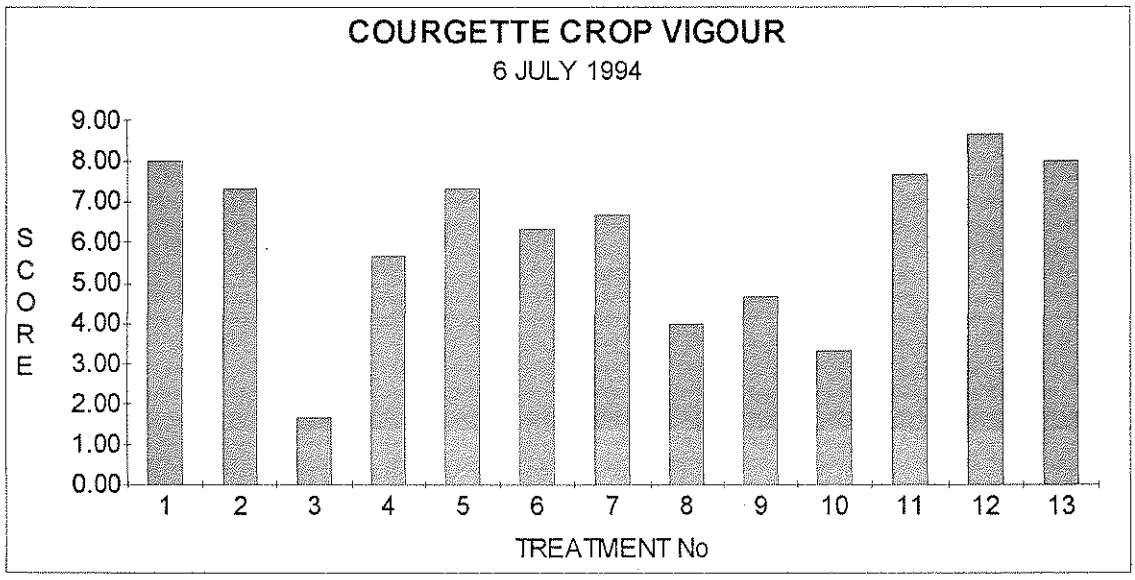
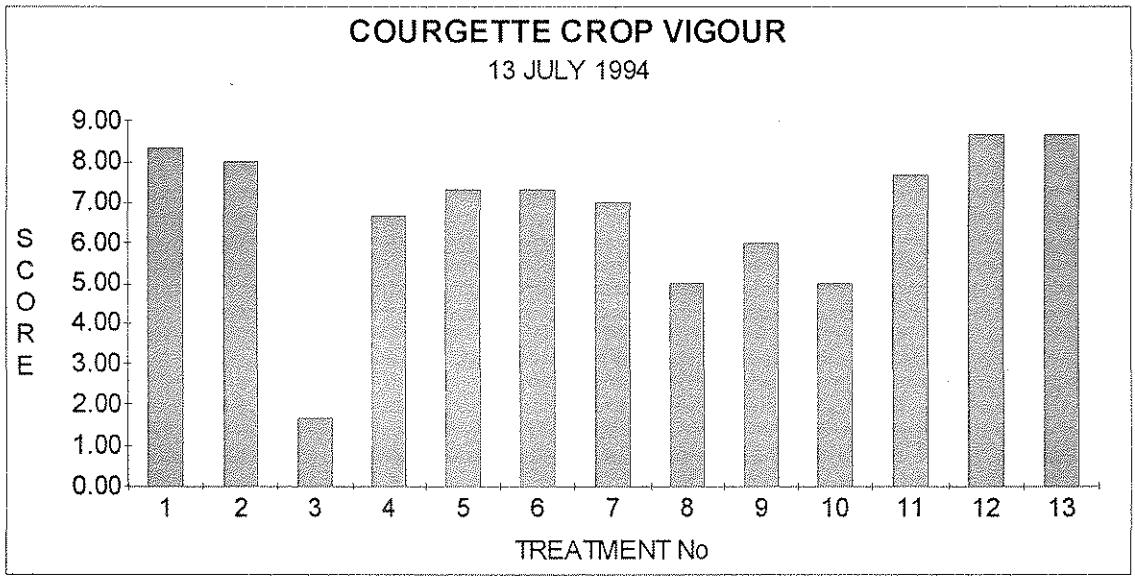


FIGURE IV: Crop vigour 13 July 1994



Most differences seen were not of significance except for Treatment No 3 (Pyramin DF) which was very damaging and reduced growth by approximately 50-75% compared with the means. Ramrod Flowable, Butisan S, Treflan and Simazine were all slightly damaging but these reductions were not significant. With the exception of Pyramin the damage seen was vigour reduction only. There were, however, considerable plant losses on the plots treated with Pyramin. There was a considerable amount of recovery of all treatments except Pyramin DF by the time of the final assessment on 13 July 1994

8.2 Weed Control

Each treatment was scored on two occasions, the first being a count of weeds present, the second a score of 0-9, 0 equivalent to no weeds present, 9 equivalent to complete weed cover.

The best treatment, which completely stopped weed growth, was the black plastic mulch. Weed growth on the plots was generally light with germination of weeds being reduced by the very dry conditions that followed planting and treatment. There were, however, patterns which emerged with all the treatments being an improvement over the control plots.

Courgettes are a competetive crop with large leaves which shade out weed growth to a large extent. This is borne out by the score for weed control on the Pyramin DF treatment where crop growth was reduced and weed growth was therefore not suppressed by the crop. By the second assessment date the only herbicide treatment that was of significance was the Pyramin DF which was giving very poor weed control.

FIGURE V: Weed counts per plot 6 July 1994

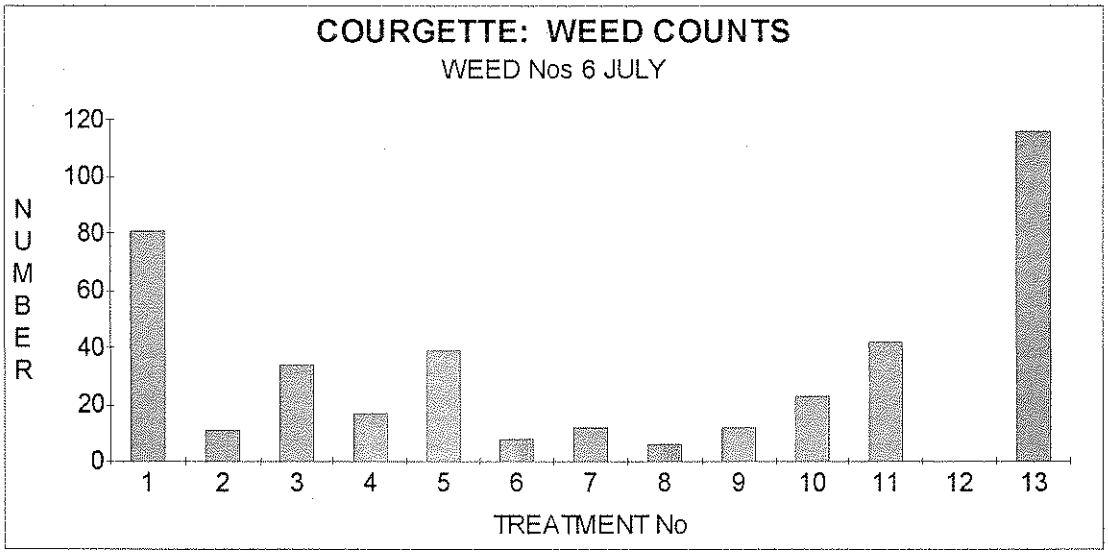
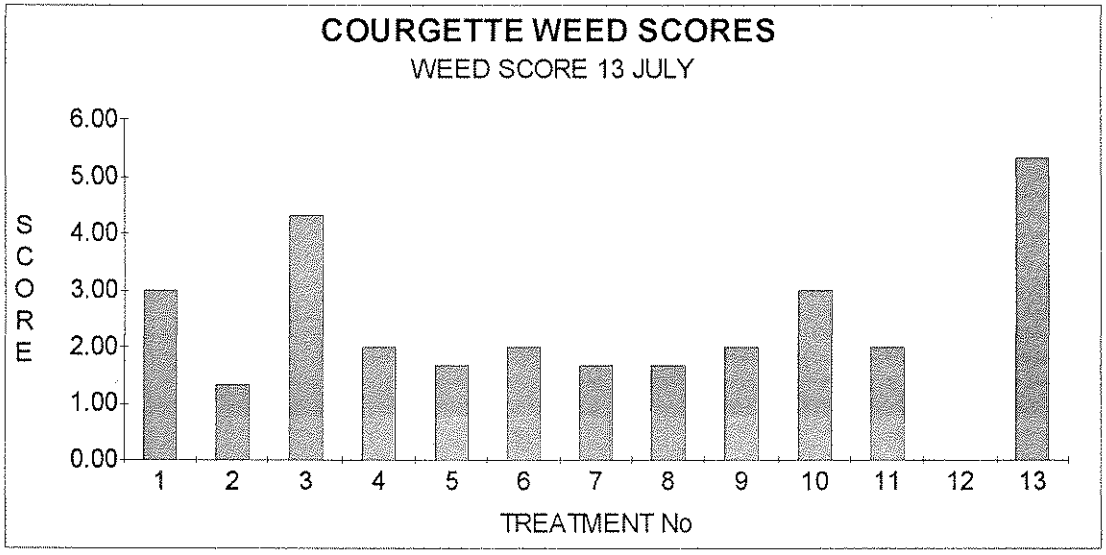


FIGURE VI Weed scores 13 July 1994



8.3 Yield Assessment

Yield assessments were made twice on all plots, with flower numbers being taken as a measure of the yield potential at the first date. At the second date a count of fruit numbers was made and a score of 1, 2 or 3 attributed to small, medium and large fruits respectively.

Pyramin DF was again a consistently poor performer with no open flowers counted on the first assessment and a very low yield score on the second assessment. Yield scores on the second date with the exception of Pyramin DF, Butisan S and Simazine were all remarkably similar with no significant differences seen.

Yield data was also taken on a regular basis between 12 July and 25 July from Replicate 1 only. As a result no statistical analysis is possible on this data, though it is still valid and gives very useful information on the trends seen.

FIGURE VII: Courgette yield (flower number) 6 July 1994

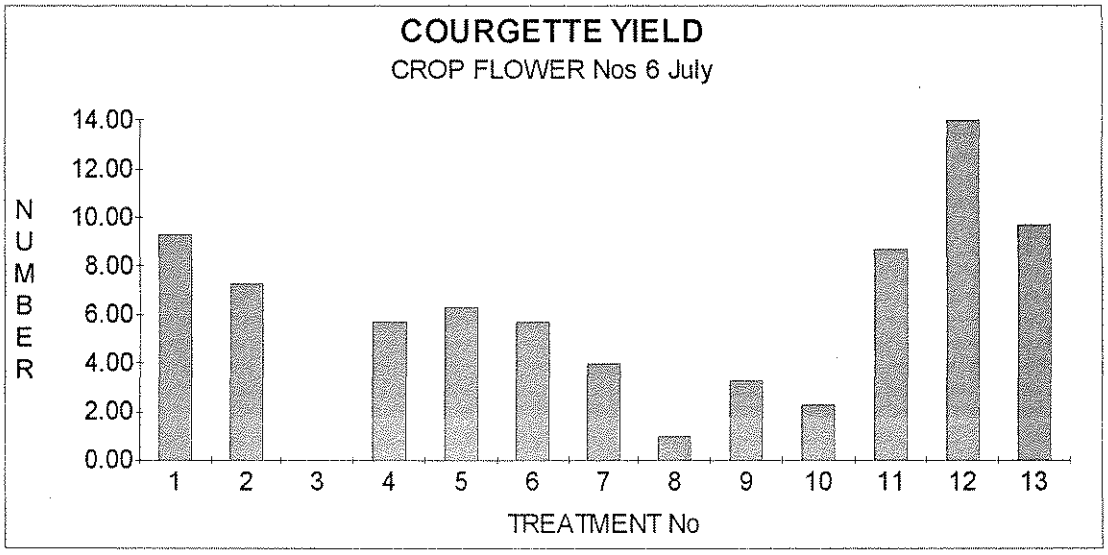


FIGURE VIII: Courgette yield 13 July 1994

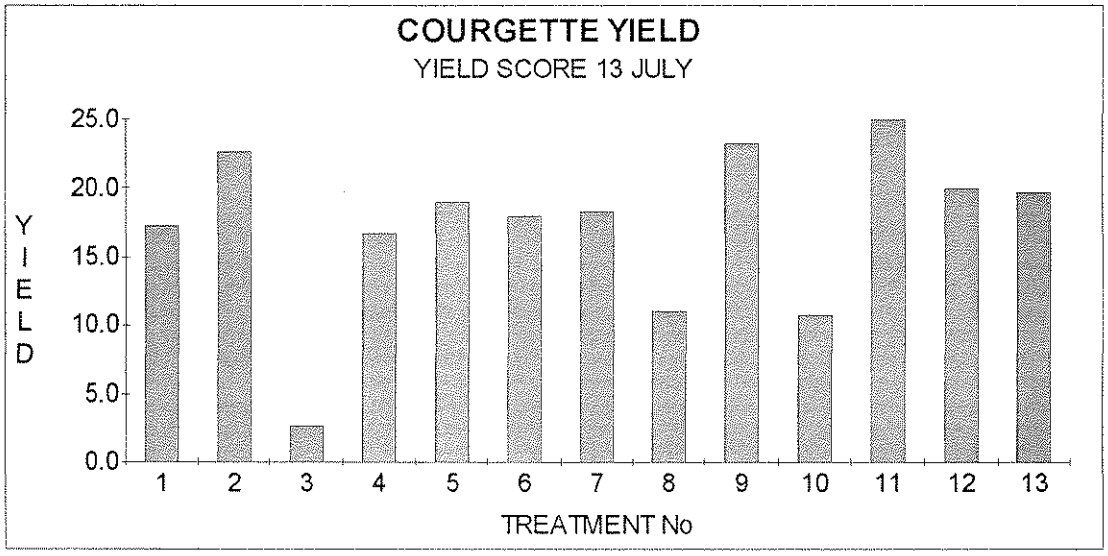
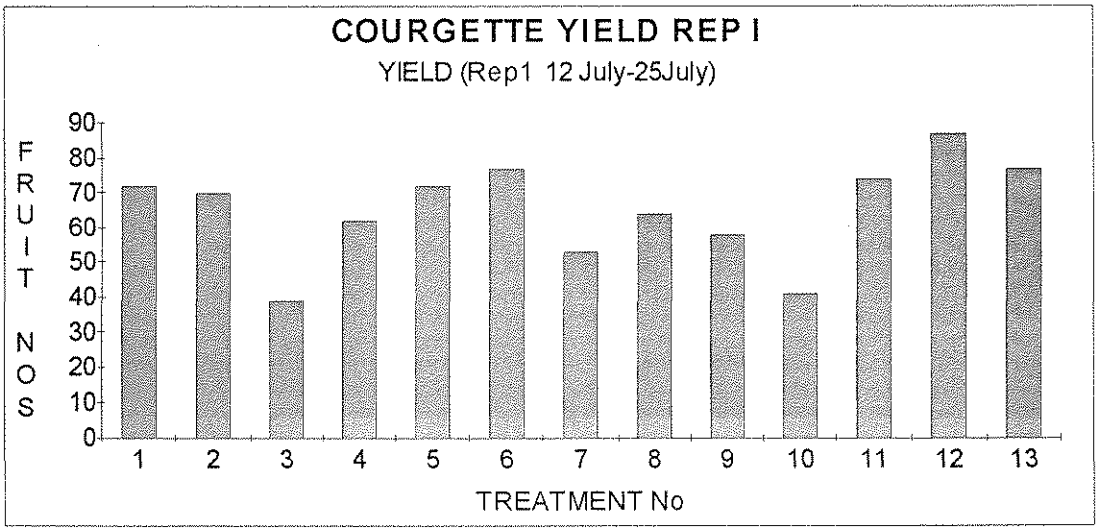


FIGURE IX: Courgette yield (Rep I only) 12 July - 25 July 1994



9.0 DISCUSSION

9.1 Crop Safety

The herbicide treatments which appear most promising and are worth further investigation are Dacthal W75, Comodor 600, Flexidor 125, Ashlade Linuron FL, and Kerb 50W. Some other herbicides, (Ramrod Flowable, Butisan S, Treflan and Simazine), were marginal in terms of safety but could also be worth further testing, as safety may have been compromised by the weather conditions this year. Black plastic mulch was totally safe as expected and gave both excelent weed control and the highest yield

9.2 Weed Control

Weed germination and growth were lower than anticipated as a result of the very hot, dry and sunny conditions after planting and treatment. When the weather became wetter later in the life of the trial, the crop had generally grown to the point where weed growth was suppressed. However where crop growth was reduced by the herbicide treatment, as in the case of Pyramin DF, weed scores were higher than average.

Different results may have been obtained in a wetter year, with greater differences occuring between treatments. However weed control is often thought to be necessary in this crop only until the crop itself suppresses weeds. The greater weed scores on the control treatments suggests that there was a beneficial effect from the herbicides tested in spite of the very dry weather.

9.3 Yield

Estimates of yield from this trial were possible only from counts made of flower numbers and fruit numbers. Weight records were not taken. Data from Rep I which was not possible to analyse for statistical purposes was also available thanks to staff of A L Tozer Ltd. All the yield data shows the success of black plastic mulch which gave the highest yield, but also shows the promise of several other herbicide treatments including Dacthal W75, Comodor 600, Flexidor 125, and Kerb 50W.

10.0 RESULTS YEAR 2 1995

10.1 Treatments: Year 2 1995

In the second year the range of treatments was ammended to take account of the results from the first year and was as follows:-

TREATMENT	RATE/Ha PRODUCT	TIMING
1 Hand weeded control		
2 Dacthal W75	6 kg	post planting
3 Dacthal W75	9 kg	post planting
4 Kerb 50W	1 kg	post planting
5 Kerb 50W	2 kg	post planting
6 Flexidor 125	1 litre	post planting
7 Flexidor 125	2 litre	post planting
8 Comodor 600	3.5 litre	post planting
9 Comodor 600	3.5 litre	pre planting
10 Linuron Flowable	1 litre	pre planting
11 Linuron Flowable	2 litre	pre planting
12 Treflan	1.7 litre	pp incorporated
13 Black plastic mulch		
14 St Regis paper mulch		

All treatments were applied just prior to or just following planting of courgette transplants. The plants were raised in peat compost in module trays of 104 cells and planted at the 2-3 leaf stage. All treatments were applied using a precision knapsack sprayer in water volumes equivalent to 600 l/ha.

11.0 RESULTS YEAR 2 1995

11.1 Crop safety

None of the treatments in the second year was as devastating to the crop as was Pyramin DF in the first year but differences were seen which were consistent across the replicates, if not statistically significant. The treatments which showed the highest vigour were the black plastic mulch and the St Regis paper mulch where the latter had not torn. Of the chemicals, the lower rate of Dacthal W75, both Kerb 50W rates, both Flexidor 125 rates and the lower rate of Linuron Flowable were acceptable.

The treatments which proved less acceptable for vigour reduction were the higher rate of Dacthal W75 and both pre and post-planting Comodor 600 applications.

FIGURE X Crop vigour 13 June 1995

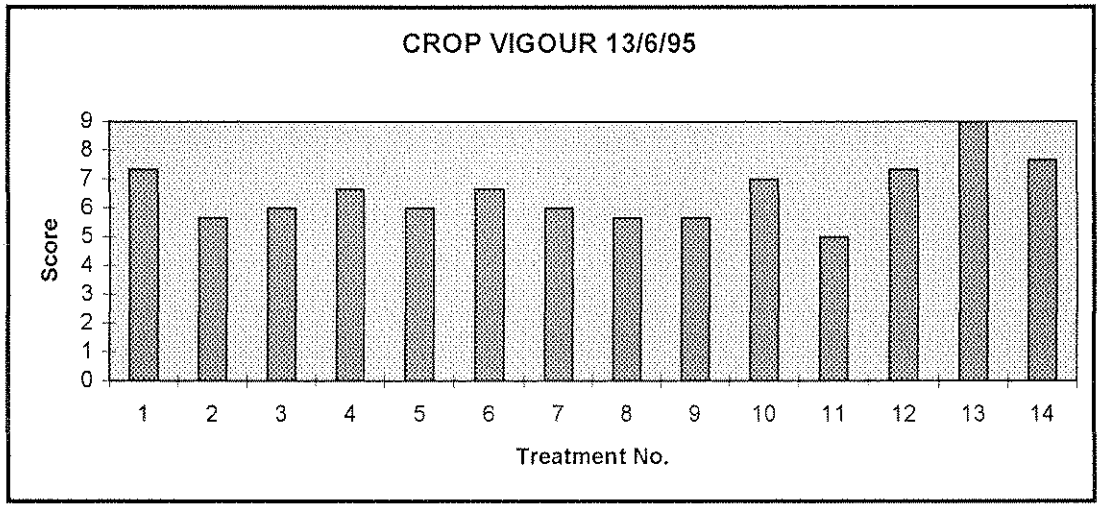


FIGURE XI Crop vigour 21 June 1995

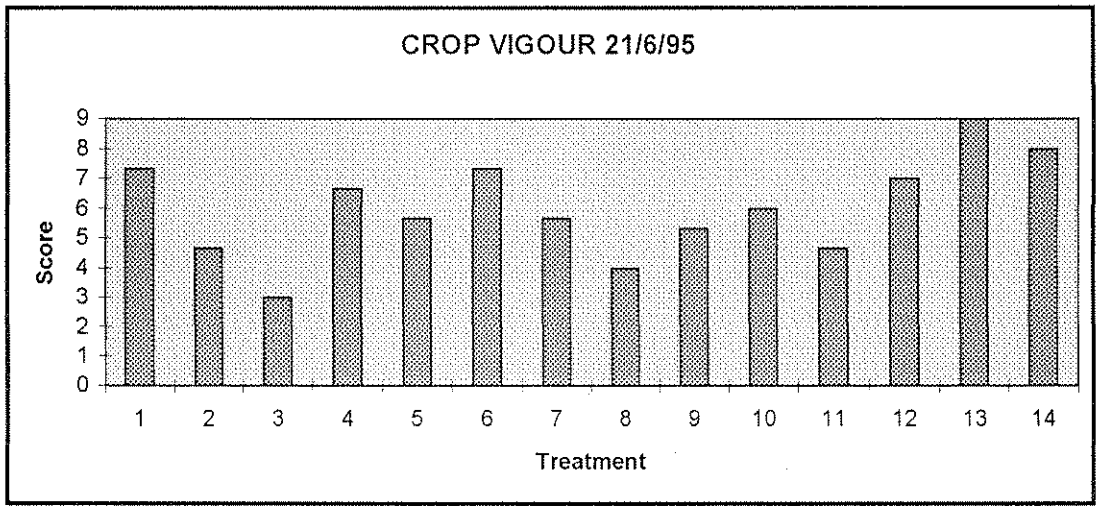


FIGURE XII crop vigour 27 June 1995

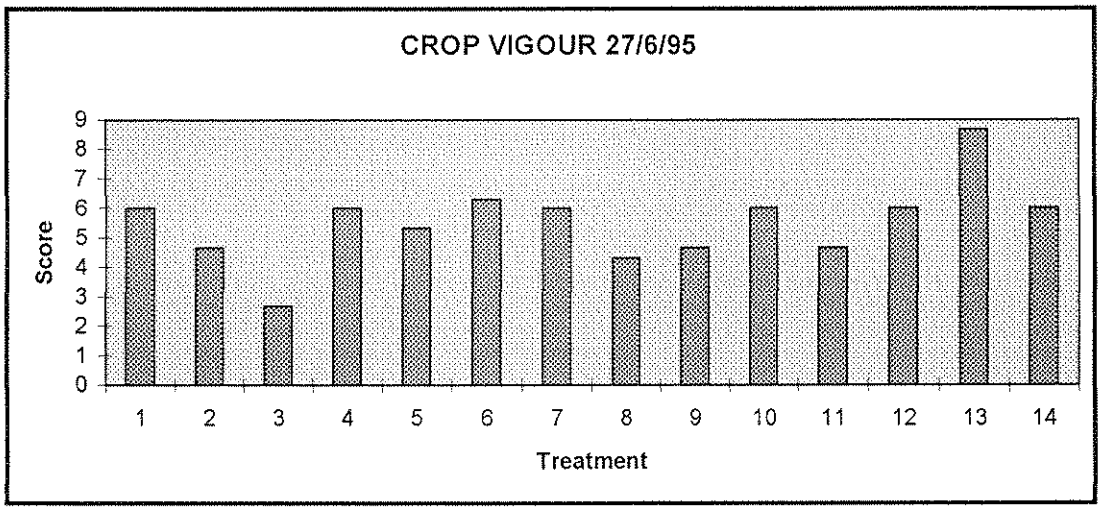
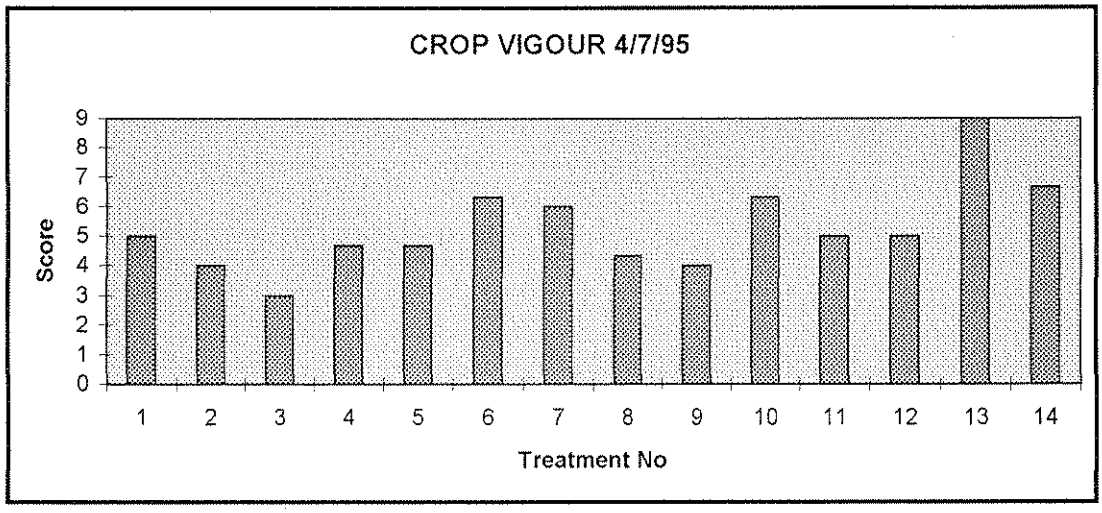


FIGURE XIII Crop vigour 4 July 1995



11.2 Weed control

The treatments which gave the most effective weed control were the black plastic mulch and the St Regis paper mulch where it remained intact. Both of these completely eradicated weed growth by stopping germination. The chemical treatments which gave best control were the two Flexidor 125 rates and the two Linuron Flowable rates. By the final assessment these four treatments were significantly better than all other treatments except the mulches. The Dacthal W75, Kerb 50W, Comodor 600 and Treflan treatments did not achieve adequate weed control.

FIGURE XIV **Weed score 13 June 1995**

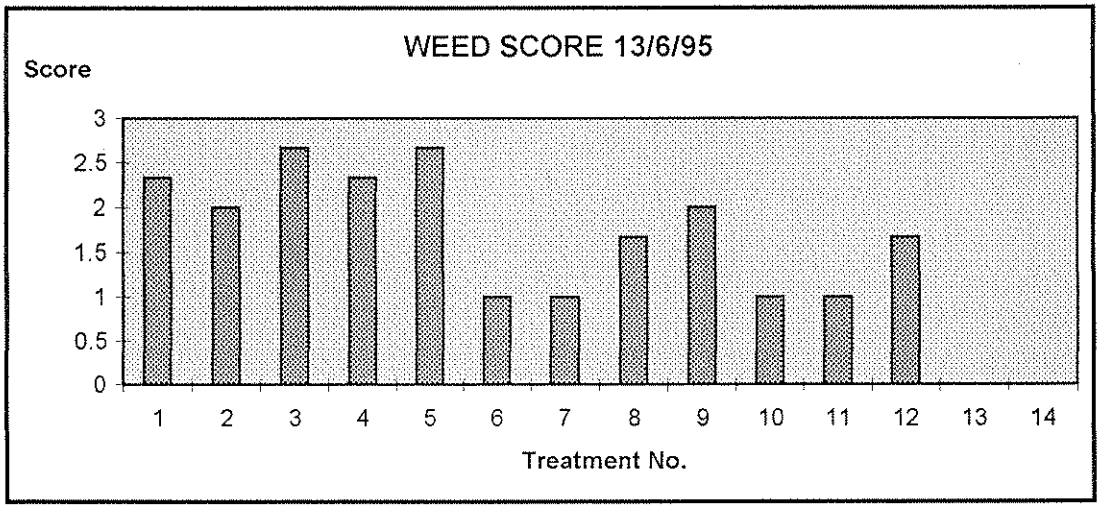


FIGURE XV **Weed score 21 June 1995**

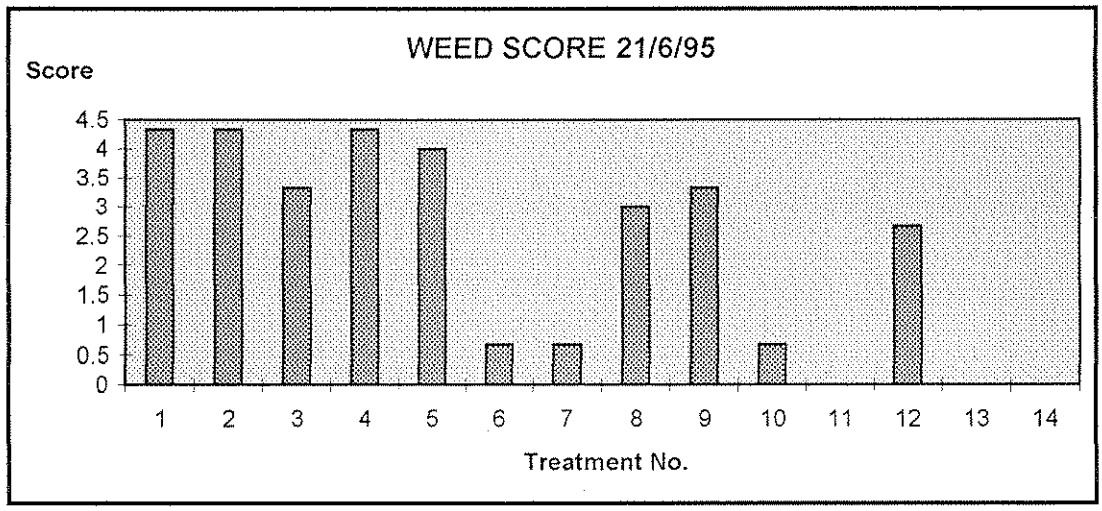


FIGURE XVI **Weed score 27 June 1995**

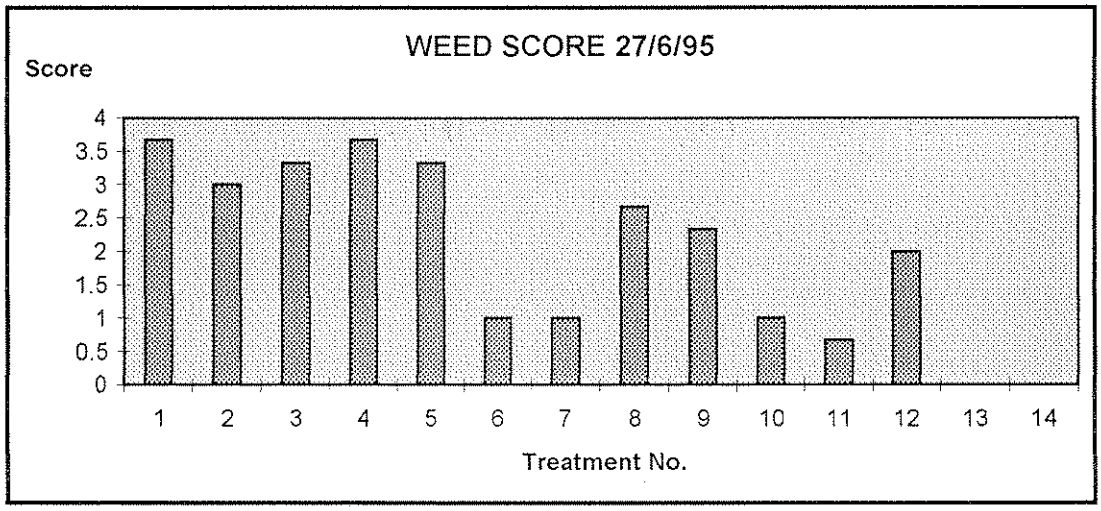
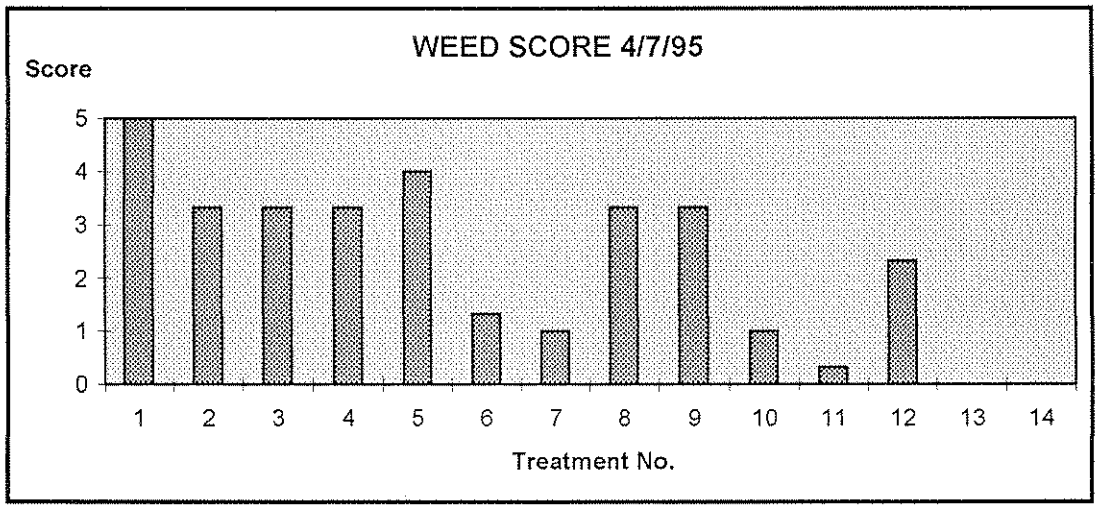


FIGURE XVII Weed score 4 July 1995

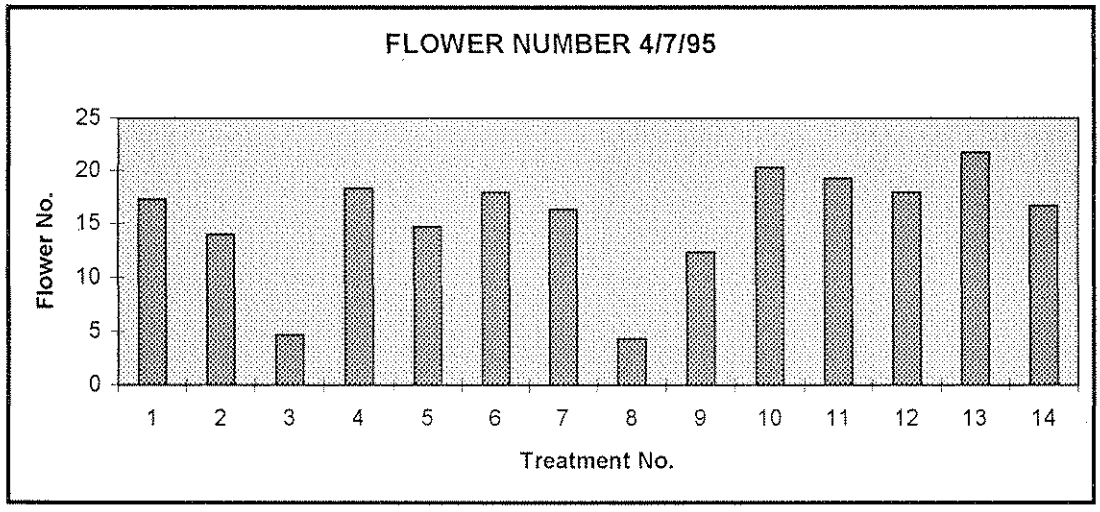


11.3 Yield

Yield was assessed in the second year again by taking a count of open flower numbers on the first occasion and subsequently by a count of fruit numbers, rather than weight. Numbers of fruit were possible only from Rep I as fruit had to be picked each day to give meaningful figures. As a result it is not possible to statistically analyse the yield data but nevertheless the figures do give useful information and tend to follow closely the crop vigour figures.

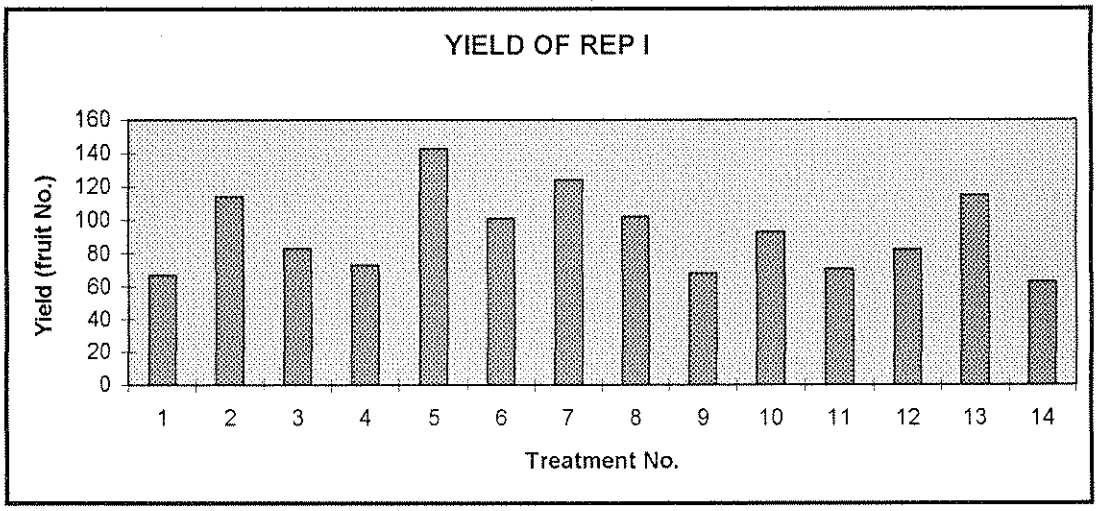
As in the first year yield was highest in the most vigorous growing plots, though there were few significant differences other than the higher rate of Dacthal W75 and the post-planting application of Comodor 600, both of which reduced flower numbers and early yield. Later yields, as shown by the figures from Rep I only, did catch up and do not show a similar reduction. The highest flower numbers were from the two rates of Kerb 50W, the Flexidor 125 and the Linuron Flowable, though fruit numbers did not show an exactly similar pattern

FIGURE XVIII Flower number 4 July 1995



ADAS

FIGURE XIX Yield of Rep I 14-25 July 1995



ADAS

12.0 DISCUSSION

12.1Crop safety

Following the first year when the most damaging herbicide treatments were discovered and discarded, the second year of this trial did not include any treatments which were completely devastating to the crop. Whilst this may have been partly a result of the different weather conditions it is more likely that it was a direct effect of the herbicide activity, as the results followed closely those of the first year in terms of relative crop safety.

Black plastic mulch was the most vigorous growing treatment and the St Regis paper mulch would have performed similarly were it not for the tearing of the paper at the edges and the subsequent growth reduction. None of the chemical treatments used in the second year caused great damage, the least safe herbicides having been removed from the list after the first year.

The chemical treatments which were safest were again the low rate of Dacthal W75, both Flexidor 125 rates, Kerb 50W and Linuron Flowable. Of these only Flexidor 125 gave sufficient weed control to be commercially acceptable.

12.2 Weed control

Weed germination in the second year was much greater than in the first and gave a much better test of the efectiveness of the treatments. Large numbers of Galinsoga were present on the plots, and being a composite this was not controlled by some of the chemicals used, particularly Kerb 50W. As a result of this it is possible that the weed control scores achieved were lower on these plots than they would have been on a diferent site with another weed population. Composite weed species are very common, however, and this may be a limitation of these treatments. Dacthal W75 though safe at the lower rate of 6 kg/ha did not achieve acceptable weed control.

The most effective treatment overall for weed control effect was Flexidor 125 at both rates with these plots being almost completely free of the weeds. Linuron Flowable was also effective though not quite so good as Flexidor 125. On all the other treatments apart from the mulches weeed control was not acceptably good.

12.3 Yield

Estimates of yield from the second year of the trial were possible only from the flower number records taken on the first July assessment and the numbers of fruit from the first replicate on subsequent assessments. Once again the black plastic mulch gave good yield though no better than that from some of the chemical treatments, notably Flexidor 125, Kerb 50W, and Linuron Flowable. None of the treatments was devastating to the yield of the crop and with the exception of the flower number counts for the high rate of Dacthal W75 and the post-planting application of Comodor 600, both of which reduced flowers, there were no significant differences. Even these two treatments caught up by the end of the trial and fruit numbers, though lower than most treatments were not the lowest.

13.0 CONCLUSIONS

Black plastic mulch and the St Regis paper mulch both performed well but the St Regis paper mulch was too fragile and requires further work to ensure that it is stronger and does not tear in use.

Flexidor 125, Kerb 50W and Linuron Flowable appear to be safe on the crop though weed control was best in the Flexidor 125 treatments. The need to apply the Linuron Flowable pre-planting reduces its practicality, even though it does not need incorporation.

Consideration should be given to further investigations of the better treatments to ensure that the results are repeatable and to refine the details of most appropriate rates of application.

14.0 ACKNOWLEDGEMENTS

Many thanks are due to Dr Peter Dawson of Messrs A L Tozer Ltd for his great interest and assistance with this trial, for offering the sites, supplying some of the herbicides used and for the loan of farm staff who assisted with planting and harvesting.

Thanks is also due for the hospitality shown on the afternoon of the growers' open day on 27 July 1994 and for transporting the many visitors who attended to the trial site.