EFFICACY OF *AZADIRACHTA INDICA* A. JUSS (NEEM) AGAINST LARVAE OF *LYMANTRIA DISPAR* LINN. (GYPSY MOTH) IN THE LABORATORY

G. A. Bajwa[1] and G. Zimmermann[2]

Abstract

An oil formulation of Neem *Azadirachta indica* was tested in four concentrations of 3.2%, 4.8%, 6.4% and 8.0% against larvae of *Lymantria dispar* in the laboratory. 1st instar larvae of the pest were fed on neem sprayed leaves of *Prunus domestica*. 100 percent mortality was observed in all neem test treatments within 21 days. In the highest dose (8%) maximum mortality was recorded after 72 hours which may be due to contact action of neem oil formulation. On the other hand, the lower doses caused slow mortality in the beginning and progressed steadily, owing to growth regulating behaviour of neem. The neem formulation at 6.4% and 8% were phytotoxic to *Prunus domestica*.

Key words: Neem, *Azadirachta indica*, Gypsy moth, *Lymantria dispar*, Control

Introduction

Gypsy moth having its origin in Asia and Europe is a polyphagous, cosmopolitan pest, spreading all over the world distribution (Bathon, 1993). It infects forest plantations every year from Asia-Pacific, Europe to North America. The pest was controlled with chemical insecticides, however growing awareness about the side effects of insecticides has restricted their uses, particularly in protected and residential areas. To overcome this problem, alternative control possibilities were searched out, with the use of entomophagous insects and entomopathogenic viruses, bacteria, fungi and protozoa in integrated pest management.

[1] Pakistan Forest Institute, Peshawar, Pakistan.

[2] Federal Biological Research Centre for Agriculture and Forestry, Institute for Biological Control, Heinrichstr. 243, 64287 Darmstadt, Germany.

In the new concept of integrated pest management soft insecticides were encouraged over synthetic highly toxic ones. That is why the all times traditional subcontinental botanical insecticide *Azadirachta indica* A. Juss has gained boost throughout the world. At least 125 species of insect pests, mites and nematodes, including many species of Coleoptera (25), Lepidoptera (25), Diptera (10) and Orthoptera (9) are being controlled with the help of neem and its products (Hepburn, 1989). Similarly, Dreyer and Hellpap (1992) have used successfully the crude water extract of neem in field against major insect pests of economical crops in Africa and Latin America. They furthermore considered it as the most suitable for integrated pest management owing to peculiar mode of action on target organisms, limited side effects on beneficial organisms and absence of toxicity on warm blooded animals. Also, neem has advantages over synthetic insecticides because it possesses a complex work action. For example, it acts as insecticides, ovicides, antifeedants, deterrents antimoultants, etc. Likely, insects also suffer from physical and physiological abnormalities by the use of neem (Bidmon *et al.*, 1987; Naqvi, 1987; Parmar, 1986; Wilps, 1987). Because of this multifaced behaviour of action, neem is the most effective natural pesticide active against insecticide resistant insect pests. Therefore, keeping the importance of pest and the role of neem in pest management and as an outbreak of *Lymantria dispar* was observed in some areas in Germany, the present trials were carried out in the laboratory.

Materials and Method

A neem oil formulation (80% neem oil, 20% additives) was tested against larvae of *Lymantria dispar* L. (Lep., Lymantriidae) to evaluate its control potential in the laboratory. There were four concentrations used, i.e. 3.2%, 4.8%, 6.4% ,8% (pure neem oil) and a control. Twigs with leaves of *Prunus domestica* L. were sprayed until running off using common hand spray pump. The twigs were dried at room temperature, put in small vials with water and placed in plastic boxes (16x12x6cm). In the control the leaves were sprayed only with tap water. Ten 1st instar larvae of the pest were used in each treatment. For the first 3 days, the larvae were kept on treated twigs, thereafter fresh twigs with untreated leaves were given at alternative days. The experiment was conducted at room temperature and natural day/night rhythm.

Randomized complete block design with five treatments including control and three replications was applied. The data were statistically analyzed by analysis of variance (ANOVA) and least significant difference test (LSD).

Results and Discussion

Mortality caused by neem in different treatments was converted in percentage and after analyzing statistically is presented in Table 1.

Table 1. Multiple comparison of percent mortality of *L. dispar* fed on leaves, treated with Neem oil

Neem oil (%)	Percent mortality (after treatment)					
	72 hours	96 hours	120 hours	1 Week	2 Weeks	21 days
	**	**	**	**	**	**
3.2	16.67 b	20.0 c	33.33 b	46.67 b	53.33 b	100 a
4.8	16.67 b	26.67 c	33.33 b	46.67 b	66.67 b	100 a
6.4	23.33 b	43.33 b	50.0 b	50.00 b	73.33 ab	100 a
8.0	66.67 a	80.0 a	80.0 a	83.33 a	86.67 a	100 a
Control	3.33 c	3.33 d	3.33 c	3.33 c	3.33 c	3.33 b

** Significant at 1% level, - Figures in same column sharing same letter are non significant

The results indicated that neem oil caused highly significant ($P<0.01$) mortality after 72, 96, 120 hours, one week and two weeks over control. With minor exceptions same pattern of dose - mortality response was observed. The highest test dose (8%) had given markedly higher mortality ($P<0.05$) after 72, 96, 120 hours and one week than the other test doses except after two weeks when it was insignificant with immediate lower dose (6.4%). Similarly, the three lower doses (3.2%, 4.8%, 6.4%) were non significant among themselves ($P<0.05$) except after 96 hours when the second highest dose (6.4%) differed significantly with two lower neem test doses (3.2%, 4.8%).

The mortality between the two extreme neem concentrations tested (3.2% and 8%) has a big margin of difference after 72 hours. The mortality was increased progressively more in lower doses than higher one, consequently margin of difference was also narrowed. This two way response of treated larvae, i.e. immediate and slow mortality, towards dosage displays two different characteristics of neem and its products. The treated caterpillar became sluggish, could not moult and did not feed after one week, unlikely in control where they were active, well fed and have passed through 3 moultings in 21 days. After 21 days in all neem test doses all larvae died, while in control only 3.33% died. Neem in higher dose, especially oil formulation, has contact action (Parmar, 1987.) which is also evident from these results. Likewise, Emsley (1991) has reported insecticidal properties of azadirachtin itself which results in direct mortality of insects. On the other hand, neem in low doses did not kill insects directly but rather acts as an antimoulting agent. Here, the results too display, where larvae could not moult for 21 days and ultimately died.

These results are in confirmation with Skatulla and Meisner (1975) who also obtained 100% mortality of gypsy moth caterpillars with neem extracts when used at 0.02%, 0.2% and 0.5% concentrations in the laboratory. Similarly, 100% mortality of gypsy moth caterpillar was registered after 25 days by using Margosan-O, a commercial neem product at the rate of 0.2 lit./ha. (Anonymous, 1991). In contrast to our experiments they used rather low concentrations. They obtained low mortality in the beginning while in our experiment high mortality was obtained by high dose in the same time. However, the different qualities of neem oil and the variations in the content of azadirachtin and other insecticidal compounds in formulated or unformulated products may have a major role in determining dose rate.

In the trial, neem oil at doses of 6.4% and 8% has burnt leaves of *Prunus domestica* L. Earlier, this phytotoxic impact of neem was also reported by Chianella and Rovest-(1992), and by Jakob (1992). Both have found that neem oil formulations are more phytotoxic than aqueous ones.

Conclusively, it can be inferred that neem oil has potential for controlling *L. dispar*. However, higher doses should be avoided on account of phytotoxicity and economics. Moreover, detailed work on dose rates and LD_{50} is required for standardization of different neem formulations for practical use in the field.

Acknowledgements

The authors are thankful to Mr. Temmen, Hattersheim/Germany who has provided the neem product for the trial. Thanks are also extended to Institute for Biological Control, Darmstadt-Germany where the experiment was conducted and to German Foundation for International Development who provided financial support for this programme.

References

Anonymous, 1992. Neem: A tree foı solving global problems. Natural Academy Press, Washington,D.C.,pp. 50.

Bathon, H., 1993. Biologische Bekämpfung des Schwammspinners: Rauber und Parasitoid. In A. Wulf und K. H. Berendes [eds.] Schwammspinner-Kalmität im Forst: 117. Kolloq. 19-20 Oktober 1993, Braunschweig, Germany.

Bidmon, H.E.J., G. Kauser, P.Mobus and J. Koolman, 1987. Effect of azadirachtin on blowfly larvae and pupae. Proc. 3rd Int. Neem Conf. (Nairobi,1986):253-271.

Chianella, M. and L. Rovest, 1992. First experiences with neem in Italy and its potential uses in plant protection. In H. Kleeberg [ed.] Practice Oriented Results on Use and Production of Neem Ingredients and Pheromones. Proc. 2nd Workshop Wetzlar Nov.30th-2nd Dec., 1992.

Dreyer, M. and C. Hellpap, 1992. Neem-a promising natural insecticides for small scale vegetable and production in tropical and subtropical countries. Plant Res. Develop. 35(1):7-18.

Emsley, J., 1991 Probing the chemistry of antifeedants. Shell Agri. 11, pp.30-32.

Hepburn, G., 1989. Pesticides and drugs from the neem tree. The Ecol., 19(1):31-32.

Jakob, G., 1992. Studies on the phytotoxicity of different neem seed extracts. In H. Kleeberg [ed.], Practice Oriented Results on Use and Production of Neem Ingredients and Pheromone. Proc. 2nd Workshop on Neem and Pheromone. Wetzlar, Nov.30th-2nd Dec., 1992.

Naqvi, S.N.H., 1987. Biological evaluation of fresh neem extracts and some neem components, with reference to abnormalities and esterase activity in insects. Proc. 3rd Int. Neem Conf. (Nairobi,1986):315-330.

Parmar, B.S., 1987. An overview of neem research and use in India during the years 1983-86. Proc. 3rd Int. Neem Conf. (Nairobi,1986):55-80.

Skatulla, U. and J. Meisner, 1975. Laborversuche mit Neem-Samen-extrakt zur Bekämpfung des Schwammspinners, *Lymantria dispar* L. Anz. Schadlingskde, Pflanzenschutz 48: 38-40.

Wilps, H., 1987. Growth and adult moulting of larvae and pupae of the blowfly *Phormia terraenovae* in relationship to azadirachtin concentrations. Proc. 3rd Int. Neem Conf. (Nairobi,1986):55-80.