THE EFFECT OF MALEIC HYDRAZIDE

IN CONTROLLING PLANT POPULATIONS

IN THE STRAWBERRY IN SOUTHWEST VIRGINIA

by

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Thesis submitted to the Graduate Faculty of the

Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

Horticulture

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August, 1977

Blacksburg, Virginia

DEDICATION

The author wishes to dedicate this thesis to his wife, Shelly, without whose patience, sacrifice and encouragement none of this would have been possible.

ACKNOWLEDGEMENTS

The author wishes to express appreciation to R. D. Morse, his committee chairman, for his time and advice during this study. Appreciation is extended to J. A. Barden for his suggestions and assistance in the final stages of the study, and to C. R. O'Dell for his support and suggestions throughout the course of this study. Appreciation is also extended to D. C. Coston for his advice and input into the preparation of this manuscript.

The author is also indebted to Wolde Woubneh, Tom Martin, and Dave Bender for their assistance with the statistical analysis, to Lynn Gayle and the entire farm crew for their help with much of the cultural work, to John Love for his artistic input, to the graduate students in the Departments of Horticulture and Agronomy for aid in collecting and recording data, and to his wife Shelly for her assistance in establishing the experiment, collecting and recording data, and typing this thesis.

The author wishes to thank his family for their encouragement, especially to his parents for their support and love throughout his life.

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INTRODUCTION

The strawberry, (<u>Fragaria</u> sp.) when grown under ideal conditions of water, soil fertility, and temperature, will produce runners to the extent that they will become troublesome. The majority of runners are produced after September 1 (24, 38, 42). These late-formed runner plants will not attain sufficient size to form flower buds (38), and will act as weeds competing with the earlier formed plants for water, nutrients, and light (11, 24).

Investigations have shown increased yields by reducing the number of late formed runners (10, 11, 24, 26, 36, 44). Morrow et al. (31) showed early rooted plants to be many times more productive than those formed after October. Schilletter (35) and Shoemaker (38) reported similar results.

Although growers are aware of the benefits of removing excess runners, it is not a standard practice because of the expense involved. Because of this expense, many investigations have been conducted to find a method of economically and efficiently controlling late formed runners (19, 24, 26, 27). Maleic Hydrazide (MH) was found to be effective in controlling plant populations in strawberries (19, 24, 27). It has also been shown be several investigators (4, 6, 19, 24, 26, 27) to affect flower initiation. It is believed that fall temperatures, in the areas where MH has been tested, were not warm enough for an adequate period of time for flower initiation to continue after the sprays of MH had dissipated (25). Hitz (25) stated that for MH to be profitable "it must be used in a locality where blossom initiation is not halted by cold weather for a considerable period after the shortening days of autumn preclude the necessity of runner control." Transition from the vegetative to reproductive stages has been shown to be rapid (22). It may be possible therefore, for flower initiation to proceed normally after the effect of MH has dissipated, in a locality where the short days of late fall are warm enough to permit flower initiation, even though initiation may be slowed during part of the spray period.

The purpose of this study was to determine if Southwest Virginia is a location where fall temperatures are warm enough to allow the use of MH to control runner elongation without economically affecting flower initiation.

LITERATURE REVIEW

Factors affecting runner production

Photoperiod. The vegetative and reproductive stages of the strawberry plant are affected by photoperiod. The long days of summer will induce the initiation of runners while the short days in the fall will cause the initiation of fruit buds (14). Runner formation is not solely a result of a photoperiodic reaction, although day length is the triggering mechanism. Practices such as temperature manipulation in the greenhouse will also influence runner production, and in some instances will override the initial effect of the photoperiodic response (14, 39, 40). Cultivars, chilling requirements, and environmental factors such as climate will also affect runner production.

Cultivars. Strawberry cultivars will differ in their ability to produce runners (28, 31). Runner formation from plants of the same cultivar are affected by soil, cultural, and climatic conditions.

Chilling. Strawberries undergo a rest period brought about by the combination of low temperatures and short days (14). This rest period can be artificially broken by exposing the plant to supplemental light and high temperatures (15). However, the rest period is naturally broken by exposure to winter temperatures below 7.2^{o}C. In response to this chilling, the strawberry plant becomes more vigorous, has longer leaves, long petioles, produces fewer flowering stems, and produces more fruit and runners than plants not receiving adequate chilling (2, 5, 13, 14, 20).

Climate. Differences between climatic conditions will also affect the number and length of runners formed. The average number of days from the time of planting to the formation of the first daughter plant on each of five runner series studied was found to be 30 days in one year as compared to only 13 days the following year under identical cultural conditions (33). The marked increase in the formation of plants in the second year was attributed to an increase in precipitation accompanied by an increase in temperature. The interval between the formation of successive series became progressively longer under low temperature and low precipitation (33).

In a study conducted at two localities representing mountainous, Swannanoa, N.C., and relatively flat land, Willard, N.C., Morrow (30) found that the differences in seasonal average temperature, 19.4^{o}C vs. 23.5^{o}C respectively was probably responsible for the increased number and length of runners in 'Blakemore', 'Missionary', 'Klondike', 'Premier', and two number selections from the USDA trials at Willard. However, data on the relation of temperature and rainfall were not reported.

Deficiencies in soil moisture will limit the formation of runners as well as the development and rooting of already formed plants. Waldo (44) reported a smaller number of plants in matted rows receiving early and late irrigations as compared with rows receiving three irrigations.

Under favorable conditions, runners will form throughout the summer months and well into the fall, arising from the axil of the leaf (21). Faster plant growth results in more runners. The older runners, i.e. early rooted plants, will have the most leaves and greater leaf area, and will produce more fruit (16). Sproat et al. (41) have shown the relationship between leaf size and fruit yield. These findings were that plants in crowded matted rows will yield only one-fifth the fruit as compared to plants in spaced rows (41).

Utilization of plant spacing to control plant population

Plant spacing has been widely used to control strawberry plant populations. For a complete discussion of spacing, see Hitz (24). Hill and Haut (23) have shown a positive yield and growth response of the 'Temple' strawberry to modifications of the normal matted row system by thinning and spacing techniques. Three techniques studied were thinned rows, 30, 46, and 61 centimeters, spaced rows, with plants placed 23 cm apart, and the conventional matted row, with row width spacings similar to thinned rows. The dry weight of the plant for spaced rows (46.1 g) proved to be 10 times as large, and for thinned rows (7.0 g), twice as large as that for matted rows (4.9 g). Yield per acre was found to be nine times greater for spaced rows and one-third more for thinned rows as compared to matted rows.

Determining the effects of spacing of strawberry plants on the leaf development, Christopher (10) found a marked increase in the number of leaves per plant in spaced rows over matted rows. A negative correlation between the number of plants and leaf area was also found; that is, the greater the number of plants, the smaller the leaf area per plant. Matted rows had the fewest leaves, smallest average leaf size, as well as the smallest leaf area per plant.

Crane and Haut (12) found that as the width of the rows increased over 25 cm in the 'Blakemore' cultivar, a progressive decrease in yield occurred, the reason being that the narrower 25-cm rows had larger, earlier formed, better established runners. The wider rows, on the other hand, contained a larger percentage of late formed runner plants. A spacing of 20 cm proved to be beneficial in five of six cultivars studied by Childs (9) in relation to increased yield in the strawberry. Berry size was also increased by spacing of 20 cm. For all cultivars except one, the actual yield was greater earlier in the season. Christopher (11) found spacing of more than 15 cm in Rhode Island with 'Dorsett' and 'Premier' cultivars to be harmful to yield but was higher compared with the matted row.

Spacing studies with and without irrigation on several strawberry cultivars were conducted by Schrader and Haut (36) at College Park, MD. Spacings of 18 and 28 cm were compared to the matted row. Both the 18 and 28 cm spacing showed an increase in yield over the matted rows under all conditions of moisture. Under favorable conditions there was little difference between 18 and 28 cm spacing, however, under very low moisture supply, the 28 cm spacing was superior. Berry size was also superior with the 18 and 28 cm spacings. Under dry conditions the application of water within the matted row showed only a small increase in berry size as compared with the spaced treatments.

Chemical control of plant populations

Attempts to find a chemical that would be effective in controlling plant populations in the strawberry have been undertaken by many investigators (7, 19, 27, 43). Hitz et al. (27), Denisen (19), and Carlson (7) found MH to be the most effective compound. Much of the literature on the use of MH as well as other chemicals used in controlling excess runners has been reviewed by Hitz (24).

Effect of MH on yield. Higher yields and larger berries in both early and late pickings have been reported by Denisen (19) with 'Dunlap' and 'Robinson'. Carlson (8) found no significant increase in yield in the first pickings in either 'Robinson' or 'Paymaster' as a result of MH treatment. Yields of 'Sparkle' and 'Catskill' in matted rows were less when sprayed with MH, with most of the yield reduction occurring in the early pickings (4).

Spray application of MH on everbearing cultivars prior to blossom, resulted in abnormal flowers, delayed production and reduced yields (18).

Blossoms were reported by Denisen (19) to be larger on treated plants than on non-treated plants. Hitz (24) reported more berries from MH treated rows than from non-sprayed rows. The increased number of berries with MH treated rows was attributed to an increase in flower initiation.

Effects of MH on runner elongation. Runner elongation of 'Blakemore' and 'Tennessee Beauty' was reduced by sprays of MH. Plant populations were also lower, crowns heavier, and yields larger for sprayed rows (1, 26). Runner elongation was also inhibited in the 'Robinson' and 'Paymaster' cultivar (7). The average runner number per plant in the 'Dunlap' strawberry was 1.3 for treated rows and 24 for check rows (17).

Applications of MH to 'Temple' cultivar on three separate dates, August 1, September 1, and September 28, resulted in a marked decrease in runner elongation from the August 1 application only (27). Sprays on September 1 and 28 were not effective. Hitz et al. (27) found that older plants do not absorb MH.

Physical factors of MH

Absorption. Radioautographic studies have shown MH to accumulate in areas of active growth, primarily the growing tips of the runners. The position of MH eventually becomes fixed,and the growth appearing after treatment is unable to dissipate the deposited MH (6). Brown (6) suggests that this may be partly responsible for the inconsistency of MH in past experiments.

Timing. The time and rate of MH has been shown to affect the reaction of strawberries to MH by Hitz and Brown (26). Several other factors will also modify the response of MH in the strawberry. Since relative humidity affects rate of absorption of MH, the inconsistencies may be associated with this factor (45).

Concentration. Concentration studies reported by Brown (6) indicate that the material may not be effective if an insufficient amount is applied. Tests showed MH to be most effective in controlling runner elongation in the strawberry at spray rates of 1000 ppm (18, 24, 26). Plants should be wet thoroughly to run off (6, 26). Cultivar differences in time of floral initiation will also affect the response to later sprays. Spray applications should begin when a desired plant density of rooted and unrooted plants is reached (26).

Active ingredients and mode of action. The active ingredient of MH was found by Miller and White (29) to be 6-Hydroxy - 3(2H) pyridazione. It has both inhibitory and herbicidal activities (45, 46). MH inhibits growth by competing with uracil in synthesis of ribonucleic acid (32).

Formulations. MH is available as either MH-30, a diethanolamine salt, or as MH-40, a water soluble powder of sodium salt (45, 46).

METHODS AND MATERIALS

The study was conducted at the Virginia Polytechnic Institute and State University Horticultural Research Farm located in Montgomery County, Virginia.

Dormant 'Earlidawn' and 'Guardian' plants were set in a split plot design and replicated four times in May 1976. There were 4 treatments per cultivar within each replication. Each plot was 4.87 m in length with each plant spaced 30.5 cm apart. Between row spacing was 1.21 m. The outer rows of each replication and the middle rows between the split plots served as border rows and were made up of matted rows of 'Delite'. The soil at the site was a silt loam.

Maleic Hydrazide, in the form of MH-40 at 1000 ppm active ingredient, was sprayed to runoff on treatments 3 and 4 on designated dates. The treatments were as follows:

Treatment One: Matted row. Runners were allowed to form without any interference. The matted row acted as a check treatment.

Treatment Two: Hand-thinned row (removal of all non-rooted and newly formed runners beginning August 16).

Treatment Three: Spray applications of Maleic Hydrazide on August 16 and September 1.

Treatment Four: Spray applications of Maleic Hydrazide on August 15, September 5, and September 26.

Plots were fertilized with 7.3 kg of 10-10-10 per plot, equivalent to 560 kg per hectare, several days before planting, and irrigated by overhead sprinklers the day following planting. Cultivation and weeding were begun immediately and continued throughout the season as needed. Irrigation was also applied when needed. Runners were pegged down as soon as they began to form within the thinned rows. Beginning on the first day of the spray treatment, all unrooted and new runners within the hand thinned rows were removed and counted. Runners within the check and spray rows were allowed to form. The plants were maintained within 0.6 m boundaries. This was accomplished by marking off each row with string and maintaining the runners within the designated area. Plants extending beyond the designated area were cut. Pine needle mulch was applied in January 1977 and removed and placed in the aisles in April.

Measurements taken to evaluate the effectiveness of Maleic Hydrazide were:

A) Runner elongation
B) Plant population counts
C) Total yield
D) Number of berries
E) Size of berries

Runner elongation was determined by tagging 7 plants at random per plot in treatments 1, 3, and 4, and making weekly measurements. Population counts were made by marking off two areas 1.2 m in length and counting the number of plants (rooted and non-rooted) within each area. Counts were made before each spray and again when the plants were dormant.

Total yields were determined from weight of berries per plot. Harvest began May 23 and continued at approximately three-day intervals until June 16, 1977. Total weight divided by the number of berries gave average berry weight.

RESULTS AND DISCUSSION

The effect of MH upon runner elongation. In determining the effectiveness of MH sprays on runner elongation, an attempt was made to locate the part of the plant most affected. A distinction was made between side and primary runners. Primary runners were designated as runners forming in a straight line from the mother plant. Side runners were designated as runners developing from the side of primary runners. MH treatments did not affect elongation of side runners. There were, however, differences for the primary runners. Primary runners were greatly affected by MH treatments. These differences became evident beginning September 29 and remained throughout the study (Fig. 1, Appendix Table 8).

The effect of MH sprays on runner elongation appeared to be directly related to the stage of development at the time of spray application. Data obtained from three selected days showed that 62% of the side runners developed from rooted primary plants (Table 1). Approximately 96% of the primary runners originated from non-rooted plants (Table 2). Brown and Hitz (6) have shown MH to concentrate in those areas of active growth, primarily in the tips of non-rooted runners. Denisen (19) found rooted runners to be least affected by sprays of MH. Findings were similar in this study. Leaves of tagged rooted plants became chlorotic, but runner length was not affected. Runners developing at the time of spray application remained stunted and rarely developed into plants (Fig. 2). This was also reported by Denisen (19).

The fact that rooted plants are not affected by sprays of MH to the same degree as non-rooted plants may explain why there were no

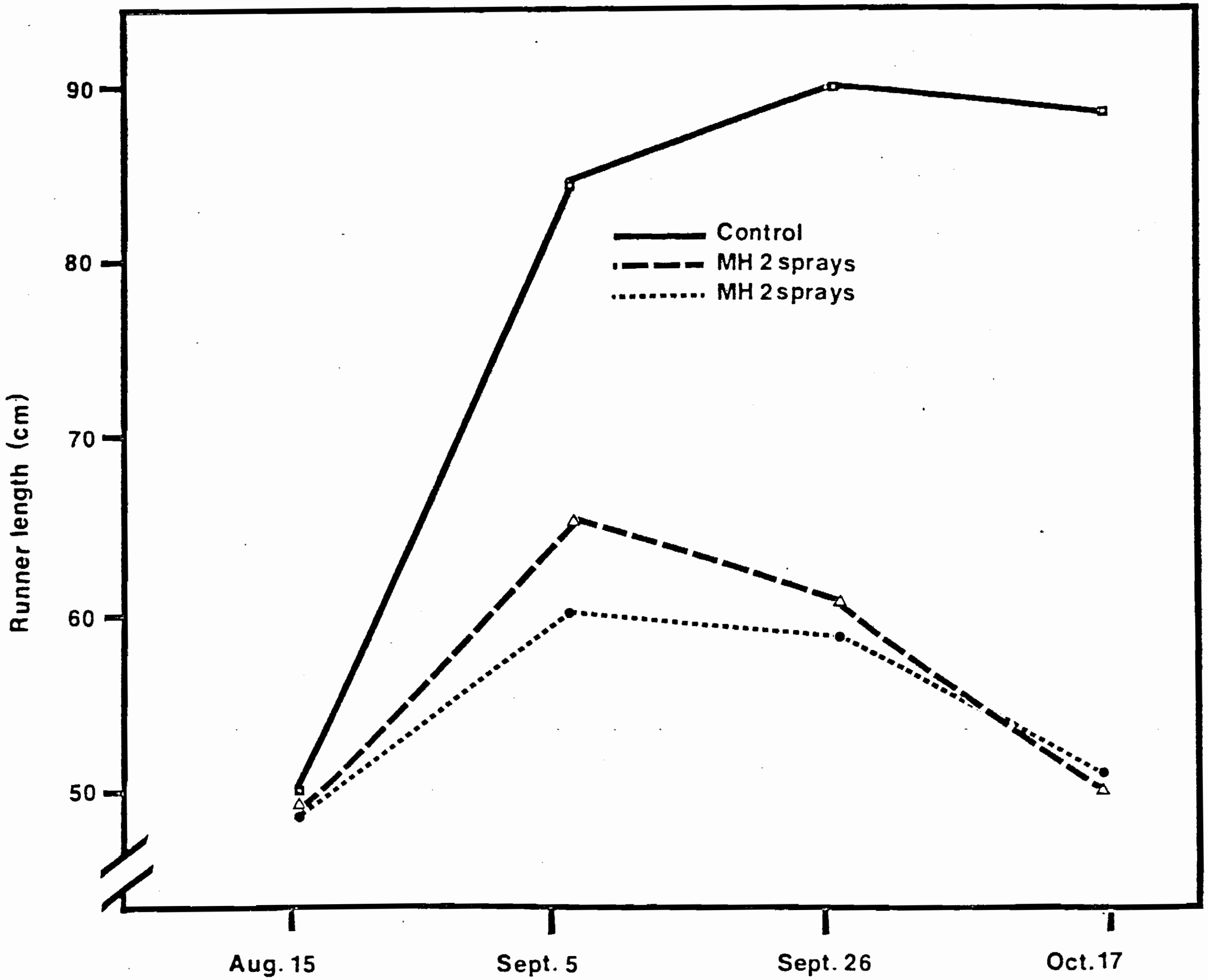

Figure 1. Primary runner elongation of tagged runners of 'Guardian' and 'Earlidawn' strawberries.

Table 1. Number of side runners developed from rooted and non-rooted plants.

	No. of side runners^{z} developed from	
Date	Rooted plants	Non-rooted plants
8/15	9	5
9/5	30	20
9/26	33	18

^{z}Data are means for 'Earlidawn' and 'Guardian'.

Table 2. Number of primary runners developed from rooted and non-rooted plants.

	No. of primary runners[z] developed from	
Date	Rooted plants	Non-rooted plants
8/15	3	82
9/5	2	75
9/26	6	75

[z]Data are means for 'Earlidawn' and 'Guardian'.

Figure 2. Effect of MH on runner development. Runners developing at the time of spray application usually remained stunted, rarely developing into plants.

differences in the side runners but consistent differences in the primary runners.

Other than suppressing runner elongation, no effects were noticeable until September 5 when newly formed leaves of sprayed plants appeared chlorotic (Fig. 3). On sprayed plants, a side runner started at the node behind the affected runner plant (Fig. 4). Hitz (6) and Hitz and Brown (26) reported similar findings. No differences in runner elongation were noted between plants sprayed two and three times with MH. Differences between cultivars were evident throughout the study. Runners on 'Guardian' plants were longer than those on 'Earlidawn' (Appendix Table 8).

The effect of MH upon plant population. 'Guardian' produces runners freely, wheras 'Earlidawn' will generally produce fewer runners than most cultivars (3, 37). Data in Table 3 indicate a similar relationship but the differences were not significant.

Differences in plant population became evident on September 5. The matted row produced the highest population. The hand pruned plots had the lowest, and the spray rows less than matted rows. These differences were consistent until October 17, at which time the sprayed and hand pruned plots were similar, but still different from the matted row (Table 4). The lack of an increase in plant population from September 26 to October 17 within the control and hand pruned plots probably is a result of photoperiodic response. The natural shortening of day length in the fall inhibits runner elongation (14). The reduction in runner length in October with 2 and 3 sprays (Fig. 1, Appendix Table 8) was a direct result of MH sprays. Plants forming runners at the time

Figure 3. Chlorotic symptoms of newly formed leaves of sprayed plants.

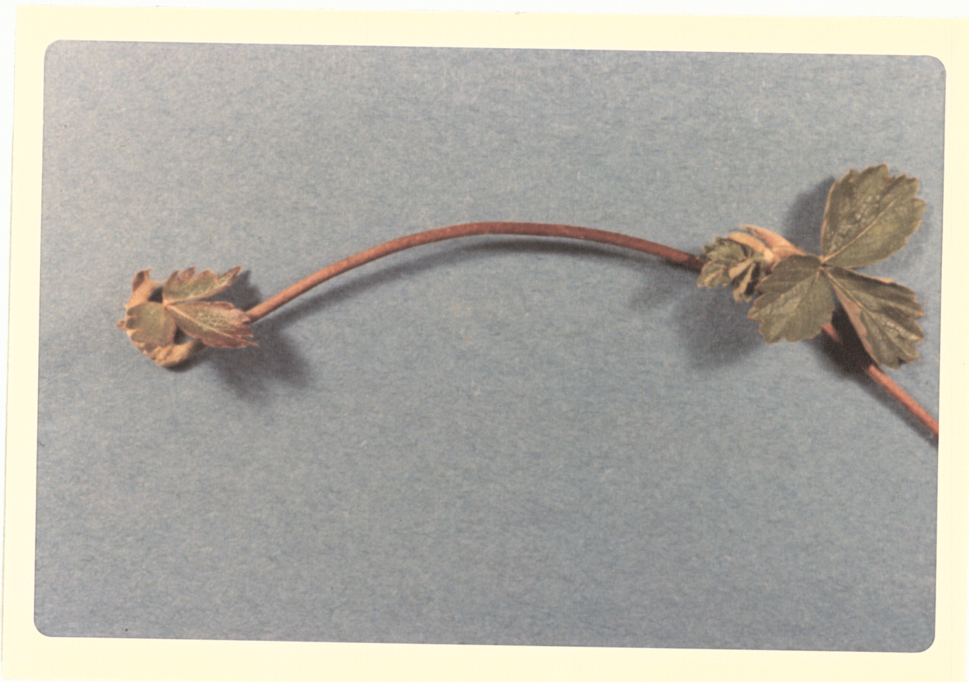

Figure 4. Side runner developing from node of affected plant.

Table 3. Mean number of runners removed in hand-pruned plots.[z]

Cultivar	No. of runners removed at following dates							
	8/15	8/22	8/29	9/5	9/12	9/19	9/26	Total
Guardian	108.3	53.5	51.3	31.8	19.3	11.8	2.0	278.0
Earlidawn	77.3	31.5	15.3	10.5	4.8	1.5	.8	141.7

[z]No differences were significant at .05 level.

Table 4. Strawberry plant population as influenced by hand thinning and sprays of Maleic Hydrazide.

Date	Cultivar	No. of plants per 1.24 m of row: Control	Hand Thinned	MH 2 Sprays	MH 3 Sprays	Cultivar Mean
8/15	Guardian	55.0	41.8	47.8	48.0	48.2b
	Earlidawn	53.0	53.0	57.3	62.8	56.6a[y]
	Mean	54.1a[z]	47.4a	52.5a	55.4a	
9/5	Guardian	97.5	41.5	79.3	81.8	75.0b
	Earlidawn	93.3	54.3	81.8	84.0	78.4a
	Mean	95.4a	47.8c	80.5b	82.8ab	
9/26	Guardian	98.5	42.3	91.8	69.5	75.5b
	Earlidawn	120.3	54.5	79.5	92.0	86.6a
	Mean	109.4a	48.4c	78.0b	80.8b	
10/17	Guardian	92.3	50.0	49.0	48.0	59.8b
	Earlidawn	120.8	52.8	53.8	67.5	69.2a
	Mean	106.5a	47.1b	51.6b	49.8b	

[z] Separation of treatment means by Duncan's multiple range test, 5% level
[y] Cultivar mean separation by Duncan's multiple range test, 5% level

of the second spray period became stunted and eventually dried up and died. This could account for the decreased plant population in the MH treatments on October 17 compared to September 26 (Table 4).

The effect of MH upon yield, number of berries, and size of berries. Tables 5-7 present the yield data for this experiment. Frost was experienced during the blossom period, but blossoms were protected by sprinkler irrigation and little damage occurred. Both number and weight of fruit were greater for 'Earlidawn' than for 'Guardian' (Tables 6-7). No differences were found between cultivars in berry size (Table 7).

Sprayed and hand-pruned plots had significantly lower yields (Table 5) and numbers of fruit (Table 6). Berry size was the same for all treatments throughout the harvest season.

In designing the experiment, commercial production methods were followed. Once the plants covered the designated row width of 0.6 m, spraying commenced and continued at 3 week intervals as suggested by Hitz and Brown (26). This appeared to be most practical as it seemed unlikely that growers would "mother" their operations until Hitz and Brown's (26) suggestion of a plant density of 98-148 plants per running meter was obtained. However, higher plant population appeared to be the reason why the matted row produced higher yields than the other treatments. Plant populations for other treatments did not approach the suggested population of 98-148 plants per running meter (Table 4). Rogers and Modlibowska (34) found that increasing the number of plants per acre will increase the crop of fruit. They reasoned that wide spaced rows do not lead to more efficient use of the total available soil

Table 5. Total fruit yield harvested from 'Earlidawn' and 'Guardian'.

Cultivar	Yield (kg per hectare)				
	Control	Hand pruned	MH 2 sprays	MH 3 sprays	Cultivar mean
Guardian	3640	3316	2248	1238	2610a[y]
Earlidawn	5507	3868	3087	2115	3640b
Mean	4573a[z]	3592b	2668c	1677d	

[z]Separation of treatment means by Duncan's multiple range test, 5% level.

[y]Cultivar mean separation by Duncan's multiple range test, 5% level.

Table 6. Total number of fruit harvested from 'Earlidawn' and 'Guardian'.

	Total no. of fruit harvested[z]				
Cultivar	Control	Hand pruned	MH 2 sprays	MH 3 sprays	Cultivar mean
Guardian	54516	42462	33264	19950	37506
Earlidawn	84882	53634	45276	37044	43092a[x]
Mean	69720a[y]	48048b	39270b	28476c	

[z]Fruit per 0.1 hectare.

[y]Separation of treatment means by Duncan's multiple range test, 5% level.

[x]Cultivar mean separation by Duncan's multiple range test, 5% level.

Table 7. Average weight of fruit harvested from 'Earlidawn' and 'Guardian'.

	Fruit weight (g per fruit)				
Cultivar	Control	Hand pruned	MH 2 sprays	MH 3 sprays	Cultivar mean
Guardian	6.52	7.65	6.52	6.80	6.80a[y]
Earlidawn	6.52	7.08	6.80	5.66	6.52a
Mean	6.52a[z]	7.37a	6.66a	6.23a	

[z]Separation of treatment means by Duncan's multiple range test, 5% level.

[y]Cultivar mean separation by Duncan's multiple range test, 5% level.

moisture and nutrients by the roots. However, Denisen (19) and other investigators (26, 27, 36) found that reducing the number of plants by either spacing or sprays of MH, increased availability of water, nutrients, and solar radiation, thereby increasing yield and berry size. Christopher (11) found spacing of more than 15 cm in Rhode Island to be detrimental to yield with 'Premier' and 'Dorsett'. Twenty-three-cm spacings did not show any benefit the first year with 'Temple' (27).

It appears, from the findings in this experiment and the work of Brown and Hitz (6), that sprays should not commence when the populations have reached 321-486 plants per square meter regardless of their stage of development, but only when the desired population of plants has rooted.

Rooted plants, according to Denisen (19), Hitz (24), and Brown and Hitz (6), other than becoming chlorotic are not affected by sprays of MH, providing the sprays are not applied during the period of flower initiation. This study, as well as other studies of similar scope, have shown the effectiveness of MH in reducing plant population. Increases in yield and berry size, however, have been inconsistent(4, 19, 24).

The success of MH for future use is dependent upon several factors. First, proper spacing for individual cultivars must be determined. Second, methods of accurately determining the period of flower initiation is essential. Third, sprays must not begin until the desired population of rooted plants is obtained. Fourth, sprays should be applied every 3 weeks and stopped at the beginning of flower bud initiation.

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APPENDIX

Appendix. Table 8. Primary runner elongation of tagged runners of 'Guardian' and 'Earlidawn' strawberries from August 15 to October 31.

		Runner elongation (cm)			
Date	Cultivar	Control	MH 2 sprays	MH 3 sprays	Cultivar mean
8/15	'Guardian'	57.4	54.6	53.8	55.4 a[y]
	'Earlidawn'	48.0	46.4	45.7	46.7 b
	Mean	52.8 a[z]	50.5 b	49.7 b	
8/22	'Guardian'	75.2	70.6	64.7	70.1 a
	'Earlidawn'	58.7	53.5	53.1	55.1 b
	Mean	66.8 a	61.9 b	58.9 b	
8/29	'Guardian'	88.1	73.2	68.8	76.7 a
	'Earlidawn'	68.6	58.2	56.6	45.9 b
	Mean	78.5 a	65.5 b	62.2 b	
9/5	'Guardian'	95.8	72.6	69.1	78.9 a
	'Earlidawn'	74.6	62.9	57.4	65.0 b
	Mean	85.1 a	67.8 b	63.2 b	
9/12	'Guardian'	95.3	70.1	66.5	77.2 a
	'Earlidawn'	79.2	56.1	55.4	63.5 b
	Mean	87.3 a	63.2 b	60.9 b	
9/19	'Guardian'	100.5	69.8	69.0	79.7 a
	'Earlidawn'	83.1	57.3	56.1	65.3 b
	Mean	91.9 a	63.5 b	62.7 b	

[z] Separation of treatment means by Duncan's multiple range test, 5% level. Treatment x cultivar interaction was not significant

[y] Cultivar mean separation by Duncan's multiple range test, 5% level.

Appendix. Table 8.(cont'd). Primary runner elongation of tagged runners of 'Guardian' and 'Earlidawn' strawberries from August 15 to October 31.

		Runner elongation (cm)			
Date	Cultivar	Control	MH 2 sprays	MH 3 sprays	Cultivar mean
9/26	'Guardian'	100.8	69.1	66.5	78.7 a[y]
	'Earlidawn'	84.1	57.9	55.6	65.8 b
	Mean	92.5 a[z]	63.5 b	60.9 b	
10/3	'Guardian'	103.6	66.8	66.5	78.9 a
	'Earlidawn'	85.1	57.2	55.9	66.0 b
	Mean	94.2 a	61.9 b	61.2 b	
10/10	'Guardian'	105.4	67.3	64.7	78.9 a
	'Earlidawn'	84.1	53.8	57.4	65.0 b
	Mean	94.7 a	60.9 b	60.9 b	
10/17	'Guardian'	102.1	57.2	59.7	72.8 a
	'Earlidawn'	81.7	51.1	51.3	61.2 a
	Mean	91.9 a	54.1 b	55.4 b	
10/31	'Guardian'	103.1	41.7	50.3	65.0 a
	'Earlidawn'	82.0	54.1	40.6	58.9 a
	Mean	92.5 a	47.8 b	45.5 b	

[z] Separation of treatment means by Duncan's multiple range test, 5% level. Treatment x cultivar interaction was not significant

[y] Cultivar mean separation by Duncan's multiple range test, 5% level.

VITA

Rene J. Gingras was born June 4, 1951 in Rochester, New Hampshire. He received his primary education in Rochester, N.H. at Holy Rosary grammar school, and his secondary education at Desales High School, Geneva, New York. He entered St. Francis College, Biddeford, Maine in 1970, transferred to the University of New Hampshire in 1972 and was awarded a Bachelor of Science in Entomology with a minor in general Plant Science in 1975.

He worked for the Department of Entomology as an undergraduate and for the mosquito commission of N.H. at Hampton during the interim months before entering graduate school. In 1975 he entered graduate school at Virginia Polytechnic Institute and State University as a graduate in Plant Pathology and Physiology, Plant Protection option. He transferred, in January 1976, into the Department of Horticulture, where he worked on a quarter-time teaching assistantship while pursuing the Master of Science degree.

He was married to the former Shelly A. Sharples of Newmarket, N.H. in November, 1973.

Rene J Gingras

THE EFFECT OF MALEIC HYDRAZIDE IN CONTROLLING PLANT POPULATIONS IN THE STRAWBERRY IN SOUTHWEST VIRGINIA

by

Rene J. Gingras

(ABSTRACT)

The effects of Maleic Hydrazide (MH) in controlling strawberry plant populations were studied. Foliar applications of MH at 1000 ppm resulted in reduced runner length. The effect of MH sprays appeared to be directly related to the stage of rooting at the time of spray applications. Rooted plants were affected less than non-rooted plants. By the end of the growing season (Oct. 31) plant populations were significantly less than the control (matted row) and equalled that of a hand thinned treatment. Sprayed and hand-pruned plots were significantly lower in yield and fruit number. Berry size was the same for all treatments.