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Efficacy of Bio-Rational Insecticides Against Thrips of Onion

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Abstract

The field experiment was conducted at Spices Research Centre, Shibganj, Bogra, Bangladesh during Rabi season of 2016-17 to evaluate the efficacy of different bio-rational insecticides for the management of thrips of onion. Six treatments were replicated three times in randomized complete block design. The treatments were T_1= Spraying of *Beauveria bassiana* @ 5g/litre of water; T_2= Spraying of *Metarhizium anisopliae* @ 4g/litre of water; T_3= Spraying of Spinosad (Success 2.5 SC) @ 1.2ml/litre of water; T_4= Farmers practice- Three spraying of Dimethoate (Tafgor 40EC) @ 1ml/litre of water; T_5= Control (Water +Sticker i.e Trix @ 5ml/litre of water) and T_6= Absolute control. All the insecticides were significantly better than absolute control in reducing thrips population after every spray. It was evident from the study that significantly lowest (4.30 thrips/plant) thrips populations were recorded from bio-pesticide Spinosad treated plot followed by farmers practice (7.95 thrips/plant) and *Beauveria bassiana* (8.46 thrips/plant) at 4th day after 3rd spray. Maximum marginal benefit-cost ratio was also obtained from Spinosad treated plot (33.09) followed by farmers practice (30.62) and *Beauveria bassiana* (15.96). This study showed that bio-pesticide Spinosad (Success 2.5 SC) @ 1.2 ml/litre of water three times at an interval of 10 days from the first appearance of thrips infestation may be recommended for the management of thrips of onion.

Keywords: *Bio-rational, Insecticides, Thrips, Onion*

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1. INTRODUCTION

Onion (*Allium cepa* L.) is grown all over the world and is a favourite spices crop in Bangladesh. In Bangladesh, the area of onion is 1.70 lakh hectare and the total production is 17.04 lakh metric tons with average yield of 10.05 t/ha [3]. Onion contains a lachrymatic agent, a strong antibiotic in addition to fungicidal, bacterial, anti-cholestrol, anti-cancer and anti-oxidant component such as quercetin [4]. Consumption of onions has been increasing significantly in the world partly because of the health benefits they possess [13, 29]. Onions are also rich in flavonoids and alkenyl cysteine sulphoxides which play a part in preventing heart disease and other ailments in humans [9, 13, and 16]. Major limiting factors of onion production are diseases and pests such as thrips (*Thrips tabaci*) and cut worms (*Agrotis sp*.) [27]. Onion thrips which is considered to be the most economically serious pest of onion worldwide [26] is responsible for causing considerable reduction in yield [5, 22, and 26]. Its feeding can reduce onion bulb weight [17, 25] resulting in yield losses of nearly 50% [7] and 60% [28]. Thrips puncture leaves and suck the exuding sap, leaving whitish area on leaves. Infestation is worse in very dry seasons and can often leads to destruction of entire crop. The use of synthetic chemical pesticides for the control of pests and diseases is generally avoided due to their detrimental side effects on human body and his environment. There are some alternative measures to conventional methods; one of which is the use of bio pesticides. Bio pesticides contain microorganisms as the active ingredients. These bio pesticides are extracted from living organisms using various processes that do not alter their chemical composition [18]. Botanicals are now emerging as a viable component of integrated pest management (IPM) strategies for all crops due to their efficacy to managing pest, environmental and public health safety, eco-friendly nature, and cost effectiveness. Botanical pest control is a distinct possibility in subtropical countries, which are endowed with the biodiversity of such plants. The repeated application of synthetic insecticides has resulted in development of insecticide resistance in pest populations [20, 23]. Spinosad 45 SC @ 125 ml/ha was effective against thrips [24]. *Beauveria bassiana* is effective against white fly and other insects [19]. In laboratory studies, *Thrips tabaci* was susceptible to *Verticillium lacanii*, *Beauveria bassiana* and *Metarhizium anisopliae* [8, 11]. This type of research works so far has not been

conducted in Bangladesh. So, the present study was designed to assess the efficacy of bio-rational insecticides against thrips of onion.

2. MATERIALS AND METHODS

The study was conducted at Spices Research Centre, Shibganj, Bogra, Bangladesh during Rabi season of 2016-17 to evaluate the efficacy of different bio-rational insecticides for the management of thrips of onion. The experimental plot was prepared with five ploughings and cross ploughings followed by laddering to break the clods as well as level the soil. The weeds and stubbles of previous crops were collected and removed from the soil. The unit plot size was 3 m × 1.2 m and spacing was 15 cm × 10 cm. The treatments were T_1= Spraying of *Beauveria bassiana* @ 5g/litre of water; T_2= Spraying of *Metarhizium anisopliae* @ 4g/litre of water; T_3= Spraying of Spinosad (Success 2.5 SC) @ 1.2ml/litre of water; T_4= Farmers practice- Three spraying of Dimethoate (Tafgor 40EC) @ 1ml/litre of water; T_5= Control (Water +Sticker i.e Trix @ 5ml/litre of water) and T_6= Absolute control. The application of treatments was started at first appearance of the thrips infestation and a total of 3 sprays were given at 10 days' interval except absolute control treatment. Sticker i.e Trix @5ml/litre of water invariably mixed in each spray solution as sticky agents. Treatments were assigned in a randomized complete block design with three replications. BARI Piaz-1 was used as test crop for this trial. Fourty day's old onion seedlings were transplanted on 28 December 2016. In addition to 5 t/ha of cow dung, the crop was fertilized with $N_{120}P_{40}K_{75}S_{30}$ kg/ha. The entire amount of cow dung TSP and ½ of N and K were applied during final land preparation. The rest N and K was applied in two equal splits as top dress at 25 and 50 days after transplanting (DAP) [1]. Three weeding were done at 25, 50 and 75 DAP. To control purple blotch disease, the crop was sprayed three times with Rovral 50 WP @ 2g/l of water at 35, 45 and 55 DAP. Three irrigations were done at 10-20 days' interval during vegetative growth stage. Depending on the maturity, the crop was harvested on 25 March 2017. Number of thrips (both nymphs and adults) was recorded from 20 randomly selected plants in each plot by keeping a white sticky paper below the plant and then shaking the plants with finger. The data were on thrips populations were recorded a day before and four days after each spray. The first spray was applied when the thrips population was observed at economic threshold level (6-10 thrips per plant) [14]. The Minolta SPAD 502 chlorophyll meter was used for the measurement of onion leaf color. Harvesting was done by hand at physiological maturity when 50-80% of the foliage had fallen over and the tops and roots were cut off. The bulbs from each plot were weighed and the marketable bulbs that were greater than 3 cm diameter separated and graded into non-split or non-double bulbs [15]. The onion bulb yield was extrapolated into ton per hectare. Data on plant height at 85 DAT, Chlorophyll Concentration Index (CCI) at 85 DAT, bulb weight and yield (at harvest) were also recorded. The recorded data were analyzed and mean values were adjusted and separated by DMRT [12]. Percent thrips population reduction over untreated control was calculated using following formula [6].

Percent thrips population reduction over untreated control

$$= \frac{\text{Mean value of control} - \text{Mean value of the treatments}}{\text{Mean value of control}} \text{x} 100$$

The percent increase in yield over control in various treatments was calculated by using the following formula.

$$\text{Percent increase of yield in treatment over control} = \frac{\text{Yield of treated plot} - \text{Yield of control plot}}{\text{Yield of control plot}} \text{ X } 100$$

3. RESULTS AND DISCUSSION

3.1 Efficacy of different treatments against thrips of onion

Efficacy of different treatments against thrips of onion is presented in Table 1. The average number of thrips/ plant before application of treatment varied between 8.85-11.20. It was evident that on the fourth day after 1st spray, mean thrips population was lowest (3.95 thrips/plant) in Spinosad treated plot with population reduction of 68.43% and it was followed by farmers practice (6.20 thrips/plant) with population reduction of 50.44% and *Beauveria bassiana* (6.95 thrips/plant) with population reduction of 44.44%. The absolute control treatment exhibited significantly highest thrips per plant (12.51 thrips/plant). After 2nd and 3rd spray similar trend of results were also observed but thrips population was higher as compared to four days after first spray. Prasad and Ahmed (2009) [24] reported that Spinosad 45SC @ 125 ml/ha was effective against thrips. Gillespie (1986) [11] & Fransen (1990) [8] reported that *Thrips tabaci* was susceptible to *Verticillium lacanii, Beauveria bassiana* and *Metarhizium anisopliae.*

Table 1. Efficacy of different treatments against thrips of onion

Treatments	Pre-treatment count (thrips/plant)	Number of thrips/plant after			% reduction over control after		
		1st spray	2nd spray	3rd spray	1st spray	2nd spray	3rd spray
Beauveria bassiana	9.30	6.95c	8.15cd	8.46c	44.44	51.80	58.01
Metarhizium anisooliae	9.85	8.65b	9.13c	9.50c	30.86	46.01	52.85
Spinosad (Success 2.5SC)	10.20	3.95d	4.10e	4.30d	68.43	75.75	78.66
Farmers practice	9.80	6.20c	7.20d	7.95c	50.44	57.42	60.55
Control (water + sticker	11.20	9.50b	13.15b	17.20b	24.06	22.24	14.64
Absolute control	8.85	12.51a	16.91a	20.15a	-	-	-
CV (%)	10.14	7.61	6.95	5.71	-	-	-
Level of sigf.	NS	**	**	**	-	-	-

NS= Not significant. Data represent mean of three observations, Mean followed by the same letter (s) in the same column did not differ significantly from each other at 1% level by DMRT.

3.2 Effect of different treatments on the yield and yield contributing characters of onion

Efficacy of different treatments on the yield and yield contributing characters of onion are presented in Table 2. All of the treatments gave significant effect on plant height, SPAD value (CCI), bulb weight and yield of onion over the absolute control. The tallest plant (56.43 cm) was recorded from Spinosad treated plot followed by farmers practice (51.80 cm) and *Beauveria bassiana* (50.57 cm) while the shortest plant (43.60 cm) was recorded from absolute control. The highest Chlorophyll Concentration Index of leaf (64.70) was also recorded from Spinosad treated plot followed by farmer's practice (60.60) and *Beauveria bassiana* (58.20). The lowest (47.90) Chlorophyll Concentration Index of leaf was recorded from absolute control treatment. The maximum bulb weight (29.20 g) was recorded from Spinosad treated plot followed by farmer's practice (25.05 g) and *Beauveria bassiana* (24.33 g) and the minimum bulb weight (16.22 g) was recorded from absolute control. However, the highest onion bulb yield (17.90 t/ha) was also obtained from the plot treated with Spinosad. The yield increase of spinosad treated plot was 81.17% over absolute control that indicated better thrips control compared to other treatments. The lowest yield (9.88 t/ha) was recorded from absolute control followed by control treatment (10.44 t/ha). Mandal *et al.* (2008) [21] reported 16.91 to 27.07% increase in yield of cotton over control due to use of biopesticides.

Table 2. Effect of treatments on the yield and yield contributing characters of onion

Treatments	Plant height (cm)	SPAD value (CCI) at 85 DAT	Mean bulb weight (g)	Bulb yield (t/ha)	% yield increase over control
Beauveria bassiana	50.57abc	58.20a	24.33b	15.20b	53.85
Metarhizium anisooliae	50.05abc	56.40ab	23.11b	13.70b	38.66
Spinosad (Success 2.5SC)	56.43a	64.70a	29.20a	17.90a	81.17
Farmers practice	51.80ab	60.60a	25.05b	15.40ab	55.87
Control (water + sticker	45.93bc	48.50b	18.67c	10.44c	5.67
Absolute control	43.60c	47.90b	16.22c	9.88c	-
CV (%)	5.79	6.05	7.04	7.15	-
Level of sigf.	**	**	**	**	-

Data represent mean of three observations, Mean followed by the same letter (s) in the same column did not differ significantly from each other at 1% level by DMRT. CCI= Chlorophyll Concentration Index of leaf

3.3 Economic analysis of different treatments against thrips of onion

The marginal benefit-cost ratio (MBCR) has worked out based on the expenses incurred and value of crops obtained from the treated plot for the control of thrips in onion is presented in Table 3. It was noted that expenses incurred referred to those only on pest control. It was revealed that the highest marginal benefit-cost ratio (33.09) was obtained from the plots treated with Spinosad followed by farmer's practice (30.62) and *Beauveria bassiana* (15.96). In contrast, the lowest MBCR (2.65) was obtained from control (water + sticker) treatment. So, considering marginal benefit-cost ratio bio-pesticide Spinosad (Success 2.5SC) may be recommended for effective management of thrips in onion field.

Table 3. Economic analysis of different treatments against thrips of onion

Treatments	Bulb yield (t/ha)	Gross return (TK/ha)	Cost of treatment (TK/ha)	Net return (TK/ha)	Adjusted net return (TK/ha)	MBCR
Beauveria bassiana	15.20	380000	7840	372160	125160	15.96
Metarhizium anisooliae	13.70	342500	6240	336260	89260	14.30
Spinosad (Success 2.5SC)	17.90	447500	5880	441620	194620	33.09
Farmers practice	15.40	385000	4365	380635	133635	30.62
Control (water + sticker)	10.44	261000	3840	257160	10160	2.65
Absolute control	9.88	247000	-	247000	-	-

MBCR= Marginal benefit-cost ratio

[Price of onion bulb @Tk. 25.00 per kg; Cost of *Beauveria bassiana*: @Tk. 160/100gm; Cost of *Metarhizium anisooliae*: @Tk. 120/100gm; Cost of Success: @Tk. 85/25ml; Cost of Tafgor: @Tk. 105/100ml; Cost of Trix: @Tk. 80/500ml; Cost of spray: Three laborers/spray/ha @400Tk./labour/day; Spray volume required: 500L/ha].

4. CONCLUSION

From the study, it may be concluded that spraying with Bio-pesticide Spinosad (Success 2.5SC) @1.2ml/L of water three times at an interval of 10 days from the first appearance of thrips infestation may be recommended for the management of thrips of onion with higher yield and economic return.

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