Research Article

Comparative efficacy of four insecticides and two indigenous plant extracts against wild crucifer aphid, *Lipaphis erysimi* (Hemiptera: Aphididae)

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Abstract

Gold-of-pleasure, leindotter and linseed dodder are the titles used for *Camelina sativa* L. This crop is under menace of severe infestation of aphid. Aphid population of was noted from arbitrarily five selected camelina plants of every treatment. Two plant oils (*Ricinus communis*, *Jatropha curcus*) and four synthetic insecticides (Acetamiprid, Imidachloprid, Cypermethrin and Diafenthuiuron) were used. Mortality data of *L. erysimi* was recorded at regular interval of 24 hs. till 96 hs. of treatments applications. Results of toxicity bioassays displayed that application of Acetamiprid and *R. communis* resulted in enhanced mortality of *L. erysimi* than the other treatments, applied. Highest mortality rate (78.67%) of the test insect pest was recorded in Canadian variety of camelina by application of Acetamiprid whilst lowest 36.10% was observed by Diafenthuiuron, after exposure period of 96 hs. While highest and lowest mortality rates of the target insect pest in Australian camelina were 70.19% and 29.10%, respectively. Consequently, it is concluded that the application of Acetamiprid can be an effective tool in integrated pest management programme.

Keywords: Infestation; Integrated pest management; Mortality; Treatment and varieties

Introduction

There is shortage of vegetable oil production in Pakistan and current native oil resources fulfill on 28% of the country needs. In order to meet the shortage, 75% is being imported [1]. The budget for imported comestible oils is rising into billions of dollars; becoming a

huge drain on our external exchange reserves. During 2006-2007, import of oilseeds and edible oil cost of US\$ 1045 million. Requirement for edible oil stood at 3.094 million tons (MT) in the similar year [2]. Several factors can be ascribed to the low production like change of cropping

preference, reduction of area under oil seed crop, old cultural practices [3], non-availability of better-quality seeds, attacks of diseases and insect pests [4]. The feeding behaviors and consequent sternness of these insect pests differs in diverse agro-ecological situations. A huge number of oleaginous crops are cultivated in several areas (like Faisalabad, Sahiwal, Multan etc. and in some areas of Sindh as well) of Pakistan; nevertheless the quantity of edible oil is not adequate to fulfill our requirements [5]. Therefore, we have to import a huge quantity of comestible oil 143.5 million tones (MT) from foreign countries. Therefore, a massive quantity of foreign exchange i.e. 19044.8 million rupees is spend to import the comestible oil [6]. In the years 2009-2010, comestible oil yield was around 1.749 (MT) in Pakistan. Growing request of edible oil, variations in national yield and nonstop upsurge in the imports are the dominant features of current comestible oil condition in the Pakistan [7]. In 2018-19 (July-March), 2.421 (MT) edible oil was imported. Local production of edible oil during this period recorded at 0.500 million tons [8].

Camelina sativa seeds have 28-40% of vegetable oil, which is tremendously better to that normally present in soybean (18-22%) [7]. Two varieties of camelina crop are usually grown for the purpose of edible oil; spring variety (*Camelina sativa* L. Crantz) and winter camelina (*Camelina silvestris* Wallr) whereas spring variety of *Camelina* is known as the best for biodiesel. The fruit and seed length of *C. sativa* is greater compared to *C. silvestris* [9]. Camelina crop cultivation is amplified owing to its little requirements of agronomic inputs and greater potential for biodiesel production [10]. *C. sativa* is a spring annual oilseed and broad leaf crop that can be grown well in moderate climates. Contrasting to other usually cultivated oilseed crops such as sunflower, soybean, rapeseed and canola, *C. sativa* does not need

ample fertilizer, water and pesticide. The average produce of the crop ranged from 420-640 L/ha whereas contents of fiber and protein in camelina crop are similar to that of soybean meal [11]. As camelina is comparatively a foreign crop, vulnerability to different diseases and insect pests is not well understood. Many species of insect pests like cabbage seed pod weevil, flea beetle and aphid that normally distress canola has not been detected in camelina crop [11, 12]. *C. sativa* has an elevated level of resistance to flea beetle attack as described by many researchers [13-15]. Unluckily, this crop in a great menace of severe infestation of aphid in Pakistan. Camelina crop is recently familiarized in Pakistan and low numbers of insect pests have been noticed that result in severe harm to canola crop [16]. *Lipaphis erysimi* (Kalt.) is known to be the most severe insect pest amongst these insect pests, which is accountable for a substantial yield loss ranging in 35.4-96% depending upon growing seasons. Young ones and adults of aphid contribute meaningfully to damage through feeding on the plant and frequently casing the whole surface of pods, shoots and flower buds [17]. For the management of *L. erysimi*, effective entomocidal chemicals must be practiced at suitable dosages. Numerous investigators have examined effectiveness of many insecticides including thiamethoxam, diafenthiuron and acetamiprid against turnip aphid, *L. erysimi* [16]. Mustard crop can perform a significant part in accomplishing the needs of edible oil if it is cultivated on large scale and suitable managing approaches are practiced for the aphid control. Therefore, the present investigation was concentrated to assess the effectiveness of *Ricinus communis*, *Jatropha curcus*, Cypermethrin, Imidachloprid, Acetamiprid and Diafenthiuron against *L. erysimi* in the both varieties of camelina.

Materials and methods

The research work has been carried out on two varieties of camelina (Australian and Canadian) sown in November 2018 at field area of University of Agriculture, Faisalabad, Pakistan by hand-driven drill technique at a seed rate of 5kg per hectare. Standard cultural practices were followed. The research trial was laid out in a Randomized Complete Block Design having four replicates. Camelina crop was monitored from germination to maturity for recording insect pests. Insect pests populations have been noted after regular intervals of seven days. *L. erysimi* was detected as the main insect pest.

Population of aphid was documented from arbitrarily chosen five plants of every treatment. The sampling technique of *L. erysimi* was identical as described by [18].

The insecticides and their recommended dose rates are mentioned in (Table 1). Water was used as control.

All the insecticides were sprayed using knapsack sprayer (hand operated) with a hollow cone nozzle (KB-5C, Korea). The volume of sprayer tank was 5 L using work pressure of 1-2 bar. The mortality findings were noted afterward regular intervals of 24 hs. till 96 hs. of the treatment application.

Table 1. List of different treatments and recommended dose rates

Treatments	Common Names	Brand/Scientific names	Formulations	Dose/acre
T ₁	Acetamiprid	Rani	20%SP	50g
T ₂	Imidachloprid	Confidor	20%SL	250 ml
T ₃	Cypermethrin	Mustang	10 EC	250 ml
T ₄	Diafenthiuron	Polo	50%SC	200 ml
T ₅	Castor bean	<i>Ricinus communis</i>	Liquid	-
T ₆	Jatropha oil	<i>Jatropha curcus</i>	Liquid	-
T ₇	water	Control	Liquid	-

Statistical analysis

The collected data was subjected to Abbott's formula for calculation of mean percent mortality and then data were subjected to STATISTICA 8.1 software package

[19] Means of treatments have been compared by Tuckey's HSD test at probability (P= 0.005). LC₅₀ has been calculated using Probit-analysis.

Results

Findings of (Table 2) displayed that use of *R. communis* and Acetamiprid caused higher mortality of *L. erysimi* compared to other treatments, used. Mortality of the target insect pest was 78.67, 72.19, 58.17, 51.24, 45.76 and 36.10 % in Canadian variety of camelina by application of Acetamiprid, *R. communis*, *J. curcus*, Cypermethrin,

Imidachloprid and Diafenthiuron, correspondingly after exposure period of 96 (hs.). While mortality values of the target insect pest in Australian camelina were 70.19, 67.56, 54.17, 49.62, 41.35, and 29.10 %, respectively after longest exposure period (96 hs.). Control was least effective as no mortality was recorded in control experimental blocks.

Acetamiprid displayed relatively more toxicity with LC₅₀ value of 12.380 g ml⁻¹ followed by *Ricinus communis* and *Jatropha curcus* with values of 19.042 and 30.157 g ml⁻¹, correspondingly. Overall all the tested insecticidal chemicals performed better than control but acetamiprid was the most toxic (Table 3).

Table 2. Toxic impacts of different treatments (plants oils and synthetic insecticides) against *Lipaphis erysimi*

Treatments	24 hs.	48 hs.	72 hs.	96 hs.
Australian variety				
Acetamiprid	38.23±1.30a	43.56±3.10a	55.23±2.70a	70.19±3.20a
<i>Ricinus communis</i>	34.10±2.07b	39.26±3.04c	50.74±1.10b	67.56±2.78ab
<i>Jatropha curcus</i>	29.35±3.09c	40.04±2.56ab	45.14±2.44c	54.17±1.11b
Cypermethrin	18.10±1.10d	25.12±3.11d	41.20±3.11d	49.62±2.10c
Imidachloprid	15.10±2.34de	21.35±1.00e	37.16±1.11e	41.35±2.0d
Diafenthiuron	12.34±2.10de	17.11±3.10f	24.30±3.23f	29.10±3.10e
Canadian variety				
Acetamiprid	45.15±2.30a	56.04±2.01a	67.19±3.20a	78.67±3.20a
<i>Ricinus communis</i>	41.21±2.87ab	44.04±1.92b	59.19±2.78b	72.19±2.78b
<i>Jatropha curcus</i>	34.14±1.46c	41.53±1.11b	48.17±1.11c	58.17±1.11c
Cypermethrin	28.35±3.27d	37.15±3.10bc	46.35±2.10c	51.24±2.10d
Imidachloprid	23.20±2.14e	29.35±3.07d	40.41±2.0d	45.76±2.0e
Diafenthiuron	18.02±1.3f	21.35±2.56e	27.35±3.10e	36.10±2.10f

Table 3. LC₅₀-values

Treatments	Exposure period (hs)	Slope	Z-value	P-value	R ² -value	LC ₅₀ (value) (g ml ⁻¹)	Fiducial limit (95.0%)	
							Lower	Upper
Acetamiprid	24	6.3	2.13	0.028	0.897	58.239	25.73	92.56
	48	5.4	2.01	0.040	0.915	40.017	16.93	81.10
	72	10.1	3.56	0.001	0.941	29.380	13.60	36.40
	96	12.4	3.56	0.001	0.921	12.380	10.60	25.07
<i>Ricinus communis</i>	24	7.1	2.63	0.002	0.982	34.251	22.95	94.21
	48	8.4	2.49	0.021	0.940	30.770	27.35	62.72
	72	14.5	2.61	0.008	0.913	21.042	29.60	45.04
	96	15.2	3.81	0.006	0.913	19.042	13.60	29.04
<i>Jatropha curcus</i>	24	9.8	2.72	0.032	0.988	38.367	25.01	87.34
	48	7.2	2.44	0.027	0.903	34.420	22.79	62.30
	72	10.4	2.21	0.031	0.945	30.157	24.54	58.19
	96	17.0	3.23	0.015	0.926	28.941	20.40	56.13
Imidachloprid	24	5.7	2.48	0.019	0.950	41.670	23.45	94.67
	48	6.3	2.42	0.124	0.972	38.134	37.72	108.90
	72	4.9	2.38	0.030	0.969	36.121	23.76	86.51
	96	16.2	2.29	0.028	0.965	35.170	20.33	76.32
Diafenthiuron	24	4.7	1.57	0.137	0.989	146.603	91.07	214.90
	48	5.5	1.49	0.107	0.938	124.105	82.67	208.45
	72	17.0	2.85	0.001	0.986	42.613	22.01	74.10
	96	18.5	3.02	0.001	0.987	44.654	18.01	76.18

In (Fig. 1) data showed that relative higher aphid population was recorded on Canadian variety of camelina than the Australian

variety in all the three experimental blocks before the treatments applications.

Figure 1. Mean population of the aphid on two varieties of camelina crop under study

Discussion

Camelina sativa is an oil seed crop which belongs to family Brassicaceae that comprises of numerous plant species. The findings of the current study specified that the aphid is one of the severe insect pests of *C. sativa* crop in Pakistan. However, the variation between *L. erysimi* populations on both camelina varieties might be owing to vegetative features of the plant. There is very restricted research work found on Australian camelina, though there is likelihood that host plant resistance mechanisms may be cause non-preference of *L. erysimi* to this crop [18, 20]. There is difference in leaf morphologies of both varieties of camelina crop. The leaves of Canadian camelina are only superficially serrated but of Australian camelina are extremely saw-like and greater leaf area index as compared to Canadian camelina. Leaves of Australian camelina are hairier as compared to Canadian camelina [21]. As far as the Chemical control is concerned, it yet remains key management tool of insect pest control and is also important in the notion of Integrated Pest Management (IPM). Results of toxicity bioassays reflected that *R. communis* oil and acetamiprid were relatively

greater effective chemicals than that of *J. curcus*, Cypermethrin, Imidachloprid and Diafenthiuron. Average mortality rate after 96 hs has been noted as 78.67, 72.19, 58.17, 51.24, 45.76, 36.10% in Canadian variety and 70.19, 67.56, 54.17, 49.62, 41.35, 29.10% in Australian camelina. Among the all treatments, Acetamiprid was the most operative insecticide in the varieties of *C. sativa*, being revealed in our study.

The results of current research displayed that acetamiprid executed best in decreasing *L. erysimi* population on camelina crop trailed by *Ricinus communis*, *J. curcus*, Cypermethrin, Imidachloprid and Diafenthiuron nevertheless their efficacy nearly parallel to each other. Yet, acetamiprid executed best in decreasing the aphid population on both camelina varieties. The outcomes of presented research work are extremely concurring with [22] in which they applied thiamethoxam, diafenthiuron and acetamiprid for the control of aphid population. The findings of their experimentations reflected that acetamiprid was the most operative as compared to diafenthiuron, thiamethoxam in controlling of aphid populations. Outcomes of our

experiment are in agreement with the results of [16] who checked the effectiveness of some insecticides against *Phyllotreta* spp.) on Indian mustard. Acetamiprid (125 g/ha) showed as the most effective insecticide trailed by acephate, oxydemeton, profenofos, imidacloprid, dimethoate, thiamethoxam and methyl for the control of aphids. [23] tested the effectiveness of 5 insecticides viz., Lannate 40SP (methomyl), Advantage 20 EC (carbosulfan), Mospilan 20SP (acetamiprid), Confidor 200 SL (imidacloprid) and Actara 25 WP (thiomethoxan) for the control of aphid. The findings displayed that imidacloprid and acetamiprid provided best outcomes against aphid. Our findings also support the results from many researchers that acetamiprid was very effective against various insect pests.

The information regarding growth of insecticidal resistance against traditional insecticides has raised stern anxieties concerning to their effectiveness in the field. Nonetheless, the neonicotinoids as acetamiprid and imidacloprid proved extremely operative for farmers owing to altered way of action than to the former insecticides. Acetamiprid be in the accurate place to second generation of the nicotinoids. Being systemic insecticide, it has translaminar activity and both contact as well as stomach mode of actions. Its foliar spray is very operative for the control of aphid populations than that of other insecticides. Owing to their mode of action, there is no or little cross-resistance to earlier developed insecticides like chlorinated hydrocarbons, carbamates, organophosphates, and pyrethroids. Currently, Neonicotinoids are substituting earlier insecticides for the effective control of many major crops insect pests [24].

Conclusion

Outcomes of the toxicity bioassays disclosed that amount all the treatment used. However, oil of *R. communis* oil and acetamiprid were

the most operative entomocidal candidate to control the population of *L. erysimi*. Exposure period was important as comparative greater mortality of the aphid was achieved after longest exposure period (i.e. 96 hrs.). Hence, use of *R. communis* oil and acetamiprid are suggested as perfect and effective chemicals for the integrated pests management of aphid populations on camelina crop.

Authors' contributions

Conceived and designed the experiments: H Rehman & A Rasul, Performed the experiments: H Rehman, Q Ali & B Majeed, Analyzed the data: M Sagheer & MA Farooqi, Contributed materials/ analysis/ tools: B Majeed & MA Farooqi, Wrote the paper: H Rehman.

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