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DEVELOPMENT OF INSECTICIDE BASED MANAGEMENT APPROACH AGAINST THRIPS AND IRIS YELLOW SPOT VIRUS IN ONION

M.M. HOSSAIN[1*], K.M. KHALEQUZZAMAN[2], M.A.A. MAMUN[3], M.T.R. MONDAL[4] AND R.N. AHMED[5]

[1*]Scientific Officer, Spices Research Centre, BARI, Shibganj, Bogra, Bangladesh; [2]Senior Scientific Officer, Spices Research Centre, BARI, Shibganj, Bogra, Bangladesh; [3]Assistant Professor, Dept. of Soil Science, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh; [4]Scientific Officer, Bangladesh Institute of Nuclear Agriculture, Mymensingh, Bangladesh and [5]UAO (LR), DAE, Khamarbari, Dhaka, Bangladesh.

*Corresponding author & address: Md. Motaher Hossain, E-mail: ripon01_src@yahoo.com
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ABSTRACT

Hossain MM, Khalequzzaman KM, Mamun MAA, Mondal MTR, Ahmed RN (2015) Development of insecticide based management approach against thrips and iris yellow spot virus in onion. *Int. J. Expt. Agric.* 5(3), 1-7.

The field experiment was conducted at Spices Research Centre (SRC), Bogra during the Rabi season of 2014-15 to evaluate the efficacy of different insecticides for the management of thrips and Iris yellow spot virus on bulb onion. Six treatments (Five insecticides + control) were replicated three times in randomized complete block design. All the insecticides performed better than untreated control treatment in reducing pest population. The insecticide Success offered best protection followed by Intrepid and Confidor. Thrips populations were positively correlated with Iris yellow spot virus in onion. The lowest number of Iris yellow spot (7.47/plant) at 85 days after transplanting (DAT) was recorded from Success 2.5SC followed by Intrepid 10SC (9.67/plant) with severity rating 2 and the highest number of Iris yellow spot (27.42/plant) at 85 DAT was recorded from untreated control treatment with severity rating 4. Maximum marginal benefit-cost ratio was recorded for Success 2.5SC (31.99:1) followed by Intrepid 10SC (28.76:1) and the least was recorded from the Actara 25WG (12.88:1) treated plots. Success 2.5SC and Intrepid 10SC may be recommended for the management of thrips and Iris yellow spot virus in onion.

Key words: *insecticide, management, thrips, iris yellow spot virus, onion*

INTRODUCTION

Onion (*Allium cepa* L.) is the most economically important spice crop in Bangladesh. Its total production is about 13.40 lakh metric tons of bulbs from 1.80 lakh hectares of land (AIS 2014). Onion contains a lachrymatic agent, a strong antibiotic in addition to fungicidal, bacterial, anti-cholestrol, anti-cancer and anti-oxidant component such as quercetin (Baghizadeh *et al.* 2009). The consumption of onions has been increasing significantly in the world partly because of health benefits they possess (Havey *et al.* 2004; Wang *et al.* 2006). Onions are also rich in flavonoids and alkenyl cysteine sulphoxides which play a considerable part in preventing heart disease and other ailments in humans (Gareth *et al.* 2002; Havey *et al.* 2004; Javadzadeh *et al.* 2009). Major limiting factors of onion production are diseases such as downy mildew (*Peronospora destructor*), purple blotch (*Alternaria porri*), leaf spots and onion smudge (*Colletotrichum circinans*) and pests such as thrips (*Thrips tabaci*) and cut worms (*Agrotis* sp.) (Rabinowitch and Currah, 2002; Muendo and Tschirley, 2004). Onion thrips which is considered to be the most economically serious pest of onion worldwide (Trdan *et al.* 2005) is responsible for causing considerable reduction in yield (Brewster 1994; Nawrocka 2003; Trdan *et al.* 2005). Its feeding can reduce onion bulb weight (Kendall and Capinera, 1987; Rueda *et al.* 2007) resulting in yield losses of nearly 50% (Fournier *et al.* 1995) and 60% (Waiganjo *et al.* 2008). 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. Recently, *Thrips tabaci* Lind (Thysanoptera: Thripidae) has been reported to transmit Iris Yellow Spot Virus (IYSV) that acquire the virus during their larval stage and transmit the virus for their entire life (Kritzman *et al.* 2001; Nagata *et al.* 1999). IYSV causes irregular or diamond-shaped straw-colored lesions that develop on leaves and seedstalks (Du Toit *et al.* 2004; Gent *et al.* 2004; Schwartz *et al.* 2005). If IYSV symptoms become severe, bulb size is reduced and the yield of larger bulb classes is reduced (Gent *et al.* 2004). The control of IYSV requires an integrated approach, including control of the vector, cultural practices, and genetic resistance/tolerance. Though many control tactics such as cultural (i.e. host plant resistance, mix cropping, destruction of hibernating pupae) (Atwal 1976; Uvah and Coaker, 1984), biological (i.e. predators and parasitoids) (Atwal 1976; Gandhale *et al.* 1984) are available for the management of this insect, synthetic pesticides and chemicals along with their environmental and health hazards (Shah *et al.* 2000) could not be avoided because of their quick knockdown action and epidemic condition. Kisha (1979) evaluated different insecticides and recommended methomyl (0.53 kg a.i. ha^{-1}) and phenthoate (1.08 kg a.i. ha^{-1}) against onion thrips, if applied at 14 days interval. Spinosad 45 SC @ 125 ml/ha was found effective against thrips (Prasad and Ahmed, 2009). Anonymous (1999) reported that a good control of onion thrips could be achieved by application of various insecticides. Since the development of insect resistance against insecticides was reported from various parts of the world, it is desirable to screen the new products and evaluate the efficacy of existing insecticides and record the development of resistance. Keeping in this view, the experiment was designed to evaluate some insecticides for the management of thrips and Iris yellow spot virus in onion.

MATERIALS AND METHODS

The field experiment was conducted at Spices Research Centre, Shibganj, Bogra during the Rabi season of 2014-15. 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 Spirotetramat (Movento 150SC) @ 1ml/litre of water; T_2= Spraying of Thiamethoxam (Actara 25WG) @ 0.2g/litre of water; T_3= Spraying of Imidacloprid (Confidor 70WG) @ 0.2g/litre of water; T_4= Spraying of Chlorphenapyr (Intrepid 10SC) @ 2ml/litre of water; T_5= Spraying of Bio-pesticide Spinosad (Success 2.5SC) @ 1.2ml/litre of water and T_6= Untreated control. Treatments were assigned to a randomized complete block design with three replications. BARI Piaz-1 was used as test crop for this trial. The seedlings of onion were transplanted on 28 December 2014. In addition to 5 t ha^{-1} 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) (Anonymous 2010). Three times 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/litre 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 10 April 2015. Thrips population was counted at 7 days interval starting from the first appearance of infestation. Then 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 first spray was applied when the thrips population was observed at economic threshold level (6-10 thrips per plant, as described by Hazara *et al.* 1999). The number of iris yellow spot was counted at 85 DAT by randomly sampling ten plants from the inner rows of each plot. The leaf surface showing IYSV damage severity was assessed based on a scale of 1-4 (Schwartz and du Toit, 2005) where 1 = 1–2 small lesions per leaf, 2 = 3–10 medium lesions per leaf, 3 = 11–25 medium to large lesions per leaf and 4 = >25 medium to large lesions per leaf. 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 according to HCDA (1991). The onion bulb yield was extrapolated into ton per hectare. Another data were recorded on plant height at 85 DAT, Chlorophyll Concentration Index (CCI) value at 85 DAT, bulb diameter, bulb weight and yield at harvest. The recorded data were analyzed and mean values were adjusted and separated by Duncan's Multiple RangeTest (DMRT) according to Gomez and Gomez (1984). Percent thrips population reduction over untreated control was calculated using following formula of Dutta *et al.* (2014).

$$\text{Percent thrips population reduction over untreated control} = \frac{\text{Mean of control} - \text{Mean of treatments}}{\text{Mean of control}} \times 100$$

RESULTS AND DISCUSSION

Efficacy of different treatments against thrips population after first spray of onion

Efficacies of different treatments against thrips population after first spray of onion are presented in Table 1. The results showed mean number of onion thrips per plant and their respective mortality percentage caused by insecticides after 24 hours, 48 hours, 72 hours and one week intervals. All the insecticides evaluated against thrips on onion crop were significantly better than the control treatment. After 24 hrs of spray, Success 2.5SC caused 70.43% mortality followed by Intrepid 10SC (60.08%), Confidor 70WG (50%), Movento 150SC (37.02%) and Actara 25WG (26.02%). After 48 hours, the highest mortality was recorded for Success 2.5SC (81.32%) followed by Intrepid 10SC (74.70%) while the lowest mortality was recorded for Actara 25WG (52.48%) followed by Movento 150SC (61.46%). After 72 hours, percent mortality maintained almost the same range for all insecticides which was recorded after 48 hours but very much fluctuation was recorded after one week among the treatments but it was significantly better than the control. After one week, the highest mortality was also recorded for Success 2.5SC (51.03%) while lowest mortality was observed again for Actara 25WG (18.49%).

Table 1. Efficacy of different treatments against thrips population after first spray of onion

Treatments	Mean no. of Thrips/plant				Mortality over control (%)			
	After 24hrs	**After 48hrs**	**After 72hrs**	**After 7days**	**After 24hrs**	**After 48hrs**	**After 72hrs**	**After 7days**
Movento 150SC	10.65bc	8.15bc	8.65bc	10.50bc	37.02	61.46	58.91	28.08
Actara 25WG	12.51b	10.05b	11.50b	11.90b	26.02	52.48	45.37	18.49
Confidor 70WG	8.46cd	5.90cd	6.25cd	9.90bcd	50.00	72.10	70.31	32.19
Intrepid 10SC	6.75de	5.35cd	5.95cd	7.95cd	60.08	74.70	71.73	45.55
Success 2.5SC	5.00e	3.95d	4.75d	7.15d	70.43	81.32	77.43	51.03
Untreated control	16.91a	21.15a	21.05a	14.60a	-	-	-	-
CV (%)	10.90	14.62	12.64	9.99	-	-	-	-

Mean followed by the same letter (s) in the same column did not differ significantly from each other at 1% level by DMRT

Efficacy of different treatments against thrips population after second spray of onion

Efficacies of different treatments against thrips population after second spray of onion are presented in Table 2. The results indicated that the mean number of onion thrips per plant and percent mortality caused by insecticides after 24 hours, 48 hours, 72 hours and one week intervals respectively of second spray were quite effective. All the insecticides evaluated against thrips on onion crop were significantly better than the control tretamnet. After 24 hrs of spray, Success 2.5SC caused 94.05% mortality followed by Intrepid 10SC (90.89%), Confidor 70WG (64.68%), Movento 150SC (62.83%) and Actara 25WG (42.75%). After 48 hours, the highest mortality was recorded for Success 2.5SC which was (95.90%) followed by Intrepid 10SC (91.98%) while the lowest mortality was recorded for Actara 25WG (48.48%) followed by Movento 150SC (66.13%). After 72 hours, percent mortality maintained almost the same range for all insecticides which was recorded after 48 hours but very much fluctuation was recorded after one week among the treatments but it was significantly better than the control. After one week, the highest mortality was also recorded for Success 2.5SC (77.80%) followed by Intrepid 10SC (71.04%), Confidor 70WG (49.47%), Movento 150SC (39.75%) and Actara 25WG (20.30%).

Table 2. Efficacy of different treatments against thrips population after second spray of onion

Treatments	Mean no. of Thrips/plant				Mortality over control (%)			
	After 24hrs	After 48hrs	After 72hrs	After 7days	After 24hrs	After 48hrs	After 72hrs	After 7days
Movento 150SC	10.00c	9.50c	11.95c	14.25c	62.83	66.13	56.78	39.75
Actara 25WG	15.40b	14.45b	16.65b	18.85b	42.75	48.48	39.78	20.30
Confidor 70WG	9.50c	7.20c	10.05c	11.95c	64.68	74.33	63.65	49.47
Intrepid 10SC	2.45d	2.25d	4.05d	6.85d	90.89	91.98	85.35	71.04
Success 2.5SC	1.60d	1.15d	3.85d	5.25d	94.05	95.90	86.08	77.80
Untreated control	26.90a	28.05a	27.65a	23.65a	-	-	-	-
CV (%)	8.96	11.54	9.79	7.30	-	-	-	-

Mean followed by the same letter (s) in the same column did not differ significantly from each other at 1% level by DMRT

Efficacy of different treatments on Iris yellow spot virus of onion

Efficacies of different treatments on Iris yellow spot virus of onion are presented in Table 3. The results of the study indicated that minimum number (7.47) of Iris yellow spot virus per plant was recorded from Success 2.5SC with severity rating 2 followed by Intrepid 10SC (9.67) with the same disease severity as of Success whereas, the maximum number (27.42) of Iris yellow spot virus per plant was recorded from untreated control with severity rating 4. However, the highest reduction(72.76%) of Iris yellow spot virus over untreated control was also calculated from Success 2.5SC followed by Intrepid 10SC (64.73%) and Confidor 70WG (55.51%) while the lowest reduction (25.35%) of Iris yellow spot virus over untreated control was calculated from Actara 25WG followed by Movento 150SC (48.03%).

Table 3. Efficacy of different treatments on Iris yellow spot virus of onion

Treatments	Mean Number of Iris yellow spot/plant at 85 DAT	Severity rating (1-4 scale)	Reduction over control (%)
Movento 150SC	14.25c	3	48.03
Actara 25WG	20.47b	3	25.35
Confidor 70WG	12.20cd	3	55.51
Intrepid 10SC	9.67de	2	64.73
Success 2.5SC	7.47e	2	72.76
Untreated control	27.42a	4	-
CV (%)	9.65	-	-

Mean followed by the same letter (s) in the same column did not differ significantly from each other at 1% level by DMRT

The results obtained in this study are quite in conformity with the findings of previous workers who used synthetic insecticides for the management of onion thrips in different parts of the world and got a considerable knockdown effect (Kisha 1979; Gandhale *et al.* 1984; Hussain *et al.* 1997). Kisha (1979) tested different insecticides and reported that onion thrips can be controlled by methomyl (0.53 a.i. kg/ha), Malathion (1.0 kg ha^{-1}) and phenthoate (1.08 kg ha^{-1}), if applied at 14 days interval. It showed that the residue lasted for 14 days, which confirm the finding of present studies, although different insecticides were used in different agro-ecological zones. Gandhale *et al.* (1984) also reported a good control of onion thrips and the residues could last for a period of one week or so. Since all the insecticides used lost their effect after 15 days, it is assumed that pre harvest period supposed to be somewhat longer than over twenty days. However, instrumental residual analysis studies are needed for definite and safe pre-harvest period. Prasad and Ahmed (2009) reported that Spinosad 45SC @ 125 ml/ha was effective against thrips. Hussain *et al.* (1997) tested different insecticides against *Thrips tabaci* and found that Methamidophos was the most effective insecticides for the control followed by Dicrotophos and Endosulfan. Cypermethrin and Monocrotophos were the least effective. Actara failed to suppress the population of *T. tabaci.* The non effectiveness of the Actara against the *T. tabaci* is also reported by Razzaq *et al.* (2003).

Relationship between thrips population and Iris yellow spot virus of onion

The relationship between thrips population and Iris yellow spot virus after second spray in onion are presented in Fig. 1. There was strongly positive correlation between thrips population and Iris yellow spot virus in onion. The regression equation was y = 0.517x + 3.616 and correlation coefficient was r = 0.9894**. The figure indicates that the number of Iris yellow spot virus increased with the increase in thrips population. Hsu *et al.* (2010) reported a positive correlation between high numbers of *T. tabaci* sampled in onion field and high level of IYSV.

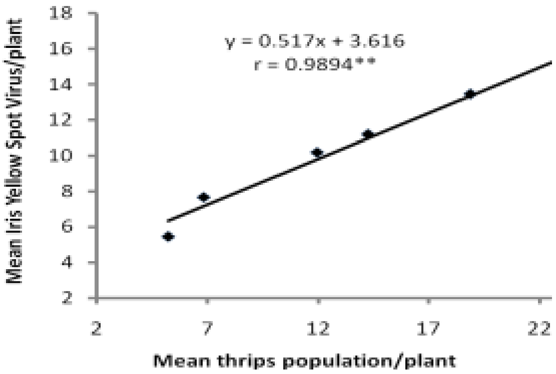

Fig. 1. Relationship between thrips population and Iris Yellow Spot Virus after 2nd spray in onion

Distribution of Iris yellow spot virus in leaves of naturally infected onion plants

The distribution of Iris yellow spot virus in leaves of naturally infected onion plants from the field are presented in Table 4. The results of the study indicated that the maximum number (52) of IYSV in onion leaf was recorded from top leaf section followed by base leaf (20) and neck leaf section (11) while the lowest number (4) of IYSV was recorded from the middle leaf section. However, among the top leaf section the highest number (18) of IYSV was also recorded from 7th younger leaf followed by 6th intermediate leaf (14), 8th younger leaf (8), 2nd older leaf (5) and 5th intermediate leaf (4) while the lowest number of those virus was recorded from 3rd older, 1st older, 4th intermediate and 9th younger leaf. Among the middle leaf section IYSV was recorded only in 5th and 6th intermediate leaf. In base leaf section, the maximum IYSV (7) was recorded from 5th intermediate leaf and minimum number of those virus was recorded in 6th intermediate, 7th intermediate and 9th younger leaf. Similarly, among the neck leaf section IYSV was recorded only in older leaf and other leaf become free from that virus. Plant viruses are biotrophic pathogens and it would be expected that as onion leaves aged and senesce from leaf tips down towards leaf bases, virus titer should accordingly move ahead of the senescing front.

Table 4. Distribution of Iris yellow spot virus in leaves of naturally infected onion plants

Leaf age[a]	Single leaf			
	Top leaf section	**Middle leaf section**	**Base leaf section**	**Neck leaf section**
1[x]	0	0	1	3
2[x]	5	0	2	6
3[x]	1	0	2	2
4[y]	0	0	5	0
5[y]	4	2	7	0
6[y]	14	2	0	0
7[z]	18	0	0	0
8[z]	8	0	3	0
9[z]	0	0	0	0
Total	52	4	20	11

[a]Leaf age from oldest (Leaf 1) to youngest (Leaf 9). Leaves were characterized into three distinct groups in which: [x]indicates older leaf group, [y]indicates intermediate leaf group and [z]indicates younger leaf group

Efficacy 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 5. All of the treatments gave significant effect on plant height, SPAD value (CCI), bulb weight, bulb diameter and yield of onion over the untreated control plot. The tallest plant (64.30 cm) was recorded from Success 2.5SC treated plot which was closely followed by Intrepid 10SC (62.80cm) and the shortest plant (50.30 cm) was recorded from untreated control plot. The highest Chlorophyll Concentration Index of leaf (69.12) was also recorded from Success 2.5SC treated plot followed by Intrepid 10SC (66.93) and Confidor 70WG (64.75). The lowest (51.20) Chlorophyll Concentration Index of leaf was recorded from control treatment. The maximum bulb weight (46.83g) and bulb diameter (4.28 cm) was recorded from Success 2.5SC treated plot followed by Intrepid 10SC (43.50g and 4.05cm) and Confidor 70WG (41.63g and 3.97cm) and the minimum bulb weight (20.42g) and bulb diameter (2.97cm) was recorded from untreated control plot.

Table 5. Efficacy of different treatments on the yield and yield contributing characters of onion

Treatments	**Mean plant height at 85 DAT (cm)**	**SPAD value (CCI) at 85 DAT**	**Mean bulb diameter (cm)**	**Mean bulb weight (g)**	**Yield (t ha^{-1})**	**% Increase over control**
Movento 150SC	57.50ab	59.07abc	3.72ab	35.98bc	13.89bc	52.47
Actara 25WG	56.70ab	55.90bc	3.28bc	31.28c	11.33cd	24.37
Confidor 70WG	59.00ab	64.75ab	3.97a	41.63ab	14.28bc	56.75
Intrepid 10SC	62.80a	66.93ab	4.05a	43.50ab	16.67ab	82.99
Success 2.5SC	64.30a	69.12a	4.28a	46.83a	18.61a	104.28
Untreated control	50.30b	51.20c	2.97c	20.42d	9.11d	-
CV (%)	8.00	7.63	6.42	8.58	9.51	-

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

Effects of different treatments on bulb yield of onion

Effects of different treatments on bulb yield of onion are presented in Fig. 2. The highest bulb yield (18.61 t ha^{-1}) was also obtained from Success 2.5SC. The yield increase was 104.28% over untreated control that indicated better thrips control compared to other treatments. The lowest yield (9.11 t ha^{-1}) was recorded from untreated control plot followed by Actara 25WG (11.33 t ha^{-1}). Mandal *et al.* (2008) reported 16.91 to 27.07% increase in yield of cotton over control due to the use of biopesticides.

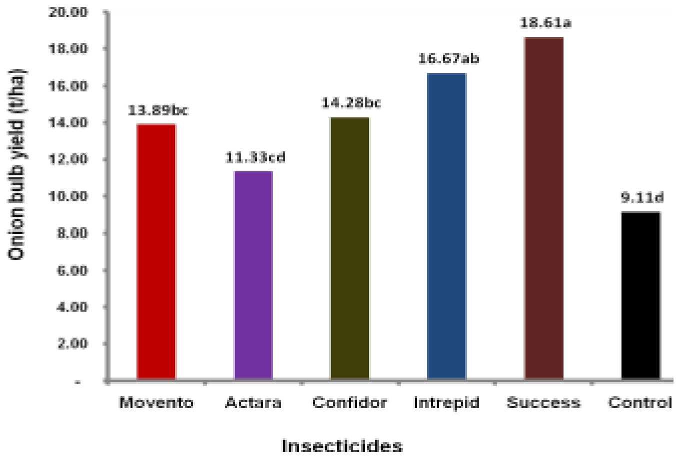

Fig. 2. Effect of different treatments on bulb yield of onion

Economic analysis of different treatments against thrips of onion

The marginal benefit-cost ratio (MBCR) as 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 6. It was noted that expenses incurred referred to those only on pest control. It was revealed that the highest marginal benefit-cost ratio (31.99) was obtained from the plots treated with Success 2.5SC followed by Intrepid 10SC (28.76) and Confidor 70WG (23.62). In contrast, the lowest MBCR (12.88) was obtained from Actara 25WG treated plot. So, considering marginal benefit-cost ratio Success 2.5SC and Intrepid 10 SC may be recommended for effective management of thrips and Iris yellow spot virus in onion field.

Table 6. Economic analysis of different treatments against thrips in onion

Treatments	**Yield (t ha^{-1})**	**Gross return (TK/ha)**	**Cost of treatment (TK/ha)**	**Net return (TK/ha)**	**Adjusted net return (TK/ha)**	**MBCR**
Movento 150SC	13.89	416700	6150	410550	137250	22.32
Actara 25WG	11.33	339900	4800	335100	61800	12.88
Confidor 70WG	14.28	428400	6300	422100	148800	23.62
Intrepid 10SC	16.67	500100	7620	492480	219180	28.76
Success 2.5SC	18.61	558300	8640	549660	276360	31.99
Untreated control	9.11	273300	-	273300	-	-

MBCR= Marginal benefit-cost ratio

[Price onion bulb @Tk. 30.00 per kg; Cost of Moento: @Tk. 2900/L; Cost of Success: @Tk. 95/25ml; Cost of Intrepid: @Tk. 194/100ml; Cost of Confidor; @Tk. 30/2g; Cost of Actara; @Tk. 40/4g; Cost of spray: Two laborers/spray/ha @300Tk./labour/day; Spray volume required: 500L/ha]

CONCLUSION

From the study, it may be concluded that spraying with Success 2.5SC (1.2 ml/L of water) or Intrepid 10SC (2 ml/L of water) two times at an interval of 10 days from the first appearance of thrips infestation may be recommended for the management of thrips and Iris yellow spot virus in onion with higher yield and economic return.

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