



## Alternative Techniques for Control of Cabbage Maggot in Cabbage - 2019

By Faruque Zaman, Kelly Jackson, and Daniel Gilrein, Cornell Cooperative Extension of Suffolk County  
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### Background and Objectives

Several conventional and organic insecticides and other alternative methods were compared for control of cabbage maggot (*Delia radicum*) in fresh-market cabbage. Treatments tested included insecticides Verimark 1.67SC (cyantraniliprole, FMC) at 13.5 fl. oz/A, Entrust SC (spinosad, Corteva) at 8.0 fl. oz/A, Radiant 1SC (spinetoram, Corteva) at 10.0 fl. oz/A, Tek-Knit exclusion netting (80-gram) over a black plastic mulch planting bed, and black plastic mulch planting bed alone. Lorsban 75WG (chlorpyrifos, Gowan) at 1.8 oz/1000 ft row was used as a standard for comparison. Verimark, Entrust and Radiant were applied as a pre-plant transplant tray drench and followed by one directed application two weeks after transplanting. Lorsban was applied in a 4-inch band spray over the furrow 7 days after planting. Untreated plots were used as a control.

### Methods

This trial was conducted from mid-April to August 30, 2019. On April 12<sup>th</sup> 'Bravo' cabbage was sown into Speedling transplant trays using a standard peat-based media (Pro-Mix BX with Mycorrhizae, Premier Horticulture Inc.). Plants were maintained in a greenhouse on overhead watering as needed including a commercial fertilizer (15-5-15 Cal-Mg, 150 ppm N Jack's Professional). On May 24 plants were transplanted 11" apart in 34-inch rows in the main field except for black plastic mulch rows, where plants were set on a 31-inch wide bed in rows spaced 18" and 15" apart in an alternate planting design. For exclusion netting plots, 18-inch row spacing allows about 6.5-inch clearance between plants and sidewall of the net coverings. Four rows 30 feet long (approximately 340 sq. ft.) per replication and four replications per treatment were used. Insecticide treatments were applied using a CO<sub>2</sub>-powered backpack sprayer fitted with a TJ60 4003EVS nozzle operating at 20 psi. Pre-plant tray drenches were applied to transplants 24 hours prior to setting in the main field. Post-transplant targeted applications were made two weeks after transplanting, directing spray to the lower stems and soil at the base of plants. Exclusion netting rowcover was set within 24 hours following transplanting of the 6-week old cabbage seedlings in 2" x 2" holes on black plastic mulch and rows remained covered until harvest. Where black plastic mulch was used alone, plants were set in a similar way to those in the exclusion net+ mulch treatment. Transplant flat rates for tray drench treatments were calculated to provide an amount of active ingredient per plant equivalent to the field rate per plant, using 500 ml water per 26 5/8" x 13 5/8" (200 cell) tray. Lorsban 75WG was applied per label in 64 gal water per acre as a 4-inch banded spray to soil at the base of plants immediately after setting (within 7 days of transplanting). Plants were watered lightly after transplanting and as needed afterwards. Drip tape irrigation was used both black plastic mulch plots. The other plots were irrigated by overhead sprinkler system. Fertilizer





was applied at 500 lb/A rate prior to planting and no herbicides were used in either plastic mulch treatment. On June 24 cabbage maggot damage was evaluated (presence or absence of cabbage maggot damage and severity in roots) by digging up 20 randomly selected plants from the middle two rows of each plot (80 plants per treatment), then washing and inspecting for cabbage maggot damage (gallery or tunneling in main root) and rating severity (based on number and length of feeding marks) on a 0 – 10 scale (0 = no damage, 3 = moderate, 5 – 7 = high, 8 – 9 = extreme, 10 = plant dead). The percent damaged plants and mean damage severity were calculated for each treatment. Stem diameter at the soil line, cabbage head weight and diameter at harvest, foliage feeding by other insects, and marketable head quality were also measured (1 = 5 scale, 1 = poor quality, 3 = marketable, 5 = excellent). ANOVA and multiple comparisons among treatments were performed on raw data using the Tukey's HSD (JMP Pro 14.0, SAS Institute). Treatments and data are shown in Figure 1 to 7.

## Results & Discussion

Cabbage maggot pressure in the area was moderate with 46.25% plants in untreated control plots showing some levels of root damage. Overall infestation level was slightly lower in the 2019 season compare to that observed in similar trials over the past several years. Besides normal population fluctuations, an unusually wet and cool spring season might also partly explain the slightly lower cabbage maggot pressure.

There was a significant effect due to treatment, with the lowest levels of maggot-damaged plants in exclusion netting + black plastic mulch plots (> 98% roots undamaged), and black plastic mulch alone (>95% roots undamaged), followed by Lorsban (9.0%), Radiant (12.5%), and Verimark SC (15%). Entrust SC appeared to provide a significant if moderate level control with nearly 70% undamaged roots (Figure 1). Control plants had 55% roots undamaged by cabbage maggot. Severity of root damage (0 – 10 scale, 0 = no damage, 10 = root completely consumed) was significantly lower in all insecticide and mulch treatments than in control plots (Figure 2), although the overall damage severity rating was minimal in the control plot averaging 1.21 out of 10. There was no phytotoxicity observed in any treatment.

Above-ground average stem diameter (N = 20/rep) for 4-week-old plants was significantly higher in plots covered with exclusion netting than in all other treatments (Figure 3). Climatic conditions such as temperature and soil moisture under the netting might have influenced greater plant growth. Among the seven treatments average head diameter at harvest (N = 20/rep) was not significantly different. However, compared with controls average cabbage head weight at harvest was significantly higher in all treatments with more than 80% undamaged roots (i.e. all except for Entrust).

There was moderate pressure in this trial from foliar-feeding insects, primarily crucifer flea beetle (*Phyllotreta cruciferae*) and lepidoptera (imported cabbage worm, *Pieris rapae*; cabbage looper, *Trichoplusia ni*) (Figure 6). Plants in Lorsban 75WG, black plastic mulch only, and untreated control plots



had significantly higher (about 2.75 - 3.0%) foliar damage (defoliation) from cabbage flea beetle and worms than other treatments. There was almost no defoliation (<0.10%) in plots treated with Verimark and exclusion netting. There was a small but significantly higher level of foliar damage (1.1 – 1.2%) observed in plots treated with Entrust and Radiant. Cabbage head quality (based on feeding holes on head and 5 wrapper leaves) was significantly higher in plots treated with Verimark and exclusion netting. Marketable quality (Figure 7) was also acceptable in plots with Entrust, Radiant and plastic mulch alone though the level of protection was significantly lower than where Verimark and exclusion netting were used. Foliar feeding damage was not controlled by Lorsban application and the level of damage was not significantly different from that in untreated control.

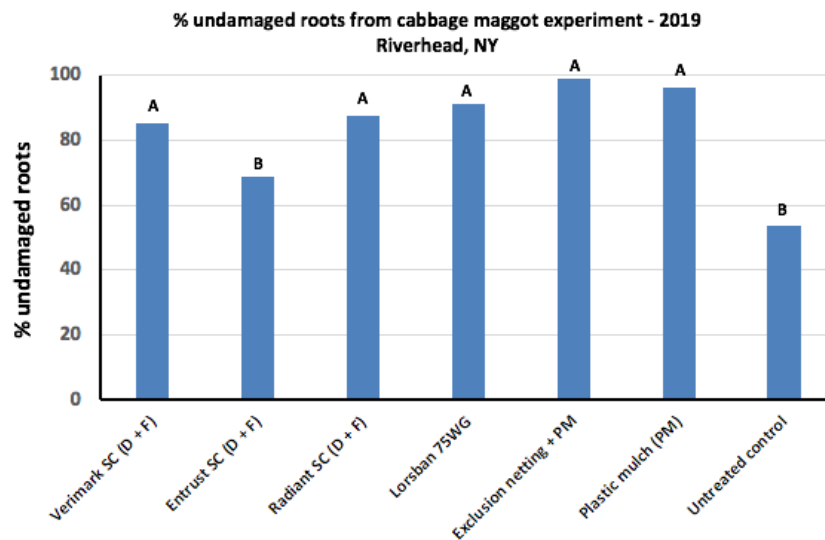


Figure 1. Percentage of undamaged roots from various treatments at four weeks after transplanting ( $N = 20/\text{rep}$ ,  $80/\text{treatment}$ ,  $P = <0.001$ ). D + F = drench followed by directed spray. PM = cabbage transplant over black plastic mulch.

## Conclusions

In our study planting cabbage under exclusion netting and/or over black plastic mulch may provide more than 95% root protection from cabbage maggot. Pre-transplant tray drench + one additional targeted spray application with Verimark 1.67SC and Radiant 1SC at 2-week interval may provide over 80% undamaged roots which is close to the protection from Lorsban 75WG (>90% undamaged roots). Further research will be done growing cabbage on black plastic mulch in 2020.

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