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Efficacy of Novaluron against Tobacco cutworm, *Spodoptera litura* (F.) on Cauliflower

Wali Muhammad Mangrio[1*], Hakim Ali Sahito[1], Abdul Qadir Malik[2], Sanaullah Sattar[3] and Fahmeeda Imdad Sahito[4]

1. Department of Zoology, Faculty of Natural Sciences, SALU, Khairpur Mirs (66111) Sindh-Pakistan
2. Department of Entomology, Faculty of Crop Protection, SAU, Tandojam (70060) Sindh-Pakistan
3. Department of Zoology, Faculty of Wildlife and Fisheries, UVAS, Lahore (54000) Punjab-Pakistan
4. Department of Teacher Education, Faculty of Education, SALU, Khairpur Mirs (66111) Sindh-Pakistan

***Corresponding author e-mail:** wali.mangrio@salu.edu.pk

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SUMMARY

Tobacco cutworm, a sporadic insect pest frequently found in America, Africa, and Asia, is an extensive creepy crawly-making insect pest species. Broadly harm cauliflower vegetables at blossoming and vegetative stages. The research study was performed to examine the efficacy of Novaluron against the biology of *Spodoptera litura*. The 4th stage larvae of the tobacco cutworms were collected from cauliflower vegetable crops for insecticide application and laboratory examination during, 2022. The sub-lethal effects of the insecticide were examined at 250 ppm, 200 ppm, 150 ppm, 100 ppm, and 50 ppm. After drying, the leaves were dipped in each concentration, and treated leaves were given to larvae as a food source. The result indicated that the novaluron caused maximum larvae mortality and reduction % on dose 1st, and minimum on dose 5th. The larvae and pupae consumed maximum time, pupae weight reduction, development time, total life span, and copulation time, on dose 1st compared to 5th. Whereas; short fecundity, fertility, and adult longevity of tobacco cutworm was recorded on dose 1st followed by dose 5th. From the results mentioned above, it is concluded that the Novaluron by their sub-lethal concentration against *S. litura* is more effective. The insect pest management broad spectrum and intensive application of toxic insecticides may cause a rush of problems, and it should be used wisely. However, intensive care should be given to the application of such insecticides, which contain potential power against the biology of the above insect pest.

Keywords: Cauliflower, Novaluron, Sub-lethal, Tobacco cutworm, Vegetable

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INTRODUCTION

Cauliflower originated about 200 years ago in the Mediterranean, then in other countries of the world contributed positively to human health (Gaur and Kumar, 2010). This vegetable crop is harmed by many species of Spodoptera viz., *S. exempta* (Walker), *S. frugiperda* (Smith), *S. litura* (Fabricius), *S. exigua* (Hubner) but *S. littora* (Boisd) are frequently occurring (Dhawan *et al.*, 2009). *Spodoptera litura* is locally called cluster caterpillar, tobacco caterpillar, tobacco cutworm, or Indian leaf worm and is capable of moving across the field like an army hence called armyworm

(Murtaza, 2019). Throughout Asia and many other countries of the world, the cauliflower crop is massively harmed by this polyphagous cosmopolitan insect pest species (Singh *et al*., 2015). *S. litura*, the sporadic insect pests, which can feed on more than 100 host plants at the vegetative and blossoming stages, may cause up to 100% yield losses (Fu *et al*., 2015). The tobacco caterpillar attacks *Solanaceae*, *Fabaceae*, *Cruciferae*, and *Malvaceae*, which causes severe economic losses to valuable crops such as; cauliflower, sugar beet, *Brussels sprouts*, tomato, cotton, and maize (Ramzan *et al*., 2019c). The outbreaks of *S. litura* usually in Pakistan start in March and continue till November, particularly depending on resistance to insecticides, patterns of cropping, heavy rainfall, and favorable weather conditions (Sayyed *et al.,* 2008), due to this *S. litura* species of the insect is becoming challenging task (Acharya *et al*., 2020). Mostly the farmers of our country completely rely on insecticides and the use of such indiscriminately created *S. litura* resistance problems destroyed pollinator fauna, natural enemies, environmental and health lethal issues (Tong *et al.*, 2013).

Tobacco cutworm population can be controlled by the application of insect growth regulators, that cause genitalia deviation, restriction in matting of the insect pests, such as; the methoxyfenozide mimics, molting and cause genitalia deviation in premature larvae (Smagghe *et al*., 2003). Low ecological effects, short persistence and safety against non-target organism type of insecticides can be applied for the management of tobacco cutworm (Pineda *et al*., 2007). The emamectin benzoate, chlorpyrifos, spinosad, profenofos, lufenuron, methoxyfenozide, and indoxacarb insecticides are suggested for the population management of *S. litura* (Khan *et al*., 2011). The toxicity of spinosad, profenofos, emamectin benzoate, and imidacloprid were found effective against the larvae population of tobacco cutworm on groundnut, sunflower, and potato leaves. From all synthetic pyrethroids emamectin benzoate was observed more effective under laboratory conditions (Bhushan *et al*., 2010). The 2^{nd} and 4^{th} stage larvae of *S. litura* were tested against lufenuron and proved with meaningful control under laboratory examination (El-Sheikh and Aamir, 2011). The novaluron proved with maximum efficacy as compared to abamectin against tobacco cutworm (Rehan *et al.*, 2011). The wise application of insecticides is the best solution (Mangrio *et al*., 2023) to control the population of insect pest underneath economic injury level, tested and less toxic insecticides with effective insect pest management for future endeavors. The main object of the present study was to examine the efficacy of novaluron at different dosages on cauliflower leaves.

MATERIALS AND METHODS

Collection of *Spodoptera litura* larval population

The larval population of the tobacco cutworms were collected from Rais Nabi Bux Khan Mangrio, cauliflower field at district, Naushahro Feroze and reared under Biocontrol Laboratory of Entomology, Department of Zoology, Shah Abdul Latif University Khairpur during- 2022. The larval population of the *S. litura* was kept at 26±20C constant temperature and 50-60% relative humidity. From the cultured larvae population of *S. litura*, the 4^{th} stage larvae were taken for the application of novaluron insecticide. Experiments started 500 numbers of 4^{th} stage instars and with novaluron insecticide the larval population was treated with five variable doses.

Experimental Design

The novaluron, an insect growth regulators viz., 250, 200, 150, 100, and 50 ppm dissolved in 1 litter of water and each treatment was replicated three times. Inside the bucket, the solution of the novaluron was prepared. In each concentration only for 10 seconds the leaves of the cauliflower were placed again leaves were taken from the buckets and kept under shade to dry. The treated insecticide leaves were given as food source to 10 larvae from each concentration of 4^{th} stage to feed individually. After 48^{th} hours, untreated leaves were given to surviving larvae as food source. Then treated, surviving larvae of the *S. litura* were kept in plastic jars to convert into pupae. When from pupae adults emerged frequently shifted into emerging cages for oviposition, 20% honey solution was given as food source and solution was changed on every alternate days. Within emerging cages after matting, adult female of *S. litura* eggs which were first counted then transferred into petri dishes containing blotting paper. Again fresh and new emerged leaves were given to newly hatched larvae in every day. After treatment with sub-lethal doses of novaluron the intensive observation was made on mortality larvae growth in hours, pupae period and weight reduction measured in mg, copulation time and sex ratio in minutes and seconds, fecundity, fertility and total life span in days of the tobacco cutworm. The D1, D2, D3, D4, D5 represents the doses and DW, distilled water in tables was used for control.

Data Analysis

From larval to adult stages, the data of the *S. litura* was subjected to analysis in each replication at different dosage. The Analysis of variance found with significant difference at different post-treatment days. The mean % LSD was subjected to analysis at (P< 0.05) through the source of student package SWX software 8.1 USA.

RESULTS

Spodoptera litura mortality % after 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th} post-treatment days

The larval mortality % of *S. litura* varied significantly (DF= 4, 24; F= 8.10; P= 0.02) after application of novaluron at different doses. The highest larvae mortality % was recorded after 24 hours of post-treatment at (20.00±5.77 at 250 ppm) followed by (6.67±2.48 at 200 ppm), (6.67±2.45 at 150 ppm), (3.32±2.45 at 100 ppm), and (0.00 ±0.00 at 50 ppm), respectively. The highest mortality % was recorded after 48 hours post-pray at (36.65±6.67; at 250 ppm), followed by (23.33±8.82 at 200 ppm), (16.67±6.67 at 150 ppm), (6.67±2.67 at 100 ppm), and (3.00 ±0.01 at 50 ppm). The highest mortality % was recorded after 72 hours post-treatment at (60.00±5.77; at 250 ppm), followed by (36.63±6.67 at 200 ppm), (23.32±2.67 at 150 ppm), (13.35±2.76 at 100 ppm), and (10.00±0.00 at 50 ppm). After 96 hours of post-spray the maximum mortality % was recorded at (66.67±8.82; at 250 ppm), followed by (36.65±3.33; at 200 ppm), (30.00±5.77; at 150 ppm), (20.00±0.00; at 100 ppm), and (13.31±3.33; at 50 ppm). The mortality % of the larvae population of *S. litura* after 120 hours of post-spray was recorded (73.33±3.33; at 250 ppm), followed by (46.65±3.67; at 200 ppm), (36.67±6.65; at 150 ppm), (20.00 ±0.00; at 100 ppm), and (20.00±0.00; at 50 ppm). All treatments were significantly different to each other comprises at different dosages against larvae of insect pest as shown in (Table 1).

Table 1: Larval mortality (%) of *S. litura* 24, 48, 72, 96 and 120h of post-treatment.

Novaluron	Dose	Concentration (ppm)	Mean±SD
24h	D^1	250	20.00±5.77
	D^2	200	6.67±2.48
	D^3	150	6.67±2.45
	D^4	100	3.32±2.45
	D^5	50	0.00±0.00
48h	D^1	250	36.65±6.67
	D^2	200	23.33±8.82
	D^3	150	16.67±6.67
	D^4	100	6.67±2.67
	D^5	50	3.00±0.01
72h	D^1	250	60.00±5.77
	D^2	200	36. 63±6.67
	D^3	150	23.32±2.67
	D^4	100	13.35±2.76
	D^5	50	10.00 ±0.00
96h	D^1	250	66.67±8.82
	D^2	200	36.65±3.33
	D^3	150	30.00±5.77
	D^4	100	20.00±0.00
	D^5	50	13.31±3.33
120h	D^1	250	73.33±3.33
	D^2	200	46.65±3.67
	D^3	150	36.67±6.65
	D^4	100	20.00±0.00
	D^5	50	20.00±0.00
Control	DW	0	0.00±0.00

Spodoptera litura **weight reduction % after 1st, 2nd, 3rd, 4th, and 5th post-spray days**

The larval weight reduction % of tobacco cutworm was found significantly different (DF=4, 24, F=28.67; P=0.02) at different doses of novaluron insecticide. After 24 hours of insecticide application, the maximum larvae weight reduction % of the insect pest was recorded (19.79±0.09; at 250 ppm), followed by (9.44±0.10; at 200 ppm), (7.59±0.06; at 150 ppm), (6.42±0.05; at 100 ppm), and (5.71±0.09; at 50 ppm). The maximum weight reduction % of the larvae was recorded after 48 hours of post-spray at (45.68±0. 16; at 250 ppm), followed by (28.67±0.18; at 200 ppm), (21.43±0.11; at 150 ppm), (12.88±0.11; at 100 ppm), and (10.84±0.04; at 50 ppm). The larvae weight reduction % after 72 hours of post-treatment was recorded (63.28±0.14; at 250 ppm), followed by (42.86±0.15; at 200 ppm), (27.89±0.07; at 150 ppm), (19.95±0.09; at 100 ppm), and (19.41±0.04; at 50 ppm). *S. litura* larvae maximum weight reduction % was recorded after 96 hours of post-treatment (71.44±0.17; at 250 ppm), followed by (51.40±0.13; at 200 ppm), (36.22±0.11; at 150 ppm), (29.76±0.05; at 100 ppm), and (25.39±0.03; at 50 ppm). The maximum larvae weight reduction % was recorded after 120 hours of insecticide application (79.20±0.05; at 250 ppm), followed by (61.42±0.01; at 200 ppm), (49.58±0.10; at 150 ppm), (38.47±0.02; at 100 ppm), and (35.74±0.05; at 50 ppm). All treatments were applied at different doses and found significantly different in their results, further justification of larvae reduction % is shown in (Table 2).

Table 2: Larval weight reduction (%) of *S. litura* at 24, 48, 72, 96, and 120h post-spray

Novaluron	Dose	Concentration (ppm)	Mean±SD
24h	D^1	250	19.79±0.09
	D^2	200	9.44±0.10
	D^3	150	7. 59±0.06
	D^4	100	6.42±0.05
	D^5	50	5.71±0.09
48h	D^1	250	45.68±0.16
	D^2	200	28.67±0.18
	D^3	150	21.43±0.11
	D^4	100	12.88±0.11
	D^5	50	10.84±0.04
72h	D^1	250	63.28±0.14
	D^2	200	42.86±0.16
	D^3	150	27.89±0.07
	D^4	100	19.95±0.09
	D^5	50	19.41±0.04
96h	D^1	250	71.44±0.17
	D^2	200	51.40±0.13
	D^3	150	36. 22±0.11
	D^4	100	29.76±0.05
	D^5	50	25.39±0.03
120h	D^1	250	79.20±0.05
	D^2	200	61.42±0.01
	D^3	150	49.58±0.10
	D^4	100	38.47±0.02
	D^5	50	35.74±0.05
Control	DW	0	0.00±0.00

Spodoptera litura larvae, pupae time consumption and pupae weight reduction % at different dosages

The larval period of *S. litura* varied significantly (DF=4, 14; F=131.49; P=0.02) after 24, 48, 72, 96 and 120h of novaluron application. The maximum larvae time consumption of tobacco cutworm was recorded (23.90±0.46; at 250 ppm), followed by (22.77±0.17; at 200 ppm), (21.20±0.13; at 150 ppm), (20.40±0.23; at 100 ppm), (19.53±0.21; at 50 ppm) and (14.22 ±0.08; at 0.00 ppm) control. After the application of treatments, the pupae period found significantly varied (DF=4, 14; F=196.13; P=0.02). The pupae maximum consumption of time of tobacco cutworm was recorded (11.66±0.26; at 250 ppm), followed by (10.86±0.27; at 200 ppm), (10.33±0.18; at 150 ppm), (9.06±0.08; at 100 ppm), (8.36±0.13; at 50 ppm), and (6.80±0.15; at 0.00 ppm) control. At post-treatment, the weight reduction % of the pupae observed varied significantly (DF=4, 14; F=23.13; P=0.02). The maximum weight reduction % of the pupae was recorded (38.57±0.20; at 250 ppm), followed by (36.63±0.21; at 200 ppm), (34.53±0.29; at 150 ppm), (32.47±0.56; at 100 ppm), (30.90±0.55; at 50 ppm), and control (24.02±0.36; at 0.00 ppm). The time consumption of larvae and pupae reduction % were found significantly different in different doses of the insecticide, as shown in (Table 3).

Table 3: Larval and pupal time consumption, pupal weight reduction % of *S. litura*.

Minutes and Seconds	Dose	Concentration (ppm)	Mean±SD
Larvae	D^1	250	23.90±0.46
	D^2	200	22.77±0.17
	D^3	150	21.20±0.13
	D^4	100	20.40±0.23
	D^5	50	19.53±0.21
Control			14.23±0.09
Pupae	D^1	250	11.66±0.26
	D^2	200	10.86±0.27
	D^3	150	10.33±0.18
	D^4	100	9.06±0.08
	D^5	50	8.36±0.13
Control			6.80±0.15
Pupae weight reduction (%)	D^1	250	38.57±0.20
	D^2	200	36.63±0.21
	D^3	150	34.53±0.29
	D^4	100	32.47±0.56
	D^5	50	30.90±0.55
Control			24.02±0.36

Spodoptera litura development time, adult longevity and total life span at different dosages

Tobacco cutworm development time observed significantly varied (DF=4, 14; F=240.16; P=0.02) after 24, 48, 72, 96 and 120h of novaluron insecticide application. The maximum development time was recorded (38.57±0.20; at 250 ppm), followed by (36.63±0.21; at 200 ppm), (34.53±0.29; at 150 ppm), (32.47±0.56; at 100 ppm), (30.90±0.55; at 50 ppm), and control (24.02±0.31; at 0.00 ppm). The longevity of adult *S. litura* found significantly different (DF=4, 14; F=28.94; P=0.02) at post-treatment. The minimum longevity of tobacco cutworm was recorded (6.46±0.67; at 250 ppm), followed by (7.83±0.17; at 200 ppm), (8.76±0.13; at 150 ppm), (9.53±0.36; at 100 ppm), (10.20±0.40; at 50 ppm), and control (11.83±0.44; at 0.00 ppm). After the application of insecticide, the total life period of tobacco cutworm was recorded significantly varied (DF=4, 14; F=48.69; P=0.02). The maximum life period of *S. litura* was recorded (45.03±0.48; at 250 ppm), followed by (44.33±0.33; at 200 ppm), (43.33±0.14; at 150 ppm), (42.33±0.53; at 100 ppm), (41.13±0.14; at 50 ppm), and control (35.86±0.73; at 0.00 ppm). The development time, adult longevity, and total life span of the insect pest was found significantly different in each treatment as justified in (Table 4).

Table 4: Development time, adult longevity, and total life span of *S. litura* after insecticide application

Time consumption	Dose	Concentration (ppm)	Mean±SD
Hours	D1	250	38.57±0.20
	D2	200	36.63±0.21
	D3	150	34.53±0.29
	D4	100	32.47±0.56
	D5	50	30.90±0.55
Control			24.02±0.31
Adult longevity (days)	D1	250	6.46±0.67
	D2	200	7.83±0.17
	D3	150	8.76±0.13
	D4	100	9.53±0.367
	D5	50	10.20±0.40
Control			11.83±0.44
Total life span (days)	D1	250	45.03±0.48
	D2	200	44.33±0.33
	D3	150	43.33±0.14
	D4	100	42.33±0.53
	D5	50	41.13±0.14
Control			35.86±0.73

***Spodoptera litura* male and female sex-ratio at different dosages**

The sex proportion through the different treatment dose of novaluron demonstrates that the male of tobacco cutworm were susceptible more when compared with the female to IGR treated at different doses. The sex-ratio of male and female under given result was recorded 2:05 at 250 ppm, 5:08 at 200 ppm, 5:11 at 150 ppm, 6:17 at 100 ppm, 1:02 at 50 ppm, and control 1:02 at 0.00 ppm, as shown in (Table 5).

Table 5: *Spodoptera litura* male and female sex ratio comparisons in response to insecticide application

Treatment	Dose (ppm)	Total pupae	Emerged	Not emerged	Male (average)	Female (average)	Sex Ratio
Novaluron	250	8	7	1	2	5	2:05
	200	16	13	3	5	8	5:08
	150	19	16	3	5	11	5:11
	100	24	23	1	6	17	6:17
	50	24	24	0	8	16	1:02
Control	0	30	30	0	10	20	1:02

Spodoptera litura copulation time, fecundity and fertility at different dosages

The copulation time of tobacco cutworm varied significantly (DF=4, 14; F=0.07; P=0.07) after 24, 48, 72, 96 and 120h of novaluron insecticide application. Tobacco cutworm minimum copulation time in minutes and seconds was recorded (31.65±0.16; at 250 ppm), followed by (29.16±0.15; at 200 ppm), (26.66±0.16; at 150 ppm), (24.16±0.33; at 100 ppm), (22.11±0.29; at 50 ppm), and control (57.02±0.02; at 0.00 ppm). After application of insecticide, the female fecundity in days was found significantly varied (DF=4, 14; F=0.03; P= 0.09). The minimum fecundity in adult female was recorded (37.00±6.56; at 250 ppm) followed by (40.33±5.90; at 200 ppm), (43.67±6.49; at 150 ppm), (46.00±9.29; at 100 ppm), (50.67±10.71; at 50 ppm) and control (78.01±50.52; at 0.00 ppm). *S. litura* female fertility % found significantly different (DF=4, 14; F=0.03; P=0.06) at post-spray. The lowest adult female fertility % of the insect pest was recorded (48.25±1.06; at 250 ppm), followed by (56.74±1.21; at 200 ppm), (59.63±1.54; at 150 ppm), (63.31±1.03; at 100 ppm), (70.64±0.71; at 50 ppm), and control (93.06±5.01; at 0.00 ppm). The copulation time, fecundity, and fertility of *S. litura* were found significantly different in each treatment as shown in (Table 6).

Table 6: Post-treatment copulation time, fecundity, and fertility of _S. litura_

Novaluron	Dose	Concentration (ppm)	Mean±SD
Copulation (minutes and seconds)	D^1	250	31.65±0.33
	D^2	200	29.16 ±0.15
	D^3	150	26.66±0.16
	D^4	100	24.16±0.33
	D^5	50	22.11±0.29
Control			57.02±0.02
Fecundity (no. of egg laid)	D^1	250	37.00±6.56
	D^2	200	40.33±5.90
	D^3	150	43.67±6.49
	D^4	100	46.00±9.29
	D^5	50	50.67±10.71
Control			78.01±50.52
Fertility (%)	D^1	250	48.25±1.06
	D^2	200	56.74±1.21
	D^3	150	59.63±1.54
	D^4	100	63.31±1.03
	D^5	50	70.64±0.71
Control	DW	0	93.06±5.01

DISCUSSION

The present research study was performed to assess the efficacy of the novaluron on the different biological stages of tobacco cutworm. The larvae of the insect pest were collected from cultivated cauliflower vegetable field at fruit farm of Rais Nabi Bux Khan Mangrio, Naushahro Feroze- Sindh, and brought under laboratory examination for insecticide application. The novaluron treated food was given to the larvae of the insect pest to find out the larvae mortality and reduction %, larvae and pupae time consumption, pupae weight reduction %, development time, adult longevity, total life span, male and female sex ratio, copulation, fecundity, and fertility of the *S. litura*. Pakistan ranked top ten cauliflower producing country in the world and this vegetable is beneficial against cardiovascular, diabetes and cancer due to containing such potential properties, present research work was conducted and applied novaluron insecticide because the insect pest species lay plenty of eggs on the surface of the new emerging host plant leaves and cause severe economic losses (Mangrio *et al*., 2020). Tobacco cutworm insect species is a voracious, polyphagous damaging pest, affecting seriously different variety agricultural crops (Chandi *et al*., 2022).

The maximum larvae mortality % was recorded at 250 ppm and minimum at 50 ppm, is with the work similarity of (Ahmed *et al*., 2022) sprayed emamectin benzoate for the management of *S. litura* and this insecticide found with more efficacy power followed by chlorantraniliprole, flubendiamide and fipronil against tobacco cutworm under laboratory examination. The emamectin insecticides showed 100 % larvae mortality after 72h of post-treatment. (Ramanagouda and Srivasta., 2009) through leaf dip method used imidacloprid, indoxcarb, thiamethoxam, fipronil and methomyl and recorded highest longevity in 5th dose but in 1st dose longevity gradually reduced against 7th day old larvae of *S. litura*. The maximum larvae weight reduction % reported at 250 ppm and minimum 50 ppm as documented by Ramzan *et al*. (2021) applied emamectin benzoate, lufenuron and chlorpyrifos on cabbage vegetable and proved emamectin benzoate with more efficacy power against the 2nd larvae stage of *S. litura* but in lethal time and concentration values significant differences was recorded. At LT50 values chlorpyrifos found more effective followed by lufenuron and emamectin benzoate requires minimum time to kill 50% 2nd stage larvae of tobacco cutworm. The maximum larvae, pupae time consumption and pupae weight reduction % was found at 250 ppm and minimum at 50 ppm of the novaluron with the work agreement of (Khan and Naveed, 2020), find out the toxicity of conventional and insect growth regulator insecticides by using a diet incorporation bioassay against 2nd and 3rd larvae stages of *S. litura*. The emamectin benzoate proved more effective, caused 100% mortality of larvae compared to chlorpyriphos. Among IGRs lufenuron observed with more toxicity power caused 100% mortality in 2nd stage larvae of tobacco cutworm. The maximum development time, adult longevity and life span reported at 250 ppm and minimum at 50 ppm as reported (Mangrio and Sahito, 2022) sprayed helmet, regent, emamectin benzoate, and coragen but belt proved most effective against another species of Lepidoptera, *P. demoleus* larvae.

The adult male insect pests were found more susceptible in sex-ratio compared with female as documented (Vardhini *et al*., 2001) observed the effects of endosulfan, monocrotophos and carbaryl against the larvae population of tobacco cutworm and proved with meaningful result. Farmers confused by the application of these insecticides due to slow knockdown on the population of insect pest species, but these insecticides are less-toxic and having low effect on other species of fauna. (Chandi *et al*., 2022) reported effect of spinosad, emamectin benzoate, indoxacarb, cyantraniliprole and fenvalerate against the larvae population of tobacco cutworm under laboratory conditions among all insecticides emamectin benzoate found the most potent effect. Similarly, copulation time, fecundity and fertility increased at 250 ppm as compared to 50 ppm, this as reported (Wankhede *et al*., 2022) applied herbal karanj oil in mixture with lambda cyhalothrin 5 EC, fenvalerate 20 EC, cypermethrin

10 EC but lambda cyhalothrin 5 EC, insecticides observed with more effective against 3rd stage larvae. (Sahito *et al*., 2020) documented the sub-lethal doses of the lufenuron to find out the mortality of the *S. litura* under laboratory conditions. The applied insecticide caused larvae mortality, pupae weight reduction, copulation time, fecundity and fertility compared to control. The minimum mortality, larvae reduction, larvae and pupae period, pupae weight reduction, adult longevity, copulation time, fecundity, fertility recorded in dose 1st and maximum dose 5th but longest life cycle recorded in dose 1st dose and short in dose 5th as compared to control. Tobacco cutworm is a gregarious feeder and need to be control at initial larvae stages to avoid extensive crop damage and economic losses. It is further needed to study on different angles against *S. litura* and their biological controlling agents.

CONCLUSIONS AND RECOMMENDATIONS

In present investigation, an attempt has been made to develop IMP protocol and find out the efficacy of novaluron against the growth index and survival rate of *S. litura*. The knowledge on the biological stages, feeding behavior, growth, development and host characteristics are most important for the sustainable and suitable population diminish of *S. litura*. The insecticide novaluron was found with potential efficacy against the population of the *S. litura*. The cauliflower growers are strictly advised to use wisely any group of toxic chemicals and make an attention to combat against any insect pest species by eco-friendly and through biological control.

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NOVELTY STATEMENT

Cauliflower is an important vegetable, widely used as vegetable as well as in different kind of salads, in homes and hotels throughout the year. This study was conducted to provide timely information about the efficacy of novaluron and sustain control, and the output of this research study will be helpful in population combat against tobacco cutworm.

AUTHORS CONTRIBUTION

W.M. Mangrio, the main author of this manuscript, performed conceptualization, software, formal analysis, original writing, validation, methodology, and data curation. H.A. Sahito, supervised and visualization. A.Q. Malik, data collection and experiment performed. S. Sattar and F.I. Sahito, contributed tools, materials.

DECLARATION AND COMPETING INTEREST

The corresponding author describe that there is no financial relationship and conflict of interest regarding the detailed work which is performed in this research paper.

DATA AVAILABILITY STATEMENT

Data are available on the request to the corresponding author.

INFORMED CONSENT STATEMENT

All responsibilities are accepted by corresponding author for releasing this research work.

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