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# EFFECTS OF ALUMINUM FOIL MULCH ON PARASITISM AND FECUNDITY OF APTEROUS *MYZUS PERSICAE* (HOMOPTERA: APHIDIDAE)[1]

Frank G. Zalom[2] and Whitney S. Cranshaw

ABSTRACT

Chinese cabbage plants grown in flats containing either aluminum foil mulch or no mulch cover were uniformly infested with a single apterous adult *Myzus persicae* (Sulzer) and exposed in a greenhouse to a free-flying population of the parasite *Aphidius ervi* (Haliday). Aphid fecundity, plant growth, and temperature were greater in reflective mulch plots. Aphid parasitism was lower over mulched plots until foliage growth obscured the mulch. Later, parasitism was more frequent in mulched plots. The effects upon parasitism, fecundity, and microclimate may explain instances where aluminum mulches have not reduced aphid populations.

Reflective mulches represent a unique approach to reducing the spread of nonpersistent viruses (Kring 1964). The mulches act by reflecting the sun's ultraviolet (UV) rays, thus confusing the insect vector (Toscano et al. 1979). Reduced numbers of alate aphids alighting on plants and increased yields often result from this treatment (e.g. Wyman et al. 1979). Failure of mulches to adequately protect crops has been attributed to insufficient reflective surface (Dickson and Laird 1966, Rothman 1967), overabundance of vectors (Kring 1972), and plant growth over the mulches (e.g. Shands and Simpson 1972). Cranshaw and Radcliffe (1980) observed that a significant reduction occurred in captures of alate green peach aphid, *Myzus persicae* (Sulzer), over mulched potato plots through midseason, but that apterae on foliage were not well correlated with the alate captures. They speculated that interference with natural control over mulched plots may contribute to a higher rate of population growth by aphids colonizing mulched plots. Such secondary effects may obscure the evaluation of a mulch for plant protection particularly if primary spread by vectors early in the season is of greatest importance, and if the evaluation is made by checking apterae populations.

Here we demonstrate that aluminum foil mulching influences parasitism, aphid fecundity, and plant growth when compared to unmulched controls.

## METHODS

Twenty-four wooden flats were arranged in a row two deep and 12 across on the bench in a glasshouse on the University of Minnesota campus. Each flat was filled with soil and seeded with Chinese cabbage at 13-cm intervals (12 plants/flat). Four adjacent flats constituted one replication of a treatment (48 plants total). Treatments consisted of covering the soil, excluding a 1.5 cm hole around the base of a seedling, with aluminum foil, or allowing the plants to grow over bare soil. Ultraviolet lamps were suspended 1 m above the surface of the flats to increase the intensity of UV light that was potentially reduced by the glass roof. A thermostat in the glasshouse remained set at 22°C for the experiment. A recording therm-

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ograph measured the temperature immediately above the mulched and unmulched treatments. Weeds were manually removed from each flat.

When the first true leaf of each plant became fully expanded, a single apterous adult green peach aphid was transferred to the leaf. On the same day, 24 mature cabbage plants containing numerous aphid mummies were removed from a colony cage of a braconid parasite, *Aphidius ervi* (Haliday), of the green peach aphid. The plants were evenly spaced along the length of the bench at least 25 cm from the nearest cabbage plant to allow equal dispersal of the parasites over control and treatment plots.

One week following the aphid transfer and twice weekly thereafter, 12 plants from the central area of each block were inspected for total numbers of aphids, aphid mummies, and leaves. Aphid mummies were removed from the leaves after counting. Cabbage plants from border rows in each block were not considered. Final counts were made four weeks following the initial infestation as the plants had grown to cover the mulch.

## RESULTS

Aphid mummies were recorded on some of the Chinese cabbage plants one week after infestation by aphids and subsequent release of parasites. Initially, the number of mummies on the plants in the unmulched treatment exceeded that of the mulched treatment, but the trend was reversed beginning with the fourth sampling period (Fig. 1). The differences between the treatments were significant ($P < 0.05$) in each of the first two and final two sampling periods when compared by 2-way analysis of variance. No significant difference ($P > 0.05$) was recorded in sampling periods 3 ($F_{1,4} = 2.627$) or 4 ($F_{1,4} = 2.041$).

More aphids were recorded from mulched plots than unmulched plots on each sampling date (Fig. 2). Although the differences were not significant ($P > 0.05$) in sampling period 1 ($F_{1,4} = 5.077$) or 2 ($F_{1,4} = 4.103$), the differences were significant ($P < 0.05$) in each period thereafter when compared by 2-way analysis of variance.

The Chinese cabbage plants from blocks covered with foil mulching appeared to be noticeably larger and more robust than those from unmulched plots throughout the experiment. The mean total number leaves per 12 plants from mulched blocks was significantly ($P < 0.05$) greater than that of unmulched blocks during each sampling period when compared by 2-way analysis of variance (Fig. 3). The reflective surface was estimated to be 90% occluded due to plant growth by the fourth sampling period. Large deposits of honeydew on leaf surfaces were noted beginning with the fifth sampling period. Air temperature immediately above the mulched plots was ca. 3°C warmer than over unmulched plots prior to occlusion of the reflective surface.

## DISCUSSION

Aluminum foil mulching seemed to significantly affect parasitism, aphid fecundity, and plant growth in our experiment. As all three factors may influence one another, the contribution of each could not be separated, but some general trends became apparent.

Significantly less parasitism was noted over mulched plots than unmulched plots before the plants grew so as to cover most of the foil, suggesting an effect on the parasites similar to that of alate aphids flying over reflective surfaces. Under these circumstances, a few initial colonizers could increase at a greater rate on mulched plots than unmulched plots. The tremendous increase in aphid mummies on the final sampling dates within blocks with a reflective surface was probably a function of increased aphid abundance on those plants and lack of interference from the foil.

Nawrocka et al. (1975) showed that although alate aphids landing on lettuce were lowest in plots treated with aluminum foil mulch, the greatest production of winged aphids also occurred on those plots. Increased fecundity could have been due to the warmer temperature (Daniels 1957, Coon 1959) noted over mulched plots. Higher reproductive rates resulting from the use of reflective mulches might require some other treatment to reduce the number of colonizers.

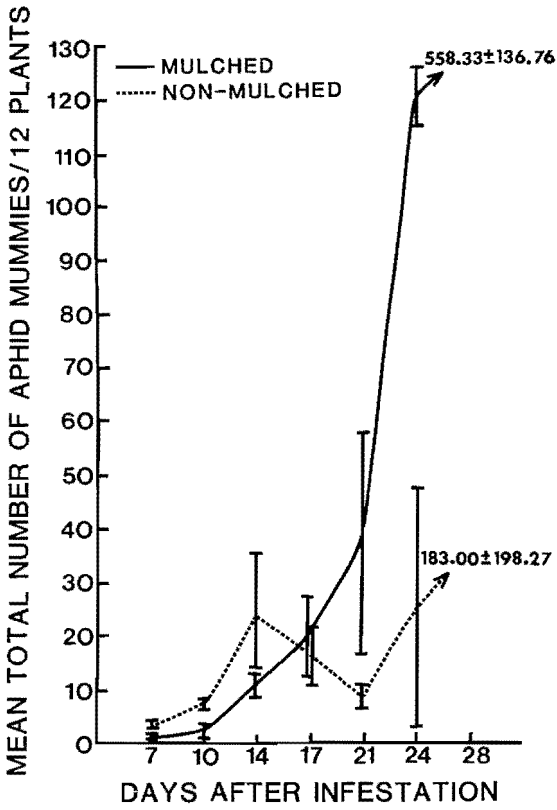


Figure 1. Mean (± SD) total number of green peach aphid mummies per 12 Chinese cabbage plants in flats with and without reflective mulches.

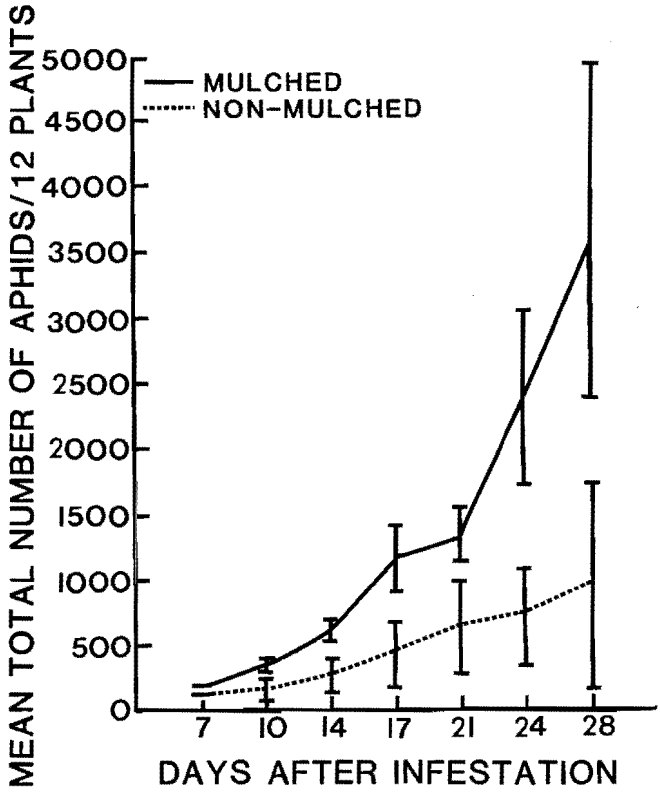


Figure 2. Mean (± SD) total number of green peach aphids per 12 Chinese cabbage plants in flats with and without reflective mulches.

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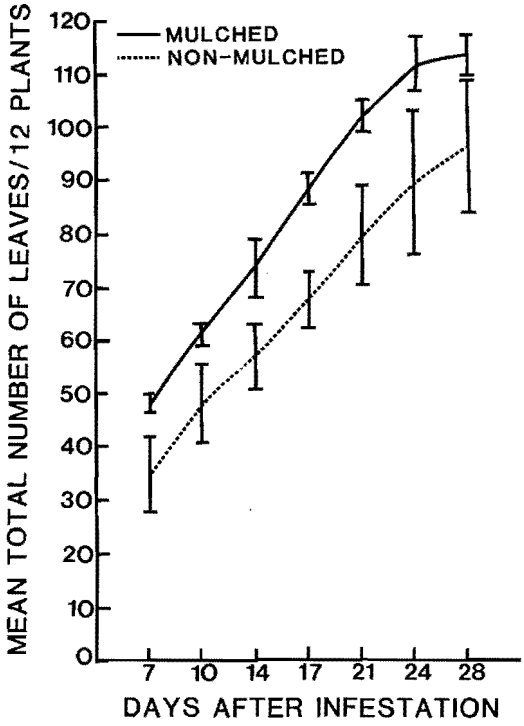


Figure 3. Mean (± SD) total number of leaves per 12 Chinese cabbage plants in flats with and without reflective mulches.

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