BioOne COMPLETE

# Effect of Straw Mulch on Populations of Microtheca ochroloma (Coleoptera: Chrysomelidae) and Ground Predators in Turnip Brassica rapa in Florida

Authors: Manrique, Veronica, Montemayor, Cecil O., Cave, Ronald D., Skvarch, Edward A., and Smith, Bradley W.

Source: Florida Entomologist, 93(3) : 407-411

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.093.0314

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

# EFFECT OF STRAW MULCH ON POPULATIONS OF *MICROTHECA OCHROLOMA* (COLEOPTERA: CHRYSOMELIDAE) AND GROUND PREDATORS IN TURNIP *BRASSICA RAPA* IN FLORIDA

VERONICA MANRIQUE[1], CECIL O. MONTEMAYOR[1], RONALD D. CAVE[1], EDWARD A. SKVARCH[2] AND BRADLEY W. SMITH[1]
[1]University of Florida, Indian River Research and Education Center, 2199 South Rock Road, Fort Pierce, FL 34945

[2]St. Lucie Co. Cooperative Extension Service, University of Florida, 8400 Picos Rd., Fort Pierce, FL 34945

ABSTRACT

*Microtheca ochroloma* Stål (Coleoptera: Chrysomelidae), the yellow-margined leaf beetle, is a serious pest of crucifer crops in the southeastern USA. The objective of this study was to investigate the effect of straw mulch on the abundance of *M. ochroloma* and ground predators in turnips in Florida, and subsequent influence on crop damage and yield. Eight plots (5 m long × 9 m wide) were established, and each plot consisted of 5 beds with 10 turnip plants each (50 turnips per plot). An 8-10-cm layer of straw mulch was applied by hand 2 d after planting to half of the plots in a complete randomized block design. The abundance of *M. ochroloma* and other insect herbivores were recorded twice weekly from Mar 13 to Apr 24, 2009. In addition, 3 pitfall traps per plot were used for sampling predatory arthropods during each sampling period. Higher numbers of *M. ochroloma* were found in plots with mulch compared to plots with no mulch, whereas greater numbers of ground predators were obtained in the no mulch treatment. The most abundant predators found in pitfall traps were ants, earwigs, and spiders, while lower numbers of predatory beetles were recorded. At the end of the experiment, greater leaf biomass (dry weight) was obtained from turnip plants grown in plots with straw mulch, but those plants suffered greater herbivory since the leaf area removed was greater in that treatment. Mean weight of tubers did not vary significantly between treatments. In conclusion, the use of straw mulch as a pest management option for *M. ochroloma* in crucifer crops on organic farms is not recommended.

Key Words: organic mulch, insect populations, cultural control, yellow-margined leaf beetle, pitfall traps

RESUMEN

El escarabajo de la hoja, *Microtheca ochroloma* Stål (Coleoptera: Chrysomelidae), es una plaga importante de cultivos de crucíferas en el sudéste de los Estados Unidos. El objetivo de éste estudio fue investigar el efecto de la cobertura de heno en la abundancia de *M. ochroloma* y los depredadores de suelo en cultivos de nabo en Florida, y el subsecuente daño foliar y el rendimiento del cultivo. Se establecieron 8 parcelas (5 m de largo × 9 m de ancho) y cada parcela estuvo compuesta de 5 camas con 10 plantas de nabo cada una (50 plantas por parcela). Dos días luego de haberse plantado el cultivo, se agregó una cobertura muerta de heno de 8-10 cm de ancho a la mitad de las parcelas siguiendo un modelo de bloques aleatorizados. La abundancia de *M. ochroloma* y de otros insectos herbívoros fueron evaluadas 2 veces por semana desde marzo 13 hasta abril 24 de 2004. También se utilizaron trampas de intercepción o "pitfall traps" (3 por parcela) para la captura de artrópodos depredadores durante cada muestreo. Se encontró mayor número de *M. ochroloma* en las parcelas con cobertura de heno en comparación con las parcelas sin cobertura; mientras que los depredadores de suelo fueron más abundantes en las parcelas sin cobertura. Hormigas, tijeretas, y arañas fueron los depredadores más abundantes capturados en las trampas de intercepción. Al final del experimento, se obtuvo mayor biomasa foliar (peso seco) en las plantas de nabo provenientes de las parcelas con cobertura de heno. Sin embargo, ésas plantas sufrieron un mayor daño dado que el área de la hoja removida fue mayor en ése tratamiento. El promedio de peso de los tubérculos no varió significativamente entre tratamientos. En conclusión, no se recomienda el uso de la cobertura de heno para el manejo de *M. ochroloma* en cultivos de crucíferas en granjas orgánicas.

Translation provided by the authors.

*Microtheca ochroloma* Stål (Coleoptera: Chrysomelidae), the yellow-margined leaf beetle, is a serious pest of crucifer crops in the southeastern USA (Chamberlin & Tippins 1949). The pest is a native of southern South America and was first found in Florida on watercress near Tampa in

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

1972 (Woodruff 1974). It is currently distributed along the Gulf Coast from Florida to Texas, and in Georgia, North Carolina, and Arizona. The biology, ecology, and feeding preferences of *M. ochroloma* were studied by Ameen & Story (1997a, b). Larvae and adults are defoliators that feed only on plants in the family Brassicaceae. Preferred hosts are turnips, mustard, radish, watercress, and Chinese cabbage, while less preferred hosts include cabbage and cauliflower (Chamberlin & Tippins 1949; Ameen & Story 1997b).

There are at least 497 organic farms in Florida involved in the production of crucifer vegetables (Florida Organic Grower 2008). However, many growers have reduced the proportion of crucifer crops as a consequence of damage by *M. ochroloma* (Bowers 2003). This pest is a serious problem from Oct to Apr, which corresponds to the primary growing season for organic farmers in many parts of Florida (Capinera 2001). Damage caused by *M. ochroloma* prevents the growers from selling high quality products, thus resulting in significant economic losses. Management of *M. ochroloma* is usually achieved with foliar insecticides (Capinera 2001), which are not an option for organic farmers. Management by cultural control has received limited study. According to Bowers (2003), intercropping mizuna (*Brassica rapa* L. var. Kyona) and oak leaf lettuce (*Lactuca sativa* L.) did not provide effective control of *M. ochroloma*. Therefore, organic farmers are desperately searching for alternative and more effective control measures against this pest.

Cultural practices have been used as a component of integrated pest management in several cropping systems. For example, the use of organic mulches has resulted in reduced pest populations, increased soil moisture, suppression of weeds, and increased crop yield (Greer & Dole 2003). In addition, the positive effect of mulches on ground predator populations has been reported in several cropping systems, including onion, potato, and soybeans (Halaj et al. 2000; Johnson et al. 2004). The objective of our study was to investigate the effect of straw mulch on the abundance of *M. ochroloma* and ground predators in turnip in Florida. In addition, measurements of leaf damage and yield were compared between treatment plots at the end of the experiment.

## Materials and Methods

### Field Site

This study was conducted during Mar and Apr 2009 at the University of Florida's Indian River Research & Education Center, Fort Pierce, FL (27°25'34.3"N, 80°24'20.31"W). The experimental plots had not been cultivated for at least 2 years prior to this study and were separated from adjacent crops (cucumber and tomato) by at least 200 m. The experimental design consisted of 2 treatments (straw mulch, no straw mulch) in a complete randomized block design, with 4 replications per treatment. Before planting, 2 fertilizers were incorporated into the plot beds, a root fertilizer 4-16-4 N-P-K (5 kg/30.5 m) and a plant growth fertilizer 8N-12$P_2O_5$-20-$K_2O$ (10 kg/30.5 m) (Howard Fertilizer Co., Inc., Orlando, FL). Flood irrigation was provided between beds throughout the experimental plot. Turnip plants (*Brassica rapa rapifera*, Seven Top) (2 weeks old) were transplanted to the field on Mar 10, and an 8-10-cm thick layer of dried straw mulch was applied by hand 2 d later to half of the plots. The straw mulch (Bahia hay, Fair-Us Tractor Service, Okeechobee, FL) was 3 months old when the experiment started. Eight plots (5 m long × 9 m wide) separated by at least 10 m were arranged in a complete randomized block design. Each plot consisted of 5 beds separated by 1 m. Ten turnip plants were planted with a spacing of 50 cm in each bed (50 turnips per plot).

### Sampling Insect Herbivores

Abundance of *M. ochroloma* and other insect herbivores was recorded twice weekly from Mar 13 to Apr 24. Six plants (2 plants in each of 3 inner beds) from each plot were selected randomly and visual observations of whole plants were conducted. Because *M. ochroloma* was not found on the experimental plots during the first 2 weeks of sampling, 10 pairs of adults were released in the outer beds of each plot on Mar 27.

### Sampling Ground Predators

A pitfall trap consisting of a plastic cup (9 cm diameter at soil surface, 12 cm depth) was placed in each of the 3 inner beds of each plot (3 traps per plot). Traps were half-filled with soapy water and checked twice weekly from Mar 13 to Apr 24. The arthropods from each trap were preserved in separate vials with 75% EtOH. All predators were counted and identified to order or family.

### Foliar Damage and Yield

At the end of the experiment (Apr 24), 6 randomly selected turnip plants from each plot were collected and brought to the laboratory. One new leaf and 1 older leaf were selected randomly from each plant and the leaf area consumed per leaf was determined by scanning each leaf and measuring the total area removed by herbivory with the software Image-J (http://rsb.info.nih.gov). New leaves were those that ranged from 10 to 15 cm in length, and older leaves were those ranging from 30 to 35 cm. Fresh weight of the tuber and dry weight of all leaves were recorded for each plant.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Data Analysis

Repeated measure analysis of variance was used to compare the abundance of *M. ochroloma*, total herbivores, predators per taxon, and total predators between treatments (mulch versus no mulch) over time. Data for each predator were combined for all dates because there were no interactions (treatment × time effect), except for earwigs and spiders, which were analyzed by single factor analysis of variance for each date. Leaf area consumed and yield were compared between treatments by single factor analysis of variance. Means were separated with the Student–Newman–Keuls (SNK) test (SAS Institute, 1999). A significance level of $\alpha = 0.05$ was used for all statistical analyses. Means are reported with their standard error.

## Results

Insect Herbivores

Differences were detected in the number of *M. ochroloma* found between treatments over time, with a significant interaction between treatment and time ($F = 3.65$, $df = 11, 95$, $P = 0.0005$). When analyses were conducted separately for each date, higher numbers of *M. ochroloma* were found in plots with mulch compared to plots with no mulch (Fig. 1). Other insect herbivores found on turnip plants included aphids, several lepidopteran species, and other leaf beetles. However, no significant differences between treatments were detected for total number of herbivores per plant (~28 per plant) (treatment × time: $F = 1.24$, $df = 11, 95$, $P = 0.27$; treatment: $F = 1.48$, $df = 1, 95$, $P = 0.22$). Aphids were the most abundant insect herbivore in Mar, whereas *M. ochroloma* was the most abundant herbivore in Apr. The high numbers of *M. ochroloma* (20-28 per plant) recorded in Apr may not correspond to natural infestations since adults were released in each plot at the beginning of the experiment.

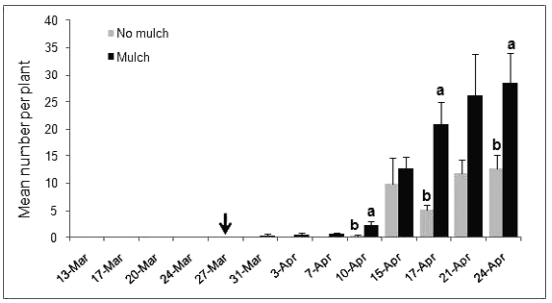



Fig. 1. Mean numbers (± SE) of *Microtheca ochroloma* per turnip plant in straw mulch and no straw mulch treatments. Arrow indicates the date that adults were released in each treatment plot. Different letters above paired bars for a date indicate significant differences between treatments ($P < 0.05$).

Ground Predators

Higher numbers of predators (each predator taxon and total predators) were recorded in the no-mulch treatment compared with the mulch treatment (Table 1). Fewer predatory beetles (ground beetles, Carabidae; rove beetles, Staphylinidae; and lady beetles, Coccinellidae) were captured compared with the higher numbers of ants (Formicidae), earwigs (Dermaptera), and spiders (Aranaeae). Overall, significantly more ground beetles and rove beetles were captured in traps in the no mulch treatment versus the mulch treatment. No significant difference in abundance of lady beetles between treatments was detected on any date. Significant treatment × time effect interactions were observed for earwigs and spiders; therefore, data were analyzed separately for each date. Significantly more earwigs were recorded in the no-mulch treatment on all but 2 of the 13 sampling dates ($P < 0.05$). For spiders, significantly higher numbers were recorded from the traps in the no-mulch treatment on 5 of the sampling dates ($P < 0.05$); on all but 2 dates for which there was no significant difference between treatments, more spiders were noted in the no-mulch treatment.

Foliar Damage and Yield

Leaf area consumed from new turnip leaves was greater in plants from plots with straw mulch (mean = 4.1 ± 0.4 $cm^2$) compared to those from plots without mulch (mean = 2.0 ± 0.5 $cm^2$) ($F = 9.09$; $df = 1, 7$; $P = 0.02$). However, no differences were detected between treatments for damage to older leaves (no-mulch treatment mean = 5.6 ± 1.5 $cm^2$, mulch treatment mean = 8.4 ± 1.4 $cm^2$) ($F = 1.88$; $df = 1, 7$; $P = 0.22$). Similar mean tuber weights were recorded for turnips in the no-mulch (mean = 130.7 ± 24.9 g) and the straw mulch (mean = 145.9 ± 18.1 g) treatments ($F = 0.25$; $df = 1, 47$; $P = 0.62$). However, greater dry leaf weight was obtained for turnips in the straw mulch treatment (mean = 142.9 ± 16.4 g) compared with the no-mulch treatment (mean = 97.8 ± 9.5 g) ($F = 5.66$; $df = 1, 47$; $P = 0.02$).

## Discussion

Our study shows that the use of straw mulch does not provide a means for adequately controlling populations of *M. ochroloma* in turnips. Moreover, greater pest populations occur in plots with straw mulch compared to plots without mulch during Mar and Apr 2009. These data suggest that adults of *M. ochroloma* are able to suc-

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

TABLE 1. MEAN NUMBERS (±SE) OF PREDATORS RECOVERED PER PITFALL TRAP IN STRAW MULCH AND NO STRAW MULCH PLOTS OF TURNIPS.

| Predator | Straw mulch | No straw mulch | Treatment effect | Time effect | Treatment × time effect |
|---|---|---|---|---|---|
| Carabidae (ground beetles) | 0.12 0.08 b | 0.41 0.17 a | $F = 19.40$, $P < 0.0001$ | $F = 1.64$, $P = 0.09$ | $F = 1.57$, $P = 0.11$ |
| Staphylinidae (rove beetles) | 0.07 0.04 b | 0.19 0.11 a | $F = 7.74$, $P = 0.006$ | $F = 1.25$, $P = 0.26$ | $F = 0.73$, $P = 0.72$ |
| Coccinellidae (lady beetles) | 0.05 0.04 a | 0.11 0.07 a | $F = 2.89$, $P = 0.09$ | $F = 2.19$, $P = 0.02$ | $F = 1.45$, $P = 0.16$ |
| Formicidae (ants) | 2.81 0.82 b | 4.12 1.18 a | $F = 7.88$, $P = 0.006$ | $F = 1.97$, $P = 0.03$ | $F = 0.48$, $P = 0.92$ |
| Dermaptera (earwigs) | 0.43 0.23 b | 2.45 0.62 a | $F = 100.06$, $P < 0.0001$ | $F = 2.58$, $P = 0.006$ | $F = 2.03$, $P = 0.03$ |
| Araneae (spiders) | 1.07 0.3 b | 2.01 0.40 a | $F = 39.57$, $P < 0.0001$ | $F = 2.81$, $P = 0.003$ | $F = 2.18$, $P = 0.02$ |
| Total | 4.69 1.51 b | 10.02 2.55 a | $F = 48.45$, $P < 0.0001$ | $F = 1.26$, $P = 0.26$ | $F = 0.68$, $P = 0.76$ |

Different letters within each predator group indicate a significant difference between straw mulch and no straw mulch treatments ($P < 0.05$).

cessfully locate and recognize their host plants growing in straw mulch and that the pest population increases following colonization. Similarly, other pests, for example the squash bug, *Anasa tristis* (DeGeer), and the American palm cixiid, *Myndus crudus* Van Duzee, are favored by the use of organic mulches (Howard & Oropeza 1998; Cranshaw et al. 2001). In contrast, the use of organic mulches in other cropping systems has resulted in a decrease in pest populations. This has been observed for the onion thrips, *Thrips tabaci* Lindeman, in onions (Larentzaki et al. 2008), the silverleaf whitefly, *Bemisia argentifolii* Bellows & Perring, in zucchini squash (Summers et al. 2004), and the Colorado potato beetle, *Stilodes decemlineata* (Say), in potato (Johnson et al. 2004).

The use of straw mulch has been reported to increase the abundance of predators in the field, which in turn reduces pest populations (Halaj et al. 2000; Johnson et al. 2004). In our study, however, a greater abundance of ground predators was recorded in plots with no straw mulch compared to plots with straw mulch. The most abundant predators in pitfall traps were ants, earwigs, and spiders, while lower numbers of predatory beetles were recorded. The reduced numbers of *M. ochroloma* in the no-mulch treatment may be a direct effect of the greater ground predator population in that treatment. It could be that the absence of mulch facilitated the searching behavior of the predators on both the soil and the plant. Although *M. ochroloma* larvae and adults occur more frequently on the foliage, the larvae do move to the lower parts of the plant and to the leaf litter to pupate and the adult females move to the leaf litter and soil to deposit eggs (C. O. Montemayor, personal observation). This behavior in plots without straw mulch may make the prey more susceptible to predation by ground predators, whereas in plots with the structurally complex straw mulch the larvae and adults can easily hide and escape predation from the fewer ground predators. Other factors that may affect pest and predator populations are differences in plant quality and soil moisture. For example, turnip plants in the plots with straw mulch were larger (more leaf biomass), thus presenting higher quality host plants to the pest.

The commercially valuable part of a turnip crop is the tubers and leaves that are sold in fresh markets. Although greater leaf biomass was obtained from turnip plants grown in plots with straw mulch, those plants suffered greater damage since the leaf area removed by herbivory was greater in plots with straw mulch compared to plots without mulch. Thus, the damaged leaves cannot be marketed and must be discarded, thereby resulting in lower yield from a turnip crop grown in straw mulch. The increase in leaf damage was correlated with the increase of *M. ochroloma* population in the straw mulch treatment, which highlights the importance of this pest as an economically important defoliator of turnips and other leafy green crucifer crops. Although our study was conducted during 1 growing season in 2009, the trends observed in the abundance of insect populations between treatment plots were quite significant. For example, there was a two-fold increase in *M. ochroloma* populations in the plots with straw mulch compared to the plots without mulch.

In conclusion, the use of straw mulch as a pest management option for *M. ochroloma* in crucifer crops on organic farms is not recommended. More appropriate management tactics that are environmentally-friendly and effective in reducing

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

pest populations (e.g., biological control) should be evaluated to help organic farmers in Florida and elsewhere.

## ACKNOWLEDGMENTS

The authors are grateful to Daniel Mancero Castillo and José A. Castillo Altamirano for providing field assistance during this study. In addition, we appreciate the help of other colleagues from the Indian River Research and Education Center in Fort Pierce: Janet Dawson, Rodrigo Diaz, and Randy Burton. This research project was supported by grants from the Florida Specialty Crop Foundation and Florida Department of Agriculture and Consumer Services.

## REFERENCES CITED

AMEEN, A. O., AND STORY, R. N. 1997a. Biology of the yellowmargined leaf beetle (Coleoptera: Chrysomelidae) on crucifers. J. Entomol. Sci. 32: 478-486.

AMEEN, A. O., AND STORY, R. N. 1997b. Feeding preferences of larval and adult *Microtheca ochroloma* (Coleoptera: Chrysomelidae) for crucifer foliage. J. Agr. Entomol. 14: 363-368.

BOWERS, K. 2003. Effects of Within-field Location of Host Plants and Intercropping on the Distribution of *Microtheca ochroloma* (Stål) in Mizuna. MSc Thesis, University of Florida, Gainesville, FL. 63 pp.

CAPINERA, J. L. 2001. Handbook of Vegetable Pests. Academic Press, San Diego, CA. 729 p.

CHAMBERLIN, F. S., AND TIPPINS, H. H. 1949. *Microtheca ochroloma*, an introduced pest of crucifers, found in Alabama. J. Econ. Entomol. 41: 979.

CRANSHAW, W., BARTOLO, AND SCHWEISSING, F. 2001. Control of squash bug injury: management manipulations at the base of pumpkin. Southwest. Entomol. 26: 147-150.

FLORIDA ORGANIC GROWER. 2008. List of Certified Growers and Handlers. http://www.foginfo.org/. Accessed on February 2009.

GREER, L., AND DOLE, J. M. 2003. Aluminum foil, aluminum-painted plastic, and degradable mulches increase yields and decrease insect-vectored viral diseases of vegetables. HorTechnology 13: 276-284.

HALAJ, J., CADY, A. B., AND UETZ, G. W. 2000. Modular habitat refugia enhance generalist predators and lower plant damage in soybeans. Environ. Entomol. 29: 383-393.

HOWARD, F. W., AND OROPEZA, C. 1998. Organic mulch as a factor in the nymphal habitat of *Myndus crudus* (Hemiptera: Auchenorrhyncha: Cixiidae). Florida Entomol. 81: 92-97.

JOHNSON, J. M., HOUGH-GOLDSTEIN, J. A., AND VANGESSEL, M. J. 2004. Effects of straw mulch on pest insects, predators, and weeds in watermelons and potatoes. Environ. Entomol. 33: 1632-1643.

LARENTZAKI, E., PLATE, J., NAULT, B. A., AND SHELTON, A. M. 2008. Impact of straw mulch on populations of onion thrips (Thysanoptera: Thripidae) in onion. J. Econ. Entomol. 101: 1317-1324.

SUMMERS, C. G., MITCHELL, J. P., AND STAPLETON, J. J. 2004. Management of aphid-borne viruses and *Bemisia argentifolii* (Homoptera: Aleyrodidae) in zucchini squash by using UV reflective plastic and wheat straw mulches. Environ. Entomol. 33: 1447-1457.

WOODRUFF, R. E. 1974. A South American Leaf Beetle Pest of Crucifers in Florida (Coleoptera: Chrysomelidae). FDACS-DPI Entomology Circular 148, Gainesville, FL.

Downloaded From: https://complete.bioone.org/journals/Florida-Entomologist on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use