Further Evaluation of the Efficacy of Neem Oil Against Aphids (*Aphis gossypii Clover*) on Sweet Pepper (*Capsicum frutescens L.*)

By Ma. Victoria C. Seredrica

ABSTRACT

The study was conducted from December 1998 to May 1999 at the experimental field of the CPU College of Agriculture, Iloilo City. The objectives of the study were to evaluate the effect of the different concentrations of neem oil on the control of aphids and other pests, and to monitor the abundance of the natural enemies.

The six experimental treatments consisted of neem oil at 1500, 3000 and 4500 in parts per million, 40% neem leaf aqueous extract, perla soap solution and the control (untreated). The treatments were arranged in a randomized complete block design with four replications.

Results of the study revealed that the use of neem oil at different concentrations had a better reducing effect than the other treatments on aphid population. The higher aphid density had favorably increased the number and kind of the natural enemies (Class Insecta and Arachnida) which in turn had augmented the control action of the spray solutions. White flies and grasshopper nymphs were controlled and repelled, respectively, by the neem preparations.

For economic reasons, the use of neem oil at 1500 ppm is recommended as weekly spray to control aphids, white flies and grasshoppers during the vegetative stage of pepper. Since the use of neem oil had shown a sign of favorable control against fruit flies, the concentration should be doubled from flowering to fruiting stage of the plant. When thrips is a problem, it is recommended that perla soap solution be sprayed at four-day interval for total protection of the plants.

INTRODUCTION

Background and Rationale

Sweet pepper (*Capsicum annuum L.*) is commonly grown all over the country with Ilocos region as the main growing area having 370 ha. Western Visayas has a production area of 100 ha. while Eastern Visayas has only 80 ha. However, the bulk of production in Eastern Visayas is three folds higher than in Western Visayas. Pepper is usually planted as a monocrop both in the upland and lowland areas during the cool months of the year after the rainy season (Soriano, Villareal & Roxas, 1989).

One of the most prevalent pests in pepper are the aphids (*Aphis spp.*). Aphids damage the plant directly by sucking the sap that leads to abnormal growth, and indirectly by serving as vectors of pathogenic viruses.

At present, pest control methods that are safe to the environment and naturally self sustaining are promoted. A number of botanical pesticides are locally available. In fact, a number of farmers are already using some of the promising plant materials in pest control. However, many are still reluctant to adopt this method.

One of the potential plant species that can be used as a botanical pesticide is the neem tree (*Azadirachta indica A. Juss*). Extracts from the leaves and the seeds have antifeedant, repellent, and insecticidal properties. Therefore, thorough experimentation has to be done on this line of interest since this offers a great advantage to both the producers and consumers.

Objectives of the Study

The objectives of the study were to evaluate the effect of different concentrations of neem oil in the control of *Aphis gossypii* and to monitor the abundance of the natural enemies.

Time and Place of the Study

The study was conducted from December 1998 to May 1999 at the experimental field of the College of Agriculture, Central Philippine University, Iloilo City.

METHODOLOGY

The treatments were composed of neem oil (NO) at 1500, 3000, and 4500 in parts per million; perla soap spray; and 40 percent neem leaf aqueous extract (NLAE). Plants which were not sprayed with neem extracts were provided as control. The experimental treatments were laid out in a randomized complete block design with four replications.

Neem seed oil was extracted using a manually operated grain grinder. The different concentrations of neem oil were prepared by measuring 1.5 ml, 3.0 ml and 4.5 ml of neem oil and each mixed separately in a li of water to yield 1500, 3000 and 4500 ppm, respectively. Soap spray was prepared by soaking one piece of blue perla in five li of water overnight. The 40 percent NLAE was prepared by soaking overnight 400 g of chopped fresh neem leaves in a liter of water. The resulting solution was strained prior to spraying.

The pricked seedlings were sprayed with perla soap solution to protect them from the damage of thrips. This was continued until four weeks after transplanting to further protect the plants from the same pest. Spraying of the experimental treatments was started six weeks after transplanting (WAT) when the plants were colonized by aphids.

The number of aphids was recorded when the aphid population had started to increase. The aphid density was rated using the following scale:

Scale	Description
1	0 aphid
2	1-10 aphids
3	11-100 aphids
4	101-1000 aphids
5	1001 aphids and above

The prevalence of other pests and their response to the spray applications were also noted. The kind and number of immature and mature stages of the natural enemies were recorded.

Analysis of Data

Only the data on plant height was statistically analyzed using the analysis of variance for a randomized complete block design.

RESULTS AND DISCUSSION

Plant Height

Final height measurement (Table 1)was taken at flowering period with the assumption that plants are at their maximum stage of growth. Data revealed that the height

Table 1. Height Measurement Taken Seven Weeks after Transplanting (WAT).

Treatments	Replication				
	I	II	III	IV	Mean
	-	-	cm -	-	-
1,500 ppm NO	22.00	20.60	24.80	22.40	22.45^{ns}
3,000 ppm NO	23.30	23.80	22.80	22.30	22.97
4,500 ppm NO	23.30	21.80	25.80	25.00	23.92
40% NLAE	23.80	21.00	24.30	22.10	22.80
Perla Soap Solution	22.80	22.20	25.60	23.30	23.47
Control	22.00	21.10	24.40	22.60	22.50

^{ns}not significant at the 5 percent level of probability.

of sweet pepper plants ranged from 22.45 to 23.92 cm. However, Statistical analysis revealed that height was not significantly ($P>0.05$) different among treatments.

Aphid Count, other Pests and the Natural Enemies

The abundance of aphids was recorded from six to eleven weeks after transplanting using the scalar rating (Table 2). The initial scalar rating taken ranged from 1.42 to 1.72 and at the when the ratings were made, seven black aphid mummies and two spiders (Class Arachnida) were observed. On the other hand, the abundance of natural enemies was recorded from six to nine weeks (shown as 1 to 4 weeks in Figure 1). The black mummies contain the immature stages of the aphid parasitoids (*Hymenoptera*). Swarms of grasshopper nymphs were also observed a few days after transplanting. Thrips (Thrips sp.) were likewise noted in the area. One week after spraying, plants sprayed with neem preparations and perla soap solution had a lower rating (1.52 to 1.8) than that of the unsprayed plots having a rating of 2.12. There were four adults of predatory beetles (*Coleoptera: Menochilus sexmaculatus Fabricius,*) and one nymph of praying mantis (*Mantodea*) found in the area. Moreover, the swarms of grasshoppers were no longer apparent after spraying which could be due to the repellent effect of the neem preparations.

Table 2. Scalar Rating of Aphid Population Taken Six to Eleven Weeks after Transplanting (WAT).

Treatments	WAT 6	7	8	9	10	11
	-	-	Scale	-	-	-
1,500 ppm NO	1.72	1.60	2.45	2.00	1.52	1.20
3,000 ppm NO	1.55	1.60	2.50	1.55	1.05	1.07
4,500 ppm NO	1.52	1.52	2.40	1.67	1.25	1.17
40% NLAE	1.62	1.62	2.75	2.22	2.25	1.90
Soap/Perla	1.42	1.80	3.20	2.52	2.25	2.20
Control	1.60	2.12	2.82	2.05	1.90	1.62
Mean	1.57	1.71	2.68	2.00	1.70	1.52

The peak of aphid population was observed eight weeks after transplanting, which was prior to the third-week of spray treatment. It was observed that at increasing aphid density, there was a corresponding increase in the number of natural enemies. These included 13 mummified aphids, five adult spiders and two egg masses one coccinellid (Coleoptera) egg mass, eight coccinellid larvae and three adults *(M. sexmaculatus and one Scymnus sp.)*, three adult syrphid flies (Diptera) and six syrphid maggots. A number of dragonflies (Odonata) were also observed flying over the area. The predators are considered as generalists, i.e., they have varied host ranges. Therefore, the adults may come and go looking for another prey. The adult has the instinct that they will only deposit their eggs on

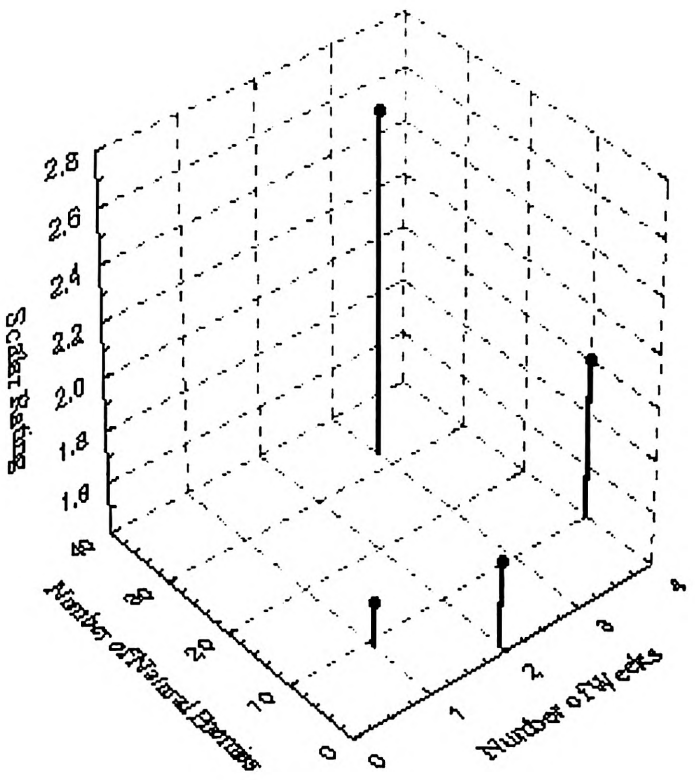

Fig. 1. Relationship between Population of Aphids and of Natural Enemies

plants having abundant host insects for the survival of their young. The larvae are cannibalistic in nature and they tend to eat each other leaving the luckiest ones to finish the available host insects. This could be the reason why the abundance of the natural enemies had also coincided with the abundance of host aphids. It was also observed that the natural enemies were present both in sprayed and unsprayed plots. The younger leaves of the untreated plants showed leaf curling and silver leaf coloration, typical symptom of aphid and thrip damage, respectively. A number of white flies *(Bemesia sp.)* were also noted.

On the fourth week of treatment (9 WAT), plants sprayed with neem oil at 3,000 to 4,500 ppm had lower aphid population than those sprayed with 1,500 ppm, 40% leaf water extract, perla solution and the control. Six larvae of coccinellid beetle were observed only on the unsprayed area and four immature spiders on the sprayed area. Some treated plants also served as host of a number of immature thrips but the damage is not as alarming as compared to those found in the untreated plants.

Data from the fifth (10 WAT) to sixth (11 WAT) weeks of spray application revealed that neem oil spray had favorably reduced the aphid population than the 40 % neem leaves and perla spray. Adult natural enemies such as coccicnellid beetles and syrphid flies hovered on the area. No immature natural enemies were observed. The lower aphid rating in the unsprayed plants than those sprayed with perla soap and 40% neem leaf extracts could be attributed to the control action of the natural enemies. The rating on aphid population was only until that stage since the plants were growing older and the fecundity of parthenogenetic adults declines dramatically with plant age.

Generally, the use of plant extracts had favored the build-up of the population of the natural enemies. Therefore, the harmonious combination of these environment friendly methods of control had a great impact on the conservation of the existing natural enemies in the field.

Fruit data was recorded during the first and second primings. But since the fruiting was not uniform and most of the fruits collected were infested with fruit fly (*Dacus cucurbitae)*, data collection was discontinued. However, the degree of fruit fly damage was continuously monitored for one

more month after the termination of the spraying schedule during which it was observed that more marketable fruits were still developed both in the treated and untreated plants. Destructive sampling was done on fruits that showed oviposition marks, but this process revealed no sign of living maggots. This implies that the control action of neem oil was on the second generation of fruit fly affecting the insect metamorphosis.

RECOMMENDATION

Based on the results of the study, the researcher recommends the use of neem oil at 1500 ppm to control aphids, whiteflies and grasshoppers during the vegetative stage. When thrips become a problem, perla soap solution can be effectively used at four to five day interval for total protection. Since the use of neem oil showed a favorable control signal against fruit fly, the concentration should be doubled at reproductive stage. The use of botanicals in pest control is helpful in maintaining the balance of ecology by sustaining the population of the beneficial insects that likewise regulate the pest population.

REFERENCES

Ad Hoc Panel of the Board on Science and Technology for International Development National Research Council. (1992). Neem, a Tree for Solving Global Problems. Washington D.C.: National Academy Press.

Jacobson, M., Stokes, J.B., Warthen Jr., S.D., Redfern, R.E., Reed, D.k., Webb, R.E. and Telek, L. (1984). "Neem research in the U.S. Department of Agriculture: An update." Natural Pesticide from the Neem Tree (*Azadirachta indica A. Juss*) and other Tropical Plants. Proceedings of the Second International Neem Conference, May 1983 Eschborn, Germany: Dt. Ges. fur Techn. Zusammenarbeit (GTZ) GmbH.

Jotwani, M.G. and Srivastava, F. K. (1984) "A review of neem research in India in relation to insects." Natural Pesticide from the Neem Tree (*Azadirachta indica A. Juss*) and other Tropical Plants. Proceedings of the Second International Neem Conference, May 1983. Eschborn, Germany: Dt. Ges. fur Techn. Zusammenarbeit (GTZ) GmbH.

Research Information Series on Ecosystem. (1991). Reforestation Species: Pigeon pea, Malabalatong, and Neem. (Volume 3). Laguna, Philippines: Ecosystem Research Development Bureau, Department of Environment and Natural Resources.

Schmutterer, H. (1985) "Neem research in the Federal Republic of Germany since the first international neem conference." Natural Pesticide from the Neem Tree (*Azadirachta indica A. Juss*) and other Tropical Plants. Proceedings of the Second International Neem Conference, May 1983. Eschborn, Germany: Dt. Ges. fur Techn. Zusammenarbeit (GTZ) GmbH.

Soriano, J.M., Villareal, R.L. and Roxas, V.P. (1989). "Tomato and pepper production in the Philippines." Tomato and Pepper Production in the Tropics. Proceedings of the International Symposium on Integrated Management Practices, March 1988. Tainan, Taiwan: AVRDC.