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Studies on the stinging of passionfruit by Queensland fruit fly, *Dacus tryoni* and its control by bait and cover sprays

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Summary

The main economic loss in passionfruit resulting from the stinging of green fruit by Queensland fruit fly is the downgrading in quality of the mature fruit which shows the effects of the stinging. Stinging is most important in the late summer crop and to a lesser extent in the winter crop. It is least important in the main crop in early summer.

In small plots malathion-protein hydrolysate bait sprays applied to boards on the trellis posts supporting the vines were almost as effective as cover sprays of 0.04% fenthion in preventing damage. In bigger field trials in commercial plantings the bait sprays applied to the trellis posts performed poorly, whilst the standard cover spray of 0.03% dimethoate proved effective in control.

INTRODUCTION

Passionfruit grown in south-east Queensland is subject to stinging in the green fruit stage by the Queensland fruit fly, *Dacus tryoni* (Froggatt). While some of the stung green fruit falls prematurely, the main economic loss according to Hargreaves (1979) is the downgrading of quality of the mature fruit since these early stings persist through to maturity and affect the appearance of the fruit. However, Hargreaves' results were based on one year's study only (1973–74) and it was desirable to obtain additional evidence. Also further confirmation was required on the seasonal incidence of stinging. In 1973–74 stinging was most severe in the later summer and winter crop flushes but very light in the most important flush in early summer.

The other purpose of these investigations was to compare the efficacy of protein hydrolysate bait sprays and cover sprays of 0.03% dimethoate and 0.04% fenthion for the control of *D. tryoni* in passionfruit.

The currently recommended control for *D. tryoni* is cover spraying with 0.03% dimethoate but 0.04% fenthion is also known to be effective. Repeated applications are necessary since passionfruit is grown commercially on small plots (less than 4 ha) and is therefore subject to continual infestation by flies which breed on other hosts. The decision to investigate protein hydrolysate bait sprays arose out of concern that cover sprays might affect predators and parasites of other passionfruit pests such as passionvine mealybug, *Planococcus pacificus* Cox and California red scale, *Aonidiella aurantii* (Maskell). This has now been shown to be the case (Murray 1978). Hydrolysed protein bait sprays were shown by Steiner (1952) to be effective against fruit flies in Hawaii on small plots of passionfruit and other crops (0.13 to 2 ha). However, he suggested that bait sprays may be more useful in large area operations. This has been the basis for subsequent suppression campaigns in Australia against *D. tryoni* in towns and larger areas using a combination of bait sprays and male lure traps (Jones and Skepper 1965; Bateman *et al.* 1966). In Queensland, bait sprays have been used successfully since 1976 against *D. tryoni* on small blocks of citrus (2 to 10 ha), (D. Smith, pers. comm.).

The efficacy of protein hydrolysate bait sprays was compared against cover sprays of 0.04% fenthion by one of us (Hargreaves) in small field trials at the Redlands Horticultural Research Station at Ormiston near Brisbane between 1975 and 1977 and against cover

sprays of 0.03% dimethoate in bigger field trials by one of the co-authors (Murray) at Nambour in 1975–76. Since preliminary tests had shown that commercial preparations of protein hydrolysate baits were phytotoxic to passionfruit the baits were applied either to the trellis posts supporting the vines or to boards attached to the posts.

MATERIALS AND METHODS

Studies at Ormiston

Studies were made on four widely-separated 0.07 ha blocks (A, B, C, D) each comprising 54 vines in their first year of cropping. Observations were concentrated on three blocks (B, C and D) and some records were obtained from block A. Areas C and D were treated against *D. tryoni* during the period October to April in 1976 and 1977. This treatment was in the form of a weekly schedule of either fenthion 0.04% active ingredient (a.i.) cover spray or Sanitarium protein hydrolysate containing 1.25% solids plus maldison 0.9% a.i. as shown in Figure 1. Area B received a weekly schedule of the fenthion cover spray from January to April 1977 only, while area A was not treated. Cover sprays were applied, by tractor-drawn sprayer, through a side boom with droppers using 90 L of spray per 54 vines. Bait sprays (100 mL) were applied to twenty-eight 0.5 m^2 marine 5-ply boards, spaced 5.5 m apart and attached 1 m up the trellis posts.

All fallen fruit, both green and mature, were collected daily and the number of stings per fruit was recorded. A count of all open flowers was taken between 1100 and 1200 hours daily.

Studies at Nambour

Five trials were conducted between February 1975 and April 1976 on passionfruit farms located near Nambour in south-east Queensland. The treatments for each of the five trials are given in Figure 3. Treatments were applied without replication to 0.5 ha blocks of passionfruit. There was usually only one treatment allocated to a passionfruit farm during a trial.

The standard treatment of 0.03% dimethoate was applied every 14 days using a low volume blow-mist sprayer applying 500 g/ha a.i. Bait sprays were prepared by mixing either 100 or 200 mL of protein hydrolysate with 50 mL maldison (50% emulsifiable concentrate) and 4.5 L water. The protein contents of the bait sprays were about 0.5% and 1.0% respectively. Every 7 days 50 mL of maldison-protein hydrolysate bait spray was applied to alternate tellis posts in each row (18 to 20 L/ha) using a Sprayrite ® pistol grip attached to a knapsack sprayer. Three protein hydrolysate formulations manufactured by ICI Australia Limited, Lanes Limited and Sanitarium Health Food Co. were used.

The efficacy of the treatments was determined by recording percentages of developing fruit stung by the fly. For this purpose 100 fruit (Trial 1) or 50 fruit (Trials 2, 3, 4 and 5) were tagged in each treatment. When tagging, fruit were selected at random from young fruit which had set but had not emerged from the flower remnants. All tagged fruit were unstung at the time of tagging. During each trial period fruit were also inspected weekly and the number of stings on each fruit was recorded. Most trials were of 3 weeks duration as the greater percentage of fly stinging occurred during the first few weeks after fruit set.

Monitoring of *D. tryoni* activity using the male attractant, cue-lure, together with either of the insecticides dichlorvos or maldison, was carried out during each trial to determine fly activity. Three millilitres of a mixture of equal parts of cue-lure and insecticide was applied to absorbent cotton wicks and placed in Steiner type traps. For the duration of each trial, two traps were placed in border vegetation around each 0.5 ha trial block Traps were emptied every 7 days and the weekly catches of *D. tryoni* were recorded. In Trial 3, the ICI 10 mL and the Lanes 200 mL treatments were applied to adjacent blocks of passionfruit and one set of trap data only was obtained.

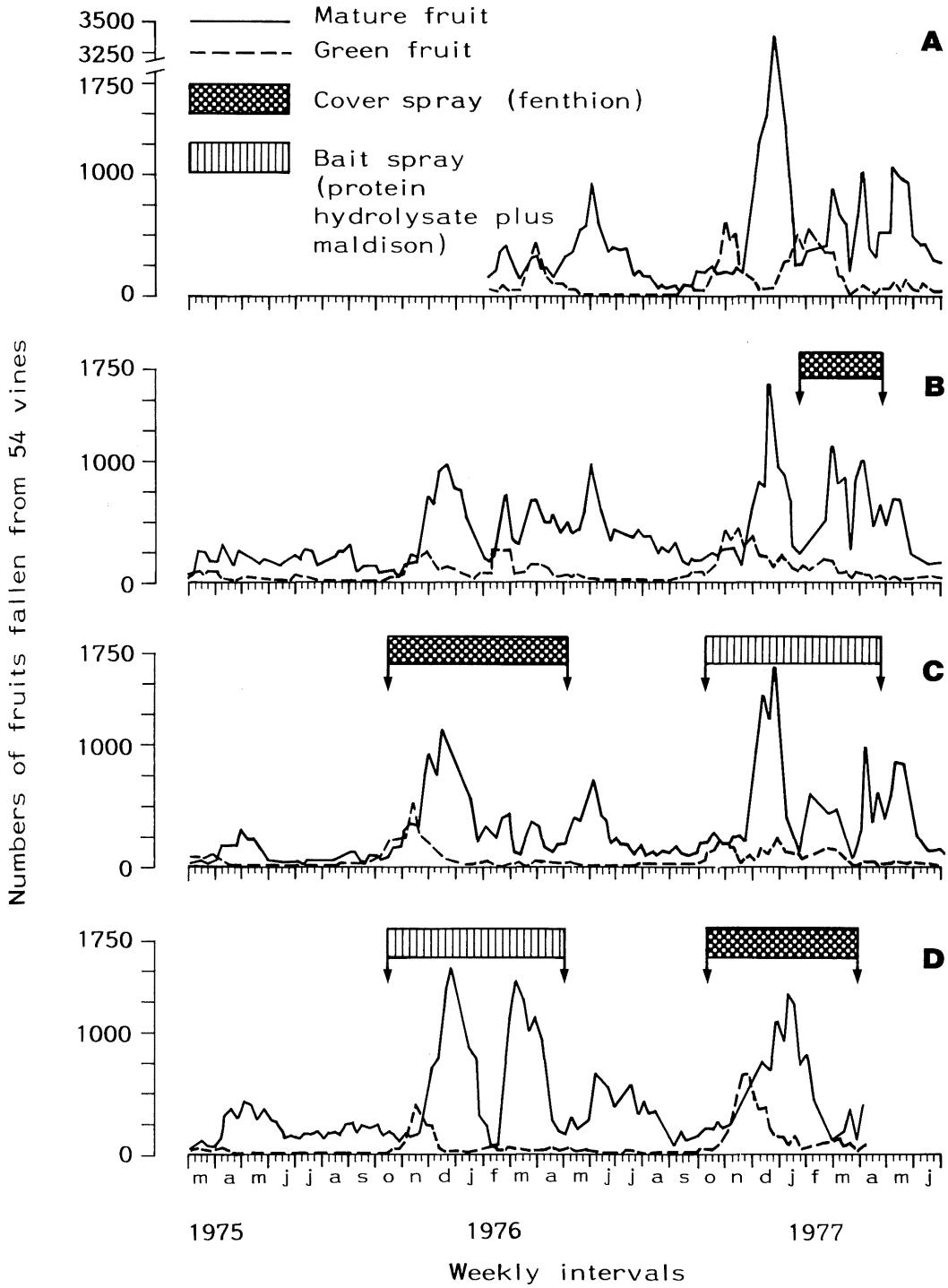

Figure 1. Numbers of fallen immature green fruit and mature fruit per 54 vines in the study areas A, B, C and D at Ormiston, 1975–77.

RESULTS AND DISCUSSION

The seasonal yield of E23 hybrid passionfruit and related damage by *D. tryoni* at Ormiston

The season variations in yield (mature fruit) shown in Figure 1 support the results of earlier work in 1973–74, reported by Hargreaves (1979). The main crop is in the early summer (October–January); a smaller crop with one or more peaks occurs in late summer (January–April) and a winter crop is also produced (May–August).

Stinging was almost entirely restricted to green fruit. Some of this fruit fell, while other stung fruit remained on the vine to fall at maturity. The seasonal incidence of stinging in the unsprayed areas is summarised in Table 1. Stinging in fallen green fruit was highest in January–April, in both 1976 and 1977, when the late summer crop was being produced. Stinging in such fruit was less in the preceding main crop produced in the early summer period October–December. The least stinging occurred during winter, May–September 1976. The results for early and late summer agree with earlier results for 1973–74 but that for winter differs from those for 1973 and 1974, Hargreaves (1979).

From Figure 2, the incidence of stinging of green fruit which fell prematurely is similar to the incidence of stinging of those green fruit persisting to fall at maturity.

The results in Table 1 also show that stinging by *D. tryoni* is not the cause of premature fall of green passionfruits. By calculation from column 4 in Table 1 it can be seen that the percentage of green fruit which fell without having been stung varied from 13% to 93%, with an overall mean of approximately 40%. Also, periods of higher incidence of stinging, as in January–April 1976 and January–April 1977, did not result in an increase in the percentage of the total crop which fell as green fruit when compared with October–December periods immediately preceding (Table 1, column 3). Finally, not all stung green fruit falls. As seen from the last column in Table 1 a considerable percentage of fruit stung as green fruit in the January–April period, when fruit fly is most active, remained on the vine to maturity. Fruit ripening time, calculated from peak flowering to peak fruit fall, averaged 10.6, 9.5, 11.4 weeks for the early summer, late summer and winter crops respectively.

Table 1. Bulking of the seasonal incidence of stinging by *D. tryoni* into unsprayed passionfruit over the main cropping periods at Ormiston

Location	Period of fruit fall	Crop falling as green fruit* (%)	Fallen green fruit which were stung* (%)	Fallen mature fruit which were stung* (%)
Area B	Oct–Dec 1975	28.8±4.7	32.3±10.0	3.7±0.9
Area B	Jan–Apr 1976	21.0±3.2	59.6± 8.0	78.0±7.1
Area B	May–Sep 1976	7.6±1.4	7.1± 1.9	11.9±2.7
Area B	Oct–Dec 1976	39.5±5.5	32.0± 9.2	2.5±0.6
Area A	Oct–Dec 1976	36.4±7.5	20.0± 8.8	0.4±0.1
Area A	Jan–Apr 1977	31.5±5.3	86.9± 2.3	70.3±8.4

*Means weekly counts±one standard error.

The main economic damage resulting from *D. tryoni* stinging of green fruit arises from the fact that the sting mark is apparent on the fruit at maturity and that such fruit is downgraded in quality by the trade. The downgrading varied from 0.4% to 3.7% of the main crop in October–December, 70.3% to 78% of the crop in January–April and was 11.9% of the May–September crop in 1976. These results concerning the economic importance of *D. tryoni* in passionfruit are in agreement with earlier results obtained in 1973–74, Hargreaves (1979).

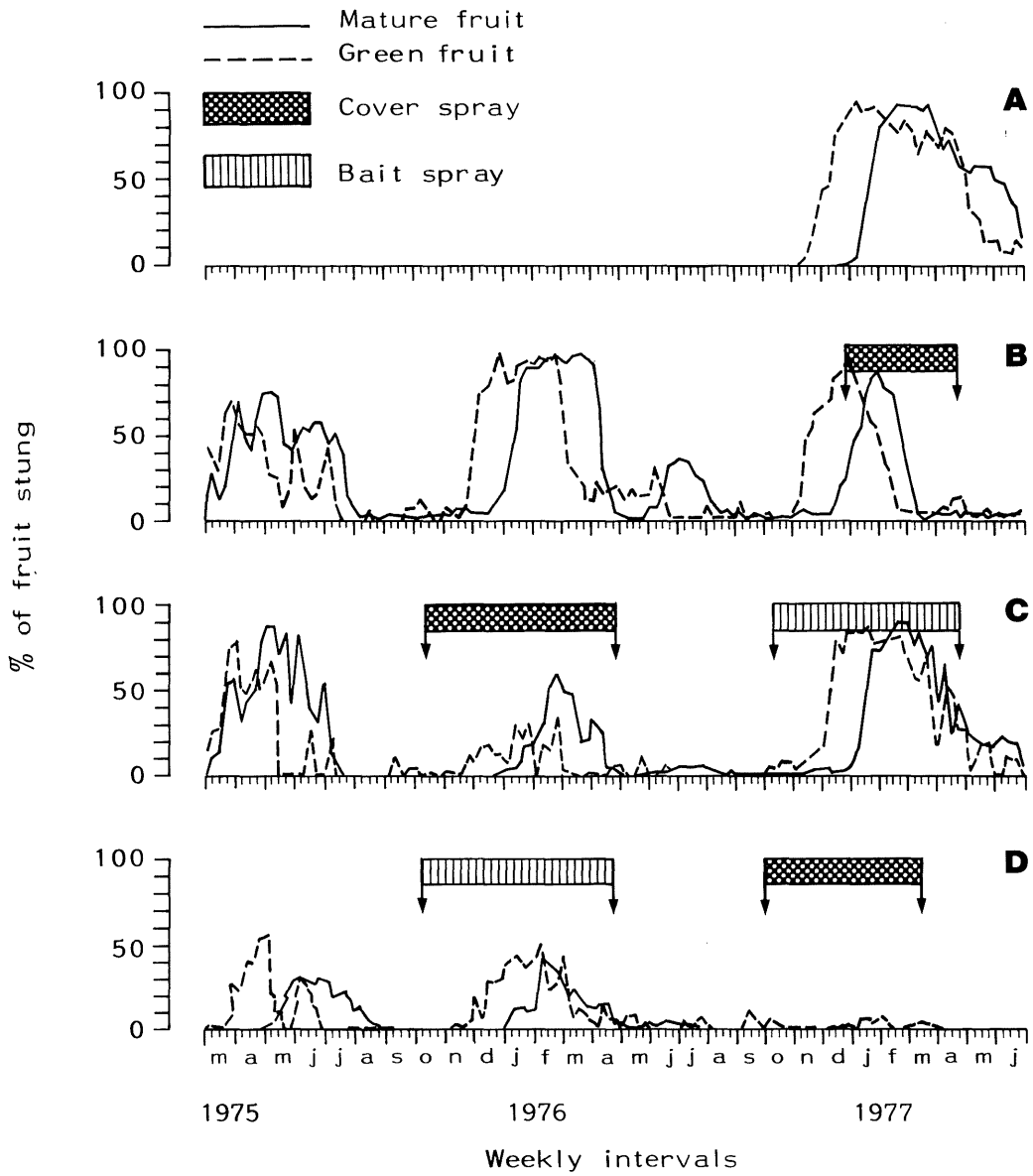

Figure 2. Weekly incidence of stung fruits from areas A, B, C and D, at Ormiston, during 1975–77.

Control of *D. Tryoni* with protein hydrolysate bait sprays compared with cover sprays of dimethoate or fenthion

The effects of bait spraying and fenthion cover spraying on the seasonal incidence of stinging at Ormiston as seen in mature fruits, are summarised in Table 2. Much less stinging occurred on sprayed than on unsprayed crops. However, there were no real differences in protection between bait spraying and cover spraying, with the exception of the late summer crop in 1977 when much better control was achieved with cover spraying.

Table 2. Bulking of the seasonal incidence of stinging by *D. tryoni* into mature fruits of unsprayed, fenthion cover sprayed and malathion-protein hydrolysate bait sprayed passionfruit at Ormiston

Cropping period		Percentage of fruits stung*		
		Unsprayed	Cover spray	Bait spray
Early summer	1975–76	16.7±6.8	3.3±1.4	3.1±1.3
Late summer	1976	82.8±7.8	32.6±5.2	22.1±3.5
Winter	1976	14.3±3.2	2.3±0.5	1.9±0.4
Early summer	1976–77	11.0±4.1	0.5±0.1	4.9±2.6
Late summer	1977	86.5±3.6	0.2±0.1	70.6±5.3

* Mean weekly counts±one standard error.

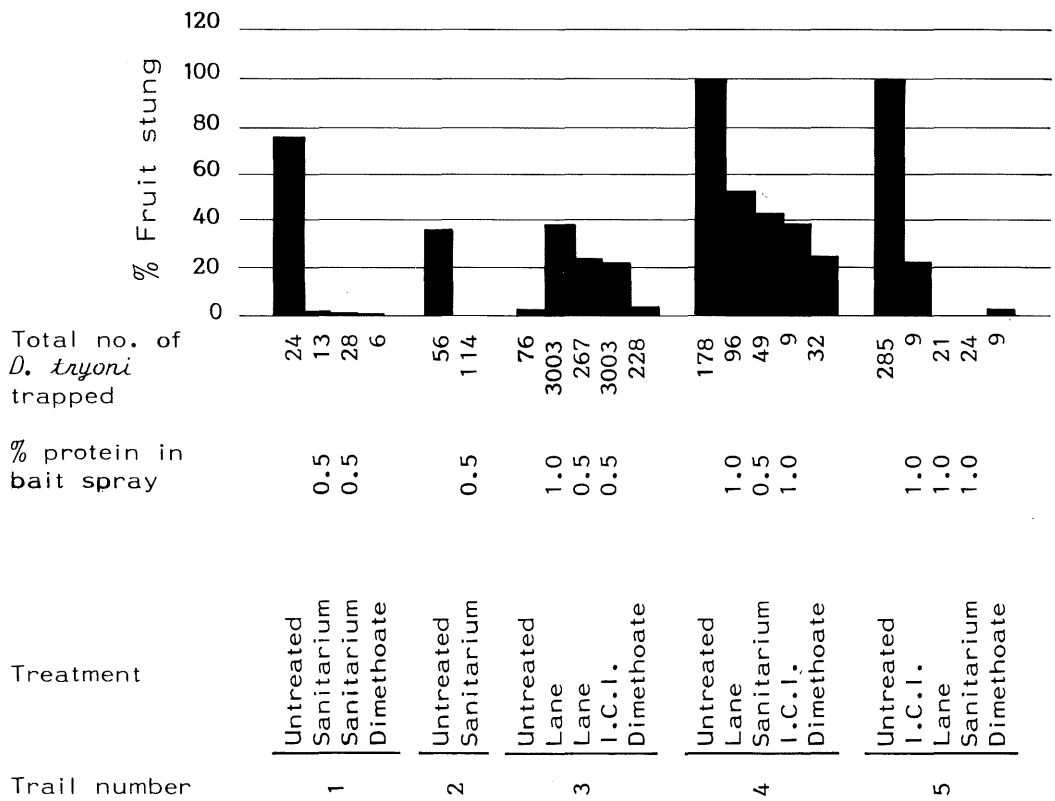

Figure 3. Mean percentage of passionfruit stung by *D. tryoni* and the total number of flies trapped by cue-lure during five insecticide trials at Nambour, 1975–76.

The results for the five field trials at Nambour are given in Figure 3. The severity of fruit fly attack was clearly demonstrated on the untreated blocks where up to 100% of all fruits sampled were stung. However, in Trial 3 there was an inexplicable low level of fly damage on the untreated block.

The standard treatment of 0.03% dimethoate spray afforded good control, with a low percentage of fruit sustaining fly injury in all trials except Trial 4. Wet weather prevented the application of the first schedule spray in this trial and 23% of fruit were stung before spraying was possible. Maldison-protein hydrolysate bait sprays provided unreliable control of *D. tryoni* under the commercial growing conditions at Nambour. Not only were there differences in the level of control afforded by the different bait formulations, but the level of control afforded by the same bait formulation varied from one trial to the next.

The better control by cover sprays in passionfruit is in agreement with findings by May (1961) and Bateman (1978). The apparent failure of bait sprays to control *D. tryoni* on passionfruit under the commercial conditions at Nambour may be attributed in part to the relatively small areas treated, but the method of application may also have been a factor. Because of phytotoxicity problems the baits were applied to the trellis posts and not directly to the foliage. Better results might have been obtained had foliar application been possible since Steiner (1955) observed that flies respond best to baits when the sprays are applied to the foliage of the host plant.

Fruit fly activity at Nambour, as measured by trapping of male *D. tryoni*, varied from site to site (Figure 3). On the untreated blocks there was a positive correlation (r=0.84) between the number of flies trapped per week and the percentage of fruit stung per week. Such a correlation was not obtained for the treated blocks.

The Nambour trials confirmed the efficacy of the standard 0.03% dimethoate spray for control of *D. tryoni* on passionfruit in south-east Queensland and demonstrated that maldison-protein hydrolysate bait sprays applied to the trellis posts did not provide satisfactory control of this pest. However, the successful use of bait sprays on large areas of citrus in Queensland together with their inherent advantages when used in integrated pest management programmes suggest that they should be investigated further (D. Smith, pers. comm. 1980). Improvement in efficacy is required to control invasions of flies into the small plots of passionfruit and a formulation is needed which can be applied safely to the foliage.

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