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THE IMPACT OF WEEDS ON THE POPULATION OF PREDATORY SPIDERS IN LIME ORCHARD

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Abstract. **The spider abundance in weeded and non-weeded plots in a lime orchard was compared. The experiment was done at the Tropical Research and Education Center (TREC), Homestead, Florida. Samplings were taken from April to July 1998. The results of the preliminary test showed that the abundance of the web-building spiders was not significantly different between the weeded and the non-weeded plots for all the sampling periods. However, for hunting spiders the abundance was significantly higher in the non-weeded plots than in the weeded plots. This results suggests the importance of weeds as refuge area for the hunting spiders.**

Several factors may contribute to variations in spider abundance and species composition in agricultural ecosystems (Riechert, 1974). One of which is the vegetational structure of the agricultural systems. A more diverse agroecosystem in terms of vegetational structure results in increased environmental opportunities for natural enemies and consequently improved biological pest control. One way to enrich the vegetational structure of cropping systems is through weed management. The impact of weed diversity in the form of weed borders, alternates rows, or by providing weeds in certain periods of the crop growth on arthropod dynamics is important in keeping the population of the existing natural enemy complex. In the early 1920s and 1930s, it was observed that uncultivated apple orchards with the presence of wild flowers were less severely attacked by codling moth (Altieri and Letourneau, 1984) and tent caterpillar (Leius, 1967). They found a significantly higher parasitism in the weedy orchards than non-weedy ones. Insect populations are more stable in complex orchard communities because a diverse habitat can maintain an adequate population of the pest and its natural enemies at critical time. This is especially true in some apple growing regions where the predatory mite, *Amblyseius fallacis* (Garman) is an important factor in the control of the European red mite, *Panonychus ulmi* (Koch). In these areas, it is desirable to maintain broadleaf weeds in the cover crop, because such plants are hosts for the two spotted mite, on which adult *A. fallacis* can secure enough food to maintain themselves and increase their population before moving into the trees to attack increasing pest mites (Altieri and Letourneau, 1984). Spider colonization has also been linked to plant diversity. The stabilizing effect of spiders on the ecosystem should be enhanced on a large scale by differentiation of crop structure (van Emden and Williams, 1974). For instance, ground covers can contribute to a more continuous and diverse selection of prey for spiders. These ground covers exemplified by varieties of weeds may affect spider species composition as well.

Understanding changes in the community resulted from the abovesaid factor is important in order to obtain the maximum control effect from spiders on pest population. In lime, no studies have been conducted to look at the effect of weeds on the population of the existing biological control agents particularly on the predatory spiders. In this paper the abundance of spiders in weedy and non-weedy plots in a lime orchard was compared. This investigation assesses the relative impact of cultivation of weeds on spider population.

Materials and Methods

Experimental Plot. This preliminary study was conducted in one of the experimental lime orchards at the Tropical Research and Education Center (TREC), Homestead, Florida. Samplings were taken from April to July 1998. The size of the experimental plot was 2.5 ha planted in 17 rows with 20 trees per row. The plot was divided into four blocks: two alternating blocks were not weeded and the other two alternating blocks were weeded every three weeks. Figure 1 shows the weeding pattern. For the weeded blocks, mowing started in March, 1998. In the non-weeded blocks, the area around each tree was manually weeded to ensure the normal growth of the trees.

Sampling procedure and Data Analysis. Sampling was done using combined visual and shake-cloth methods. The visual method includes visual observation on leaf flushes of 10 randomly selected branches (30.76 cm in length) at the exterior canopy. Sampling was done between 9:00 to 11:00 AM. Leaves webbed together were carefully inspected or unfolded to determine the presence of spiders in the retreat nest. The shake cloth method consisted of using a 1m × 1m shake-cloth placed under five branches clamped together and beaten 10 times with a wooden yardstick. Groups of five clamps were randomly selected from the tree canopy. Five trees were randomly selected in each designated sampling area. Sampling was done once every month for four months (April to July, 1998). Spider abundance was compared between the weedy and non-weedy plots using the mean monthly count.

In this experiment, spider guilds were delineated based on the method of prey capture to allow comparison of community structure between experimental blocks. Two major guilds were established for foliage spider community: web-building spiders (i.e., Araneidae, Tetragnathidae, Theridiidae), and hunting spiders (i.e., Thomisidae, Salticidae, Clubionidae, Anyphaenidae, Lycosidae). The overall mean count for the two spider guilds were compared in the non-weedy and weedy plots using Duncan's Multiple Range Test.

Results and Discussion

The results of the preliminary test on the effect of weeds on spider abundance are shown in Figures 2 to 4. For all the

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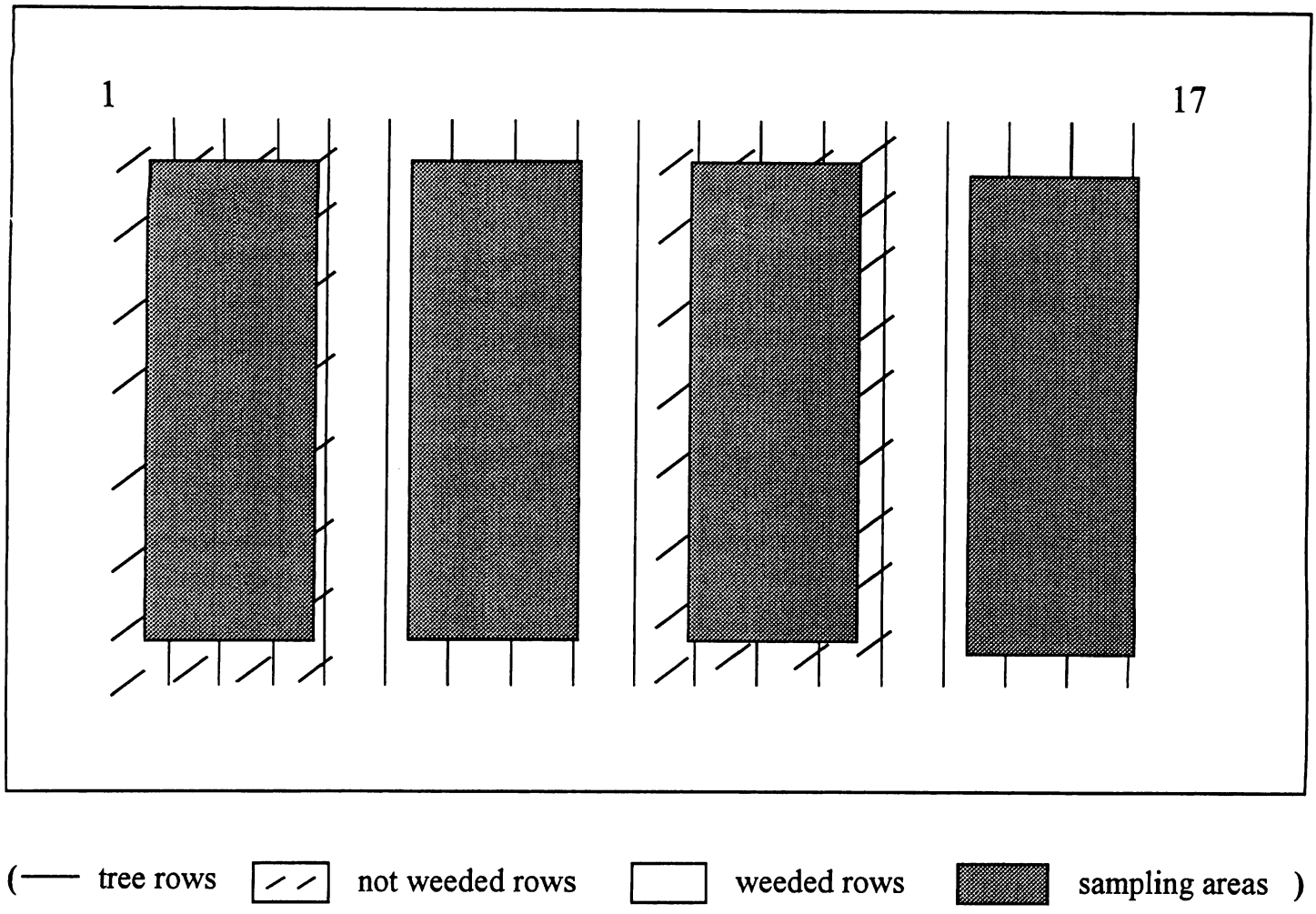

Figure 1. Experimental plot at TREC, Homestead, FL.

sampling periods, the abundance of the web-building spiders was not significantly different between the weedy and non-weedy plots (Fig. 2); whereas, the abundance of hunting spiders was significantly higher in the non-weedy plots than in the weedy plots for all the sampling periods (Fig. 3). The overall average count of spiders was significantly higher in the non-weedy plots than weedy plots (Fig. 4). The result of this preliminary test suggests that web-building spider abundance

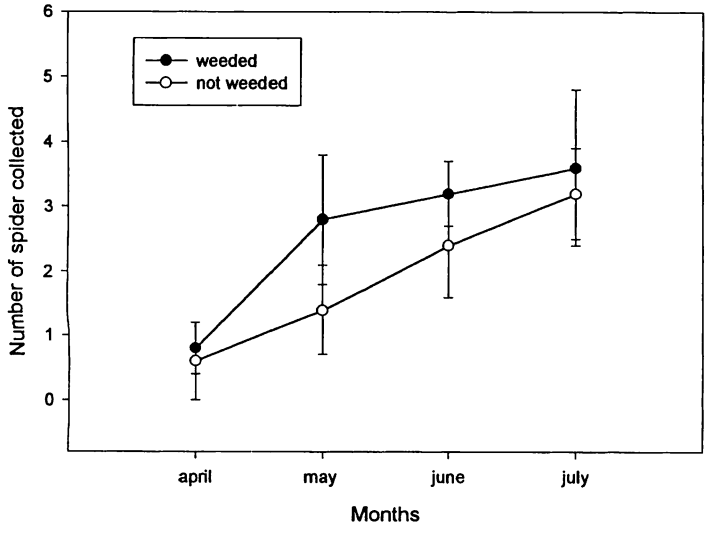

Figure 2. Average monthly count of web-building spiders in the non-

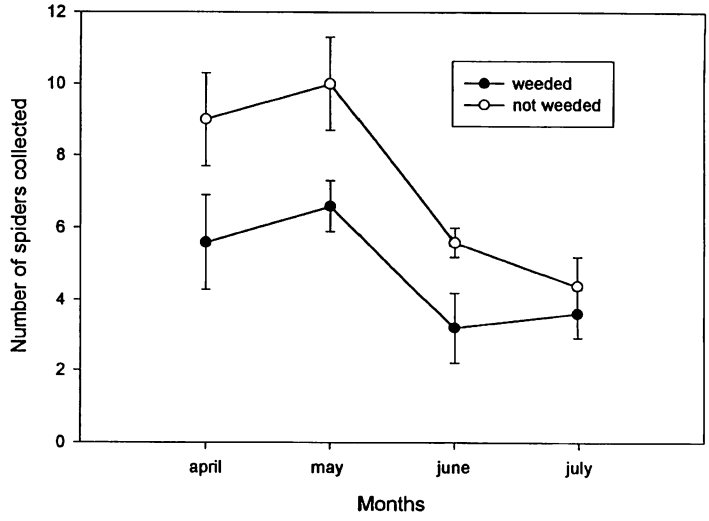

Figure 3. Average monthly count of hunting spiders in the weedy and non-weedy lime plots.

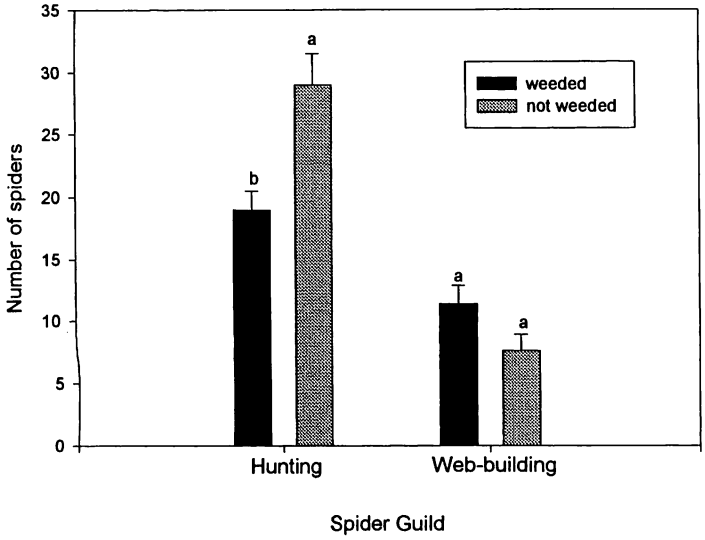

Figure 4. The overall average count of hunting and web-building spiders in non-weedy and weedy lime plots. Bars with the same letter in each spider guild are not significantly different according to Duncan's Multiple Range Test.

in lime orchards is not affected by the presence of weeds. This could be attributed to the high density of *Theridion murarium*, which dominated the population of the web-building spiders. *Theridion murarium* may have a competitive advantage in colonization and establishment in orchards without ground covers like weeds. Similar, observation was noted by Costello and Daane (1995) in grape plantations. Nevertheless, the presence of weeds in the experimental plots seems to have a positive effect on the abundance of hunting spider group. This is not surprising as the hunting spider group is dominated by the sac spiders, which are known to be nectivorous (Taylor and Foster, 1996) and may require the presence of flowering weeds for their dietary supplement.

Providing supplementary food source (i.e., pollen, honeydew, or nectar) are essential to many adult parasitoids and predators but often periodically in short supply (Debach and Rosen, 1991). There are two ways to overcome this problem. One way is through artificial spraying of the supplementary food source. In crops like alfalfa, cotton, and bell pepper, it had been shown that spraying artificial honeydew attract adult green lacewings to a given field and increase their fecundity and thereby increase in predation of pests (Hagen, 1986). Another way of increasing the population of the natural enemies in the field is by naturally increasing vegetational diversity in an agroecosystem (i.e., abundance of weed cover). Alteiri and Whitcomb (1979) showed that the predator component of the weed food webs included mainly ground beetles, predacious stink bugs, ladybird beetles, assassin bugs, and herb-stratum spiders. Since many of the predators are likely to be increased through seasonal manipulation of selected weeds are valuable enemies of important crop pests, plowing strips of land within a crop or other important surrounding habitats in different seasons, might lead to increasing population of selected weeds which provide alternate prey to numerous important predators during periods when the pest species have become scarce in the field.

Our results showed that the presence of weeds could have contributed to higher spider abundance in lime orchards particularly for the hunting spider group. Four species of hunting spiders, *Chiracanthium inclusum*, *Hibana velox*, *Trachelas volutus*, and *Hentzia palmarum* are found dominantly occurring in lime orchards in south Florida. These hunting spiders are also confirmed to feed on larvae and prepupae of citrus leafminer, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) (Amalin et al., 1995), which is one of the major pests of *Citrus* spp. The importance of these species of spiders as predator of citrus leafminer warranted the manipulation of their population in the orchard. Since, these hunting spiders are also nectivorous, it clearly showed that some of the weeds producing nectars should be allowed in lime orchards. This means that seasonal manipulation of selected weeds should be encouraged. Further investigation of the types of weeds that will enhance the population of these hunting spiders in the orchard should be done.

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