▼ Journal of Research (Science), Bahauddin Zakariya University, Multan, Pakistan.
Vol.14, No.1, June 2003, pp. 35-42 ISSN 1021-1012

LEAFHOPPER MANAGEMENT ON AUTUMN POTATO CROP IN PESHAWAR (PAKISTAN)

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Abstract: The trial was conducted from September 1994 to January 1995 in the NWFP, Agricultural University, Peshawar. The highest infestation of the leafhopper (LH) was recorded during December with 15.27 per sweep. However, the pest was well established during November and December. PBM (Potato-Berseem mix cropping) and PRM (Potato-radish mix cropping) were non-insecticidal treatments. Both were found most effective tools for the control of leafhoppers where more than 70% of the population was suppressed throughout the crop season in the natural environment. However, PBM was found better than PRM as 26% more reduction was recorded. Four insecticides, DDVP, Monitor, Anthio and Laser were used in the Insecticidal trial. These were significantly similar and gave better control to the leafhoppers when compared to control plot. Among the non-insecticidal and insecticidal treatments, PBM and PRM were better as the population of the leafhopper was half than that recorded in the insecticidal trials during the peak months of the leafhopper infestation. When weeds were removed regularly, about 12% of the pest population was reduced.

Keywords: Laser, leafhopper, management, non-insecticidal and insecticidal treatments.

INTRODUCTION

Potato (*Solanum tuberosum*) is the world's most important food crop with annual production of nearly 300 million tons on more than 12 million hectares [Martin *et al.* 1990]. Three crops of potato are annually grown in Pakistan, i.e. autumn and spring crops in the planes and summer crop in the hills [Anonymous 1991a]. According to statistics of Pakistan, the total area under potato cultivation during 1990-91 was 72900 hectares with an average production of 10 tons per hectare, where as in NWFP the crop was grown on 6900 hectares with an average yield of 13.4 tons per hectare [Anonymous 1991b].

Nearly 79 species of leafhopper (LH) have been found infesting the potato crop [Ramirez and Ramos 1982]. Among them, the most serious ones are *Empoasca fabae*, *E. decipiens*, *E. devastans*, *E. lybica*, *Koenalla confluence var. Pacifica* and *Asymmetrasia decedens* [El-Kady *et al*. 1973, El-Saadany and Fattah 1980, Karim and Das 1990, Martin *et al*. 1990 and Ramirez and Ramos 1982].

E. fabae interferes with physiology of the leaves by mechanically plugging the phloem and xylem vessels, causes stunting, curling and browning of the leaves [Borror *et al*.1981]. Feeding by adults and third-to-fifth instar nymphs of LH retarded plant height, leaf number and dry weight to about

20-50% more than did first-to-second instar [Flim and Hover 1984]. *E. decipiens* were observed on the late crop with its peak number during late October and declined thereafter [El-Saadany and Fattah 1980]. Density of *Amrasca devastans* was 1.22 per plant in 2nd week of January [Anwar *et al*. 1987].

Among the management practices, vegetational diversity is a useful tactics in the control of insect pests in various agro-ecosystems. It might change herbivore population and interferes with visual host finding cues. Mix culturing also disrupts the olfactory cues of the pest in host finding and once the pests leave the polyculture, they have difficulty in locating and relocating their host plants [Shahjahan and Streams 1973, Andow 1992]. Similarly, the subsequent removal of alfalfa in the dicultural agro-ecosystem reduced the herbivore population in the alfalfa-soybean mix cropping. *E. fabae* caused the greatest damage to soybean at the time of 1st alfalfa harvest in the dicultural agro-ecosystem. However, the subsequent removal of alfalfa reduced the leafhopper population in the alfalfa-soybean mix cropping [Poston and Pedigo 1975].

Dichlrovos is a respiratory, contact and stomach poison and used against sucking and chewing insect pests. Methamidophos is a systemic insecticide with contact and stomach action. Laser is a mixture of dimethoate and cypermethrin and is systemic with contact and stomach action [Tomlin 2001]. Different chemicals were used against LH for their control. Carbaryl, DDT, dimethoate, endosulfan, formothion, malathion, methyl-demeton, monocrotophos, fenitrothion, BHC and a mixture of BHC and DDT reduced the population of potato jassids (*Amrasca bigutulla* and *E. motti*) up to thirty-six days. The best among them were dimethoate, methyl-demeton and monocrotophos @ 0.25 kg ha^{-1} or formothion @ 0.75 kg ha^{-1} [Mavi and Singh 1975]. Six systemic insecticides, i.e. demeton-s-methyl, phosphomidon, dimethoate, thiometon, monocrotophos and Formothion gave equally good control of LH @ 1250 ml ha^{-1} [Misra and Lal 1981].

Keeping in view importance of the crop and the damage caused by the leafhopper a research project was initiated to determine the population density of leafhopper to assess the effect of Potato-Berseem and Potato-Radish mix / intercropping over the relative effectiveness of four insecticides on the population density of leafhopper.

MATERIALS AND METHODS

Research project was under taken at the Agricultural Research Farm NWFP Agricultural University Peshawar. Commercial cultivar "Al-Thamash" was sown on 10th September 1994 on an area of 720 m^2 in 28 subplots (7 treatments x 4 replications) each measuring 5 x 4.5 m confined to randomized complete block design (RCB Design) with DMR Test at 5% level of significance [Walter 1967]. The distance between plots was 0.50 m, between the rows 0.75 m and between the plants 0.20 m

was maintained. There were six rows each having 25 plants in every sub plot containing in all 150 plants. At the sowing time, "DAP" fertilizer was applied at the rate of 2 bags ha^{-1}. The data on insect pests was recorded at weekly interval from date of sowing to harvest. Treatments details are given as under:

Non-insecticidal Trials

PBM: Potato-Berseem mix cropping
PRM: Potato-Radish mix cropping

Insecticidal Trials

T_1: DDVP 80%: (Dichlrovos) @200 ml $acre^{-1}$
T_2: Anthio 25 EC: (Formothion) @250 ml $acre^{-1}$
T_3: Monitor 600 EC: (Methamidophos) @500 ml $acre^{-1}$
T_4: Laser 25 EC: (Dimethoate+cypermethrin) @500 ml $acre^{-1}$
T_5: Control: (Untreated plots)

Leafhopper was sampled with hand net. Three consecutive sweeps/plots were taken and each time the pest was counted.

NON-INSECTICIDAL TRIALS (MIX/INTER-CROPPING SYSTEM)

Berseem and radish were mix sown separately after 30 days of potato sowing. However, before sowing, all the agronomic practices to potato crop like hoeing, soil raising and tilling were completed. Berseem was sown between the ridges with broadcast method while radish was sown on alternate edge of ridges as suggested by the Department of Farm Management. Berseem was removed subsequently at fortnight intervals for fodder purposes whereas full-grown leaves of radish were left as such and removed at the time when potato crop was harvested.

INSECTICIDE APPLICATION

The insecticides were used at the recommended doses in T_1, T_2, T_3, and T_4 respectively. These insecticides were sprayed once during second week of December. Besides routine data, data one day before the spray and four data at one-day interval after spray were recorded to find the comparative efficacy of the insecticides.

RESULTS AND DISCUSSION

POPULATION DENSITY OF LEAFHOPPER *(EMPOASCA FABE)*

Leafhopper infestation started during the month of September and gradually increased. During the months of December and January, the infestation of the pest was the highest. In December, the peak infestation of 15.27 per sweep was recorded. The mean of two months was 10.70, and the seasonal mean was 5.21 per sweep (Fig. 1). Present studies follow the findings of El-Saadany and Fattah ([980]. They recorded the highest LHs population during October on late season potato crop. Similarly, Anwar *et al*. [1987] found 1.22 LH per plant during the second week of January.

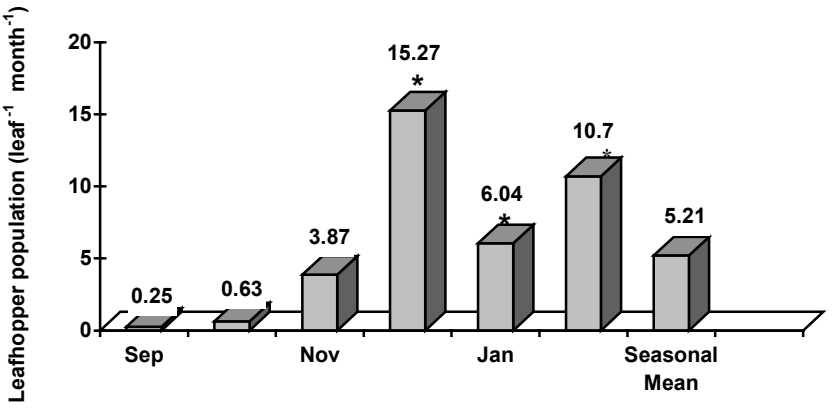

Fig. 1: Population of leafhopper in different months of year 1994-95.

MANAGEMENT TACTICS

Response of *Empoasca fabe* to Mix Cropping System

This tactic was found highly profound that kept the pest on desirable level. The pest infestation was well below the level recorded in the control plot. During November, 62 and 52% less population was recorded in PBM and PRM respectively, when compared to the control that further decreased to 80 and 75% during December. During the intact year, leafhopper population was significantly lower as 79.27% in PBM and 72% in PRM (Table 1). The reason for low population in PBM and PRM according to Tehvanainen and Root [1972] is the phenomenon as "*Associational; resistance"* which refers to reduced herbivore attack that a plant experience in association with genetically or taxonomically diverse plant habitat. Andow [1992] suggested that herbivore were more likely to be found and remain on host plants that occur in large, dense and pure stands. He also proposed that plant species diversity, when interferes with visual host finding cues in locating and relocating host plants after leaving polyculture, alter the herbivore population.

PBM Versus PRM

Leafhopper population was 26.03% less in PBM as compared to PRM during the entire growing season (Table 1). In PBM, Berseem was cut at various intervals subsequently for fodder purpose This practice disrupted the olfactory and visual cues of leafhoppers due to which the pest could not relocate its host, and was therefore unable to re-establish its population in PBM. In PRM, the cropping system remained undiluted that provided the pest longer period to establish its population. On the other hand, radish is broad-leaved plant, which in collaboration with the potato leaves attracted the pest and distributed over the whole plot. Under such

circumstances, the infestation was comparatively higher in PRM. This confirms the findings of Shahjahan and Streams [1973], and Andow [1991] who studied many *Empoasca* spp. in general and *E. fabae* in particular are more attracted to broad leafed weeds in diverse plant habitat whereas population reduces when grassy weeds i.e. maize sugarcane etc. are used in polyculture habitats.

Table 1: Pest population of insect pests of autumn potato crop in mix cropping system.

Months	Population Dynamics			Percent Reduction over Control			
	PBM	PRM	Control		Seasonal	November	December
September	0.00	0.14	0.25				
October	0.04	0.21	0.63	PBM	79.27	61.76	80.09
November	0.56	0.64	3.87	PRM	72.0	50.90	75.05
December	1.48	1.90	15.27	Differences between the treatments			
January	3.04	3.81	6.04	PBM< PRM 26.03% during			
Seasonal mean	1.08	1.46	5.21	the entire growing season			

Relative Efficacy of Insecticides

Significant control of leafhoppers was recorded with the application of insecticides (Table 2). On the first day after spray, more than 50% of the infestation was reduced which reached more than 90% on the fourth day after spray. There were no statistical differences among the insecticides and were found effective against the jassids at their recommended doses. However, Monitor was initially less effective during first three days which later on gave the highest reduction (98%) in the leafhopper population on the fourth day after spay. Previously Organophosphorus sprays including dimethoate, methyl-demeton and monocrotophos @ 0.25 kg ha^{-1} and formothion @0.75 kg ha^{-1} reduced the population for upto 36 days [Mavi and Singh 1975]. Among the systemic insecticides, dimethoate, monocrotophos and formothion gave good control of leafhoppers at @1250 ml ha^{-1} [Misra and Lal 1981].

Table 2: Percent reduction in leafhopper population after insecticide application.

Treatments	Pre-treatment Population/ Sweep	Population reduction percentage after spray				
		One day	Two days	Three days	Four days	Mean
DDVP	07.25	61.82 $_a$	74.74 $_a$	90.89 $_a$	92.61 $_{ab}$	80.02 $_a$
Anthio	09.50	66.77 $_a$	76.17 $_a$	90.61 $_a$	91.47 $_b$	81.14 $_a$
Monitor	08.08	55.51 $_a$	74.03 $_a$	89.12 $_a$	98.16 $_a$	81.79 $_a$
Laser	07.83	63.1 $_a$	78.88 $_a$	90.90 $_a$	94.04 $_a$	81.73 $_a$
Control (Adults/sweep)	13.50	14.25 $_b$	14.83 $_b$	15.08 $_b$	19.16 $_c$	15.36 $_b$

Within a column, means followed by different letters are significantly different at 5% level of significance. ANOVA followed by Duncan Multiple Range Test (DMR-Test).

Analogy Among Treatments

From September to November pest gradually increased. During this period, the plots reserved for insecticidal trial were used as control plots as no application was made. However, the weeds were removed regularly

from these plots. When the infestation increased during December, these plots were sprayed with the mentioned insecticides on the 11th of the month.

Among the non-insecticidal and insecticidal trials, PBM and PRM were found significantly better. During the peak months of the infestation "November and December", the pest population was almost less than half in these plots when compared with the remaining plots (Table 3). Afterward the population decreased and almost disappeared from all the treatments except the control plots during January and the crop was also mature and harvested during the second week of January.

Table 3: Analogy among treatments.

Treatments	Seasonal Population		Peak months population-reduction percentage			
			November		December	
	%Population	% Reduction.	Population	Reduction	Population	Reduction
PBM	29.7	79.27	38.24	61.76	19.91	80.09
PRM	28.0	72.00	49.10	50.90	24.95	75.05
DDVP	34.54	65.46	88.37	11.63	30.12	69.88
Anthio	32.63	67.37	94.83	5.17	26.20	73.80
Monitor	32.23	67.77	90.44	9.56	26.60	73.40
Laser	30.90	69.10	77.52	22.48	26.85	73.15
Control	5.21 [a]	-	3.87	-	15.27	-

Weeding practices also found an effective tool for the pest control. Overall reduction (12.21%) in infestation in the insecticidal plots before the application over the control plot reveals that the pest was controlled by regular practice of weeding in the insecticidal trials (Table 4). It is also inferred that the leafhopper population was higher in PRM because radish behaved as weed. On the other hand, in PBM, Berseem although can be considered as weed, but it was cut in intervals which kept the pest population very low.

Among the insecticides sprayed, Monitor was effective to reduce 98% of the pest after four days of spray. However, there were no significant differences among the insecticides.

Table 4: Effect of weeds on the population of potato leafhoppers

	Treatments	Population	% Reduction in weed free plots over control	
Weeds Free Plots	DDVP	3.42 $_b$	11.63	Over all reduction 12.21%
	Anthio	3.67 $_a$	05.17	
	Monitor	3.50 $_b$	09.56	
	Laser	3.10 $_c$	22.48	
Weeded Plot	Control	3.87 $_a$	0	

ANOVA followed by Duncan Multiple Range Test (DMR-Test).

From the results of present study it can be concluded that in the mix cropping system, infestation was lower among all the treatments. This

effect was observed from the start of pest infestation until the harvest. Among the insecticides, no significant difference was observed and all were equally good against the leafhoppers. Due to weed control, 12.21% of the pest population was controlled.

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