Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 16 Issue 5 Version 1.0 Year 2016
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Field Evaluation of Different Treatment Schedules Against Whitefly, *Bemisia Tabaci* Genn. Infesting Potato in West Bengal

By Kahar, B., Mondal, P. & Konar, A.
Visva-Bharati University,

Abstract- The present field investigation was undertaken to access the efficacy of different treatment schedules during rabi season from November to February in 2013-14 and 2014-15 respectively against whitefly, *Bemisia tabaci* Genn. (Aleyrodidae: Hemiptera) on potato at District Seed Farm, Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal. All the treatment schedules were significantly superior over control in decreasing the whitefly population on potato but not all around the growing season of the crop. Among the different schedules, T_1 in which phorate 10 G @ 1.5 kg a.i./ha was applied to the soil at the time of planting and then spraying of chlorpyriphos 20 EC @ 0.5 kg a.i./ha, imidacloprid 17.8 SL @ 0.04 kg a.i./ha and cartap hydrochloride @ 0.75 kg a.i./ha were done at 40, 55 and 70 days after planting (DAP), respectively was most effective in reducing the pest population over untreated check plot, which was followed by T_2, T_3, T_5, T_6, T_4, respectively.

Keywords: *potato, treatment schedules, field evaluation, whitefly, west bengal.*

GJSFR-D Classification : *FOR Code: 060899*

Field Evaluation of Different Treatment Schedules against Whitefly, *Bemisia tabaci* Genn. Infesting Potato in West Bengal

Kahar, B. [α], Mondal, P. [σ] & Konar, A. [ρ]

Abstract- The present field investigation was undertaken to access the efficacy of different treatment schedules during *rabi* season from November to February in 2013-14 and 2014-15 respectively against whitefly, *Bemisia tabaci* Genn. (Aleyrodidae: Hemiptera) on potato at District Seed Farm, Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal. All the treatment schedules were significantly superior over control in decreasing the whitefly population on potato but not all around the growing season of the crop. Among the different schedules, T_1 in which phorate 10 G @ 1.5 kg a.i./ha was applied to the soil at the time of planting and then spraying of chlorpyriphos 20 EC @ 0.5 kg a.i./ha, imidacloprid 17.8 SL @ 0.04 kg a.i./ha and cartap hydrochloride @ 0.75 kg a.i./ha were done at 40, 55 and 70 days after planting (DAP), respectively was most effective in reducing the pest population over untreated check plot, which was followed by T_2, T_3, T_5, T_6, T_4, respectively. The per cent reduction of whitefly population over control was found highest in T_1 (66.92-87.95 %), which was followed by T_2, T_3, T_5, T_6 and T_4 respectively. Marketable yield (t/ha) of potato tubers was recorded highest in T_2 (26.28-26.80), which was succeeded by lowest in control T_7 (14.17 - 15.69). Maximum cost-benefit ratio (CBR) was achieved in T_2 (1:20.92 - 1:27.06) but it was minimum in T6 (1: 5.08 – 1: 10.34).

Keywords: potato, treatment schedules, field evaluation, whitefly, West Bengal.

I. Introduction

Potato, *Solanum tuberosum* L. is grown in almost all the states in India and under very diverse conditions. Nearly 90% of the potatoes are grown in the vast Indo-Gangetic plains of North and Eastern India during short winter days from October to March. Among the States, Uttar Pradesh, West Bengal and Bihar accounted for nearly 71% area and 76 % production of the country (Chadha, 2002) [2]. In West Bengal, potato is the most important food crop, next to cereals and the State ranks second position in area (310.97 mill ha) and production (7281.67 mill tones), but first in productivity (23.65% t/ha) in the country (Rai, 2003) [6]. Earlier potato cultivation was largely confined to the districts of Hooghly, Burdwan and Midnapore, but with the increasing facilities of irrigation, introduction of high yielding early maturing varieties and development of suitable agronomic practices, potato cultivation is gradually being extended to other districts (Anonymous, 2005) [1]. More than 100 arthropods attack potato in various parts of the world (Simpson, 1977) [8]. Among these pests, whitefly *Bemisia tabaci* Genn. (Aleyrodidae: Hemiptera) is a important sucking pest which not only cause direct damage to reduce yield of potato tubers, but also transmitting various potato viruses (Khurana, 1999 and Paul & Konar 2005) [4] & [5]. Thus to reduce the incidence of whitefly, a number of synthetic insecticides are used randomly, but with limited success. Application of longer residual insecticide against whitefly in potato creates pollution to the total ecosystem. Therefore a field trial was carried out to work out the bio-efficacy of various treatment schedules including chemicals and non-chemicals against whitefly on potato.

II. Material and Methods

The present field study was laid down to find out the efficacy of various insecticidal treatment schedules against whitefly attacking potato for two consecutive *rabi* seasons from November to February during 2013-14 and 2014-15 respectively at District Seed Farm, Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal. Potato seed tubers, cv. kufri chandramukhi was planted during end November in the plots having 3.6 x2.0 m area. Each plot had 6 rows with 10 tubers or plants/ row, i.e. 60cm x 20cm maintained. All standard agronomic practices, recommended for this state, were strictly followed during growing the crop. The crop was dehaulmed at on age of 85 days and 10 days after dehaulming, harvesting of potato tuber was done.

Seven different insecticidal treatment schedules including control were tested against aleurodid in an RBD (Randomized Block Design) and each treatment was replicated thrice. The schedules were consisting of both chemical and non chemical insecticides as presented in Table 1.

Author α: Research scholar of Visva-Bharati University, Department of Plant Protection, P.O. Santiniketan, Birbhum, & Faculty of Panchakot Mahavidyalaya, Purulia, West Bengal, India.
e-mail: biplab.kahar1984@gmail.com
Author σ: Visva-Bharati University, Department of Zoology, P.O. Santiniketan, Birbhum, West Bengal, India.
Author ρ: Bidhan Chandra Krishi Viswavidyalaya, Department of Agricultural Entomology, P.O. Mohanpur, Nadia, West Bengal, India.

Table 1 : Insecticidal treatment schedules against shoot and tuber damage caused by white fly on potato

Treatment schedules	Insecticides with dose and time of application
T_1	1. Soil application of phorate 10 G @ 1.5 kg a. i./ha at planting. 2. Foliar sprays with chlorpyriphos 20 EC @ 2.5 ml/lit of water at 40 DAP. 3. Foliar sprays with Imidacloprid 17.8 SL @ 1.5 ml/7.5 lit of water at 55 DAP. 4. Foliar sprays with cartap hydrochloride 50 SP @ 1g/lit of water at 70 DAP.
T_2	1. Seed treatment with imidacloprid 17.8 SL @ 1.5 ml/7.5 lit of water at planting. 2. Foliar sprays with acephate 75 SP @ 0.75 g/lit of water at 40 DAP. 3. Foliar sprays with imidacloprid 17.8 SL @ 1.5 ml/7.5 lit of water at 55 DAP. 4. Foliar spray with chlorpyriphos 20 EC + Cypermethrin 5 EC @ 1.5 ml/lit of water at 70 DAP.
T_3	1. Soil application of phorate 10 G @ 1.5 kg a.i./ha at planting. 2. Foliar spray with chlorpyriphos 20 EC @ 2.5 ml/lit of water at 40 DAP. 3. Foliar spray with azadirachtin 1 EC @ 4 ml/lit of water at 55 DAP. 4. Foliar spray with *Bacillus thuringiensis* var. *Kurstaki* 5WP @ 2.0 g/lit of water at 70 DAP.
T_4	1. Seed treatment with *Bacillus thuringiensis* var. *Karstuki* 5 WP @ 2.0 g/lit of water at planting. 2. Foliar spray with azadirachtin 1 EC @ 4 ml/lit of water at 40 DAP. 3. Foliar spray with azadirachtin 1 EC @ 4 ml/lit of water at 55 DAP. 4. Foliar spray with *Bacillus thuringiensis* var. *Kurstaki* 5WP @ 2.0 g/lit of water at 70 DAP.
T_5	1. Soil application of phorate 10 G @ 1.5 kg a.i./ha at 30 DAP. 2. Foliar sprays with imidacloprid 17.8 SL @ 1.5 ml/7.5 lit of water at 55 DAP. 3. Foliar spray with chlorpyriphos 20 EC + Cypermethrin 5 EC @ 1.5 ml/lit of water at 70 DAP.
T_6	1. Soil application of phorate 10 G @ 1.5 kg a.i./ha at 40 DAP. 2. Foliar spray with azadirachtin 1 EC @ 4 ml/lit of water at 55 DAP. 3. Foliar spray with *Bacillus thuringiensis* var. *Kurstaki* 5WP @ 2.0 g/lit of water at 70 DAP 4.
T_7	1. Only water spray (control)

During the period of study weekly observation were taken on the infestation of whitefly on potato. The population of whitefly was recorded from the upper, one middle and one lower compound leaves of randomly selected 15 plants per treatment per replication. The weight of healthy and damaged tubers for each treatment was also noted and thereafter, the data were analyzed after converting them into necessary forms. The cost-benefit ratio (CBR) for respective treatment schedules was computed and analyzed with the help of market value of insectides as well as potato tubers.

III. Results and Discussion

The efficacy of different treatment schedules were evaluated against whitefly on potato for two consecutive years. In the first year of study during 2013-14, the treatment schedules were not significantly superior over control all the time (Table 2).

Table 2 : Population dynamics of whitefly on potato under different treatment schedules during 2013-14 at District Seed Farm, Department of Agriculture and Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal. (Means of three replications.)

Treatment Schedules	Population of Whitefly on different dates of observation										Mean White-Fly Population	Per Cent Damage
	December, 2013		January, 2014				February, 2014					
	III WK	IV WK	I WK	II WK	III WK	IV WK	I WK	II WK	III WK	IV WK		
T_1	0.0 (0.0)	0.66 (1.00)	1.33 (1.34)	2.33 (1.64)	1.00 (1.17)	3.00 (1.81)	1.33 (1.34)	2.00 (1.57)	0.66 (1.00)	2.33 (1.68)	1.22	87.95
T_2	1.33 (1.27)	2.66 (1.64)	3.33 (1.88)	5.33 (2.38)	2.66 (1.74)	4.66 (2.22)	1.66 (1.39)	2.33 (1.74)	2.00 (1.56)	3.66 (2.00)	2.47	75.62
T_3	0.0 (0.0)	1.66 (1.44)	2.33 (1.57)	3.66 (1.93)	2.33 (1.65)	5.66 (2.43)	2.00 (1.47)	3.00 (1.84)	2.66 (1.76)	6.33 (2.58)	2.47	75.62
T_4	4.33 (2.15)	6.33 (2.55)	9.00 (2.99)	12.33 (3.55)	4.33 (2.16)	7.66 (2.81)	3.33 (1.90)	5.66 (2.45)	3.66 (1.99)	6.33 (2.35)	5.24	48.27

T_5	2.66 (1.76)	4.33 (2.12)	7.33 (2.73)	10.66 (3.31)	3.66 (1.98)	5.00 (2.28)	1.66 (1.45)	2.66 (1.76)	2.00 (1.47)	3.33 (1.93)	3.61	64.36
T_6	3.33 (1.88)	4.66 (2.24)	8.66 (2.96)	11.33 (3.39)	2.66 (1.76)	3.33 (1.90)	2.00 (1.57)	6.33 (2.56)	3.66 (1.93)	7.66 (2.78)	4.47	55.87
T_7	2.66 (1.74)	5.00 (2.26)	9.66 (3.12)	12.33 (3.52)	14.33 (3.81)	17.66 (4.22)	19.66 (4.47)	16.33 (4.07)	13.66 (3.72)	10.33 (3.24)	10.13	-
SEm(±)	0.28	0.40	0.45	0.37	0.33	0.39	0.32	0.31	0.32	0.35	-	-
C.D.-0.05	0.71	NS	NS	0.94	0.82	0.98	0.80	0.79	0.81	NS	-	-

**Figures in parenthesis are logarithmic transformed values.*

The pest was first appeared on the crop during third and fourth week of December, irrespective of different schedules. In T_1, T_2, and T_3, the pest population remained lower than the other treatments throughout the growing period of crop, while T_4 harboured comparatively higher population of aleurodid, but it was quite lower than the control (T_7). Among the different treatment schedules, T_1 in which phorate 10 G @ 1.5 kg a.i./ha was applied to the soil at the time of planting and then spraying of chlorpyriphos 20 EC @ 0.5 kg/ha, imdacloprid 17.8 SL @ 0.04 kg a.i./ha and cartap hydrochloride @ 0.75 kg a.i./ha were applied at 40, 55 and 70 DAP respectively, was most effective in minimizing the population of whitefly over control, succeeded by T_2, T_3, T_5, T_6, T_4 respectively. The mean whitefly population was found maximum in T_7 (control) (10.13 per 45 compound leaves) which was followed by T_4 (5.24), T_6 (4.47), T_5 (3.61), T_2 (2.47), T_3 (2.47) and T_1 (1.22) respectively. The maximum per cent decrease of the pest population over control was found in T_1 (87.95), which was simultaneously followed by T_2 and T_3 (75.62) and then T_5 (64.36), T_6 (55.87), and T_4 (48.27) respectively.

In the second year of study during 2014-15, the treatments were significantly superior over control in reducing aleurodid population on potato, but not throughout the period of study. Among the different treatment schedules, T_1 was most effective in decreasing the infestation of whitefly on potato which was succeeded by T_2, T_3, T_5, T_6, T_4 respectively (Table 3) than control T_7.

Table 3 : Population dynamics of whitefly on potato under different treatment schedules during 2014-15 at District Seed Farm, Department of Agriculture and Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal. (Means of three replications.)

Treatment Schedules	Population of Whitefly on different dates of observation										Mean White-Fly Population	Per Cent Damage
	December, 2014		January, 2015				February, 2015					
	III WK	IV WK	I WK	II WK	III WK	IV WK	I WK	II WK	III WK	IV WK		
T_1	0.0 (0.0)	1.33 (1.27)	3.66 (2.00)	5.33 (2.34)	3.33 (1.93)	6.33 (2.52)	2.66 (1.74)	4.66 (2.21)	3.66 (2.00)	5.33 (2.38)	3.02	66.92
T_2	0.66 (1.00)	2.66 (1.74)	4.33 (2.16)	8.33 (2.90)	3.66 (2.00)	5.66 (2.44)	3.00 (1.84)	4.33 (2.15)	2.66 (1.76)	4.66 (2.22)	3.33	63.53
T_3	0.0 (0.0)	2.00 (1.47)	3.66 (2.02)	6.33 (2.55)	3.66 (1.94)	7.66 (2.80)	5.33 (2.38)	3.33 (1.93)	4.33 (2.15)	9.33 (3.06)	3.80	58.38
T_4	3.66 (2.00)	6.66 (2.62)	10.33 (3.22)	13.33 (3.67)	4.66 (2.23)	8.66 (2.97)	5.33 (2.35)	7.66 (2.78)	4.66 (2.22)	8.66 (2.99)	6.13	32.86
T_5	2.33 (1.64)	4.66 (2.22)	9.33 (3.08)	7.66 (2.81)	3.33 (1.93)	4.66 (2.22)	2.66 (1.76)	4.66 (2.22)	4.00 (2.23)	6.33 (2.55)	4.13	54.76
T_6	3.33 (1.93)	5.66 (2.44)	8.33 (2.92)	10.66 (3.29)	2.66 (1.76)	5.33 (2.37)	3.66 (2.02)	4.33 (2.16)	5.66 (2.44)	8.66 (2.95)	4.85	46.88
T_7	3.00 (1.78)	4.66 (2.23)	7.33 (2.73)	9.33 (3.08)	15.66 (3.97)	21.33 (4.65)	17.66 (4.23)	13.33 (3.69)	10.66 (3.28)	6.66 (2.62)	9.13	-
SEm(±)	0.27	0.37	0.45	0.45	0.34	0.41	0.31	0.37	0.35	0.43	-	-
C.D.-0.05	0.68	NS	1.02	NS	0.86	1.03	0.79	0.94	NS	1.09	-	-

**Figures in parenthesis are logarithmic transformed values.*

The mean whitefly population on potato under different treatment schedules was ranged from 3.02 per 45 compound leaves in T_1 to 9.13 in T_7 (control). Similarly, T_1 obtained maximum per cent reduction of aleurodid population (66.92) over control, which was closely followed by T_2 (63.53) and then T_3 (58.38), T_5 (54.76), T_6 (46.88) and T_4 (32.86) respectively.

It may be concluded that among the different treatment schedules, T_1 in which phorate 10 G was applied to the soil at the time of planting and then spraying of chlorpyriphos 20 EC, imidacloprid 17.8 SL and cartap hydrochloride were applied at 40, 55 and 70 DAP respectively, was most effective in minimizing the pest population (66.92-87.95%) over control which was followed by T_2, T_3, T_5, T_6, T_4 respectively. It was occurred due to application of phorate and imidacloprid as both of them are systemic in nature and remained active for a long period (Roy, 2002) [7], Chandramohan & Nanjan (1992) [3] also recorded low population of whitefly on potato when treated with the systemic insecticide, monocrotophos. The treatment schedule, T_5 was also consisting of phorate and imidacloprid, but was not as effective as T_1. Because the treatment was started as 40 DAP and these two insecticides were applied at 40 and 55 DAP respectively and hence, the crop remained unsprayed upto 40 DAP. As a result, T_5 harboured a greater whitefly population during early crop growth stage than T_1, T_2 and T_3 were also quite effective in decreasing the pest population than the others, while T_4 was not so effective as it could not reduce 50 % of aleurodid population over control.

The marketable tuber yield of potato (t/ha) during 2013-14 was recorded maximum in T_2 (26.28) which was succeeded by T_5 (26.25), T_1 (22.92), T_3 (21.67), T_4 (19.19), T_6 (18.14), and T_7 (15.69) respectively (Table 4).

Table 4 : Cost effectiveness of different treatment schedules against pests of potato during 2013-14 and 2014-15

Treatment Schedules	Marketable Yield (t/ha)		Increased Yield Over Control (t/ha)		Added Benefit Over Control (Rs./ha)		Cost of Treatment (Rs./ha)		Net Profit (Rs./ha)		CBR	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
T_1	22.92	23.19	7.23	9.02	34,704	45,100	2,844	3,060	31,860	42,040	1:11.20	1:13.73
T_2	26.28	26.80	9.59	12.63	46,032	63,150	2,100	2,250	43,939	60,900	1:20.92	1:27.06
T_3	21.67	23.33	5.98	9.16	28,704	45,800	2,432	2,962	26,272	42,838	1:10.80	1:14.46
T_4	19.19	19.44	3.50	5.27	16,800	26,350	1,776	1,990	15,024	24,360	1:8.45	1:12.24
T_5	26.25	26.67	10.56	12.50	50,688	62,500	2,395	2,560	48,293	59,940	1:20.16	1:23.41
T_6	18.14	19.17	2.45	5.00	11,760	25,000	1,934	2,204	9,826	22,796	1:5.08	1:10.34
T_7	15.69	14.17	-	-								

**Selling price of potato = Rs. 4,800 per ton during 2013-14*

**Selling price of potato = Rs. 5,000 per ton during 2014-15*

T_5 obtained highest additional benefit (Rs. 50,688 per ha) over control, while it was lowest in T_6 (Rs. 11,760 per ha). Maximum return (Rs./ha) in income was also found from T_5 (Rs. 48,293) and then in order were T_2 (Rs. 43,939), T_1 (Rs. 31,860), T_3 (Rs. 26,272), T_4 (Rs. 15,024) and T_6 (Rs. 9,826) respectively. Similar cost-benefit ratio (CBR) was found highest in T_2 (1:20.92), which was followed by T_5 (1:20.16), T_1 (1:11.20), T_3 (1:10.80), T_4 (1:8.45) and T_6 (1: 5.08) respectively.

During 2014-15, the highest marketable yield of potato tuber (t/ha) was obtained in T_2 (26.80), succeeded by T_5 (26.67), T_3 (23.33), T_1 (23.19), T_4 (19.44), T_6 (19.17) respectively than (control) T_7 (14.17). Increased production (t/ha) over control was observed maximum from T_2 (12.63), followed by T_5 (12.50), T_3 (9.16), T_1 (9.02), T_4 (5.27) and T_6 (5.00) respectively (Table 4). Hence the added benefit (Rs./ha) over control was noted maximum in T_2 (Rs. 63,150) and minimum in T_6 (Rs. 25,000). Thus T_2 was most economical as it produced highest net profit per ha and CBR (Rs. 60,900 and 1: 27.06 respectively) which was followed by T_5 (Rs. 59,940 and 1: 23.41), T_3 (Rs. 42,838 and 1: 14.46), T_1 (Rs. 42,040 and 1:13.73), T_4 (Rs. 24,360 and 1:12.24) and T_6 (Rs. 22,796 and 1:10.34) respectively.

IV. Conclusion

From the result of two consecutive potato growing seasons during 2013-14 and 2014-15, it may be concluded that amongst the seven different treatment schedules, T_5 and T_2 were much better in increasing the marketable yield of potato and net return over control than other treatments. The present results support the findings of Tripathi *et al.* (2003) [9].

V. Acknowledgement

The authors are grateful to the Farm Manager, District Seed Farm, Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal, for providing various facilities including land to undertaken the present study.

References Références Referencias

1. Anonymous (2005). Annual Report, AICRP on potato, BCKV, Kalyani, Nadia, West Bengal. pp-32-34.
2. Chadha, K.L. (ed.). (2002). In: *Handbook of Horticulture*, ICAR, New Delhi, pp- 8-10.
3. Chandramohan, C. And Nanjan, K. (1992). Population distribution, host range and control of glass house whitefly, *Triaeurodes vaporariorum* (W). *Madras Agricultural Journal*, 79 (6): 316-320.
4. Khurana S M P (ed.) (1999). In: *Diseases and Pests of Potato* – A Manual. CPRL, Shimla, Himachal Pradesh, pp. 41-66.
5. Paul, S. And Konar, A. (2005). Population dynamics of whitefly on potato planted on different dates. *Potato Journal*, 32 (3-4): 251.
6. Rai, M. (2003). Role of potato in food and Nutritional security in developing countries with special reference to India. Proceeding of National Symp, "Potato Research Towards National Food and Nutritional Security", CPRI, Shimla, H.P., pp. 19-30.
7. Roy, N. K. (2002). In: *Chemistry of pesticides*. CBS Publication Distributors, New Delhi, India, pp. 105-106.
8. Simpson, G.W. (1977) Potato insects and their control in: *potatoes production, storage and processing*. (O. Smith, ed.), AVI Publishing Co., Westport, Connecticut, USA, pp.550-605.
9. Tripathi, D.M., Bisht, R. S. & Mishra, P. N. (2003), Bioefficacy of some synthetic insecticides and biopesticides against black cutworm, *Agrotis ipsilon* infesting potato (*Solanum tuberosum*) in Garhwal Himalaya. *Indian J. Ent*., 65(4), 468-473.