HERBICIDES FOR STRAWBERRY RUNNER-BEDS

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Summary

Once stolons have commenced growth in strawberry runner-beds, weed control by mechanical means is impossible. Hand-weeding, then necessary, is tedious and costly. Several herbicides and methods have been under trial in recent seasons at the Horticultural Research Station, Levin. This report deals mainly with the 1960-61 trial. MB was applied before planting and chlorpropham, simazine and 2,4-DES were applied both three weeks after planting and at the time of stolon emergence three weeks later. Following both 2,4-DES applications, 2,4-DB was applied in early January. The earlier applications of chlorpropham and 2,4-DES not only caused greater damage to mother-plants than the later application but also gave considerably less initial weed control. Cultivation following 2,4-DES, chlorpropham and simazine did not appear to reduce their initial weed control. Simazine, in spite of damaging mother-plants in the earlier application, was sufficiently promising to warrant further study.

INTRODUCTION

STRAWBERRIES are commercially propagated from well spaced healthy mother plants which produce stolons, or runners. These root at successive nodes to form stolon-plants—*i.e.*, runner-plants. The areas as a whole are termed runner-beds.

Weeds should be controlled during runner and runner-plant formation to avoid competition for moisture, nutrients and light, and to facilitate regular and essential therapeutant applications. Freedom from weeds at the time of runner-plant lifting is also highly desirable.

Eradication of weeds by mechanical cultivation can be done fairly closely to mother-plants until stolons are being produced. From this time until runner-plants are dense enough to smother germinating weeds, the weeds must be removed by hand hoeing. This is a tedious and time-consuming operation involving high labour usage. With increasing labour costs it is becoming even more necessary to control weeds in runner-beds by alternative methods. The use of weedicides is a logical choice.

A series of trials on the use of weedicides in runner-beds was commenced at Horticultural Research Station, Levin, in the 1955-56 season. Variable degrees of weed control and tolerance by strawberry plants have been obtained even with the same herbicides, and while there has been some promise of success, the ideal herbicide and technique have not been found.

This paper concerns the trial done in the 1960-61 season. The treatments applied are given in Table 1. MB was included because it is used on some areas in spite of its high cost.

In previous trials, 2,4-DES gave variable weed control but it was included here because strawberry mother-plants tolerated it. The follow-up application of 2,4-DB was to eliminate weeds missed by 2,4-DES. Chlorpropham, with mother-plants protected, had previously shown promise of being useful if applied a few weeks before runner-plants started rooting into the soil.

TABLE 1: TREATMENT OF EXPERIMENTAL PLOTS

Treatment (lb. a.i. per acre)	Plant Protec- tion	Date of Applica- tion	Special Cultivation Type	Date	Condition of Plants
(1) Chlorpropham 5.0	3 in. pots	November 8	Hand hoeing	November 7	Very vigorous though small.
(2) Chlorpropham 5.0	5 in. pots	November 29	Hand hoeing	November 29 before application	Very vigorous. Stolons appearing.
(3) Simazine 1.0	3 in. pots	November 8	Hand hoeing	November 7	Very vigorous though small.
(4) Simazine 1.0	5 in. pots	November 29	Hand hoeing	November 29 before application	Very vigorous. Stolons appearing.
(5) { 2,4-DES 6.3	—	November 8	Hand hoeing	November 7	Very vigorous though small.
	—	January 3	—	November 11*	Definite symptoms of 2,4-DES of November 8. Stolons appearing and runner plants rooting.
(6) { 2,4-DES 6.3	—	November 29	Hand hoeing	November 29 before application	Very vigorous. Stolons appearing.
	—	January 3	—	—	Slight symptoms of 2,4-DES of November 29. Stolons appearing and runner plants rooting.
(7) MB 580	Not planted	October 5	—	—	Not planted.
(8) Control	—	—	Hand hoeing	November 29	Very vigorous. Stolons appearing.

* Weeds survived hoeing of November 7 because of following rain.

Weed control and runner-plant rooting had not been affected in previous trials by 1 in. deep rotary cultivation immediately following chlorpropham and 2,4-DES applications in the summer. Because of the few weeds present at the time of application of 2,4-DB this weedicide contributed very little to weed control in Treatments 5 and 6.

EXPERIMENTAL

OVERALL CULTIVATION

Rotary cultivation to a depth of 1.5 to 2 in. to loosen soil for runner-plant rooting was due on December 5. Hand-weedings followed weed assessments to eliminate surviving weeds were due on January 26 and March 8.

SOIL

The trial area is Levin silt loam of which the upper 8 in. is a dark brown silt loam. It had been under cultivation for the two previous seasons, and was finally prepared by rotary cultivations to 3 to 4 in. deep in September and rolling and raking in early October. The surface was level and, apart from minor depressions, smooth.

IRRIGATION

On January 11, 2.5 in. of water was applied overhead.

PLANTS

The variety was Redgauntlet. Plants were cold stored from mid-July until planting.

PLANTING

Plants were set out on October 18.

LAYOUT

The design was that of a randomized block with nine replications.

PLOTS

The size was 24 ft × 6 ft, with six pairs of mother plants in each. The plants of each pair were 12 in. apart and the pairs were 4 ft apart. The least healthy plant of each pair was removed in mid-December so that runner-plant production was from only six mother-plants.

METEOROLOGICAL DATA

Rainfall from November to February was 9.82 in. and from December to February 5.13 in.

APPLICATION METHODS

Chlorpropham, simazine, 2,4-DES and 2,4-DB were applied in 40 gal water per acre, by means of a plot sprayer, at constant nozzle delivery and forward speed. MB was applied under a supported polyethylene sheet which had been placed 24 hours before the application. The sheets were not removed for 26 to 27 hours following application.

ASSESSMENT OF RUNNER-PLANT PRODUCTION

All runner-plants within three sample strips per plot were lifted in early May. Each strip was 4 ft × 1.5 ft, and sited between mother plants and across the plots. Plants were sorted into first, second and unrooted grades. First grade plants were those with a crown diameter of 7 mm or more and abundant roots.

WEED ASSESSMENTS

Numbers of healthy annual weeds beyond the first true leaf stage were assessed by counts on January 19 and by scoring on March 1 over three randomly chosen areas per plot. Counting was by means of a grid with 25 2 in. × 2 in. squares. One or more weeds per square constituted a point. Scoring was based on degrees of infestation from 0 to 5 — *i.e.*: 0 = no weeds; 1 = slight infestation; 3 = medium infestation; 5 = maximum infestation.

WEED SPECIES

When the assessments were made the species most common in each plot were noted.

RESULTS

RUNNER-PLANT PRODUCTION

Plants produced per treatment are shown in Table 2.

Though mother-plants were initially damaged (see below) in Treatments 1, 2, 3, 5 and 6, total production of runner plants from each treatment was not significantly different from control. Treatments 4 and 7 not only produced the greatest number of plants in all grades but also the greatest number of first grade and second grade plants. The number of second grade plants from Treatment 7 was not, however, significantly different from Treatment 8.

None of the herbicides appeared to have impaired runner-plant rooting as the numbers of unrooted plants were more or less in proportion to the other grades.

VISIBLE DAMAGE TO MOTHER-PLANTS

Plants in Treatments 1 and 2 were abnormal following the applications of chlorpropham. Young leaves were flaccid and light green for 2 to 3 weeks. By mid-December plants were recovering but the more mature leaves were cupped and still yellowish green in colour. Plants in Treatment 1, with chlorpropham on November 8, were considerably affected but those in Treatment 2 only slightly so.

Simazine applied in Treatment 3 caused degrees of damage to mother-plants from very slight to very severe, yet in Treatment 4 no damage occurred. In Treatment 3, in general each of a pair of mother-plants showed similar degrees of damage, while adjacent pairs of plants differed widely. Two weeks following application, mature leaves of damaged plants had a distinctly yellow chlorosis between the main veins which was succeeded by necrotic scorching. Leaves of severely damaged plants dried completely. Some five weeks later plants were recovering but the oldest leaves of severely damaged plants had necrotic and up-rolled leaf margins. Less damaged plants had leaves with definite chlorotic leaf margins and a marbling pattern of chlorosis between the main veins. In both Treatments 3 and 4 occasional runner-plants showed moderate symptoms in late February but these recovered.

TABLE 2: NUMBERS OF RUNNER-PLANTS OF VARIOUS GRADES FROM ALL TREATMENTS — EARLY MAY

Treatment	Mean No. of Runner-plants per Plot from three sample areas				Total
	1st Grade	2nd Grade	Unrooted		
(1) Chlorpropham on November 8	58 b	118 bc	12 abc		188 b
(2) Chlorpropham on November 29	60 b	103 c	13 abc		177 b
(3) Simazine on November 8	56 b	96 c	9 c		160 b
(4) Simazine on November 29	80 a	147 a	14 ab		242 a
(5) { 2,4-DES on November 8	53 b	97 c	10 bc		160 b
2,4-DB on January 3					
(6) { 2,4-DES on November 29	61 b	105 c	11 abc		177 b
2,4-DB on January 3					
(7) MB pre-planting	90 a	134 ab	16 a		240 a
(8) HWC	57 b	117 bc	11 abc		185 b
C.V.	20.6%	24.2%	43.6%		19.3%

Following the 2,4-DES application in Treatment 5 plants showed typical and moderate 2,4-D damage with reddened and twisted leaf petioles and elongated leaflets; it was still apparent in early December. By mid-December plants were recovering, but elongated leaflets were still present. In Treatment 6 damage from 2,4-DES though apparent was only slight. 2,4-DB in Treatments 5 and 6 resulted in a fair degree of typical 2,4-D damage with plants starting to recover two or three weeks later.

WEED CONTROL

Results of weed assessments are shown in Table 3.

Chlorpropham in Treatment 1 initially controlled only about half of the weeds while in Treatment 2 it controlled some four-fifths. The degree of control by March was similar in both treatments, and not of much value.

Simazine gave very good initial control following applications in both treatments. It considerably reduced weeds, in both cases, into March.

Weeds were initially reduced by only about three-quarters following the application of 2,4-DES in early November. When applied three weeks later very good control resulted. Neither applications of 2,4-DES gave control of much value into March.

MB gave very good initial weed control and fair control into March.

Observations on weed species on January 19 indicated that twin-cress (*Coronopus didymus*) and red deadnettle (*Lamium purpureum*) were partly resistant to chlorpropham.

All species were initially controlled by simazine, MB, and 2,4-DES in Treatment 6.

By March twin-cress was one of the dominant weed species in all treatments except MB. Spurrey (*Spergula arvensis*) was dominant in Treatments 1, 5, 6, 7 and 8, while annual poa (*Poa annua*) accompanied it in Treatment 6. It was noticeable that white clover (*Trifolium repens*) and storksbill (*Erodium* spp.) by March were fairly common in MB treated plots.

TABLE 3: ASSESSMENTS OF WEED INFESTATION ON JANUARY 19 AND MARCH 1

Treatment				January 19, 1961 Mean No. of Weeds for 3 Samples per Plot*	March 1, 1961 Mean Score of Weeds for 3 Samples per Plot†
(1)	Chlorpropham on November 8	.....	.....	13.6	6.7 b
(2)	Chlorpropham on November 29	.....	.....	5.0	7.2 b
(3)	Simazine on November 8	.....	.....	0.4	3.4 c
(4)	Simazine on November 29	.....	.....	0.2	2.9 c
(5)	{ 2,4-DES on November 8	.....	.....	6.4	7.3 b
	{ 2,4-DB on January 3	.....	.....		
(6)	{ 2,4-DES on November 29	.....	.....	0.3	6.7 b
	{ 2,4-DB on January 3	.....	.....		
(7)	MB pre-planting	.....	.....	0.1	3.3 c
(8)	HWC	.....	.....	25.7	9.1 a
	C.V.	.....	.....	—	16.5%

* Maximum possible = 75

† Maximum possible = 15

DISCUSSION

Total runner-plant production was a good indication of vigour of the mother-plants. There was no significant difference between total

numbers of runner-plants produced by Treatments 1, 2, 3, 5, 6 and 8 (control). This suggested that control plants suffered from weed competition and unavoidably greater disturbance during hand-weeding. Under Treatments 4 and 7, in which mother-plants were not damaged and competition from weeds was most reduced, production of runner-plants was significantly greater than the other treatments. Rooting down of runner-plants was no doubt assisted by cultivation which diluted chlorpropham, 2,4-DES and simazine. However, earlier trials indicated that, if a few weeks' period followed their application, rooting down was not impaired.

It was not normally recommended that cultivation should follow chlorpropham, 2,4-DES and simazine. If mechanical weed control is replaced by herbicides in strawberry runner-beds, cultivation may be needed to loosen the soil and encourage runner-plant rooting. In this trial the cultivation of December 5 was on the deep side. Cultivation after application of chlorpropham, by placing it below the soil surface, probably reduced its volatilization. This would help explain the reduced loss of chlorpropham following the early November application.

Simazine damaged mother-plants following the earlier, though not the later application, but weed control was the same in both cases. It apparently reached the roots only following the earlier application. There was some indication that severely damaged plants were in slight depressions. Other and more recent trials indicated that protection of plants during simazine application was not necessary. The results from this trial suggested that other factors are important.

The only real differences between conditions of the early and late November applications were those of soil moisture and rainfall. Following the November 8 application soil was very moist while following November 29 it was dry. Rainfall was considerably higher in the period following the earlier application.

MB gave disappointing persistence of weed control probably because at the time of its application the soil was fairly firm and penetration of the gas impeded. Temperature at the time was on the low side but according to McNeur (1961) temperatures above 40° F are satisfactory.

The plant damage in Treatment 3 and the apparent loss of some residual weed control by simazine could be partially attributed to rainfall and irrigation. Burnside *et al.* (1961) found that leaching of simazine to lower depths increases with increasing rainfall.

CONCLUSIONS

Cultivation following 2,4-DES, chlorpropham and simazine did not appear to reduce weed control over about six weeks, though it probably did over three months.

Strawberry plants which are cold stored and planted late (usual for runner-bed mother plants) could well be very susceptible to weedicides in the few weeks following planting.

In the warm weather loss of chlorpropham and 2,4-DES appeared to be rapid when the soil was very moist. This resulted in loss of weed control and considerable damage to rapidly growing plants. Thus chlorpropham and 2,4-DES not only give variable weed control but under some conditions cause plant damage.

Because 2,4-DB damaged mother-plants it appeared too hazardous to be further considered. Its weed control was not assessable in this trial.

Simazine caused different degrees of damage to plants 4 ft apart. There was some suggestion that this was caused by it being washed into minor depressions.

Penetration of MB into fairly firm soil appeared to have been impeded. It appeared to be favourable to mother plants, and did not impair rooting of runner-plants.

Rooting was not impaired by chlorpropham, 2,4-DES, or simazine.

Twincress and red deadnettle appeared partially resistant to chlorpropham. Simazine, MB, and 2,4-DES in one treatment, initially controlled all species.

MB has obviously a place for runner-bed weed control, at least for areas where its high cost is warranted.

It was again obvious that the period between first stolons and full cover by runner-plants is the critical one in which weed control must be obtained.

This trial emphasized that the ideal weedicide for strawberry runner-beds must not only give good weed control over a period of about three months and not reduce runner-plant production, but must also be unaffected by shallow cultivation following its application.

Because it is more economical than MB, and because of its promise to fulfil the above specification, simazine applied at the time of first appearance of stolons is worth consideration for further trial work.

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