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Efficacy of organophosphate insecticides against thrips on different varieties of onion in agricultural field Sariab, Quetta (Balochistan) Pakistan

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Abstract

The present study was conducted to manage the thrips (*Thrips tabaci*) on onion varieties namely Chiltan-89, Phulkara, Trichmir, Gulnar, Nasarpori using chemical pesticide (Chlorpyrifos) in field. For experimentation, the randomized complete block design was used by performing three treatments in agriculture vegetable and seed farm Sariab, Quetta. Three sprays of Chlorpyrifos of equal concentration were applied on the five mentioned different onion varieties. Thrips were recorded before starting the treatments and monitoring thrips mortality rate at the intervals of 24 hours (hrs), 48 hrs, 72hrs and a week after each spray. Results revealed that the pesticide showed high significant control of thrips infestation of Chiltan-89 variety after 24 hrs at P value<0.0001 in all three treatments: 48 hrs (P<0.001) in treatment 1 and P value<0.0001 for T2 and T3: 72 hrs (P<0.05, P<0.001 and P<0.0001) for T1, T2 and T3, and (P<0.05 and P<0.0001) after a week in T2 and T3. The same pesticide showed comparatively least control of Trichmir at P value less than 0.001 and P<0.0001 after 24 hrs for T2 and T3: 48 hrs (P<0.05) for both T2 and T3: while after 72 hrs and one-week interval P<0.0001 and P<0.05 was noted for treatment 3, respectively. Furthermore, treatment 3 showed more significant results then treatment 1 and 2. Whereas more positive control was observed after 24hrs in all the five varieties.

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Introduction

Onion (*Allium cepa* L.*)* is one of the most important commercial vegetable crop grown for its pungent bulbs and flavorful leaves worldwide (Patel *et al*., 2009; Asghar *et al.,* 2018). Onion has a great socioeconomic importance as it is used almost in all the four seasons of the year. Generally all parts of *Allium cepa* can be consumed by humans except the seeds (Gebretsadik and Dechassa, 2018; Shweta *et al*., 2019). Onion is an important food ingredient in heaving a significant nutritional and medicinal values. It is an essential part of daily meal which can be eaten uncooked or cooked worldwide. It has higher consumption rate for their unique flavor hence enhances the flavor of other foods (Rabinowitch and Currah, 2002; Omer *et al.,* 2019).

Onion is an important vegetable of Pakistan cultivated in both rabi and kharif seasons. According to the report of Government of Pakistan Agricultural Statistics and Livestock Economic Wings (2012), in Pakistan onion crop is grown on an area of 1209602 hectares with 1817,350 tones production rate per annum. Onion can be sharp, spicy, pungent, tangy and sweat in savor and hanging on the variety according to pesticide residue and global food trade2008 (Abid *et al.,* 2014).

The onion plant is attacked by several insect pests like thrips, onion fly, cut worms and tobacco caterpillars etc. The major insect pests include onion thrips (*Thrips tabaci* Lindeman) as reported by (Kumar *et al.,* 2019). Thrips belongs to the order Thysanoptera which describes small fringe-winged insects with elongate body(Mound and Kibby, 1998). *Thrips tabaci* (Thripidae) possess a piercing-sucking mouthparts leaving silvery areas on onion leaves (Stafford *et al*., 2011). Onion thrips is a cosmopolitan pest which is recorded on more than 300 species of host plants mainly cabbage, cotton, carnation, garlic, onion and cereals especially wheat (Nault and Hessney, 2009; Shweta *et al.,* 2019). Onion thrips attack directly on leaves causing blotches and distort the bulbs causing yield loss. The affected leaves became curled, wrinkled, and gradually dry up. Heavily infested plants do not form bulbs or the flowers produce seed (Din *et al.,* 2016). Thrips is a very prolific and have overlapping generations under conductive environmental conditions particularly at high temperatures (Bergant *et al.,* 2005). Thrips turn to drought at high temperatures above 30°C (86°F) (Alimousavi *et al.,* 2007; Zereabruk *et al.,* 2019).

Farmers use very toxic insecticides for the control of insects, especially during its peak activity, furthermore, the insect pest infestation continued on crop till harvesting stage. The scientific data showed that agro-ecosystem of onion crop serves as a bed for insects that attract different natural enemies (Wagan *et al.,* 2014). Insecticides usage for the control of insects may cause acute antagonistic health effects, remain as toxic residues and the tendency of pesticides are being subjected to extreme contact. Before consuming such products, the removal of these toxic pesticide residues is of significant health importance (Abou-Arab, 1999; Soliman, 2001; Cengiz *et al.,* 2007). The onion thrips feed primarily on leaves, transmit IRIS YELLOW SPOT VIRUS and plummeting bulb development, in tunnel caterpillar in roots seedlings and stunted plants and young bulbs triggering reduced stands (Nault and Shelton, 2010). Since development of insect resistance against insecticides has been reported from various parts of the world, so it is desirable to screen the new products and evaluate the existing insecticides and different varieties of onion for the efficacy and recording incidence of development of resistance.

Keeping in view the importance of subject matter, an experiment was planned to evaluate the efficiency of organophosphate insecticides (Chlorphyrifos) was applied on five different varieties of onion like Chiltan-89, Phulkara, Trichmir, Gulnar, Nasarpori to manage onion thrips in agriculture field at vegetable seed farm, Sariab Quetta.

Materials and methods

Study site and climate

The present study was conducted during 2018-2019 in a field plot of onion crop at vegetable seed farm

located some 10 kilometers in the west from Metropolitan city Quetta. The average annual precipitation rate, temperature and relative humidity is recorded during study year is given in Table 1.

Nursery managements

Seeds of five different varieties of onion with taxonomic characters were collected from Agriculture vegetable and seed farm Sariab, Quetta (Table 2). The seeds were sown in spaced of 2 cm between seeds and 3.5ft between rows on 15th October 2018, onion seedlings were managed in the nursery for 140 days before transplantation.

Transplanting

Seedlings were transplanted to the main experimental field when they attained 3-4 true leaves in the month of March 2019, by carefully uprooting them from nursery beds. One day before transplanting, the nursery beds were irrigated to ease uprooting of seedlings. During transplanting healthy, vigorous and uniform seedlings were transplanted and gap filling was made within a week after transplanting to maintain the desired plant population per plot.

Field management

The field furrows were irrigated twice in a week during the first four weeks and once in a week thereafter, fertilizer Diammonium phosphate (DAP) was applied during transplanting at the rate of 100 kg/acre (18% N: 46% P2O5). But urea was applied at the rate of 100 kg/acre (44% N/acre) in split applications at transplanting and a month after transplanting, harvesting was done when plants attained physiological maturity but all plants were not picked at once, depend on variety, Chiltan-89 was harvested in September 2019, Phulkara in August 2019, Trichmir at August-September 2019, Gulnar in September 2019 and Nasarpori in September-October 2019, (agriculture vegetable and seed farm Sariab, Quetta,(Balochistan), Pakistan.

Experimental design and treatments

The experiment was laid out in a randomized complete block design (RCBD) with split plot arrangement divided into five parts, where five onion varieties (Chiltan-89, Phulkara, Trichmir, Gulnar, Nasarpori) were grown.

The plot size was 230ft in North and 210ft in West respectively. Spacing between the furrow and ridges were 40 and 20 cm and spacing between plants were 10-20 cm. The soil type is classified as a characteristic feature of clay soil type with pH 7.5 to 8.3.

The onion was treated applying three timely sprays of organophosphate group (chlorpyrifos), Table 3. When the thrips population had reached economic threshold level (ETL) i.e. 30 thrips/plant. Thrips population was recorded before application of treatments, and monitoring the mortality rate followed by intervals of 24hrs, 48hrs, 72hrs & 1 week after each spray. The 1st spray was used after 66 days of transplantation 2nd after 21 days of 1st spray and 3rd after 25 days of 2nd spray.

Data collection

Thrips were counted by examination of the entire plant with the aid of 10X magnifying hand lens. Counting thrips was done during wind free time of the day normally, early in the morning and late afternoon. The percent reduction of number of thrips/plant was calculated using the formula of (Dutta *et al., 2014*).

$$\text{Mortality Rate} = \frac{(\text{Mean of control} - \text{Mean of treatment})}{\text{Mean of control}} \times 100$$

Thrips infestation was calculated as a ratio of infested to total sampled plants (100 plants). Leaves of each randomly tagged standing plants were examined to assess severity on a scale of 1-5 based on (16) where 1 = no damage, 2 = up to 25%, 3 = 26-50%, 4 = 51-75% and 5 = >75% damage.

Data analysis

The data were analyzed by using Graph Pad Prism (version 6) the result where presented in mean ±S.D. Two-way ANOVA followed by Tukey's post hoc test were done. Differences where considered significant at P-Value Less than 0.05.

Results and discussion

In the present study day before initiation of spray application uniform distribution of thrips were observed in the plots among the different treatment of chlorpyrifos. Three sprays of this insecticide with equal dozes were applied on the onion crops and evaluated the efficiency of chlorphyrifos on all the five verities of onion.

Table 1. Average Temperature and Precipitation of Study area from October, 2018-October, 2019.

Months	Average daily temperature		Average precipitation (mm)	Probability that a month will be dry (%)
	Maximum (°C)	Minimum (°C)		
October	25.3	06.1	44	75
November	21.0	02.7	40	69
December	17.0	-03.0	39	59
January	14.5	-01.8	47	30
February	11.5	00.2	65	18
March	10.8	03.2	78	15
April	25.7	11.8	52	20
May	29.6	13.2	30	37
Jun	35.0	18.8	22	60
July	38.1	22.9	37	48
August	36.1	20.8	29	58
September	34.6	16.5	27	80
October	27.1	10.1	42	73

Table 2. Taxonomic characteristics with descriptions of onion varieties.

Characteristics	Varieties				
	Chiltan-89	Phulkara	Trichmir	Gulnar	Nasarpori
Season	Rabi	Rabi	Rabi	Rabi	Rabi
Crops	Onion	Onion	Onion	Onion	Onion
Spacing B/W Row	3.5ft	3.5ft	3.5ft	3.5ft	3.5ft
Color of bulb	Pink	Pinkish Red	Brownish white	Red	Light Red
Size of bulb	50-80 mm	55-80 mm	65-90 mm	70-110 mm	50-70 mm
Area	Uplands (also suitable in Upland II)	Plains	Uplands and Upland II	Uplands, Upland II	Upland II – Plains
Time of sowing (for Bulb)	October	October	October	October	October
Time of transplantation	March	March	March	March	March
Harvesting	September	August	August-September	September	September-October
Seed Type	Open Pollinated	Open Pollinated	Open Pollinated	Open Pollinated	Open Pollinated
Day of maturity	145-150 days	120-140 days	130-150 days	140-160 days	120-130 days
Irrigation	22-25	20-24	24-28	24	22
Shelf life	Up to 5 months in room temperature	Up to 4 months in room temperature	Up to 5 months in room temperature	Up to 6 months in room temperature	Up to 4 months in room temperature
Certification	Directorate of Vegetable Seed Production Sariab Quetta, Balochistan.	Directorate of Vegetable Seed Production Sariab Quetta, Balochistan	Directorate of Vegetable Seed Production Sariab Quetta, Balochistan	Directorate of Vegetable Seed Production Sariab Quetta, Balochistan	Directorate of Vegetable Seed Production Sariab Quetta, Balochistan

In this regard highly significant results in terms of thrips control ($P<0.0001$) were observed after 24-hour interval in all the three treatments for Chiltan-89 variety of onion.

Similar results at $P<0.001$ in T1 and $P<0.0001$ in T2 and T3 was also observed after 48 hrs. But after 72hrs the same insecticide showed least significant results ($P<0.05$) in T1 and $P<0.001$, $P<0.0001$ in T2 and T3 respectively, and after one week ($P<0.05$, $P<0.0001$) was observed in treatment 2 and 3. However, least significant result was found in Trichmir variety in all the four intervals, after 24 hrs ($P<0.001$, $P<0.0001$) in T2 and T3 respectively, ($P<0.05$) in T2 and T3 after 48 hrs. And after 72 hrs P value< 0.0001 in T3, and one week intervals $P<0.05$ was also noted in

treatment 3. Overall, treatment 3 indicated more significant results than treatment 1 and 2. However, high mortality rate of thrips was observed after 24hrs in all the five verities, P<0.0001 for Chiltan-89, Pulkara, Gulnar and Nasarpori in all the three treatments but P< 0.001 and P<0.0001 in T2and T3 for Thrichmir (Table 4).

Table 3. Insecticides (Chlorpyrifos) with recommended dozes.

Treatment	Insecticide Group	Chemical name	Active ingredients	Time of Spray application	Dose/acre
T1	Organophosphate 40%EC	Chlorpyrifos	40% W/V and 38.27% W/W	1st Spray May,2019	1000ml/acre
T2	Organophosphate 40%EC	Chlorpyrifos	40% W/V and 38.27% W/W	2nd Spray Jun,2019	1000ml/acre
T3	Organophosphate 40%EC	Chlorpyrifos	40% W/V and 38.27% W/W	3rd Spray July,2019	1000ml/acre

Many lethal pesticides like pyrethroids, carbamates groups, and organophosphate group are used in vegetables field against major insect pests to protect the crops and increase the yield (Krol *et al.,* 2000). Some organophosphate insecticides like Chlorpyrifos ($C_9H_{11}C_{13}NO_3PS$) showed reportedly effective control of pest if applied with proposed dozes and at appropriate times (Martin *et al.,* 2003). Chlorpyrifos is characterized by high fumigate (higher vapor pressure 2.5 dmPa at 25°C) and toxicant properties (Jahromi, 2008).

Table 4. Mean number of onion thrips per variety and percentage mortality rate after different intervals.

Varieties	Treatment	Control	After 24hrs	After 48hrs	After 72hrs	After 1 week	%mortality After 24hrs	%mortality After 48hrs	%mortality After 72hrs	%mortality After 1 week
Chiltan-89	T1	59.7±16.1	25.8 ±10.4***	36.8±12.3**	39.2±11.2*	46.6±16.1	56.7	38.3	34.3	21.9
Pulkara	T1	56.3±17.5	31.3±7.9***	35.4±12.0**	38.1±14.9	49.3±9.0	44.4	37.1	32.3	12.4
Trichmir	T1	60.2±16.8	44.4 ±13.3	46.4±10.7	50.2±9.1	57.3±4.5	26.2	22.9	16.6	4.8
Gulnar	T1	62.8±12.5	32.9 ±8.1***	41.9±9.9**	43.9±10.6	49.1±14.4	47.6	33.2	30.0	21.8
Nasarpori	T1	58.6±13.6	30.9 ±9.8***	37.9±14.0*	41±12.4	45.7±11.3	47.2	35.3	30.0	22.0
Chiltan-89	T2	55.6±6.4	20.8±10.6***	26.9±9.5***	31.7±8.1***	34.7±9.5**	62.5	51.6	42.9	37.5
Pulkara	T2	60.8 ±3.1	30.8 ±8.2***	31.2±13.8***	40.5±9.0*	49.3±9.7	49.3	48.6	33.3	18.9
Trichmir	T2	63.6± 6.9	40.8 ±8.1**	42.7±8.5**	46.3±12.5	59.2±4.4	35.8	32.8	27.2	6.9
Gulnar	T2	58.7 ±3.7	27.3±7.1***	33.7±9.6***	38.5±9.6*	45±10.1	53.4	42.5	34.4	23.3
Nasarpori	T2	56.8 ±5.9	23.1±8.6***	29.5±8.6***	37.9±11.3	42±11.7	59.3	48.0	33.2	26.0
Chiltan-89	T3	50.3±10.3	9.8 ±6.4***	14.7±6.8***	16.9±7.0***	19.7±8.3***	80.5	70.7	66.4	60.8
Pulkara	T3	53.1 ±8.8	19.6±7.0***	17.6±6.5***	32.3±11.6*	21.1±6.9***	63.0	66.8	39.1	60.2
Trichmir	T3	65.4±6.3	29.8±11.8***	44.4±8.8**	35.4±12.5***	45.3±8.1*	54.4	32.1	45.8	30.7
Gulnar	T3	60.2 ±5.7	23.2 ±8.6***	26.5±12.7***	28.4±8.3***	39.4±11.0*	61.4	55.9	52.8	34.5
Nasarpori	T3	59.2 ±6.0	21.6±6.7***	24.1±8.0***	38.5±13.6*	27.7±10.7***	63.5	59.2	34.9	53.2

Data presented in Mean±SD. * represent P<0.05, ** represent P<0.001 and *** represent P<0.0001.

Higher mortality rate of chlorpyrifos is associated with tendency of emulsion ingredients (30±2 °C) to absorb in the waxy layer of the leaves (Yarahmadi *et al.,* 2009). All insecticides can control thrips in onions, however, chlorpyrifos gives best results (Asghar *et al.,* 2018). In a study (Lebedev *et al.,* 2013) Etrimfos (organophosphate) was used against onion thrips, the insect showed resistance. Other insecticides of the same group (diazinon, dichlorvos) was sprayed onto onion crop monitored weekly showed no significant reduction of thrips populations. The pest showed resistance against these insecticides

(Din *et al.,* 2016). These results are not in line with our results where we applied three timely spray of chlorpyrifos on five different varieties of onion monitored with different intervals (24, 48, 72 hrs and 1 week) produced significant results.

However, Workman and Martin (2002) suggested that organophosphate insecticides may not be used on onion crops until synthetic pyrethroids group failed. The farmers also prefer to use synthetic pyrethroids. For this reason, organophosphate insecticides may not show efficiency.

These findings are also not in accordance with our findings where we used only Chlorpyrifos instead of synthetic pyrethroids group. Hence, farmers of the area are supposed to follow the same strategy, and the same insecticide may be purposed for onion growers.

Conclusion

Chlorpyrifos (40EC) gave best results applied after 24 hrs interval than all other mentioned intervals against the pest, therefore Chlorpyrifos 1000 ml/acre is recommended against thrips in district Quetta, Balochistan province, Pakistan. For protection of onion crops, thrips should regularly be monitored if the population enhanced by 30 thrips per plant, the crop should be sprayed with recommended insecticide on recommended dose. The spray application can be repeated if thrips population exceeds this number.

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