Summary

The mechanization of harvesting vegetables in Florida has developed rapidly in recent years. The rate of development has been more rapid with some vegetables than with others, owing partly to the differential susceptibility of vegetables to damage resulting from the harvest operation. Techniques and machinery have been developed for mechanizing the harvest of potatoes, radishes, corn, celery, lettuce, cabbage, cauliflower, cucumbers, peppers, and other fresh vegetables.

Succulent fresh vegetables are generally easily damaged, whether they are harvested by hand or with the aid of a mechanical device. There may be some economic justification for the amount of damage being greater from mechanical harvest than from hand harvest, provided the reduction in harvest labor sufficiently offsets the labor or effort required to remove the damaged vegetable at the packing line. However, careful control must be exercised to maintain good quality and insure salability of mechanically harvested vegetables.

LITERATURE CITED

EFFECTS OF COMBINING HYDROCARBON INSECTICIDES WITH PARATHION OR DIAZINON FOR LEAF MINER CONTROL ON TOMATOES

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It has been known for some time that the use of organic insecticides against a particular pest will, at times, cause a build up of another pest. Recently Roberts (3) reported that the application of dieldrin granules for red rust thrips, Chaetanophothrips orchidii (Moulton), control was associated with an outbreak of the banana stalk borer, Castniomera humboldti (Bois), in Panama and Costa Rica. The ants and other natural enemies which generally prey on the eggs and other stages were eliminated, which allowed the borer to increase to devastating proportions. Before the application of dieldrin the borer was present in small numbers, but as soon as its natural enemies were reduced it became a pest of economic importance.

It has also been shown that the use of some insecticides will cause an increase in serpentine leaf miner populations. Hills and Taylor (2) have reported that repeated applications of DDT killed the parasites of the leaf miner, Liriomyza spp., resulting in an increase in the leaf miner population. Wene (4) reported that DDT, TDE and Methoxychlor, applied as a 5% dust, resulted in an increase in the number of leaves infested by L. subpusilla (Frost). On peas Wene (5) later showed that 78% more parasites were recovered from plots treated with aldrin than from plots which received no insecticide, but the leaf miner population was 182% higher than in the check, indicating that aldrin actually created an environment which favored the development of leaf miners. DDT, in the same test, caused a reduction in parasites and an increase in leaf miners. Although these relationships are known, there

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is little information on the effects of these materials when combined with a phosphatic insecticide for leaf miner control. Baranowski (1) reported that parathion combined with DDT, applied as a dust on pole beans, resulted in poorer control of the serpentine leaf miner, *Liriomyza pusilla* (Meig.), than parathion alone, suggesting that the preventive use of DDT combined with parathion actually increases the leaf miner problem and makes control more difficult.

Much of the spraying of tomatoes for insect control is of the preventive type combining two insecticides, a phosphatic for leaf miner control and a hydrocarbon for worm control. Leaf miner control measures are usually necessary throughout the season, while lepidopterous larvae, or worms, are only an occasional problem. However, the two insecticides are combined and used on a regular schedule regardless of the necessity. For this reason it seemed desirable to determine if this type of application is actually worth while.

Tomato plants of the Homestead variety were set in the field January 20, 1959. Plots consisted of two rows, 36 ft. in length, replicated four times. Parathion and Diazinon alone and in combination with DDT, Kepone and Toxaphene were applied on a weekly schedule beginning February 3. The amount of Diazinon used was reduced in order to avoid masking the effects, if any, of the insecticides with which it was combined. Unless otherwise stated, this low dosage of Diazinon will be referred to. Leaf mine counts were made February 19 and March 5. Results are given in Table 1.

At the time of the first count the number of mines was fairly low, but adult flies were very numerous, indicating that the population was high and that the number of mines would probably increase. It can be seen in the table that during the two weeks between counts the number of mines had nearly doubled.

Analysis of the February 19 data reveal that there is no statistical difference between Diazinon plus DDT or Kepone or Toxaphene. However Diazinon plus Toxaphene is statistically better than Diazinon plus DDT. The data also indicate that there is no difference between parathion and parathion plus DDT or Kepone. Parathion plus Toxaphene however, is significantly better than any of the other parathion treatments, being second only to the higher dosage of Diazinon, and statistically equal to it.

Thus, under the conditions up to this count, a low population of leaf miners and probably a low population of parasites, none of the hydrocarbons used had any adverse effect on leaf miner control by parathion or Diazinon. On the contrary, 1/2 lb. of Diazinon plus 2 lb. of Toxaphene provided about as good control as 1 lb. of Diazinon. One lb. of parathion plus 2 lb. of Toxaphene was better than parathion alone and statistically equal to 1 lb. of Diazinon.

Analysis of the March 5 data show a few changes. There is a significant difference between Diazinon and Diazinon plus DDT.

**Table I.**

<table>
<thead>
<tr>
<th>Treatments and amount form. per 100'gal.</th>
<th>Avg. no. of mines per leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feb. 19</td>
</tr>
<tr>
<td>Check</td>
<td></td>
</tr>
<tr>
<td>Diazinon 25% WP, 1 lb.</td>
<td>13.6</td>
</tr>
<tr>
<td>Diazinon 25% WP, 1/2 lb.</td>
<td>1.3</td>
</tr>
<tr>
<td>Diazinon 25% WP, 1/2 lb. + DDT 50% WP, 2 lb.</td>
<td>5.4</td>
</tr>
<tr>
<td>Diazinon 25% WP, 1/2 lb. + Kepone 50% WP, 2 lb.</td>
<td>7.1</td>
</tr>
<tr>
<td>Diazinon 25% WP, 1/2 lb. + Toxaphene 40% WP, 2 lb.</td>
<td>4.3</td>
</tr>
<tr>
<td>Parathion 15% WP, 1 lb.</td>
<td>1.3</td>
</tr>
<tr>
<td>Parathion 15% WP, 1 lb. + DDT 50% WP, 2 lb.</td>
<td>10.0</td>
</tr>
<tr>
<td>Parathion 15% WP, 1 lb. + Kepone 50% WP, 2 lb.</td>
<td>13.2</td>
</tr>
<tr>
<td>Parathion 15% WP, 1 lb. + Toxaphene 40% WP, 2 lb.</td>
<td>6.2</td>
</tr>
<tr>
<td>Parathion 15% WP, 1 lb. + Toxaphene 40% WP, 2 1/2 lb.</td>
<td>2.9</td>
</tr>
</tbody>
</table>
There is no statistical difference between Diazinon and Diazinon plus Kepone or Toxaphene. There is also a significant difference between parathion and parathion plus DDT. There is no difference between parathion and parathion plus Kepone. Parathion plus Toxaphene remains the best of the parathion treatments.

When the leaf miner population increased, and presumably the leaf miner parasites also, DDT had a definite effect on the leaf miner control by Diazinon and by parathion. One-half pound of Diazinon provided 73% control, but the addition of DDT reduced the control to 39%. Although control by parathion was poor, the addition of DDT reduced it to nothing. The control by ½ lb. of Diazinon plus 2½ lbs. of Toxaphene was not as good as 1 lb. of Diazinon, nor was parathion plus Toxaphene as good as 1 lb. of Diazinon. This combination was still the best of the parathion treatments, but the control could no longer be considered adequate.

On March 11 fifty leaflets containing mines were obtained from each of the four replicates of the Diazinon, Diazinon plus DDT and the check treatments. The samples were placed in emergence cages and held for 4 weeks. At the end of this period the number of parasites recovered was recorded. An average of 30.25 parasites were recovered from the check samples, 5.00 from the Diazinon samples and 0.75 from the Diazinon plus DDT samples. The parasites were identified as Solenotus intermedius (Grt.), Diaulinopsis callichroma Cwfd., Chrysocharis parksi Cwfd., members of the family Eulophidae and Opius dimidiatus Ashm., a member of the Braconidae. O. dimidiatus was the most abundant.

It would seem that at certain times of the year the parasites of the serpentine leaf miner provide a high degree of natural control and probably have some effect on the leaf miner population throughout the season. The number of parasites recovered from the plots certainly shows that both treatments kill a high percentage of the parasites, though Diazinon alone is not as lethal as Diazinon plus DDT. The difference in the number of parasites recovered from the two treatments, 5 from the Diazinon samples and 0.75 from the Diazinon plus DDT samples, is not as striking as the difference in the degree of control, 73% and 39% respectively, obtained from these materials. Judging from these differences it would seem that the differences in control cannot be attributed only to the parasites, since the parasite recovery from the Diazinon plots is not particularly high. A possible explanation is that even though Diazinon kills many of the parasites, it has little residual action allowing additional adult parasites to move in and parasitize the leaf miner larvae. Even though these immature parasites are killed by future applications of Diazinon, the leaf miners are also killed either by the insecticide or by the parasites. DDT, however, is highly toxic to the parasitic wasps and persists for a longer period, preventing the wasps from moving into a field and parasitizing the leaf miner larvae. This effect, combined with little or no effectiveness against the leaf miner, directly results in a rapid increase in the leaf miner population.

It should be noted that these results were obtained on small plots and over a comparatively short time. Since the parasites move about from plot to plot, it is to be expected that those surviving an insecticidal treatment in one plot might be killed when moving to another plot with a residual type insecticide. This would narrow the difference between the two treatments. Similarly the leaf miner population in a given plot is affected by the abundance of miners in adjacent plots. For these reasons one could logically expect the differences to be greater if the treatments were applied to large areas. One would also expect a greater build up of parasites with a longer period of time. As a corollary, the leaf miner problem would probably become more acute the longer an insecticidal program was followed which depressed the build up of parasites.

The idea of preventive application of insecticides, as such, is a commendable one and is practiced widely on vegetable crops having a potentially high cash value. The use of insecticides to control the serpentine leaf miner is essentially preventive application. The main advantage of this type of program is that a routine is established. It is easier and usually more dependable to tell someone to spray on a regular schedule rather than only when necessary. In some cases this is the only possible method of spraying. However, when the insect situation is such that different insecticides are necessary to control the various pests, the application of a combination of insecticides on a preventive program is highly questionable,
particularly if DDT is one of the materials. It is certainly more economical, both from the standpoint of the amount of insecticide used and from the value derived from the application, to use an insecticide for worms on tomatoes only when necessary.

LITERATURE CITED

PRELIMINARY WORK WITH SYSTEMIC INSECTICIDES ON TOMATOES

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Systemic insecticides have been defined as those compounds which are absorbed by the plant and translocated in quantities sufficient to make the site of translocation insecticidal for a period of time. Although Hurd-Karrer and Poos (4) reported in 1936 that wheat growing on seleniferous soils was not attacked by aphids and shortly after Fulton and Mason (2) produced evidence for the translocation of derris in bean plants, most of the work dealing with field application of systemic insecticides has been published during the last ten years.

Systemic insecticides have been shown to be effective against many insects and to persist in plants for long periods. Hanna (3) has shown that seed treatments with systemic insecticides protected cotton from thrips for 4-6 weeks after planting. Bowman and Casida (1) have reported that systemics implanted in the trunks of cacao trees persisted in the foliar portions for as long as 20 months. Schread (6) reported that effective control of the birch leaf miner, Fenusa pusilla (Lep.), the holly leaf miner, Phytomyza ilicis (Curt.), and the boxwood leaf miner, Monarthropalpus buxi (Lab.), was obtained by applying systemic insecticides on the ground under the plants. Parencia et al (5) have reported that in one test on cotton no infestations of the serpentine leaf miner, Liriomyza pusilla (Meig.), developed in plots treated with systemic insecticides, but 73% of the plants in the check were infested.

Since the serpentine leaf miner is one of the more important insect pests of tomatoes, experiments were designed to determine the effectiveness of three systemic insecticides against this and other pests of tomatoes.

The first experiment was conducted on seedbeds to determine if any of the treatments would reduce or delay germination, as well as to determine insect control. The beds were irrigated a few hours prior to seeding. Carbon and granular formulations of each insecticide were used. The carbon formulations were applied at the rate of two pounds of the formulation to twenty-five pounds of seed. The seed was placed in a container, moistened slightly and the insecticide added. The container was then shaken until the seeds were as uniformly coated as possible. A methyl cellulose sticker was added to the Di-Syston to aid adherence. The granular formulations of the insecticides were applied to the beds at the rate of two pounds of the formulation to twenty-five pounds of seed. The seed was placed in a container, moistened slightly and the insecticide added. The container was then shaken until the seeds were as uniformly coated as possible. A methyl cellulose sticker was added to the Di-Syston to aid adherence. The granular formulations of the insecticides were applied to the beds at the rate of one ounce per 20 sq. ft. at the time of seeding. At this rate the 2% formulation was applied at 2.7 lbs. active per acre, the 5% at 6.8 lbs. and the 10% at 13.6 lbs. per acre. Seed was planted at the rate of ½ oz. per 20 sq. ft. This amount was excessive, but a thick stand was desired to provide a greater dilution factor for the insecticides. No delay or reduction of germination was observed, nor were any phytotoxic effects noted during the experiment.

Twenty-one days after preparation the plots were examined for leaf miner damage. A second evaluation was made 8 days later. In both cases 50 plants were pulled at random from each plot and the number of mines per plant recorded. The results, expressed as the average number of mines per plant and also as