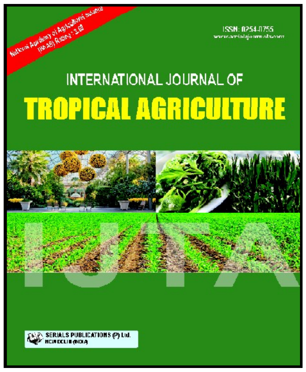

INTERNATIONAL JOURNAL OF TROPICAL AGRICULTURE

ISSN : 0254-8755

available at http: www.serialsjournal.com

Volume 35 • Number 3 • 2017

Efficacy and Economic Viability of Integrated Pest Management Modules Against Onion (*Allium cepa* L.) Thrips (*Thrips tabaci* Linderman)

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Abstract: An experiment was carried out during rabi season of 2011-12, 2012-13 and 2013-14 to evaluate the effective eco-friendly IPM modules for management of thrips (*Thrips tabaci* Lindeman) in onion. The treatments /modules M_1: IPM module consisted of planting barrier crops in outer row of maize and inner row of wheat on all sides of the onion plots prior to 7-10 days of onion planting and the seedlings roots were dipped from 1/3rd of bottom in carbosulfan solution for 2 hr before transplanting as well as spray of neem oil+carbosulfan solution or neem oil+ profenofos solutions were made whenever thrips cross ETL, M_2: Farmers practice wherein dimethoate or profenofos or carbosulfan insecticides spray was made at 15 days interval or as soon as thrips appeared in the field and M_3: untreated control laid out in randomized block design. Both M_1 and M_2 modules significantly reduced the thrips population on onion than M_3 (untreated control). The polar diameter, equatorial diameter, total yield and marketable yield were considerably high in M_1 and M_2 during all three years. However, in 2012-13 and 2013-14, these parameters were significantly higher in M_1. The three years pooled maximum marketable yield (296.51 and 297.13q/ha, respectively) was obtained in M_1 and M_2 were significantly higher than M_3 (contol, without any management of thrips). Thrips population was greatly reduced in IPM module M_1 (10.60) followed by Farmers' practice M_2 (12.46) over the control M_3 (26.86) as pooled of three years indicated the barriers are real restrictors for invasion of thrips. The gross income, additional income and additional yield were similar in modules M_1 and M_2. However, cost of treatments was considerably higher in module M_2 (Rs. 8258.23) than M_1 (Rs. 2604.67). Higher cost:benefit ratio was obtained in M_1 (1:27.00) than M_2 (1:8.30). It was concluded that adoption of IPM module consisting of planting of border crops of maize in outer row and wheat in inner row on all sides prior to 7-10 days of planting, seedling dip treatment with carbosulfan and neem oil based spray of insecticides when thrips population exceeded ETL reduced the thrips infestation in onion crop coupled with better yield, higher C:B ratio and economic return in onion.

Key words: *C:B ratio, Economic viability , Efficacy, IPM module, Onion, Thrips.*

INTRODUCTION

Onion *(Allium cepa* L.*)* is one of the most important commercial vegetable crops grown in India. It is an important crop used raw, as a vegetable and spice all over the world. It is a bulbous biennial or perennial herb. Bulbs are formed by the attachment of swollen leaf bases to the underground part of stem vegetable crops. It is grown in north as well as South India. The most important onion growing states are Maharashtra, Tamil Nadu, Andhra Pradesh, Bihar and Punjab. Characteristic flavor accounts for its popularity. Onion are used as salad and cooked in various ways in all curries, fried, boiled, baked, used in soup making, in pickles and for other purpose. Onion is one of the important commercial and export oriented vegetable crops widely grown by small and marginal farmers during *rab*i, *kharif* as well as late k*harif* seasons with maximum area of 70% in *rabi* alone. India is having second rank in onion production after China.

The productivity of onion in India is very low (10.38 t/ha). The main reason for low productivity in India as well as in Madhya Pradesh is follow up of traditional cultivation methods with local varieties and biotic factors. In biotic factors, insect-pest especially onion thrips (*Thrips tabaci* Lindeman) play crucial role in reducing the production and productivity. Besides direct damage to both foliage and bulbs, thrips can indirectly aggravate purple blotch and act as vector for viral diseases, like Iris yellow spots (Krishna Kumar *et al.,* 2011). Therefore, an attempt was made to find out the options for its effective management and to evaluate IPM modules with economic viability.

MATERIALS AND METHODS

An experiment was conducted at Vegetable Research Farm, Jawaharlal Nehru Agricultural University, Jabalpur (MP) during rabi season of 2011-12, 2012-13 and 2013-14 using randomized block design to evaluate integrated pest management (IPM) modules against thirps in onion. The Agrifound Light Red variety of onion was used in 250 sq m of plot for each module every year. There were 3 modules/ treatments for management of insect-pests in onion *viz.*, M_1, M_2 and M_3. The module M_1 was IPM technology consisted of planting barrier crops in outer row of maize and inner row of wheat on all 4 sides of the plot at least 7-10 days before onion planting in such a way that there was no gap between maize plants. The seedling roots were dipped (1/3rd of bottom) in carbosulfan (2 ml/L) solution for 2 hr before transplanting. The thrips population were monitored and the spray was made twice a week regularly based on economic threshold level (ETL), whenever, thrips population (nymphs) crosses 30/ plant wherein neem oil (3 ml/L) + carbosulfan (1 ml/L) or neem oil (3 ml/L) + profenofos (0.5 ml/L) were used. The module M_2 was farmers' practice wherein dimethoate or profenofos or carbasulfan insectcides spray was made at 15 days intervals or spraying was started as soon as thrips appear in the field, whereas module M_3 was control (untreated plots) wherein no insecticide spray was made. In all the modules/treatments, the spreader (1 ml/L) was used in all the sprays as recommended fungicides were also used in all the plots so as to control disease. Each module /treatment had 4 replications.

A total of 40 beds (3 × 2 sq m each) assigned to each module in each replication. The recommended package of agronomic practices for onion was adopted to obtain proper growth and development except the insecticidal treatments. Insecticidal treatments were given as soon as infestation started. The observations on thrips counts on five plants per plot were randomly taken at 30, 45, 60 and 90 days after planting (DAP) and pooled for analysis. Marketable yield and economics of each module was worked out on per hectare basis. The data obtained were subjected to statistical analysis and the efficacy of different modules was evaluated as per Gomez and Gomez (1986)

RESULTS AND DISCUSSION

The population of thrips on onion crops due to different modules of management is depicted in Figure 1. It had clear indication that the thrips population was significantly lowered in M_1 and M_2 modules over M_3 in all three consecutive years. The thrips population per plant was significantly low in module M_1, IPM technology (8.15 and 8.78) and M_2, farmers practice (8.59 and 10.91) as compared to control (22.98 and 33.44) during 45 and 60 days after transplanting, respectively. However, the thrips population did not differ significantly between modules M_1 and M_2 whereas thrips population were significantly higher in module M_3 (control) than IPM modules M_1 and M_2 during 30, 75 and 90 days after transplanting (Table 1, 2 and 3).

Similarly better efficacy of IPM (module M_1) observed during 45 and 60 days after transplanting might be due to border crop effect of both wheat and maize as the thrips are weak flier and carried by wind. Therefore, planting of maize and wheat on the sides served as barriers and could effectively block or reduce thrips reaching onion plants. Similar report of efficacy of border crop like maize and wheat to block thrips in onion was reported by Srinivas and Lawande (2006). On the other hand non-significant difference in population of thrips per plant after 75 and 90 days after transplanting between module M_1 (IPM) and M_2 (Farmers practice) might be due to senescence of border crop effect of both wheat and maize in module M_1. On the contrary, due to repeated

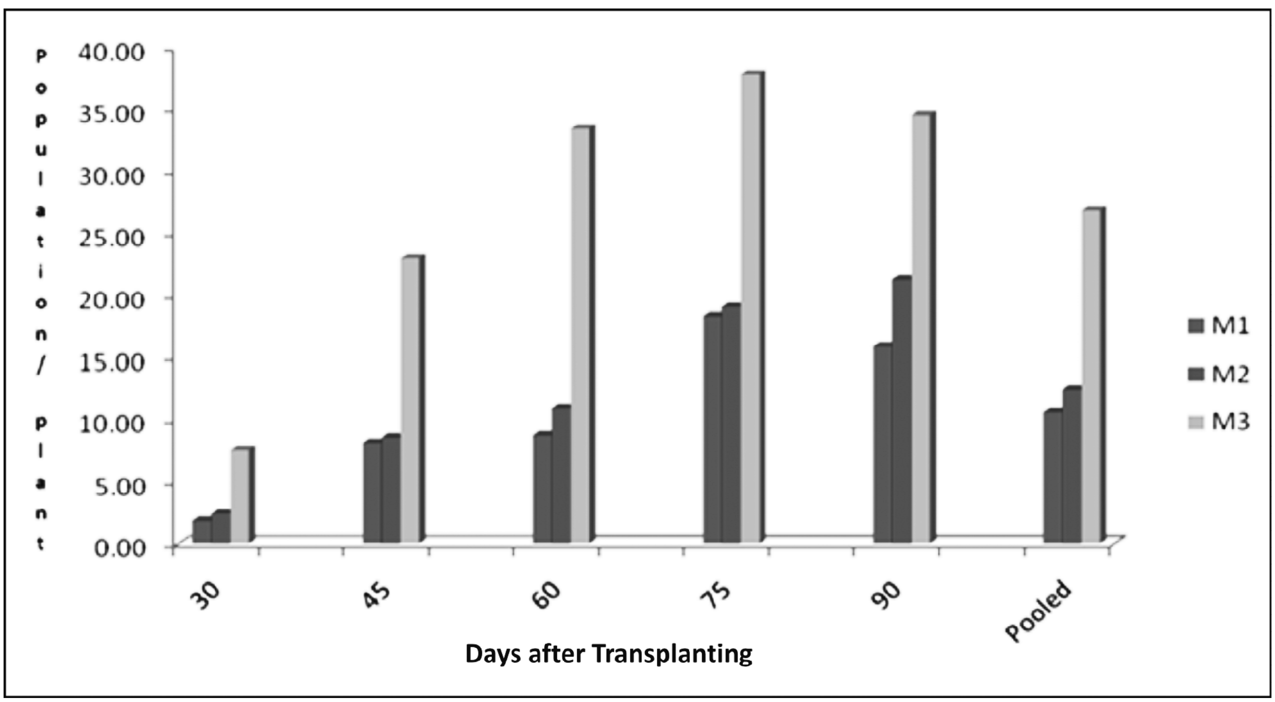

Figure 1: Population of thrips on onion DAP

Table 1
Thrips population and yield parameters under different module in 2011-12

	Thrips Population/plant after									
Module	*30 DAT*	*45 DAT*	*60 DAT*	*75 DAT*	*90 DAT*	*Pooled*	*Polar diameter of Bulb (cm)*	*Equatorial Diameter of Bulb (cm)*	*Total Yield (q/ha)*	*Marketable yield (q/ha)*
M1	3.05	10.66	5.83	14.63	8.26	8.48	5.03	4.06	283.28	269.22
M2	1.10	2.57	3.23	4.35	4.80	3.21	4.30	4.23	315.1	299.57
M3	6.08	29.57	27.33	21.75	14.20	18.57	3.23	3.73	230.98	204.99
LSD 5%	10.57	6.65	7.19	7.36	24.81		0.22	0.18	25.71	14.19

Table 2
Thrips population and yield parameters under different modules in 2012-13

	Thrips Population/plant after									
Module	*30 DAT*	*45 DAT*	*60 DAT*	*75 DAT*	*90 DAT*	*Pooled*	*Polar diameter of Bulb (cm)*	*Equatorial Diameter of Bulb (cm)*	*Total Yield (q/ha)*	*Marketable yield (q/ha)*
M1	0.00	7.1	9.78	19.10	8.20	8.83	5.26	5.15	321.4	299.6
M2	0.00	12.69	13.10	23.41	17.68	13.37	4.96	4.77	306.1	289.2
M3	0.00	19.43	45.5	53..38	36.75	31.01	4.91	3.85	294.37	255.09
LSD 5%	–	2.9	1.74	2.33	0.74		0.11	0.66	13.10	16.69

Table 3
Thrips population and yield parameters under different modules in 2013-14

	Thrips Population/plant after									
Module	*30 DAT*	*45 DAT*	*60 DAT*	*75 DAT*	*90 DAT*	*Pooled*	*Polar diameter of Bulb (cm)*	*Equatorial Diameter of Bulb (cm)*	*Total Yield (q/ha)*	*Marketable yield (t/ha)*
M1	2.53	6.68	10.73	21.23	31.21	14.48	5.20	5.54	345.1	320.7
M2	6.23	10.51	16.40	29.45	41.40	20.79	5.02	5.45	320.3	302.6
M3	16.58	19.93	27.48	38.32	52.63	30.98	4.32	4.69	256.7	192.4
LSD 5%	1.10	1.03	1.47	0.97	1.25	1.16	0.57	0.38	14.67	10.42

spraying of insecticides, the thrips population was well under control in module M_2 (farmers' practice). Although decreasing trends were observed of thrips population per plant in IPM module over farmers practice and control during all the years from 30-90 days after transplanting. The thrips population counts pooled over all the years from 30-90 days after transplanting, showed significant reduction in thrips population in both IPM (module M_1) and farmers' practice (module M_2) over control (untreated M_3). Significantly lowest thrips population per plant was recorded in IPM (10.60) and farmers' practice (12.46) over control (26.86). Both M_1 and M_2 modules were equally effective in reduction of thrips population.

The yield parameters observed on polar diameter, equatorial diameter, total yield and marketable yield are presented in Table 1, 2 and 3 for all the three years. A perusal of tables showed that polar diameter of bulb was significantly higher in all the years of study for IPM module followed by Farmers' practice and control. Similarly, the equatorial diameter of bulb also observed significantly higher in IPM module and farmers' practice. However, IPM module had a bit advantage in having 'A' grade bulb size over the other modules. With respect to total yield and marketable yield IPM module and farmers' practice showed significant improvement as compare to control. In 2012-13 and 2013-14 marketable yield (299.6 q/ha and 320.7 q/ha, respectively) was higher in IPM module than farmers' practice which could be due to less penetrance of thrips through barriers. The results were in accordance with the findings of Pyasi and Tiwari (2016).

The data on pooled value on marketable yield, additional yield, additional income and cost:benefit (C:B) ratio due to different modules of insect-pest management over 2011, 2012 and 2013 are presented in Table 4. The marketable yield recoded significant variations ranging from 234.16 q/ha in control (M3) to 297.12 q/ha in farmers practices (M_2). Significantly highest marketable yield was found in module M_2, farmers' practices (297.12 q/ha) followed by module M_1, IPM (296.51 q/ha). However, both M_2 (farmers practice) and M_1 (IPM) were statistically similar in marketable yield of onion indicating the better efficacy of both the modules for management of thrips. The economics of IPM module over three years data revealed that adoption of IPM module (M_1) gave more additional income than of farmers' practices (M_2) and highest C:B ratio of 1:27.00 in onion production in module M_1 followed by M_2 (1:8.30) (Table 1) as the cost of treatment was considerably higher in module M_2 (Rs. 8258.23) than M_1 (Rs. 2604.67). The higher C:B ratio in IPM module is primarily due to minimum insecticidal application which is in concordance with Krishna Kumaar *et al.* (2011) and additional income of border crops maize and wheat as compared to farmers practice. Srinivas and Lawande (2008) also reported higher C:B ratio when thrips control was undertaken between 45 and 75 days after transplanting of onion.

CONCLUSION

It can be concluded from the present findings that the adoption of IPM module consisting of planting of border crop of outer row of maize + inner rows of wheat on all four sides of the planting at least 7-10 days prior to planting, Seedling dip treatment with carbosulfan and need oil based application of insecticides when thrips population exceeded ETL (30 thrips/plant) reduced the thrips infestation and increased the marketable yield coupled with better C:B ratio and economic return in onion.

ACKNOWLEDGEMENT

Authors are grateful to Director Research Services, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur for providing necessary research facilities during course of the study.

Table 4
Pooled Economics of different modules against thrips management in onion

Modules/ Treatments	*Marketable Yield (q/ha)**	*Gross income (Rs.)*	*Additional yield (q/ha)*	*Additional income (Rs.)*	*Cost of treatments (Rs)*	*Cost: benefit ratio*
M_1	296.51[a]	337853.33	62.35	70558.00	2604.67	01:27.0
M_2	297.13[a]	336586.67	62.97	69257.33	8258.33	01:08.3
M_3	234.16[b]	247329.33				

[a,b]Values bearing different superscripts in a column differ significantly from each other, *$P < 0.05$.

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