Entomology

Bio-effectiveness of insecticides against *Spodoptera litura* (Cutworm) in laboratory conditions

Sanjai Kumar Gupta

Assistant Professor, Department of Zoology, Silkworm/Entomology Laboratory, Government Degree College, Barakhal, Menhdawal, Sant Kabir Nagar, Uttar Pradesh, India

Corresponding author: Sanjai Kumar Gupta

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Abstract

The present investigation was carried out in the laboratory of Department of Silkworm Laboratory, Government Model Degree College, Barakhal, Santkabirnagar during at Kharif season. *Spodoptera litura* (tobacco caterpillar/cutworm) is a major, highly polyphagous nocturnal pest affecting mulberry (*Morus alba*) in Asia, causing significant defoliation. Larvae cause "windowing" (leaf skeletonization) in early stages and total defoliation in later stages. Management includes handpicking, pheromone/light traps, and deep plowing. The larvae (caterpillars) feed on mulberry leaves, often leaving only the veins (skeletonization). They also cut young shoots, leading to stunted or branchless plants. Infestations are most common from August to February, with peak activity during winter months. The pest completes its life cycle in 30–40 days, consisting of egg, larva, and pupa stages. Six different insecticides along with one untreated control were taken for the investigation to test their bio-effectiveness against Cutworm caterpillar *Spodoptera liura*. The experiment was carried out incompletely randomized block design (CRD). All the treatments were replicated three times. Observations were recorded 12, 24 and 48hours photoperiod light a day after application of insecticides. The sample consisted of 20 larvae of cutworm caterpillar per replication. All the treatments were found superior over control. Maximum mortality percentage was recorded on Flubendiamide 12.0% WG (68.19%) which was superior, followed by Chlorantraniliprole 5% SG (58.61%) and Chlorpyrifos 50% SP (49.03%). Whereas, the least effective treatment was in Spinetoram 5.4%EC with (32.13%) minimum percentage of larval mortality.

Keywords: cutworm caterpillar, *Spodoptera litura,* effectiveness of insecticides

1. Introduction

The cutworm caterpillar, Spodoptera litura, is a polyphagous pest that belongs to the Lepidoptera order and Noctuidae family of the Insecta class. It has a chewing type mouthpart that is exclusive to the Oriental area, where it is known to cause significant damage to a number of crops that are commercially and horticultural important. It consumes pulses of tobacco leaves, morus leaf, sesame, linseed, cotton, jute, sorghum, soybeans, peanuts, and a few veggies like sweet potatoes, potatoes, radishes, pumpkins, cowpeas, etc. The pest has also been documented in a number of other nations, including India, Myanmar, Pakistan, and China (Kabir and Khan, 1968; Singh and Seghal, 1992) [8, 17]. It is a major nuisance throughout India, especially in Bihar, Uttar Pradesh, Punjab, Madhya Pradesh, Chhattisgarh, Manipur, and other states. Bombyx mori L., the silkworm, only consumes mulberry (Morus spp.) leaves in their natural state. Over 59 nations cultivate this perennial, evergreen, and abundant crop in a variety of soil types, including rain fed and irrigated soils, in row and pit systems, and as hedge and avenue trees. India is where it is grown in 23 states (Brown, E.S. et. al., 1975; Garad, G.P. et. al., 1985 & Holloway, I.D. et. al., 1989) [2, 3, 6]. Because of its rapid growth and thick green foliage, which is produced in different proportions throughout the year for food, space, or both, the crop is susceptible to damage from a variety of creatures. More than 300 insect and non-insect species are now known to infest mulberry trees at various intensities at different times of the year and throughout the course of the plant's life cycle. The species composition of various mulberry-infesting Arthropods and the harm they cause are determined by agro-climatic circumstances, diversity, and cropping systems. The primary insect species known to harm mulberry trees belong to the Hemiptera, Lepidoptera, Coleoptera, Thysanoptera, Orthoptera, and Isoptera Orders. The world's flora is severely threatened by insect pests, which also cause a considerable decrease in agricultural production. Numerous species finish their developmental phases by reproducing hundreds of times in a short period, feeding on leaves, stems, and fruits. Tobacco caterpillar, also known as the common cutworm (S. litura), is found everywhere (Miyahara, Y. et. al., 1971; Nakasuji, F. et. al., 1976 & Nakasuji, F. et.al., 1977) [9, 11, 12]. Although it was discovered somewhere in Northern Luzon, it was also mentioned in Australia, other Asian countries, and the Pacific Islands, where host plants are grown. They primarily ate plants from 44 families, including tobacco, cotton, ground nuts, cabbage, and cauliflower. According to (Prasad, 1997) [14], it also consumes weeds like Amaranthus, spinosus, portulaca, Zinnia elegans, and Chenopodium amaranticolor. Cutworm poses a threat to the production of high-quality mulberry leaves (Telan and Gonzales, 2000) [22]. In 7–10 days, a colony of 500–

600 worms can defoliate a mulberry with numerous branches. It is extremely catastrophic, particularly when circumstances call for their emergence and a population increase. As a result, it is essential to gather enough data on its biological activity and the variables that contribute to its recurrence and distribution in order to manage pests effectively. As a polyphagous pest with a broad host range, the rate of larval survival and development varies significantly depending on the host plant. In a crowded environment, the adult female deposits eggs in clusters on the lower surface of the epidermis of the leaves. The caterpillars eat in groups on the green leaves behind the veins and soft tissue during the early instars before spreading out. Plants may be totally denuded in severe infestations (Adsule and Kadam, 1979; Gyawali, 1988; Srivastava, 1993) [1, 5, 19]. The third and subsequent instar larvae inflict severe harm and a considerable decline in yield, according to (Hussain and Begum., 1995) [7] and (Gupta and Bhattacharya., 2008) [4]. In fact, chemical insecticides have been shown to be a boon for agriculture, and their usage for pest control is frequently advised to combat the infestation of these pests (Murugesan and Dhingra, 1995 & Patel, H.K, et. al., 1971) [10, 13]. Because Cutworm caterpillars occasionally exhibit varying degrees of behavioral resistance to various insecticide classes, it can be challenging to effectively manage this pest. With this in mind, studies were conducted to assess the efficacy of certain contemporary insecticides against 3rd instar larvae of Spodoptera litura. The common cutworm is a complete metamorphic insect and regarded as a significant threat to mulberry, which is essential to sericulture farmers as they try to produce high-quality leaves for raising silkworms. The eggs are often laid in 2 to 7 batches, piling up in three to four layers of rounded, glistening white eggs. The incubation period lasted two to three days. In contrast, freshly hatched translucent green larvae have tiny black patches all over their bodies (Salama, H.S, et. al., 1970; Sankarperumal, G., 1989 & Singh, S.P., 1996) [15, 16, 18]. Until they reach full maturity, their color varies with each shed of their old skin. The larval stage lasted 19-36 days. The soil was secured for pupation by adult worms, which created earthen cells as encasement. The process took 8-9 days, and right after the moth came out, there was a two-day period of mating followed by a four-day period of egg laying. The biotic and abiotic variables (predators, parasites, disease causing agents, host plants, and weather conditions) had an impact on the outbreak and increase in population. Throughout the year, a large number of cutworms and predators were observed, and egg production was impacted by the heavy downpour.

2. Materials and Methods

The present investigation was conducted in the Sericulture laboratory of Entomology, Government Model Degree College, Barakhal, Santkabirnagar, and Uttar Pradesh. Seven treatments with untreated control were tested again Cutworm caterpillar and replicated three times during season Kharif. The experiment was carried out in Completely Randomized Design (CRD), details of the materials and methods of the study are presented below:-

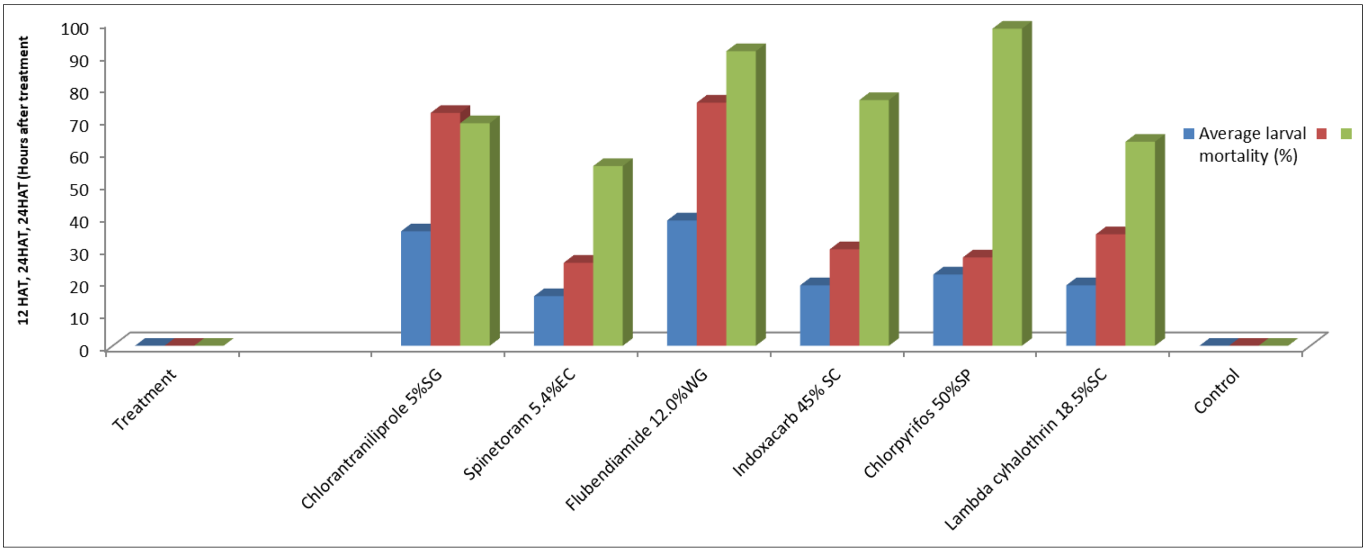
Table 1: Treatment details of Insecticides on Cutworm

S. No.	Treatment details	Dose/liter of water
T1	Chlorantraniliprole 5%SG	0.5g
T2	Spinetoram 5.4%EC	1.0ml
T3	Flubendiamide 12.0%WG	0.5g
T4	Indoxacarb 45% SC	1.0ml
T5	Chlorpyrifos 50%SP	1.0g
T6	Lambda-cyhalothrin 18.5%SC	1.0ml
T7	Control	00

The 3rd instar larvae were gathered from untreated fields during the season to investigate the effects of newer insecticides on Cutworm caterpillars. Various insecticides have been prepared in half-liter spray solution. The filter paper was immersed for one minute in the right concentration of insecticide and left to dry for one hour at ambient temperature. The treated filter paper was placed in the Petri dish, and 20 Cutworm caterpillar larvae were released. Simultaneously, the control treatment did not include any treated filter paper for comparison. Three trials of the experiment were conducted. After the release of larva, observations were made on different hours and remove of dead larva from the treatments after each observation at hours. The percentage of larval mortality was monitored 12, 24, and 48 hours following larval release under a photoperiod of 12, 24, and 48 hours light per day in order to evaluate the harmful effects.

Table 2: Bio-effectiveness of insecticides against Cutworm caterpillar *Spodoptera litura* under laboratory condition during Kharif season

Tr. No.	Treatment	Dose/lit.	Average larval mortality (%)			Overall mean
			12HAT	24HAT	48HAT	
T1	Chlorantraniliprole 5%SG	0.5gm	35.33 (37.20)	71.84 (58.68)	68.67 (61.99)	58.61
T2	Spinetoram 5.4%EC	1.0ml	15.33 (25.85)	25.61 (30.44)	55.45 (49.35)	32.13
T3	Flubendiamide 12.0%WG	0.5gm	38.67 (39.21)	75.02 (61.54)	90.89 (80.24)	68.19
T4	Indoxacarb 45% SC	0.6ml	18.67 (25.85)	29.78 (33.74)	75.81 (61.42)	41.42
T5	Chlorpyrifos 50%SP	1.0gm	22.00 (28.06)	27.26 (32.13)	97.83 (85.09)	49.03
T6	Lambda cyhalothrin 18.5%SC	0.5ml	18.67 (25.85)	34.41 (36.54)	62.95 (53.68)	38.68
T7	Control	-	0.00(0.00)	0.00(0.00)	0.00(0.00)	0.00
	S.E.M.±	-	4.63	5.72	10.70	-
	C.D.at 5%	-	8.05	11.40	26.66	-



Note: Figure in the parentheses is are angular transformation value, HAT=Hours after treatment

Fig 1

3. Results and Discussion

The bio-effectiveness of six various insecticides viz., Chlorantraniliprole 5%SG, Spinetoram 5.4% EC, Flubendiamide 12.0%WG, Indoxacarb 45% SC, Chlorpyrifos 50%SP, Lambda cyhalothrin 18.5%SC along with untreated control were tested against the larvae of Cutworm caterpillar during Kharif season (Torreno, H.S., 1985) [24].

12 Hours after treatment

The findings revealed that the highest (38.67%) mortality was obtained for Flubendiamide 12.0%WG after 12 hours after treatment of insecticide use, followed by Chlorantraniliprole 5%SG (35.33%). The next best treatment was Chlorpyrifos 50%SP which was moderately effective (22.00%). However, the lowest mortality percentage was recorded for Spinetoram 5.4% EC (15.33%).

24 Hours after treatment

It is also evident from the Table-2 that 24 hours after treatment, significantly maximum mortality of Spodoptera litura was recorded in Flubendiamide 12.0%W (75.02%) followed by Chlorantraniliprole 5%SG (71.84%). The next level best treatment was Lambda cyhalothrin 18.5%SC (34.41 %) which was found at par with Indoxacarb 45% SC (29.78 %). Minimum mortality (25.61%) was recorded in Spinetoram 5.4% EC (Truong, H.X., 1989) [25].

48 Hours after treatment

At 48 hours after treatment, all the insecticides significantly reduced the populations of Spodoptera litura compared to untreated control. Maximum mortality (97.83%) was recorded in Chlorpyrifos 50%SP followed by Flubendiamide 12.0%W (with 90.89% larval mortality). Indoxacarb 45% SC and Chlorantraniliprole 5%SG were the next level best treatment with (75.81%) and (68.67%) larval mortality, respectively. Minimum mortality (55.45%) was recorded in Spinetoram 5.4% EC.

Overall mean larval mortality percentage

The findings indicated that Flubendiamide 12.0%W had the highest mortality rate (68.19%), followed by Chlorantraniliprole 5%SG (58.61%) and Chlorpyrifos 50%SP (49.03%), among the various treatments. The following active therapy, with larval mortality rates of 41.42% and 38.68%, respectively, was recorded for lambda cyhalothrin 18.5% SC and Indoxacarb 45% SC. The least effective treatment, however, was in Spinetoram 5. 4%EC, which had the lowest larval mortality, rate (32.13%). During the Kharif season, the bio-effectiveness of insecticides for the 3rd instars of Cutworm caterpillar was tested using Chlorantraniliprole 5% SG, Spinetoram 5.4% EC, Flubendiamide 12.0% WG, Indoxacarb 45% SC, Chlorpyrifos 50% SP, Lambda cyhalothrin 18.5% SC, and an untreated control. The current findings are partly supported by the study by (Suryawanshi *et al*. 2020; Srivastava, O.S., 1972 & Thobbi, V.V., 1961) [21, 20, 23], which indicated that Emamectin benzoate 5% SG produced the greatest effects 12, 24, and 48 hours light photoperiod after the application of insecticides when compared to other insecticides, such as Chlorantranillip role 18.5% SC, Chlorpyriphos 20% EC, and Flubendlamide 39.35% SC. Nonetheless, the current results indicate that Flubendiamide 12. 0%W is the most effective therapy, followed by Chlorantraniliprole 5%SG, in terms of the highest mortality rate for Cutworm caterpillars of Spodoptera litura.

4. Conclusion

In terms of having the highest mortality rate for Cutworm caterpillars of Spodoptera litura, the present findings suggest that Flubendiamide 12.0%W is the most effective treatment, followed by Chlorantraniliprole 5%SG. Cutworm goes through four stages of metamorphosis that are known to be impacted by biotic, abiotic, and food sources. The eggs had shiny round shells and were laid beneath the center leaves in great quantities (between 557. 86-635. 67 eggs/pair). The newly hatched translucent greenish larvae known as ants underwent incubation for two to three days. During this time, they consumed soft leaves and slowly grew in size and mass as they progressed through the various stages of development. As they shed their previous skin, they experience color changes until they reach their maximum size and weight. With other instars completing between 2.44 and 2. 64 days, the first stadium was found to be the longest at 4.08 days. The larval stage lasted for 19.36 days. It took eight to nine days for the moth to emerge after the completely mature worms had secured the soil in preparation for pupation. The male and female moth mated for two days, laying eggs for four days. The total lifetime of one generation was 37. 81 days. Compared to being kept in cages, egg production was better in the typical open field. Biological agents and abiotic variables played a role in the spread and distribution of pests. Additionally, the wealth of food sources that served as their breeding host contributed to the growth of the population. Beginning in February and continuing through June, the population increased, with another peak in October before falling in December. The following was the foundation upon which the information was used to create sustainable management practices and effective pest management strategies: a) characteristics and conduct of the pest; b) using longevity as a guide for when to best tackle the pest; c) the egg-laying output of a pair of moths in order to assess their ability to reproduce; and d) documentation of biotic and abiotic variables that contribute to the appropriate timing of crop establishment, selection of cropping system, and strategic area to concentrate pest control operations without harming beneficial insects.

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