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THE OHIO STATE UNIVERSITY EXTENSION

Extension FactSheet

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# An Integrated Pest Management Program for Carrot Weevil in Parsley

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## Introduction

Parsley growers in the Great Lakes Region of the United States and Canada face yield reduction in parsley from carrot weevil infestations. Carrot weevil larvae feed in parsley roots, which kills plants and lowers the yield and market quality of the harvested leaves and petioles. According to growers in Ohio, most of the damage is seen at the second cutting of parsley, but the only way to control weevils is to spray insecticide against adults many weeks before damage is noticeable. Questions that growers must consider include whether or not to spray, when is the best time to spray, what action threshold to use, how to monitor the weevil population with accuracy, and what transect or path through the field is the best for sampling the weevil population. The answers to these questions are given in this fact sheet, along with information on carrot weevil biology and seasonal activity. The control decision rules or protocols presented here constitute a valuable tool for parsley growers to keep the carrot weevil population low, by improved timing of pesticide applications, thereby reducing economic losses.

*Figure 1. Carrot weevil adult.*

*Figure 2. Overwintering parsley field with few surviving plants, as typical in early April.*

## Life History

### *Adult Stage*

Carrot weevil adults (Fig. 1) have functional wings but rarely fly. They walk from their overwintering sites to new parsley fields, or to any other host like carrot and celery. The adult weevils overwinter in or near parsley fields, particularly those with parsley left standing during the winter season (Fig. 2). They spend the cold weather under plant residues, or about one inch below the soil surface around parsley plants. If the parsley field is plowed at the end of the crop season, and before the weevils have entered the resting or diapause stage, then the adults may be forced to walk away to overwinter in hedgerows or other sites nearby. They hide under plant debris, sod, or wood pieces.

In early spring, the surviving overwintering parsley plants resume vegetative growth at the same time that the overwintering adult weevils become active and seek host plants on which to feed and reproduce. If the overwintering parsley field can provide food and places to lay eggs in early spring, then the adult weevils do not need to walk away; if the overwintering parsley does not provide food, or if it is plowed in spring, then the weevils have to move away and any parsley field planted nearby can become infested.

Adult weevils are active in new parsley fields from approximately mid-May until the end of June, but the most activity occurs from late May until mid-June. At the end of August, a new population of adult weevils is present in the field, but the majority of this weevil population does not cause damage to the current year's crop. These weevil adults overwinter and reproduce in the following crop season (Fig. 3).

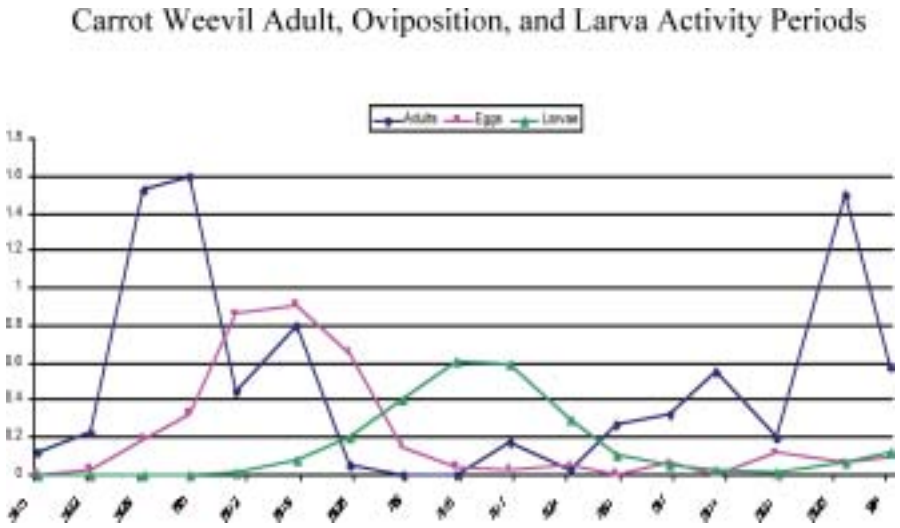


*Figure 3. Seasonal activity for three different carrot weevil stages: average number of adults per 3 meters of row, average number of eggs per plant, and average number of larvae per root.*

## *Egg Stage*

Adult weevils begin laying eggs when parsley plants have an average of four true leaves (Fig. 4). Weevil females make punctures in the plant petioles and deposit an average of three eggs inside. They then cover the oviposition scars with a dark tar-like substance. The oviposition scar looks like a round dark spot, approximately 1 mm (1/25 inch) in diameter (Fig. 5). The scar can be present anywhere in the petiole, but is most often in the concave side. The eggs are white or yellow during the first day, then gradually darken to black when the larvae are ready to hatch, which is about five days after the eggs are laid (Fig. 6). The oviposition period occurs from mid-May until the end of June, with the highest numbers of eggs per plant occurring in June (Fig. 3).

*Figure 4. Parsley plant at the four true-leaf stage, showing the fourth leaf fully expanded. Carrot weevils seldom lay eggs in smaller plants.*

*Figure 5. Carrot weevil oviposition scar in a parsley petiole.*

*Figure 6. Carrot weevil eggs.*

### *Larval Stage*

The newly hatched larvae get to the crown and root to feed by moving down the petiole or dropping to the ground. Sometimes the larvae tunnel inside the petiole, if the egg was laid close to the base of the petiole. Larval feeding can be on internal plant parts, which usually results in severe injury (Fig. 7), or close to the outer layer of the root. Infested young plants generally die (Fig. 8), but large plants can withstand even severe internal damage. Carrot weevil larvae (Fig. 9) feed in the roots for approximately 20 to 30 days, mainly in July (Fig. 3).

*Figure 7. Parsley root showing severe internal damage caused by the carrot weevil larva.*

*Figure 8. Parsley plants dead and damaged due to feeding by carrot weevil larvae.*

*Figure 9. Carrot weevil larva.*

### *Pupal Stage*

Fully grown larvae stop feeding and leave the root to pupate in the surrounding soil. The larva makes an earthen cell in which to pupate (Fig. 10). Once the pupal cell is made, the larva enters the prepupal stage and transforms to a pupa in two to seven days. During the pupal stage (Fig. 11), the larva changes dramatically and transforms to an adult in about three to 14 days. Weevils remain inside the pupal cell for about one to five days before emerging from the soil surface.

*Figure 10. Carrot weevil pupa inside an earthen cell.*

*Figure 11. Carrot weevil pupa.*

## Control Strategies

Leaving the overwintering parsley fields as a trap crop without spraying could be a good cultural practice to keep adult weevils away from new parsley fields. If the parsley trap crop is disked and plowed down immediately after the first cutting, few weevil larvae would survive.

Biological control by application of entomopathogenic nematodes is an option that shows promise for the future. This might prove to be a good biological control practice in overwintering fields if nematodes are sprayed before the adult weevils become active. Further research is needed before this option can be recommended.

At present, chemical control in early summer is the most reliable way to control carrot weevil on parsley. Adults that survive the summer could be sprayed with insecticide at the end of the crop season in autumn, but if some of the weevils

had already taken refuge for the winter under plant residues or below the soil surface, they might escape the control treatment. Growers can more reliably spray insecticide and kill these weevils in May when all of the adults have become active. Research has shown that a single well-timed application provides good control. Details about deciding when to spray insecticide are given here.

## Action Thresholds

Loss from carrot weevil infestations can be predicted from the relationship between the percentage of parsley plants infested with carrot weevil and parsley yield. Taking into account the predicted loss, the average cost of control, and the average market value of parsley provided by parsley growers, more than 1% of plants infested with carrot weevil oviposition scars would produce enough damage to justify the cost of control by insecticide. The action threshold therefore is 1% of plants infested.

## What to Sample

Carrot weevil infestations can be detected by examining plants for oviposition scars, which is easier than sampling for adults. To check a suspected oviposition scar, rub off the dark spot and check for a puncture beneath. If a puncture is found, a weevil has deposited eggs in it.

## When to Sample

Sampling should start when parsley plants have four true leaves (Fig. 4), or about mid-May for the earliest plantings. If sampling results in the decision to not treat, then the field should be sampled again the following week.

## How many plants to sample

The action threshold is one plant infested out of 100 plants. Because this action threshold is so low, a grower should be able to inspect many plants without finding oviposition scars if treatment is not necessary. Based on statistical formulae, if 148 plants can be inspected without finding any oviposition scars, then there is a 95% chance that the percentage of infested plants is less than 2%, and no treatment is needed. A maximum sample size of 148 plants is thus recommended. One person can sample 148 parsley plants in a commercial field in one hour; each plant takes very little time. If an infested plant is found before all 148 plants are examined, then the chance that the field is above the action threshold is high enough that the grower can stop sampling and decide to treat.

## How to walk the field

We compared some of the paths a grower could take through parsley fields to determine which would give the most accurate sample with the least walking. An X-shaped path that goes from corner to corner, in any direction was found to be the best (Fig. 12). Of several walking patterns tested, this X-shaped path led to the most correct decisions and the fewest incorrect decisions regarding the need for treatment. The starting point can be any corner. Each of the two diagonal paths must be divided into approximately 10 sections. Seven plants per section must be sampled along the first diagonal, and eight plants per section must be sampled along the second diagonal. Within each section, plants should be randomly selected.

Figure 12. An X-shaped transect is the best pathway to sample parsley fields for carrot weevil oviposition scars.

## Conclusion

Sampling in new parsley plantings should begin as soon as plants reach the four true-leaf stage. One person can sample 148 parsley plants in a commercial field in one hour; each plant takes very little time. If parsley growers sample their fields following the rules provided here, then they should be able to time their insecticide sprays carefully to avoid economic loss, either from spraying too soon or too late, too much or not enough.



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