Cooperative Extension • Monterey County

Crop Notes

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TIME OF CABBAGE MAGGOT ATTACK RELATIVE TO BROCCOLI PLANT DEVELOPMENT IN THE SALINAS VALLEY

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Cabbage maggot (*Delia radicum*) is one of the most destructive pests of cruciferous crops in the Salinas Valley. Cabbage maggot flies lay eggs in the soil around the base of the plant. A single female can lay about 300 eggs under laboratory conditions. Legless,8-mm long white-maggots feed on the taproot and affect normal plant development. After about 3 weeks of feeding, the maggot pupates in the surrounding soil and remains at this stage for 2-4 weeks before emerging into an adult fly. The most common above-ground feeding symptoms of cabbage maggot are yellowing, stunting and slow growth.

Because the winter weather in the Salinas Valley is mild and rarely goes below freezing point, not all cabbage maggot pupae go into a resting stage, often called as diapause. This means our unique environment enables cabbage maggot flies to remain active even in winter months, producing multiple overlapping generations throughout the year. In this post organophosphate era with stringent restrictions for chlorpyrifos and diazinon use and less persistent insecticides being available for cabbage maggot management, knowledge of field-level incidence of cabbage maggot infestation is critical to determine precise timing for insecticide applications in brassicas. We studied the temporal incidence of cabbage maggot relative to seeded broccoli and turnip in the Salinas Valley.

Cage studies showed that severe injury from cabbage maggot did not appear during the first 14 days after plant emergence but was greater during 15-28 days after plant emergence. Similarly, survey in broccoli fields indicates that cabbage maggot flies did not lay a high number of eggs at the base of the plant until three weeks after plant emergence, despite presence of adult cabbage maggot in the field during the early stages of plant development (Figures below). On turnip, notable injury from cabbage maggot did not appear until five weeks after plant emergence. This is important information because typically insecticides targeting cabbage maggot were applied mostly at planting. Researchers showed that cabbage maggot infestation could be suppressed by using organophosphate insecticides, particularly chlorpyrifos, for more than a month after planting because product residues persisted for an extended period. However, most of us are not using these insecticides and a consistent cabbage maggot control using organophosphate insecticides was never attained in the Salinas Valley. I'm working on insecticides to determine their effectiveness against cabbage maggot and will share that information as soon as it is available.

It is unclear why increased cabbage maggot oviposition did not occur during the early stages of plant development. It is possible that the invading cabbage maggot flies cannot distinguish the young seedlings at a certain size relative to the surrounding area of bare soil. Cabbage maggot populations and crop injury from this pest tend to be more abundant in the border than the interior zone of the field; this invasion pattern continues throughout the growing period. In conclusion, our data suggest that the important season periods in the central coast vegetable production area to consider targeting cabbage maggot control are three to four weeks after planting the seeds. I will continue to monitor if other maggot species (seedcorn maggot or onion maggot) which could attack when brassica plants are at younger stages especially during spring or early summer.

For those of you, who are interested to read more on it, please find the published article after clicking the link (below) and feel free to contact me (Shimat Joseph) at svjoseph@ucanr.edu or 831 759 7359.
http://cemonterey.ucanr.edu/files/190245.pdf

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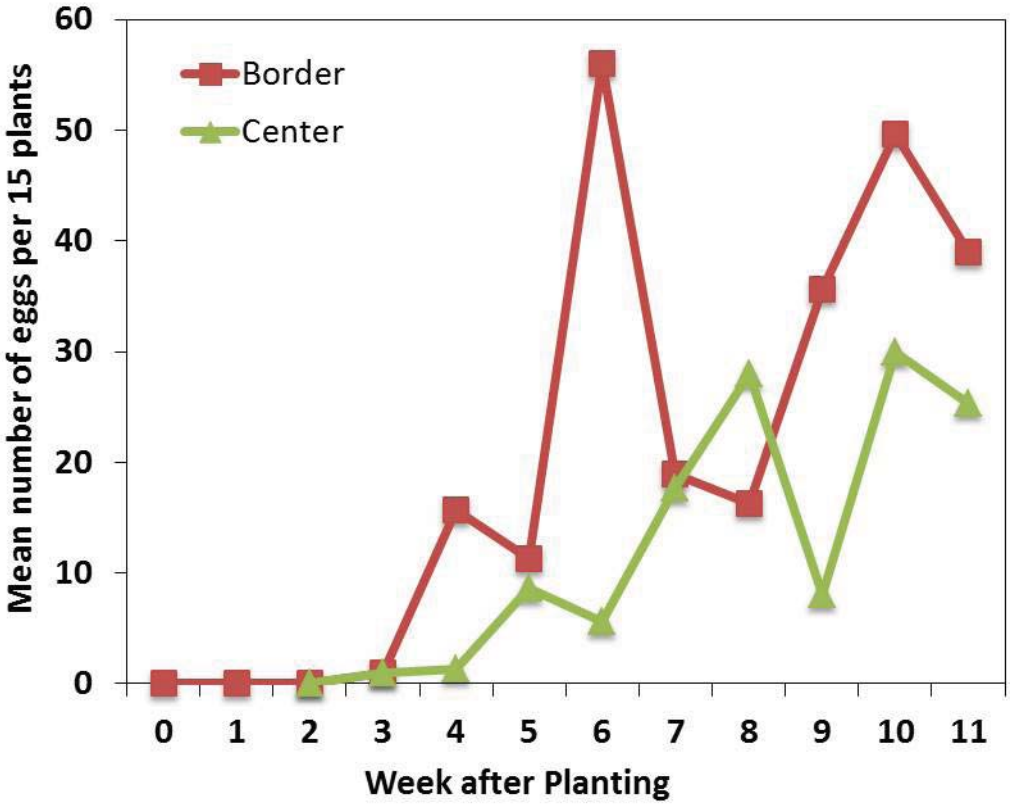

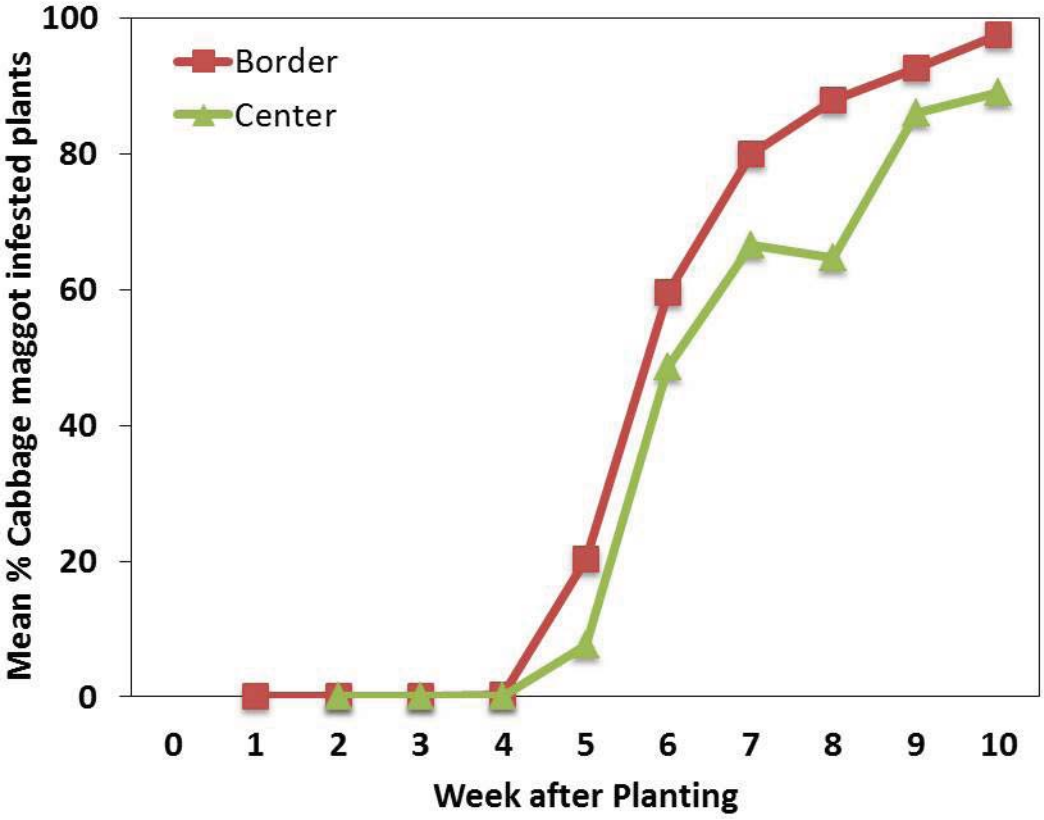

WEEDS AS SOURCES OF IMPATIENS NECROTIC SPOT VIRUS

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Virus outbreaks in lettuce: Beginning in 2006 and continuing through 2014, outbreaks of *Impatiens necrotic spot virus* (INSV) are found on lettuce in the Salinas Valley. Symptoms of this disease include stunted plant growth, overall yellowing, irregular-shaped, tan to dark brown spots or ringspots on leaves, and marginal leaf necrosis (Fig. 1). Lettuce infected at the seedling through rosette stages can be severely stunted and not form marketable heads (Fig. 2). Disease severity reached a peak in 2008 and 2009; though severity recently has decreased, the disease still occurs every year and appears to be established in the Salinas Valley. In 2011 and 2012, this disease also occurred in the Santa Maria Valley (Santa Barbara County). The disease is not seedborne, does not persist in the soil, and is spread only by thrips, primarily the western flower thrips (WFT).

INSV in other crops: Historically, INSV was considered to be a virus pathogen primarily of ornamentals; indeed, a number of ornamental crops in Monterey County are commonly infected with INSV, including aster, begonia, calla lily, chrysanthemum, lisianthus (Eustoma), orchids, and many others. However, recent findings from UC Cooperative Extension in Monterey County, along with many other researchers worldwide, document that INSV is being found more often in non-ornamental crops. In the Salinas Valley, INSV has caused damage to a number of vegetable crops, including the following: basil, bell pepper, celery, faba bean, radicchio, and spinach. Elsewhere, reports of new INSV hosts include blackberry, potato, tomatillo, and tomato. Therefore, this virus is potentially damaging to a number of Salinas Valley crops besides lettuce.

Disease development and weed surveys: Along with researchers from UC Davis, our coastal research team investigated how the disease develops in the Salinas Valley. As part of this research, we documented that INSV is present in some of the weed species growing in the coastal region. Weeds were collected from ranches known to have histories of INSV outbreaks in lettuce and were tested for INSV using serological and molecular methods. Surveys indicated that 13 species, listed in Table 1, tested positive for the virus. Shepherd's purse (Capsella bursa-pastoris) and little mallow (*Malva parvifolia*) were most commonly infected with INSV. Little mallow may be especially important because it commonly overwinters in many habitats (Fig. 3), thereby providing a source of the virus each spring. These weed surveys interestingly showed that the majority of the collected weeds that tested positive for INSV lacked virus-like symptoms (Fig. 4); only annual sowthistle, nightshade (Fig. 5), and London rocket showed virus-like symptoms that included yellow and brown leafspots, ringspots, and blotches.

Managing INSV in lettuce: Controlling virus diseases that are vectored by thrips is difficult. Currently, INSV-resistant lettuce cultivars are not available. Therefore, growers should follow a rigorous sanitation program that includes managing weeds and promptly plowing and destroying crop residues in harvested lettuce fields. These measures will reduce inoculum sources and thrips habitats. The Salinas Valley already implements comprehensive weed control programs as part of the integrated disease management strategy for managing *Lettuce mosaic virus*.

Monitoring and managing the thrips vector is an important management strategy; however, thrips management with insecticides is difficult due to limitations in efficacy of currently available insecticides, challenges in effectively applying materials to where thrips aggregate (for example, deep inside the heads of lettuce), development of insecticide resistance in WFT, high reproduction rate and multiple generations of the thrips, and strong north-south Salinas Valley winds that reintroduce thrips to fields on a daily basis.

Finally, growers should carefully consider which non-crop plant species to grow on lettuce ranches. For example, ground covers are sometimes planted along roads adjacent to fields in order to reduce dust. If possible, growers should choose ground covers that are not hosts of INSV or major reservoirs of thrips. A survey of one such ground cover, iceplant (*Carpobrotus* spp.), found that the plants harbored an average of 51 WFT per flower; this plant, therefore, could serve as a source of the vector of INSV. Organic as well as conventional growers interplant lettuce with strips of flowering annuals in order to attract beneficial insects. In our research we surveyed organic romaine fields affected by INSV. We found that the interplanted sweet alyssum tested negative for INSV but supported large numbers of thrips, including some that tested positive for INSV. Thus, because sweet alyssum flowers are very attractive to thrips (hundreds of thrips were collected from the flowers), our results show that a non-host of INSV may still play a role in the

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disease by serving as a source of the vector.

The authors acknowledge the support of the California Leafy Greens Research Board, which funded the INSV lettuce research.

Figure 1. INSV on lettuce causes brown to black spots, ringspots, and death of leaf tissue.

Figure 2. If infected early with INSV, lettuce plants will not grow to harvestable size.

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Figure 3. Over-wintering malva weeds may be one source of INSV that affects lettuce and other vegetable crops in the Salinas Valley.

Figure 4. Malva and other weeds infected with INSV often showed no disease symptoms.

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Figure 5. Only a few weed species, such as nightshade, showed symptoms caused by INSV.

Table 1. Weeds, collected from lettuce growing areas in the Salinas Valley, that tested positive for Impatiens necrotic spot virus

Botanical name	Common name
Amsinckia menziesii	fiddleneck
Capsella bursa-pastoris	shepherd's purse
Chenopodium album	lambsquarters
Chenopodium murale	nettleleaf goosefoot
Conyza bonariensis	flax leaved fleabane
Erodium species	filaree
Hirschfeldia incana	shortpod mustard
Lactuca serriola	prickly lettuce
Malva parvifolia	little mallow
Matricaria camomilla	pineappleweed
Sisymbrium irio	London rocket
Solanum sarrachoides	hairy nightshade
Sonchus oleraceus	annual sowthistle