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Assessment on Different Treatment Schedules Against Sucking Insect Pests of Potato

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***Abstract* – A field investigation was conducted for two consecutive crop seasons during Rabi season of 2013-14 and 2014-15 at District Seed Farm, Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal. Four different treatment schedules i.e. T_1(control), T_2, T_3 and T_4, were evaluated against sucking pests, viz, aphids [*Myzus persicae* (Sulzer) & *Aphis gossypii* Glover] and white fly (*Bemisia tabaci* Genn) on potato. Among these treatment schedules, T_4 treatment, (seed treatment with imidacloprid + foliar spray with cartap hydrochloride + chlorpyriphos and cypermethrin) was recorded most effective than other treatments as well as untreated control in reducing the population of aphids and white fly on potato. However, the least percentage of viral diseases (mid mosaic, severe mosaic, potato leaf roll virus and apical leaf curl disease) incidence was observed in T_4 treatment followed by T_2 (with spraying of pharate + acephate + azadirachtin + chloropyriphos) and T_3 (seed treatment with *Bacillus thuringiensis* var *Kurstaki* + foliar spray with azadirachtin + chloropyriphos and *Bacillus thuringiensis* var. *Kurstaki*) treatments, respectively. The efficacy of different treatment schedules was in order of T_4>T_2>T_3 as compared to control (T_1). The maximum yield of potato tuber (t/ha) was found in T_4 (26.93) followed by T_2 (25.42) & T_3 (23.34) respectively, than control T_1 (15.98).**

***Keywords* – Field Evaluation, Potato, Sucking Pest, Treatment Schedules.**

I. INTRODUCTION

Potato, *Solanum tuberosum* L. is one of the most important and economic food crop in the world after wheat, rice, maize and this crop is very rich source of starch, sugar, Vitamin C, magnesium and different important minerals like zinc, copper, manganese, molybdenum, selenium, cobalt, boron, iodine, bromium, boron etc in trace quantities (Basu *et al.* 2003) [1]. West Bengal is the second largest producer of potato in India. The productivity of the crop is highest in this state due to favorable climatic conditions and soil texture. But the yield of potato tuber is greatly reduced due to infestation of different sucking pests, which directly cause damage to the tubers along with the foliage of the crop. Among these Aphids [*Myzus persicae* (Sulzer) & *Aphis gossypii* Glover] and White fly (*Bemisia tabaci* Genn) are the most important sucking pest of potato reducing the yield to 25 - 90% and 35% respectively in West Bengal (Khurana, 1999, Konar & Chettri, 2003 and Paul & Konar, 2003) [2], [4] & [12]. Various synthetic organic pesticides and inorganic insecticides having broad spectrum are generally recommended for effective control of potato pests (Mondal *et al.* 2010 & Konar *et al.* 2013) [7], [11]. However, these compounds exert different hazardous effects upon ecological balance, environmental pollution, destruction of beneficial flora and fauna and health hazards in men and animals. In this regard a remarkable point is that the injudicious use of those toxic chemicals leads to the development of resistance in insect to insecticides. The best effective alternative way is the usage of bio-agents in controlling these pests as they do not leave any residue. Therefore the present field investigation was conducted to work out the efficacy of some bio-agents along with chemical against sucking pests, viz. aphid and whitefly on potato and to reduce the crop loss due to attack of various sucking pests and also to work out the most effective way for controlling these pests with a view to safer human toxicity.

II. MATERIALS AND METHODS

The present field investigation was conducted for two consecutive crop seasons during Rabi season of 2013-14 and 2014-15 at District Seed Farm, Department of Agriculture, Government of West Bengal, P.O. - Burdwan, Dist. - Burdwan and West Bengal to evaluate the efficacy of different treatments (T_1, T_2, T_3 and T_4) against important sucking pest like aphids [*Myzus persicae* (Sulzer) & *Aphis gossypii* Glover] and white fly (*Bemisia tabaci* Genn) on potato. The potato (cv. Kufri Jyoti) was planted during late November in the plots of 3.6 X 2 m area. Each plot had 6 rows with 10 plants/row, i.e. 60cm X 20cm spacing between row to row and plant to plant, respectively was maintained. All standard agronomic practices, recommended for this region were strictly followed while raising the crop. The crop was dehaulmned at an age of 90 days and the crop was harvested from the field 10 days after dehaulming. Four different treatments (see Table- I) including control were evaluated against the sucking pest complex of potato in an RBD with 5 replications

Table 1. Different treatment of Integrated Pest Management

Number of Treatment	Treatment Schedules
T_1	Control
T_2	Phorate 10 G 1.5g a.i,/ha at planting + spraying of acephate 75 SP @ 0.75g/lit of water at 45 DAP + spraying of azadirachtin 1 EC @ 4 ml/lit of water at 60 DAP.
T_3	Seed treatment with *Bacillus thuringiensis* var *Kurstaki* 5 WP @ 1.5g/lit of water at planting + foliar spray with azadirachtin 1 EC @ 4ml/lit of water at 30 days + foliar spray with azadirachtin 1 EC @ 4 ml/lit of water at 50 DAP + foliar spray with *Bacillus thuringiensis* var *Kurstaki* @ 1.5g/lit of water at 65 DAP.
T_4	Seed treatment with imidacloprid @ 0.04% conc. (10min dip) at planting + spray With cartap hydrochloride 50 SP @ 1g/lit of water at 30 DAP + spray with Chlorpyriphos 20 EC + cypermethrin 5 EC @ 4ml/lit of water at 55 DAP.

The various treatments consist of both chemical and non-chemical insecticides. Observations were recorded on the population of sucking pests as well as plant damage caused by the sucking pests of potato at weekly intervals. In case of aphids, the population was counted from one upper, one middle and one lower compound leaf of randomly selected 11 plants per treatment per replication. But in case of other sucking pests i.e. whitefly of potato population was recorded randomly from entire portion of 15 plants in each plot. The total number of plants damaged by the sucking pests (aphids and white fly) as well as different viral diseases was also noted at 7 days intervals and the percent plant damage was assessed accordingly. Similarly, the extent of infestation in tubers by different pests was recorded by counting the number of healthy and damaged tubers. Yield of healthy potato tubers was recorded in each plot during harvesting.

III. Results and Discussion

A. Population Build of Aphids on Potato in Various Treatments

The data collected in two consecutive years during 2013-14 and 2014-15 regarding the integrated management of the aphids were pooled and presented in Table II.

Table 2. Incidence of aphid species on potato in different treatments (Pooled data of 2013-2014 and 2014-2015)
Population of aphids on various dates of observation

	DECEMBER			JANUARY				FEBRUARY					
TREATMENT	**II WK DEC**	**III WK DEC**	**IV WK DEC**	**I WK JAN**	**II WK JAN**	**III WK JAN**	**IV WK JAN**	**I WK FEB**	**II WK FEB**	**III WK FEB**	**IV WK FEB**	**MEAN**	**% DECREASED OVER CONTROL**
T_1	0 (0.71)	0 (0.71)	4 (0.60)	9.5 (0.98)	19.7 (1.29)	38.5 (1.59)	67.2 (1.83)	89.6 (1.95)	128.5 (2.11)	176 (2.25)	198.8 (2.3)	66.53	-
T_2	0 (0.71)	0 (0.71)	0 (0.71)	4 (0.60)	6 (0.78)	9.5 (0.98)	5.5 (0.74)	6.75 (0.83)	9 (0.95)	10.25 (1.01)	9.75 (0.99)	5.52	91.7
T_3	0 (0.71)	0 (0.71)	2 (0.30)	3.25 (0.51)	5.5 (0.74)	6 (0.78)	8.25 (0.92)	7.25 (0.86)	10.5 (1.02)	11.25 (1.05)	13.75 (1.14)	6.14	90.77
T_4	0 (0.71)	0 (0.71)	3.25 (0.51)	2 (0.30)	2.25 (0.35)	3.5 (0.54)	1.25 (0.09)	5.5 (0.74)	6 (0.78)	6.75 (0.83)	7 (0.85)	3.41	94.87
SEM(+)	-	-	0.95	1.15	1.46	1.27	7.62	1.93	1.52	1.18	2.14	-	-
CD At 5%	-	-	3.35	3.68	3.76	3.58	4.25	4.75	5.2	2.13	2.79	-	-

***Figures in parenthesis are logarithmic transformed values**

From the table, it is revealed that all the treatments i.e. T_2, T_3, T_4 were significantly superior over untreated control (T_1) throughout the crop season. However, T_4 [seed treatment with imidacloprid 0.04% conc.(10 min. dip) at planting + spray with cartap hydrochloride 50 SP @ 1g/lit of water at 30 DAP+ spray with chlorpyriphos 20 EC + cypermethrin 5 EC @1.5 ml/lit of water at 55 DAP]was found to be the best to manage the population of aphids below its critical level persistently for longer period during the total crop season followed by T_2 (phorate 10 G @ 1.5g ai/ha at planting + spray of acephate 75 SP @ 0.75g/lit of water at 45 DAP + spraying of azadirachtin 1 EC @ 4ml/lit of water at 60 DAP) and T_3(seed treatment with *Bacillus thuringiensis* var *Kurstaki* 5 WP @ 1.5 g/lit of water at planting + foliar spray with azadirachtin 1 EC @ 4 ml/lit of water at 30 DAP + foliar spray with azadirachtin 1 EC @ 4 ml/lit of water at 50 DAP + foliar spray with *Bacillus thuringiensis* var *Kurstaki* 5 WP @ 1.5 g/lit of water at 65 DAP respectively) over untreated control (T_1). The efficacy of these treatments were in order of T_4>T_2>T_3 throughout the crop season of potato. T_4 treatment was most effective in reducing the population of aphids than T_2 and T_3 because to the fact that in the T_4 treatment, only chemical insecticides were used where T_2 treatment was continuous of chemical insecticides and bio-pesticides and in T_3 treatments only bio-pesticides or bioagents were applied. In T_4 treatment, the crop was protected from the attack of pest from planting to harvesting by chemical insecticides which were both contact and systemic in nature. Konar *et al.* (2003) [4] also recorded lower incidence of aphids when the crop were treated with contact and systemic insecticide. T_2 treatment was also effective against aphid next to T_4 as it was treated by chemicals and bio agents. The other treatment schedule (T_3), which was consisting of mainly bio-pesticides, was not so effective in reducing the population of aphids as compared to T_4 and T_2 treatments, respectively. The findings are in agreement with those of reported earlier by Konar *et al.* (2005) [5] and Konar & Chettri (2003) [4]. The It can be concluded that T_4 is an effective method for controlling the aphids on potato and it does not develop resistance in sucking insect pest and also less hazardous to the environment followed by T_2 and T_3 respectively.

B. Population Build of Whitefly on Potato in Various Treatments

The data collected in two consecutive years during 2013-14 and 2014-15 regarding the integrated management of the aphids were pooled and presented in Table III.

Table 3. Incidence of white fly on potato in different treatments (Pooled data of 2013-2014 and 2014-2015)

	Population of whitefly on various dates of observation												
	DECEMBER			JANUARY				FEBRUARY					
TREATMENT	II WK DEC	III WK DEC	IV WK DEC	I WK JAN	II WK JAN	III WK JAN	IV WK JAN	I WK FEB	II WK FEB	III WK FEB	IV WK FEB	MEAN	% DECREASED OVER CONTROL
T_1	-	1 (0.00)	2.5 (0.40)	3.75 (0.57)	4.25 (0.63)	6.75 (0.83)	8.5 (0.93)	9.45 (0.98)	12.33 (1.1)	15.5 (1.19)	18.25 (1.26)	7.48	-
T_2	0 (0.71)	0 (0.71)	1 (0.0)	1.33 (0.12)	2.68 (0.43)	3 (0.48)	3.35 (0.53)	4.25 (0.63)	4 (0.60)	2.75 (0.44)	3.35 (0.53)	2.34	68.72
T_3	0 (0.71)	0 (0.71)	2 (0.30)	2.45 (0.39)	3.75 (0.57)	4.8 (0.68)	4.75 (0.68)	5.5 (0.74)	6 (0.78)	4.33 (0.64)	6.25 (0.80)	3.62	51.6
T_4	0 (0.71)	0 (0.71)	0.52 (-.28)	0.85 (-.07)	1.25 (0.09)	2 (0.30)	2.68 (0.43)	3.15 (0.50)	3.52 (0.55)	2.12 (0.33)	2.33 (0.37)	1.67	77.67
SEM (±)	-	-	0.49	0.76	0.68	0.45	0.37	0.84	0.81	0.72	0.93	-	-
CD At 5%	-	-	0.68	1.02	0.94	NS	NS	1.05	NS	1.08	1.17	-	-

***Figures in parenthesis are logarithmic transformed values**

This is evident from the table that all the treatments such as T_2, T_3 and T_4 were significantly superior over control (T_1) in reducing the population of white fly on potato, but not all round the growing season of the crop. Among various treatments, T_4 was recorded the most effective in decreasing the population of the pest on potato as compared to other treatments as well as untreated check plot and it was found the best due to application of imidacloprid and cartap hydrochloride as both of these are systemic in nature and remained active for a long period (Roy, 2002) [14]. The performance of these treatments has been recorded in order of $T_4>T_2>T_3$ respectively. Therefore, it can be concluded that T_4 is an effective treatment to keep the population of whitefly on potato below its critical limit and protect the potato crop for whole crop season without developing resistance in insects and also without polluting the ecosystem followed by T_2 and T_3 respectively. T_4 treatment consists of chemical insecticides which were both contact and systemic in nature and thus T_4 treatment ranked first as compared to T_3 and T_2 treatments to reduce the population whitefly. Konar *et al.* (2003) [4] also recorded minimum population of pest when the crop was treated with contact and systemic insecticides. T_2 treatment was also effective against whitefly as it was treated by chemicals and bio-pesticides. T_3 treatment consists of mainly bio-pesticides, were not so effective in decreasing the population of whitefly on potato as compared to T_4 and T_2 treatments, respectively. The results of the present field investigation was more or less corroborate with the earlier reports of Konar *et al.* (2013) [6] and Konar & Chettri (2001) [3].

The data recorded in two consecutive seasons of 2013-2014 and 2014-2015 regarding cost effectiveness of different treatment schedules against important sucking pests of potato viz, Aphids [*Myzus persicae* (Sulzer) & *Aphis gossypii* Glover] and White fly (*Bemisia tabaci* Genn) were pooled and shown in Table IV.

Table 4. Cost effectiveness of different treatment schedules against important insect pest of potato (pooled data of 2013-14 and 2014-15)

Treatments	Marketable Yield (t/ha)	Increased Yield Over Control (t/ha)	Added Benefit Over Control (t/ha)	Cost of Treatments (Rs./ha)	Net Profit (Rs./ha)	CBR
T1	15.98	-	-	-	-	-
T2	25.42	9.44	70,800	3729	67,071	1:17.98
T3	23.34	7.36	55,200	3245	51,955	1:16.01
T4	26.53	10.55	79,125	3795	75,330	1:19.84

*** Selling price of potato = Rs. 7,500 per ton**

From the table it is clear that all the treatments, i.e. T_4, T_2 and T_3 were significantly superior over untreated control T_1. T_4 treatment was found to be the best in reducing the incidence of pest for longer period followed by T2 treatment and T3 treatment than untreated control (T_1). T_4 treatment also gave more healthy tuber yield (26.53 t/ha) followed by T_2 (25.42 t/ha) and T_3 (23.34 t/ha) than untreated check (15.98 t/ha). Probably it is due to its high toxicity with systemic action for a long period because of the longer persistency sulfoxide metabolite in plant (Roy, 2002) [14], but its use or potato is safe from toxic residues point of view

Misra *et al.* (1991) [10], Mohasin *et al.* (1993) [8] and Konar *et al.* (2005) [5] are recorded more or less similar results to the findings of the present field study. They also recorded the higher tuber yield from the plot which was treated with systemic insecticides as present field trials. So according the overall performance, the different treatment schedules in their descending order of effectivity were T_4, T_2 and T_3 respectively.

The results of the present investigation are at par with the findings of Paul *et al.* (2004) [13], Konar and Paul (2005) [5], Mandal *et al.* (2010) [9] and Konar, More, Maity and Dutta Ray (2013) [7] in efficacy of single component against the aphids and whitefly but not in a

schedule of various chemicals and non-chemicals throughout the crop periods.

IV. Conclusion

It may be concluded from the results of both year of study that all the treatment schedules, i.e. T_2, T_3, & T_4 were significantly superior over control in decreasing the population of aphid and whitefly. Among four treatment schedules, T_4 treatment was most effective to reduce the incidence of aphids and whitefly followed by T_2 and T_3 treatments, respectively than control (T_1). Higher tuber yield of potato was recorded in T_4 treatment which was succeeded by T_2 and T_3 respectively than control (T_1). It also can be concluded that T_4 treatment schedule is the most effective treatment to reduce the plant and tuber damage caused by different sucking pests for a longer period effectively and economically with polluting T_3 treatment, respectively.

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