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Research Article

Comparative Efficacy of Newer Insecticides against *Plutella xylostella* and *Spodoptera litura* on Cauliflower under Laboratory Conditions

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ABSTRACT

Cabbages and cauliflowers are the most important winter vegetables cultivated mainly in tropical and temperate areas of the globe. Armyworm, Spodoptera litura and Diamondback moth (DBM), Plutella xylostella are the most economic and destructive insect pest for cabbage and cauliflower. The current study was conducted to investigate three new insecticides such as emamectin benzoate, lufenuron and profenofos against two lepidopteran insect pests; Spodoptera litura and Plutella xylostella at different larval instars during 2018 under laboratory conditions. For this purpose, randomized complete design and leaf dip method was used. The current study was resulted that Emamectin benzoate proved to be effective one with significantly higher level of morality followed by profenofos and lufenuron after 48 and 72 hours respectively. Emamectin benzoate can be recommended as the most toxic insecticides against both Spodoptera litura and Plutella xylostella populations along with profenofos.

Keywords: *Plutella xylostella, Spodoptera litura, Comparative toxicity, New insecticides, Cruciferous*

INTRODUCTION

Cauliflower is an important brassica vegetable and rich source of nutrients (Fats, Protein, vitamin-A, C and minerals). It is widely grown in the tropical and subtropical regions of the world including Pakistan (Lynam et al., 2010; Canico et al., 2013). The yield of cauliflower is adversely affected through various factors such as environmental stress, pest and diseases. Among all these factors, insect pest such as *Plutella xylostella* (L.), *Spodoptera litura* and aphid are the major one.

Among insect pests, *Plutella xylostella* and *Spodoptera litura* are important and destructive pests of brassica vegetable especially cauliflowers throughout the world (Mallikarjuna et al., 2004; Maqsood et al., 2017; Prashant et al., 2007).

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P. xylostella pest can damage leafy parts of cauliflower and cause about 50-80% yield losses during severe infestation (Ayalew, 2006; Grzywacz et al., 2010; Krishnamoorthy, 2004; Prashant et al., 2007). Adult of *P. xylostella* is an efficient flier during day and night. It has ability to migrate at long distance and 14 days life cycle at 25 0C. Adult has body length and wing span 6 and 15 mm respectively. The forewings are brownish grey and narrow than hindwings. Hindwings are light grey and pointed at apex. There are four larval instars of *P. xylostella* (Golizadeh et al., 2009). Larvae of *P. xylostella* is feed on the all parts of host plants and make unfit for consumption. First instars are leaf mining and after moulting feed on the lower surface of plant leaves. Late instars chew the host parts and results in irregular patches (Golizadeh et al., 2009).

Spodoptera litura is also destructive polyphagous pest known to attack over 120 plant species (Osorio et al., 2008). It is distributed throughout the world (Thompson et al., 2000; Maqsood et al., 2017).

Various methods have been practiced to control the insect pests like cultural, physical, botanical, biological, entomopathogens and chemicals. Among them, chemical control is excessively use on small and large scale to control the pests. Excessive and improper use of chemical can cause environmental pollution and resistance in insect pest (Saxena et al., 1989; Karuppaiah et al., 2017; Rehan & Freed, 2014; Vastrad et al., 2003; Shankar et al., 1996). It can cause water pollution as well as harmful for non-target insect such as beneficial fauna. By keeping in view, the present study was conducted to evaluate the efficacy of different newer insecticides against *P. xylostellai* on cauliflower.

MATERIALS AND METHODS

Insect collection

The immature stages like eggs, larvae and pupae of *Spodoptera litura* and *Plutella xylostella* were collected from Faisalabad cauliflower fields during 2018. The collected population was brought to laboratory for rearing purpose. The larvae and eggs were kept in plastic jars along with cauliflower leaves.

Culture maintenance

Collected larvae were reared on cauliflower leaves till pupation. After emergence of adults, a pair of adults was place separately in rearing cage along cauliflower leaves for eggs lying purpose. After hatching of eggs, new larvae were collected and shifted into petri dishes for mass culturing. The new hatched larvae were reared on artificial diet under laboratory at 25+2 ^{o}C and 60-65% temperature and relative humidity respectively with 14:10 hours photoperiod. On daily basis, new and small pieces of diet were put into petri dishes and larvae were released. The same procedure was repeated until larvae was converted into pupae and shifted into cages for adult emergence. Adults were kept in cages and 10 percent honey solution was provided as food (Ahmad et al., 2008). Experiment was performed after two laboratory rearing generations to get sufficient number of larvae for bioassays.

Insecticides/Bioassay

In experiment three commercial insecticides such as profenofos (Curacron® 50EC; Syngenta (Pvt) Ltd, Pakistan), lufenuron (Match® 05EC, Syngenta (Pvt) Ltd, Pakistan) and emamectin benzoate (Proclaim® 1.9EC, Syngenta (Pvt) Ltd, Pakistan) were used. During bioassay, standard leaf disc bioassay method was used to performed the experiment. For this purpose, leaves of cauliflower crop were collected from unsprayed fields, washed with water, dried and immersed in insecticide solution for 30 second and dried at room temperature for two hours. After drying, the leaf discs were placed in petri dishes containing moistened filter paper.

Data analysis

Mortality rate of *P. xylostella* and *S. litura* was recorded after 48 and 72 hours of insecticide application. Insects were considered as dead when they failed to show any movement with gentle touch with blunt needle. Abbott's formula was used to calculate the corrected mortality and analyzed by Probit analysis using SPSS software. These values were compared from significance difference for these insecticides at particular age level and for different populations under study of *p. xylostella* and *S. litura*.

RESULTS AND DISCUSSION

Integrated pest management (IPM) strategies have proved an effective tactics against insect pests like *Spodoptera litura* and *Plutella xylostella* under both laboratory as well as field conditions. Different methods like cultural, biological, botanical and chemical have been practiced by many peoples at national and international level. Among them, chemical or use of insecticides is the best and most effective method to control the various insect pests such as *Spodoptera litura* and *Plutella xylostella* (Parsaeyan et al., 2013; Kumar et al., 2009).

In the current study, three insecticides were used to test their efficacy against two Lepidopteran pests like *S. litura* and *P. xylostella* under laboratory conditions during 2018. Both lepidopteran pests are very destructive pests of many horticultural and agricultural crops.

The current study resulted that among tested insecticides emamectin benzoate was proved an effective and toxic insecticides against first instar larvae of *P. xylostella* with least LC50 (0.39 and 0.50) value after 48 and 72 hours of application respectively followed by profenofos and lufenuron. Akbar et al. (2014) have proved that emamectin benzoate given 100% mortality of *P. xylostella* larval instars. Our findings are similar to the findings (Akbar et al., 2014). During the study, it was observed that lufenuron was most toxic insecticide for 2nd and 3rd instar larvae of *P. xylostella* with least LC50 (0.90, 0.91 and 1.31, 0.46) after 48 and 72 hours respectively. The similar findings were observed by many researchers. During the study, it was observed that profenofos was also found most toxic against 1st instar larvae of *P. xylostella* with least LC50 0.51 (0.15-0.79) and 0.35 (0.17-0.72) after 48 and 72 hours respectively.

Comparison of LC50 values of four insecticides tested against different instars larvae of *S. litura* showed that after 48hr and 72hr emamectin benzoate was most toxic insecticide against 1st, 0.03 (0.01-0.02), 0.02 (0.01-0.05) and 2nd, 0.22 (0.13-0.35), 0.14 (0.05-0.23) instars larvae respectively (Table 1).

Table 1: Toxicity of newer insecticides to four larval instars, *Spodoptera litura* L. by using leaf dip bioassay method under laboratory conditions

Insecticide	Instar	Time	LC50 (FL at 95%)	LC90 (FL at 95%)	Slope ± SE	CF1	CF2	CF3
Emamectin Benzoate	1st	48	0.03(0.01-0.02)	0.33 (0.21-0.71)	1.21±0.15	2	1	1
		72	0.02 (0.01-0.05)	0.23 (0.25-0.35)	1.34±0.17	1	1	1
	2nd	48	0.22 (0.13-0.35)	2.93 (1.42-8.17)	1.15±0.19	7.69	7.69	7.69
		72	0.14 (0.05-0.23)	1.51 (0.75-3.49)	1.27±0.16	6	6	6
	3rd	48	0.86 (0.43-1.26)	9.93(5.45-22.15)	1.23±0.15	27.6	27.6	27.6
		72	0.57 (0.44-0.97)	4.66 (3.26-8.97)	1.53±0.23	32	32	32
	4th	48	2.87 (1.51-3.52)	30.1(14.09-63.3)	1.14±0.13	79.3	77.3	77.3
		72	1.34 (1.01-2.45)	18.6 (13.6-38.6)	1.26±0.19	91.5	90.9	91.5
Lufenuron	1st	48	2.32 (1.25-3.41)	31.3 (14.1-97.1)	1.17±0.17	1.59	78.3	76.5
		72	1.70 (0.97-1.31)	17.8 (11.0-45.3)	1.28±0.22	1.66	86	84
	2nd	48	4.80 (2.99-7.31)	60.9 (36.9-132)	1.16±0.14	3.30	160	160

		72	3.17 (2.29-6.42)	36.5 (22.9-72.5)	1.30±0.10	4.31	208	209
	3rd	48	23.9 (15.9-43.9)	453 (230-1454)	1.00±0.26	17.9	932	932
		72	21.6 (11.2-31.2)	216 (120-488)	1.25±0.39	21.8	1032	1033
	4th	48	167 (86.5-248)	1633 (900-4331)	1.36±0.41	116	5230	5243
		72	92.1 (45.60-14)	640 (407-1220)	1.43±0.58	90.1	4709	4709
Profenofos	1st	48	1.41 (0.66-1.79)	28.3 (11.8-132)	0.51±0.25	2.92	60.9	60.5
		72	0.77 (0.31-0.89)	7.32 (4.15-13.5)	1.25±0.38	1.73	28.9	28.4
	2nd	48	2.11 (1.33-3.27)	32.1 (18.4-72.8)	1.60±0.54	3.35	73.9	73.7
		72	1.31 (0.83-2.34)	16.0 (9.91-31.4)	1.55±0.37	4.31	75.8	75.2
	3rd	48	2.37 (1.52-3.84)	22.5 (12.1-42.1)	1.46±0.09	4.11	84.9	85.8
		72	2.52 (1.01-3.15)	15.9 (11.2-30.0)	1.33±0.12	5.97	99.6	100
	4th	48	16.02(8.83-27.0)	386 (165-1829)	0.23±0.26	24.3	540	545
		72	10.10(6.12-20.1)	185 (94.9-586)	1.18±0.38	30.6	607	607

CF1, compared with least value of each insecticide separately for each test insect

CF2, compared with least value of all insecticides for each insect separately

CF3, compared with least value of all insecticides of both test insects

The current study was resulted that emamectin benzoate was most effective for both insect pests (*S. litura* and *P. xylostella*) (Table 1 and Table 2). Imran et al (2017) was reported the similar findings. Our findings were not agreement with the findings of Mohan & Gujar, (2003) they reported that Lufenuron was proved an effective insecticide for the management of *S. litura* under laboratory condition. El-Sheikh, (2015) reported that emamectin benzoate is toxic insecticide for the management of *S. litura* and reduce the growth and development of larvae. The study revealed the similar findings as reported by (El-Sheikh, 2015; Raju, 1996; Noma et al., 2010; Mahla et al., 2005). In Pakistan, emamectin benzoate is considered an important and toxic insecticide against armyworm (Rafiq, 2005; Fanigliulo & Sacchetti, 2008). Our findings are agreement with findings of earlier researchers (Rafiq, 2005). Comparison of three tested insecticides are given in Tables 1 and 2. Emamectin benzoate is widely use for the management of insect pest in all over the world including Pakistan (Rafiq, 2005).

Table 2: Toxicity of newer insecticides to four larval instars, *Plutella xylostella* L. by using leaf dip bioassay method under laboratory conditions

Insecticide	Instar	Time	LC50 (FL at 95%)	LC90(FL at 95%)	Slope ± SE	CF1	CF2	CF3
Emamectin Benzoate	1st	48	0.39 (0.27-2.54)	12.3 (5.02-99.9)	1.15±0.22	1.20	2.75	28.5
		72	0.50 (0.15-2.26)	5.32 (4.40-30.3)	1.23±0.23	1.31	1.34	32
	2nd	48	0.45 (0.25-1.23)	6.37 (3.28-110)	1.06±0.29	2.0	1.38	19.4
		72	0.51 (0.11-0.92)	4.97 (3.28-44.4)	1.12±0.31	1.05	1.32	25.05
	3rd	48	0.81 (0.47-1.43)	13.1 (3.30-124)	1.16±0.35	1.52	2.30	29.3
		72	0.37 (0.21-1.11)	8.10 (3.03-33.8)	1.22±0.37	1.26	1.36	30.4

	4th	48	2.00 (1.48-9.95)	140(29.1-31505)	0.96±0.21	4.06	7.37	94.6
		72	1.51 (0.43-5.00)	99.3(29.1-20144)	0.32±0.71	4.0	4.31	80.5
Lufenuron	1st	48	0.69 (0.44-1.19)	7.14 (3.91-23.3)	1.37±0.24	1.23	1.46	21.5
		72	0.54 (0.29-0.43)	2.47 (1.92-4.09)	1.44±0.42	1.45	1.50	25.01
	2nd	48	0.91 (0.32-1.49)	9.08(5.99-91.07)	1.29±0.43	1.51	2.22	30.3
		72	0.96 (0.29-1.39)	8.76 (4.99-58.8)	1.21±0.30	1.21	2.10	39.0
	3rd	48	1.31(0.45-23.81)	33.5(10.5-10.33)	0.98±0.23	2.21	2.96	43.0
		72	0.46 (0.33-1.30)	12.4 (4.12-152)	0.88±0.35	1.29	2.21	40.1
	4th	48	2.94 (1.33-8.70)	109(23.1-27141)	0.84±0.27	4.89	7.16	99.01
		72	1.87 (0.54-4.87)	86.8(15.5-21466)	0.87±0.33	4.63	4.72	90.10
Profenofos	1st	48	0.51 (0.15-0.79)	6.24 (3.72-20.9)	1.17±0.46	1.0	2.02	10.9
		72	0.35 (0.17-0.72)	3.73 (1.31-6.46)	1.79±0.34	1.0	2.99	19.10
	2nd	48	1.13 (0.51-1.85)	9.25 (5.57-61.2)	1.45±0.34	2.71	2.61	38.4
		72	0.62 (0.42-1.36)	7.63 (3.77-29.5)	1.51±0.36	2.29	2.29	59.5
	3rd	48	0.84 (0.42-1.39)	16.8 (5.21-188)	0.97±0.29	1.89	1.87	24.9
		72	0.77 (0.48-1.15)	8.77 (3.53-65.4)	1.07±0.46	1.78	1.78	29.5
	4th	48	1.59 (0.87-2.69)	30.8 (12.1-293)	0.98±0.31	3.73	3.73	47.9
		72	0.95 (0.40-2.67)	17.9 (7.78-165)	1.12±0.33	2.51	2.56	50.0

CF1=compared with least value of each insecticide separately for each test insect

CF2=compared with least value of all insecticides for each insect separately

CF3=compared with least value of all insecticides of both test insects

Many earlier researchers have reported that all insecticides proved an effective and best control against insect pests (Mohan & Gujar, 2003; Osorio et al., 2008) under laboratory and field conditions (Ahmad et al., 2008).

CONCLUSION

The present study was concluded that Emamectin benzoate was significantly more toxic and effective insecticides against insect pests. Profenofos is the 2nd most important and effective against *Spodoptera litura* and *Plutella xylostella.* The study could be suggested that Emamectin benzoate in combination with Profenofos prove an efficient to maintain the pest populations.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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