Effect of *Azadirachta indica* oil cake (NOC) and extract on Euproctis fraternal insect pests on mulberry leaves

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Abstract
Sericulture is an agro-based sector and also one of the major areas of agricultural entomology. There are four different kinds of silk produced by this sector: mulberry, muga, eri, and tassar. The demand for this mulberry silk is high in the global agricultural market. In order for mulberry silkworms (Bombyx mori) to be raised successfully, host plants are essential throughout their cultivation. However, several insect pests severely infest the host plant. The main insect pest for the mulberry tree among these is defoliators. They have an impact on different components of the plant, including the leaf, bud, stem, and other parts. Plants that are infested have reduced leaf output and stunted development. Furthermore, impacted leaves are not conducive to the growth of the silkworm's body. Mulberry is a little, quickly growing evergreen or deciduous tree that is used as a drumstick tree. We have known about its medicinal and dietary properties for a very long time. This tree is vulnerable to a variety of illnesses and insect pests. Neem seed kernel extract and neem leaf water extract are used to treat the prevalent Euproctis fraternal pest. Azadirachta indica (Neem) leaves and seeds were harvested from the field, shade dried, and then ground into powder. The 5.0% stock solution was made using this powder. The following concentrations were then made from the stock solution: 4. 00%, 3. 0%, 2. 00%, 1. 00%, 0. 5%, and 0. 25%. Following treatment against Euproctis fraternal, the current experiment examined and discussed the caterpillar's behavior related to food, body weight loss, and gain.

Keywords: Mulberry, Neem oil cake, Euproctis fraternal tussock pest

1. Introduction

Mulberry leaves (Morus alba), which are well-known for being used as silkworm food, are extremely healthy and high in antioxidants. They are frequently used in teas, salads, or as supplements to aid in the treatment of diabetes, lower cholesterol, and fight inflammation. They have a lot of raw protein and are used in traditional medicine to treat diabetes and improve skin health. The small, quick-growing evergreen or deciduous mulberry tree, commonly known as the Drumstick tree, often reaches a height of 10 to 12 meters (Vasanthara, J. *et al*., 1982; Maxwell. Lefroy, H., 1981 & Richard, O.W., 1963) [1-3]. It has a thick, corky, whitish bark, feathery foliage of tri-pinnate leaves, and a broad, open crown of droopy, brittle branches. The most commonly cultivated species of a monogenetic family is mulberry. The mulberry is which is indigenous to the Himalayan regions of India, Pakistan, Bangladesh, and Afghanistan. Its wood is of poor quality since it is a perennial softwood species that has been promoted for industrial, medicinal, and traditional uses for centuries. Humans have been eating the whole mulberry tree for a long time. Mulberry is used for a variety of purposes, including alley cropping, animal forage, bio-gas protection, household cleaning products, blue dye, fencing, fertilizer, foliar nutrients, gum, honey, and medication (all parts). Additionally, mulberry trees have been used to purify water by using seed powder, helping to address malnutrition, particularly in newborns and nursing mothers (Butani, D.K. *et al*., 1981: Kareem, A.A., 1974 & Morton, J.F. 1991) [4-6]. Despite our long-standing familiarity with mulberry's dietary and therapeutic benefits, little focus has been paid to the insect pest that targets different areas of the tree. (Pillai, K.S., 1979; Ramchandra, C. *et al*., 1980; Verma, A.N., 1974) [7-9] have documented significant and minor insect pests that harm different sections of this tree. A number of insect pests and diseases attack M- oleifera in its native Indian habitat. Among these are the budworm, Noorda mulberrye Tams, which can inflict significant defoliation and flower damage, the tussock leaf-eating caterpillar, Noorda blitealis Walk, and a number of other insect pests that cause minor or only occasionally severe damage in m. oleifera (Durhm, W.F., 1962; Batchalor, G. *et al*., 1954 & Lavy, T.L., 1980) [10-12]. The tussock caterpillar (Euproctis fraternal) is a frequent mulberry pest that can reach dangerous levels. The larvae congregate in clusters at the base of tree trunks and branches, swiftly defoliating the trees. The tussocks are also unpleasant to handle. The moth is a little larger, with yellowish wings with subtle stripes. The larvae are brownish with thin, lengthy clumps on the body, and the female deposits the eggs in clusters on soft areas. The base of the tree and the dirt are where pupation occurs (Ramesh, C. *et al*., 1992; Tribuwan, S., 1989) [13-15]. Plant protection methods are crucial for mitigating the harm caused by insect pests to various parts of mulberry as well as for improving the yield of mulberry fruits. The use of chemical pesticides is likely to be dangerous and harmful, as it tends to disrupt the natural enemy population, leave residue on treated materials that is known to be poisonous, and contribute to environmental contamination (John, C.K., 1999; Das, P.K., *et al*., 1983; Hanuappa, H.G., 1985 & Singh, R.H., 1993; Srivastava, R.C. *et al*., 1984) [16-20]. The fact that neem, which is high in azadirachtin the key ingredient in neem has pest-repellent qualities that are the core of India's traditional knowledge makes it useful and affordable for future formers (Saxena, R.C., 1981; Jotwani, M.G. *et al*.,1984 & Mishra, S.K., 1995) [21-23]. Numerous pesticidal components allow neem to defend itself against pest attacks. The broad family of natural compounds known as "triterpenes," more precisely "limonoids," includes azadirachtin. The neem tree has yielded around 40 compounds that are biologically active against insects, with azadiractin thought to be the most potent. The major insect pests of agriculture are neen products (Wilps, H., 1986; Garcea, E.S., *et al* 1984 & Schluter, U. *et al*., 1985) [24-26]. The current experiments describe the management steps taken to combat the Mulberry tree pest Tussock Leaf Caterpillar using neem leaf and seed kernel extracts.

2. Materials and Methods

Neem oil cake (NOC), a byproduct of neem oil extraction, is a precious organic fertilizer and pest repellent for mulberry plantations. It improves soil fertility, presents vital vitamins, and enables manage nematodes and different soil-borne pests and diseases. Some of the specific organic sources are the non-safe to eat oilcakes in standard and NOC in particular incorporate high amount of plant vitamins and alkaloids which induces immunity in opposition to pests and sicknesses in mulberry except its better nutrient content material than other oil desserts. The alkaloid contents (nimbin and nimbicidine) which inhibit the nitrification manner of N transformation in soil at the same time as applying nitrogenous fertilizers and makes N to be had slowly. The NOC @ 60 kg/ac/crop blended with N fertilizer notably increased the mulberry leaf yield. however, the software of 800 kg /ac in 4 cut up doses at an c programming language of 3 months at some stage in inter-cultural operations is suggested to govern root-knot sickness. The tussock leaf caterpillar was collected from mulberry in affected mulberry trees. The observations and collection of tussock leaf caterpillar affecting parts were carried out daily morning at regular intervals four selected trees and identified later. Neem is a member of the mahogany family, Meliaceae. It is known by the botanic name *Azadirachta indica* A. Jus. Neem trees are attractive evergreens that can grow up to 30m tall and 2.5 m in girth. Their spreading branches form rounded crowns as much as 20m across. The leaves fall off during extreme cold and drought. The preparation of stock solution as fresh leaves of Az*adirachta indica* were collected from the field, washed with water to remove dusts, shade dried for 3-4 days and then powdered in the pulverize sieved using 0.01 mm sieve. For the purpose 25 gms of leaf and Neeam seed KE powder was loosely bundled in a muslin cloth and soaked in 500 ml distilled water, containing 1.0 % khadhi white soap after soaking for overnight (12 hours) the material inside the bundle was needed and the contents was completely squeezed into water which formed 5% stock solution (NL WE and NSKE). From this fresh stock solution of 5%, further preparations of 4.00%, 3.00%, 2.00%, 1.00 %, 0.5 %, and 0.25 % concentrations were prepared by suitable dilutions with water. Experiment was conducted as the tussock leaf caterpillar *E. molllifera* on mulberry leaf were used and when they reached third instar, they were starved for 48 hours (over night without providing leaf for feeding). Batches of four tussock Caterpillars containing starved uniform sized larvae were separated out, weighed and provided with leaves of known surface area treated with concerned concentrations of neem leaf and seed kernel extract in water and kept in filter paper padded petridishes surface area (10cm diameter).Additionally treated leaves of known surface area was added to each batch when and where required up to 48 hours of the experimental periods. Then the larval batches were separated and weighed. Additional information on leaf area consumed was also noted.

A valuable organic fertilizer and bug repellent for mulberry orchards is neem oil cake (NOC), a byproduct of neem oil extraction. It enhances soil fertility, offers essential nutrients, and aids in controlling nematodes and other soil-borne pests and illnesses. The non-safe to eat oilcakes in standard and NOC, in particular, include a large quantity of plant vitamins and alkaloids that cause mulberry to develop immunity against pests and illnesses, as well as its higher nutritional content than other oil desserts, making them some of the particular organic sources. The alkaloids (nimbin and nimbicidine) in the soil prevent nitrogen from being converted by nitrification, while nitrogen fertilizers are used to gradually release nitrogen. The mulberry leaf output was significantly improved by the NOC at 60 kg/ac/crop combined with N fertilizer. It is recommended, though, that root-knot disease be managed by the software of 800 kg/ac in 4 cut up doses at a c programming language of 3 months at some stage in inter-cultural operations. Infected mulberry trees yielded the tussock leaf caterpillar. At four selected trees, the daily morning observation and collection of impacted tussock leaf caterpillar components were performed at regular intervals and then identified later. The mahogany family, Meliaceae, includes neem. Its scientific name is Azadirachta indica A. Jus. Neem trees are beautiful evergreens that can reach a height of 30 meters and a circumference of 2.5 meters. Their expanding branches create rounded crowns that may reach 20 meters in width. Severe cold and drought cause the leaves to fall. Fresh Azadirachta indica leaves were gathered from the field, rinsed with water to get rid of any dust, sun-dried for three to four days, and then pulverized and sieved with a 0. 01 mm sieve to make the stock solution. The material inside the bundle was needed for the purpose of 25 gms of leaf and Neeam seed KE powder being loosely packed in a muslin cloth and submerged in 500 ml of distilled water with 1.0% khadhi white soap for overnight (12 hours). The contents were then thoroughly squeezed into the water, resulting in a 5% stock solution (NL WE and NSKE). Using appropriate dilutions with water are additional preparations of 4.00%, 3.00%, 2.00%, 1.00%, 0.5%, and 0.25% concentrations were made from this newly made 5% stock solution. When the tussock leaf caterpillar E. mollifera on mulberry leaf reached third instar, the experiment was carried out; at this point, the caterpillars were kept without food for 48 hours (overnight). Batches of four tussock caterpillars, each carrying starved, consistently sized larvae, were separated out, weighed, and placed in petridishes lined with filter paper. The leaves given to the caterpillars were treated with neem leaf and seed kernel extract in water at concerned concentrations and had a surface area of 10 cm. When and when necessary, further treated leaves of known surface area were added to each batch for up to 48 hours of the experiment. The larval batches were then weighed and segregated. More data on leaf area used was also recorded.

3. Results and Discussion

In this experiment, the leaves were treated with neem leaf water extract and neem seed kernel extract at concentrations ranging from 0.25% to 5.0%, and the caterpillar's Euproctis fraternal at third instar were allowed to feed for 48 hours (Table-1 and 2). Treatments were compared to the control group, which received only water. The findings demonstrated that at 5.0% and 4. 00%, NLWE did not signal any leaf feeding, whereas the treatments made up of NLWE and NSK Eat 0.25%, 0.50% 1.00%, 2.00%, and 3. 00% yielded mean feeding that ranged from 0.10 cm2 to 0.5 cm2 and 0.33 cm2 to 0.02 cm 2, respectively. Only the water that was under control was used. In NLWE, the average feeding area was the greatest, reaching 1.70 cm2, while it was 1.68 cm2 in NSKE. The statistical analysis revealed a substantial variation between the control treatment and the other treatments using neem leaf and neem oil cake at seven concentrations. However, the effectiveness of all the treatments, save the control, was comparable, and none of them had any statistically significant differences in their results.

Table 1: Effect of Neem Leaf Water Extract (NLWE) and Neem oil cake on feeding of mulberry leaf by tussock caterpillar, *Euproctis fraternal*

Treatments	Neem Leaf Water Extract (NLWE) in different concentrations	Actual Mean	Mean leaf consumption in square cm	Decrease in feeding over control in square cm	Decrease over control (%)
T1	5.00%	Nil	0.5 (0.71)	1.71	77.38
T2	4.00%	Nil	0.5 (0.71)	1.71	77.38
T3	3.00%	0.5	1.0 (1.03)	1.21	54.75
T4	2.00%	0.10	0.77 (0.81)	1.44	65.16
T5	1.00%	0.19	0.65 (0.82)	1.56	70.59
T6	0.50%	0.25	0.7 (0.85)	1.51	68.33
T7	0.25%	0.33	0.76 (0.89)	1.45	65.61
T8	Control (water treatment only)	1.70	2.21 (1.49)	-	

Values in parenthesis are √X+0.5 transformed values in a column mean followed by common letter (s) are not significantly different by DMRT at P=0.05.

Table 2: Effect of Neem Seed Kernel Extract (NSKE) on feeding of mulberry leaf by tussock caterpillar Euproctis fraternal

Treatments	Neem Extract (NS KE) and Neem oil cake in Different concentrations	Actual Mean	Mean leaf consumption in square cm	Decrease in feeding over control in square cm	Decrease over control (%)
T1	5.00%	Nil	0.5 (0.71)	1.68	77
T2	4.00%	Nil	0.5 (0.71)	1.68	77
T3	3.00%	0.02	0.76 (0.87)	1.42	65.13
T4	2.00%	0.08	1.0 (0.98)	1.18	54.13
T5	1.00%	0.17	0.67 (0.82)	1.51	69.30
T6	0.50%	0.25	0.75 (0.87)	1.43	65.60
T7	0.25%	0.33	0.83 (0.91)	1.35	61.93
T8	Control (water treatment only)	1.68	2.18 (1.14)	-	-

Values in parentheses are transformed values in a column mean followed by common letter (s) that are not significantly different by DMRT at *p*=0. 05

Caterpillars (Euproctis fraternal) at the third instar stage were given treated and untreated leaves to feed on for 48 hours in order to observe the effects of neem oil cake and neem leaf extract. Additionally, the larvae were weighed both before beginning the experiment and again after the feeding experiment was finished. Data are presented in Table 3 and 4, along with the mean of the gram unit's body weight loss (minus) or gain (plus). The average body weight of the larvae increased (+) by 0. 02 grams in the control, where just water was used to feed the leaves, but in all seven remaining treatments with neem leaf water extract and neem oil cake extract at varying concentrations (5. 0% to 0. 25%), the caterpillars lost (-) between -0. 03 and -0. 06 grams and between -0. 04 and -0. 07 grams, respectively. The data analysis revealed a significant difference between the control and other treatments of various concentrations of neem oil cake extract and neem leaf water extract. But treatments are with concentrations ranging from 0.25% to 5.0% resulted in comparable body weight loss (-), and there were no appreciable differences in body weight loss (-). Values in parentheses are transformed values. By DMRT at P=0. 05, the column mean followed by frequent letter(s) do not differ significantly.

Table 3: Effect of Neem Leaf Water Extract (NLWE) on larval body weight loss (-) or gain (+) in tussock caterpillar, Euproctis fraternal

Treatments	Neem Leaf Water Extract (NLWE) and Neem oil cake in different concentrations	Mean body weight loss (-) or gain (+) gm	Increase (+) or Decrease (-) in weight over control in gm	Decrease of weight over control (%)
T1	5.00%	-0.06 (0.24)	-0.08	400
T2	4.00%	-0.05 (0.24)	-0.07	350
T3	3.00%	-0.06 (0.24)	-0.08	400
T4	2.00%	-0.06 (0.25)	-0.08	400
T5	1.00%	-0.05 (0.23)	-0.07	350
T6	0.50%	-0.04 (0.21)	-0.06	300
T7	0.25%	-0.03 (0.18)	-0.05	250
T8	Control (water treatment only)	+0.02 (0.15)	-	-

Values in parenthesis are transformed values in a column mean followed by common letter (s) are not significantly different by DMRT at *p*=0.05

Table 4: Effect of Neem Extract (NSKE) and Neem oil cake on bodyweight loss (-) or gain (+) in tussock caterpillar Euproctis fraternal

Treatments	Neem Extract (NLWE) and neem oil cake in different concentrations	Mean body weight loss (-) or gain (+) gm	Increase (+) or Decrease (-) in weight over control in gm	Decrease of weight over control (%)
T1	5.00%	-0.04 (0.21)	.06	300
T2	4.00%	-0.05 (0.22)	.07	350
T3	3.00%	-0.05 (0.23)	.07	350
T4	2.00%	-0.06 (0.25)	.08	400
T5	1.00%	-0.04 (0.2)	.06	300
T6	0.50%	-0.05 (0.23)	.07	350
T7	0.25%	-0.07 (0.21)	.09	450
T8	Control (water treatment only)	0.02 (0.16)	-	-

It is evident from these details gathered from several studies carried out on insect pests of crops using raw neem products that NLWE and NOC were similarly effective (Bidwan, H.T.G. *et al*., 1986, Miller, J.A., 1989) [27-28], supporting the facts that lowering feeding and lowering larval body weight due to lower feeding contributed to the effectiveness of pest management. Similar results were found in current studies, even when neem crude products like NLWE and NOC were administered in various concentrations between 5.0% and 0. 25%. The caterpillars have either not eaten or eaten very little, disrupting the mulberry insect's normal physiology and metabolism, which has caused varying degrees of larval body weight loss. Additional research at lower concentrations can be done to examine the behavior of insect pests that infest different crops in detail. In the end, the former will be able to utilize their own bio-pesticide derived from neem products, which will be more cost-effective and lucrative.

4. Conclusion

The fastest-growing, drought-tolerant tree in the genus Mulberry is the widely grown species mulberry alba. Numerous diseases cause insect pests that feed on these plants. Mulberry tree production depends heavily on pest control. The eating patterns of this bug were impacted by water and neem leaf extracts. In conclusion, experimental studies have shown that the body weight of the tussock leaf caterpillar larva has increased or decreased. As a result, neem leaf and neem oil cake contain active ingredients that further help in pest management. To maximize mulberry leaf production, it is essential to minimize the threat posed by the Euproctis fraternal caterpillar. However, because of their negative impact on the silkworm, many persistent insecticides that were evaluated for their effectiveness against a variety of pests have been withdrawn. As a result, there is a need to test a plant-based pesticide that has little impact on the physiology and development of silkworms. One of the most important species in the sericulture industry is the mulberry silkworm, Bombyx mori. Since it naturally produces white silk, there is a great need for it in the agricultural industry. The main components of silkworm farming include favorable agro-climatic and environmental circumstances, good seeds, and healthy host plants. The success of silkworm rearing depends greatly on one healthy host plant. Due to significant host plant infestations, the current study determined that many insect pests are the primary threat to mulberry silkworm culture. Defoliators are the most destructive insect pests of the mulberry tree. For the protection of mulberry silkworm food plants, it is imperative to use scientific methods to control insect pests. One of the most significant agro-based industries in the agricultural industry is sericulture. This industry addresses society's unemployment issue.

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