Number 128,1989 ISSN 0362-0069

New York's Food and Life Sciences Bulletin

New York State Agricultural Experiment Station, Geneva, A Division of the New York State College of Agriculture and Life Sciences A Statutory College of the State University, at Cornell University, Ithaca

THE EFFECTS OF GROUND COVER MANIPULATIONS ON PEST AND PREDATOR MITE POPULATIONS ON APPLE IN EASTERN NEW YORK

G. D. Smith, W. C. Stiles, and R. W. Weires
Hudson Valley Laboratory, Highland, New York

The apple industry is faced with many pests that require control measures during most growing seasons. The European red mite (ERM), *Panonychus ulmi* (Koch), is presently the most important pest mite species attacking deciduous tree fruit in New York (8). Until recently the ERM had been controlled by chemical applications applied prior to leaf bronzing caused by the pest's feeding activity. During the past several seasons, however, the ERM has developed resistance to several of the materials which formerly effectively controlled it (4,15). Because of the loss of these materials and the reluctance on the part of regulatory agencies to register new materials, increasing attention has turned to the role mite predators may play in the ecosystem.

Previous surveys found the phytoseiid mite, *Amblyseiusfallacis* (Garman), to be the principal mite predator in Eastern New York commercial apple orchards (14). *A. fallacis* is a predatory mite that feeds upon plant-feeding mites which are present on a variety of low-growing weeds and shrubs found throughout North America (2). This predator overwinters in the ground cover under the trees and between tree rows. In the humid regions of the United States, this predator will invade apple trees where it has been found to prey equally well on both its native prey, *Tetranychus urticae* (Koch), and the introduced ERM species (3). Research conducted in Eastern New York found that *A. fallacis* was capable of controlling mites using an integrated control program (13) similar to that developed in Michigan (3).

Dispersal of *A. fallacis* populations into apple trees has been suggested to occur via the tree trunk or low branches contacting the ground cover or by means of wind dispersal (6,7). The importance of maintaining adequate ground cover to facilitate predator/prey interactions has been suggested in these earlier studies but was not investigated thoroughly.

In Eastern New York as well as in most other deciduous fruit growing regions of the world, herbicides are being used more frequently to eliminate weeds within the tree row. In addition to removal of the ground cover habitat, the herbicides may also be highly toxic to predator species (5,10). This study was initiated to investigate the effects differing ground cover management practices have on the predator/prey relationships found in New York apple orchards.

The effects of ground cover management practices were evaluated by seasonal monitoring of the mite populations at two orchards sites, one near Highland and the other near New Paltz in Ulster County, New York. Treatments at the Highland site consisted of: (1) non-treated control (weeds), (2) herbicide strip, and (3) close-mowed grass. These treatments were arranged in a randomized complete block design with four replications. Each plot consisted of five trees spaced 4 by 12 feet, four-years-old, and on the EMLA 9 rootstock.

At the New Paltz site treatments consisted of: (1) close-mowed grass, (2) herbicide strip, and (3) cultivated strip. The treatments were arranged in a randomized complete block design with five replications of the four row by five tree plots. Trees at this site were five-years-old, spaced 14 by 24 feet, and on the MM 111 and M 26 rootstocks.

Trees in both orchards were sprayed only as necessary with chemicals chosen to be of no or low toxicity to *A. fallacis* (16). Mite populations were sampled in a nondestructive manner by counting all the motile forms and eggs on ten leaves on a single 'Red Delicious' tree in each plot. Populations were sampled at four week intervals throughout the growing season.

Ground cover density in the tree rows was evaluated at both sites using a Ground Cover Density Rating (GCDR) which utilized a two part index: the percent of treated area with plant cover (0-100), and the height of the weed growth (0-100). Both ratings were added together to obtain the final value which was reported as the GCDR. Shoot growth measurements were obtained at terminal bud set for both sites. The percent leaf nitrogen was also obtained in mid-August for the New Paltz site.

One of the most immediate results of the study was finding a predatory stigmaeid mite predator, *Zetzellia mali* (Ewing), at both sites. Z. *mali* has been shown to prey upon ERM and has also been observed preying on the eggs of *A. fallacis* (11). Consequently, these Z. *mali* populations were monitored through the remainder of the season.

A. fallacis populations, and to a lesser extent Z. *Mali* populations, responded directly to ERM populations at the Highland site (Fig. 1). The herbicide strip had the highest mite populations followed by the close mowed grass with the untreated plots having the lowest populations. This population response was directly related to total shoot growth and leaf nitrogen levels, but inversely related to the amount of ground cover in the three treatments (Fig. 2).

Predator/prey relationships (Fig. 3) were not as clearly defined at

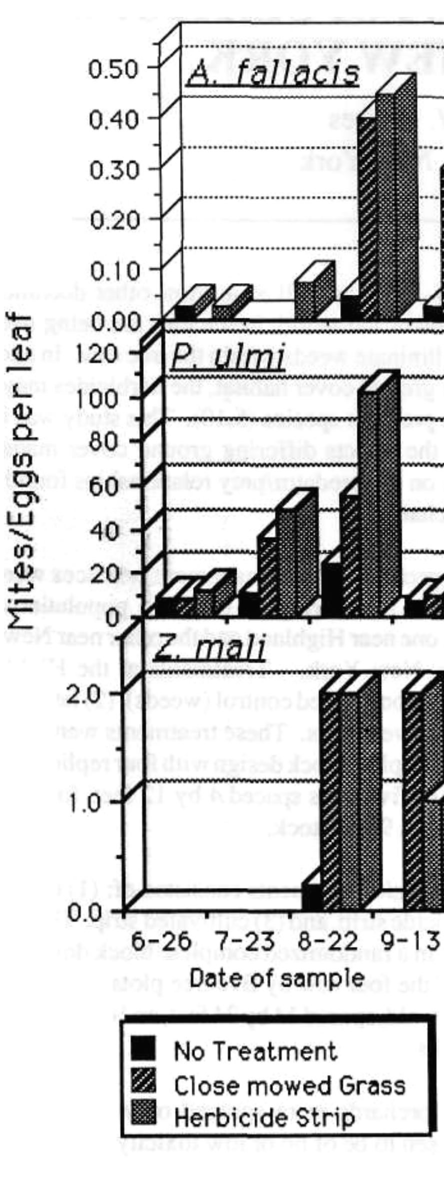

Figure l.—Mite population fluctuations under three different ground cover management practices at Highland, NY, during the summer of 1986.

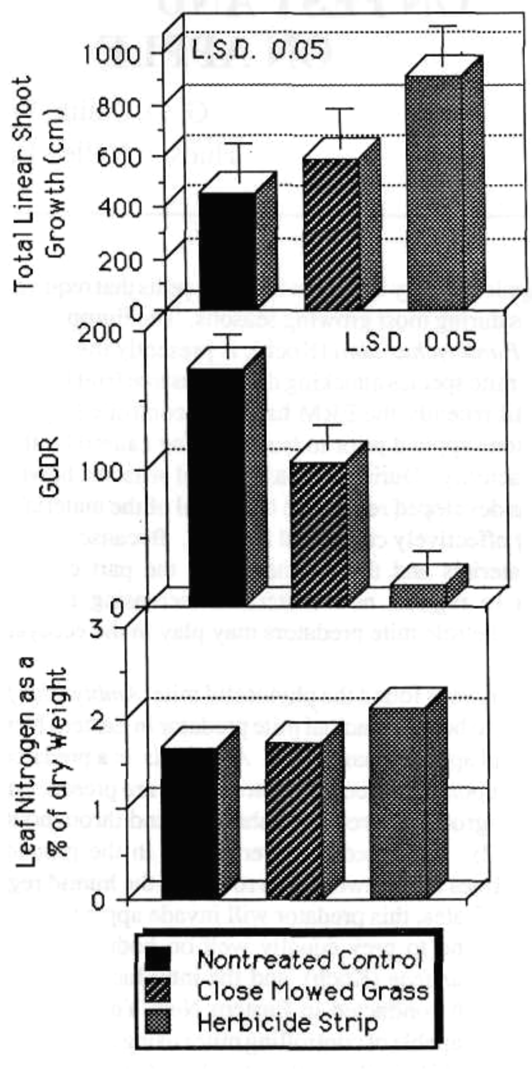

Figure. 2.—Apple shoot growth leafnitrogen levels, and ground cover density ratings for three different ground cover management practices at Highland, NY, during the summer of 1986.

the New Paltz site and the predator/prey interaction occurred earlier at this site (August 5 vs August 22 at the Highland site). This may have been due in part to the greater numbers of Z. *Mali* present at the New Paltz site which may have disrupted the *A. falladS/ERM* interaction. ERM populations were again greater where shoot growth and leaf nitrogen levels were highest (Fig. 4). Shoot growth and leaf nitrogen levels were inversely related to the amount of ground cover present in the plots.

In this study, several inter-related factors contributed to the pest mite population fluctuations. Shoot growth and leaf nitrogen content both showed decreases as the ground cover density increased. This is apparently due to increased competition for nutrients and moisture from an increased amount of vegetation in the row. This is not a new finding, as numerous reports have indicated that growing apples without ground cover competition leads to increased leaf nitrogen content and tree vigor (12).

Pest mite populations, in this study ERM, may have increased faster and/or to greater numbers on trees with the greatest growth or highest leaf nitrogen content. Earlier workers have reported ERM population increases in response to elevated leaf nitrogen content (1,9).

Predator mite populations, in this study *A.fallacis* and Z. *mali,* responded directly to ERM populations and were present in all

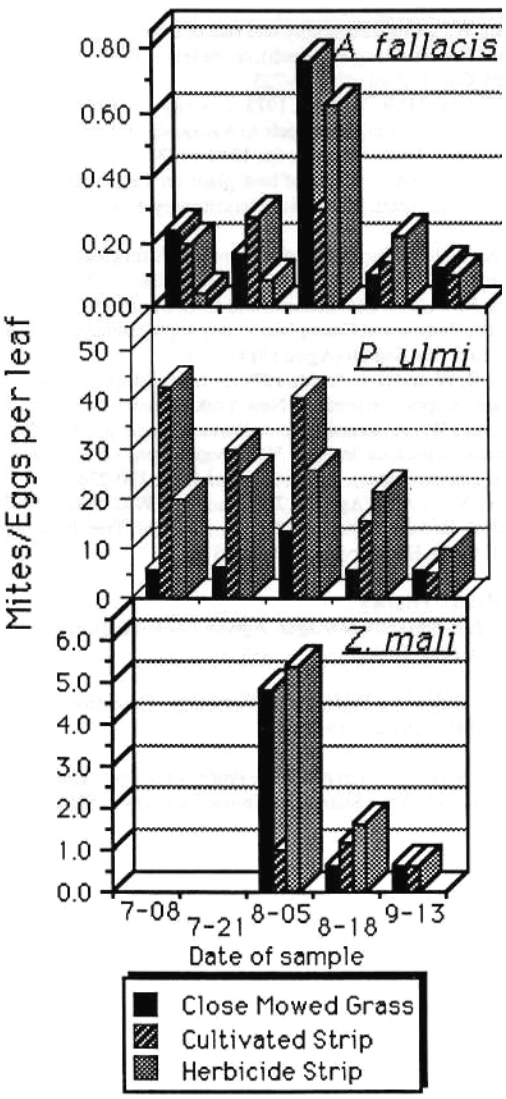

Figure. 3.—Mite population fluctuations under three different ground cover management practices at New Paltz, NY, durins the summer of 1986.

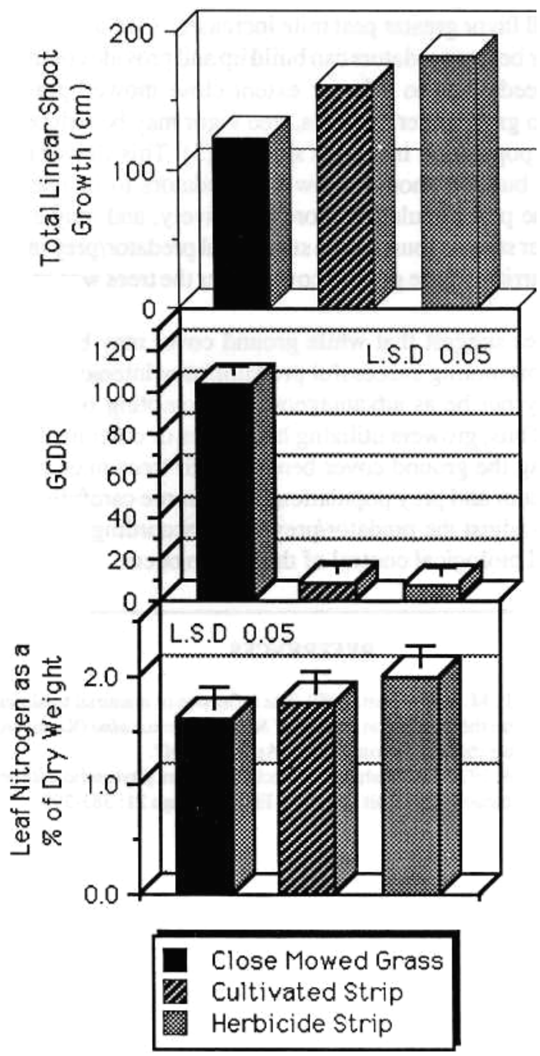

Figure 4.—Apple shoot growth, leaf nitrogen levels, and ground cover density ratings for three different ground cover management practices at New Paltz, NY, during the summer of 1986.

ground cover management treatments evaluated. The predator response was usually influenced by the rate of prey increase, which was in turn mediated by tree growth, which was directly affected by the ground cover management treatment.

Conclusions from these studies and their ramifications for growers wishing to utilize mite predators in an integrated mite control program are as follows: (1) It is likely that at least one or more predator species will be present at some point during the growing season in blocks using all forms of current ground cover management practices provided the grower does not use pesticides detrimental to their presence. (2) Ground cover management practices which eliminate ground cover beneath the trees are likely to result in greater tree vigor and higher leaf nitrogen levels which will favor greater pest mite increases. (3) Such increases may occur before predators can build up and provide control. (4) Where weeds, and to a lesser extent close mowed grass, are allowed to grow under the trees, tree vigor may be reduced and pest mite population increases slowed. (5) This slower rate of pest mite buildup should allow the predators to increase and control the pest population more effectively, and may explain why earlier studies found more successful predator/prey interactions occurring where ground cover under the trees was greatest.

Our studies suggest that while ground cover may be advantageous to promoting successful predator/prey interactions, such cover may not be as advantageous to promoting optimal tree growth. Thus, growers utilizing herbicides or other methods of eliminating the ground cover beneath their trees must monitor their predator and prey populations much more carefully and be willing to adjust the predator: prey ratios accordingly to permit successful biological control of the pest to occur.

REFERENCES

1. Breukel, L. M. and A. Post. 1959. The influence of manurial treatment of orchards on the population density of *Metatetraychus ulmi* (Koch) (Acarina: Tetranychidae). Entomol. Exp. Appl. 2:38-47.
2. Croft,B-A. 1976. Establishinginsecticide-resistantphytoseiid mite predators in deciduous tree fruit orchards, Entomophaga21:383-399.
3. Croft, B. A. and McGroarty, D. L. 1977. The role of *Amblyseiusfallacis* (Acarina: Phytoseiidae) in Michigan apple orchards. Mich. State Univ. Agric. Exp. Sta., Farm Sci. Res. Rept 333. 22 p.
4. Dennehy.T.J.J.P.Nyrop.W.H.Reissig.andR.W.Weires. 1988. Characterization of resistance to dicof ol in spider mites (Acari:Tetranychidae) from New York apple orchards. J. Econ. Entomol. 81(6):1551-1561.
5. Hislop, R.L., C. Arker, N. Alves, and RJ. Prokopy. 1978. Laboratory toxicity of pesticides and growth regulators to *Amblyseiusfallacis,* an important spider mite predator in Massachusetts apple orchards. Mass. Fruit Notes. 43(5): 14-19.
6. Hislop, R.L. and RJ. Prokopy. 1977.MitepredatorstudiesinMassachusetts apple orchards in 1976. Mass. Fruit Notes. 42(2): 5-7.
7. Johnson, D.T.andB.A. Croft. 1976. Laboratory study of the dispersal behavior of *Amblyseius fallacis* (Garman). Ann. Entomol. Soc. Am. 69: 1019-1023.
8. Iienk, S.E., CM. Waive, and R.W. Weires. 1980. Phytophagous and predacious mites on apple in New York. N.Y. State Agri. Exp. Sta., Geneva, Search (Agric.) 6:14 p.
9. Putman, W.L. 1964. Fecundity and rate of development of the European red mite, *Panonychits ulmi* (Koch), on the leaves from an abandoned peach orchard. Can. J. Zool. 42:719-723.
10. Rock, G.C. and D.R. Yeargan. 1973. Toxicity of apple orchard herbicides and growth-regulating chemicals to *Neoseiulus fallacis* and twospotted spider mite. J. Econ. Entomol. 66:1342-1343.
11. Santos, M.A. 1984. Effects of host plant on the predator-prey cycle of *Zetzetlia mali* (Acari: Stigmaeidae) and its prey. Environ. Entomol. 13:65-69.
12. Stott, K.G. 1976. The effect of competition from ground cover on apple vigor and yield. Ann. Appl. Biol. 83:327-330.
13. Weires, R. W., F. J. McNicholas, and G. L. Smith. 1979. Integrated mite control in Hudson and Champlain Valley apple orchards. New York State Agric. Exp. Sta. Search (Agric.) 9(4): 11 p.
14. Weires,R.W.andG.L.Smith. 1979.MitepredatorsinEasternNewYork commercial apple orchards. J. New York Entomol. Soc. 87:15-20.
15. Welty, C, W. H. Reissdg, T. J. Dermehy, and R. W. Weires. 1987. Cyhexatin resistance in New York populations of European red mite (Acari: Tetranychidae). J. Econ. Entomol. 80:230-236.
16. Wilcox. W. F., A.M. Agnello, J. Kovach and W.C. Stiles. 1987. Cornell Chemical Recommendations for Commercial Tree-Fruit Production. Cornell Coop. Ext. Serv. misc Publ. 55 pp.

ABOUT THE AUTHORS

Greg D. Smith is presently Manager, Agway Chemical Horticultural Service Center, Milton, New York.

Dr. Warren C. Stiles is a Professor of Pomology, Department of Pomology, Cornell University, Ithaca, New York.

Dr. Richard W. Weires, Jr. is an Associate Professorof Entomology, Department of Entomology, New York State Agricultural Experiment Station, Geneva.

It is the policy of Cornell University to support actively equality of educational and employment opportunity. No person shall be denied admission to any educational program or activity or be denied employment on the basis of any legally prohibited discrimination involving, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, sex, age, o handicap. The University is committed to the maintenance of affirmative action programs which will assure the continuation of such equality of opportunity.