INTEGRATED MANAGEMENT OF POTATO-PEACH APHID, *MYZUS PERSICAE (SULZER)*

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ABSTRACT

A Field study was conducted to devise a scheme for the integrated management of potato-peach aphid, Myzus persicae (sulzer). *Different treatments including, Imidacloprid 25 % WP, Tracer 240 EC, Acetamaprid 20 SP, Potato berseem mixed cropping with or without yellow sticky plastic sheet and Potato + Yellow traps were evaluated for their effectiveness. Among all the treatments mixed cropping of potato and berseem together with or without yellow sticky plastic sheet traps was found most effective in reducing the population density of* M. persicae *i.e. 1.92 aphid per potato leaf and culminated in enhancing the number of associated natural enemies of* M. persicae *per potato comprising ladybird beetle (9.06), syrphid fly (4.18), green lacewing (8.80), parasitoid mummies (8.18). Also highest yield (12.42 tones ha^{-1}) was recorded from the same treatments. Imidacloprid 25% WP, Acetamaprid 20 SP and Tracer 240 EC were ranked next to potato berseem mixed cropping (with or without yellow traps) in reducing the population density of* M. persicae *to 2.01, 2.01 and 2.07 aphid per potato leaf, respectively. Imidacloprid 25 % WP, Acetamaprid 20 SP and Tracer 240 EC had almost similar effect on the number of natural enemies and on the yield of potato crop.*

Key Words: ***Potato,* Myzus persicae*, IPM, Intercropping/Mixed Cropping, Yellow Sticky Plastic Sheet Traps***

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INTRODUCTION

Potato (*Solanum tuberosum* L.) is the world's most important food crop with annual production of nearly 300 million metric tones. In Pakistan it has emerged as an important cash crop and one of the leading vegetables, with an average total production of 1,108,000 tons potato tubers (Food and Agriculture Division, 2006). Under various soil and environmental conditions, three crops are grown in Pakistan. Autumn and spring crops are grown in plain areas, while summer crop in hilly areas. The per hectare national yield is about 10.8 tons, which is very low compared to the world average (16.20 tons) (Anonymous, 2005).

In Pakistan, potato crop is severely attacked by a number of insect pests which decrease yield of the crop. Among all these pests, *Myzus persicae* (Sulzer) is one of the serious pests of potato crop. Heavy infestation of *M. persicae* can cause considerable damage to the potato crop by severely dwarfing and curling the leaflets, and by dwarfing and spindling the tops. In extreme cases, the whole plant may be killed (Painter, 1951). This aphid is the known vector of several viruses of potato plants (Kennedy *et al*. 1962), the most important being potato virus Y (PVY) and potato leaf roll virus (PLRV) (Broadbent, 1953). Yield loses caused by these viruses can be as high as 90% depending on cultivar, infestation and environmental conditions (Raman, 1988; Shah, 1988; Hankock, 1990; Zanoni, 1991). Integration of chemicals with natural enemies offers promise for enhanced protection from aphid damage. Mckinlay and Cochrane (1988) demonstrated that *Aphelinus semiflavus* Howard (Hymenoptera: Encyrtidae) and *Diaeretiella rapae* (McIntosh) (Hymenoptera: Braconidae) differed significantly in their relative susceptibility to insecticides, depending on the chemical evaluated. Also, these parasitoids, while in the mummy stage, were less susceptible to insecticide toxicity than was *M. persicae*. In general, however, insecticide use in crops is more disruptive to parasitoids than to aphids, leading to larger aphid populations. Sublethal doses of some insecticides also increase aphid reproduction.

Among the management practices, vegetational diversity is a useful tactics in the control of insect pests in various agroecosystems. It might change herbivore population and be instrumental in distorted 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; van Emden and Wratten, 1990; Andow, 1992). Diverse agroecosystem created by multiple cropping tend to increase numbers of natural enemies. Natural enemies are more attracted to diverse systems of shelter, alternate Prey, humidity and flowers. Andow (1992) reported that natural enemy population often increases and seldom decreases

in polycuture systems. Yellow traps have been found very effective for trapping aphids (Broadbent, 1948; Tayler, 1973). Many aphids are attracted to yellow colours (Moericke, 1950; Hottes, 1951). Saljoqi and van Emden, (2003 a) by using a yellow sticky plastic sheet traps reported a remarkable reduction in aphid population. Rogerson (1975) compared two auto mobile greases as the adhesive on sticky traps for aphids and found that yellow calcium grease was superioir to darker litjium grease. Potato- berseem is a common practice in most of the areas in Pakistan. Berseem, *Trifolium alexandrium* (L.) belongs to family Leguimonseae a major fodder crop in Pakistan, and it is grown simultaneously with potatoes. A field study was there fore conducted to explore the possibilities of reducing *M. persicae* populations by a) mixed cropping/intercropping of potatoes with berseem and b) by yellow sticky plastic sheet traps.

Keeping in view the importance of the crop and the damage caused by the aphid, this study was conducted for the first time in Pakistan which integrated the effects of insecticides, mixed cropping and yellow sticky plastic sheet traps alone and in different combinations for the management of aphids. Also the effects of all these combinations were studied on the natural enemies' population of *M. persicae* and yield of potato crop.

MATERIALS AND METHODS

A research study was conducted for the integrated management of *M. persicae* in the spring potato field crop at the Agricultural Research Farm, NWFP Agricultural University, Peshawar-Pakistan, during 2006. Commercial cultivar Kuroda was sown in the middle of January, 2006 on an area of 864 m^2 in 28 sub plots (7 treatments x 4 replications) confined to Randomized Complete Block Design (RCBD). Row to row distance was 75 cm and plant to plant was 25 cm. Each sub plot was having four rows and ten plants were sown in each row.

Treatments details:

S. No.	Treatments		
	Common Name	Trade Name	Rate/hec.
T1	Immidacloprid	Immidacloprid 25% WP	312.5 g
T2	Tracer	Tracer 240 EC	100 ml
T3	Acetamaprid	Acetamaprid 20 SP	200-250 mg
T4	Potato-berseem mix cropping		PBM
T5	Yellow sticky plastic sheet traps		P+YSPST
T6	Yellow sticky plastic sheet traps + Potato-berseem mix cropping		YSPST+PBM
T7	Check (Untreated plots for population density)		

Myzus persicae *Population Estimate*

Aphids were counted on three tagged leaves on each plant, one each in the top, middle and lower regions of three randomly selected plants, avoiding the border rows, from each plot. The data was recorded on the same leaves on the different occasions. In the insecticide treated plots, data was recorded on the I^{st} day, 2^{nd}, 3^{rd}, 10^{th}, 17^{th}, 24^{th}, 31^{st} and then on 38^{th} day after spray application.

Natural Enemies Population Estimate

Natural enemy population i.e. ladybird beetles (*Coccinella septempuntata*) (Linnaeus) , syrphid fly**,** (*Episyrphus balteatus*) (de Geer), green lacewing, *Chyrsoperla cornea (*Stephens) and parasitoid mummies**,** *Aphidius matricariae* (Haliday) data was collected on the I^{st} day, 2^{nd}, 3^{rd}, 10^{th} , 17^{th}, 24^{th}, 31^{st} then on 38^{th} day after spray application.

Yellow Sticky Plastic Sheet Traps (YSPST)

Yellow sticky plastic sheet traps 60 x 30 cm^2 were fixed in T5 and T6 one meter above the ground level. The traps were operated from the emergence of the potato seedlings up to the harvest of the crop. Common engine oil (SAE 40/60) was used on these sheets as the adhesive material. The aphids stuck to these traps were counted at weekly intervals.

Potato Berseem Mixed Cropping

Potato was mixed sown with berseem. Berseem was sown between the ridges of potato crop. The population of aphids was recorded only on leaves of potato crop.

Insecticides Application

All insecticides were applied at recommended doses in T1, T2 and T3. The insecticides were applied when the aphid population reached to its peak. Beside routine weekly data collection, the aphid population estimate, their natural enemies, percent parasitism data was collected on the Ist day, 2nd, 3rd, and then weekly basis till the 38th day after spray application. After harvesting the crop, the yield obtained was weighed separately for each treatment in kg, which was then converted into t ha^{-1}. The data was analyzed by analysis of variance of Factorial Randamised Complete Block Design (RCBD) (Mead et al. 1993), using 'MSTAT-C' Computer programme and the means were compared by using Duncan's Multiple Range Test (DMRT) (Steels and Torrie, 1960).

RESULTS AND DISCUSSION

Effect of different Treatments on the Population Density of Myzus persicae (Sulzer) per Potato Leaf in the Spring Potato Field Crop

Table I shows the effect of different treatments, time intervals and their interaction on the number of *M. persicae* per potato leaf. The data revealed that all the treatments were found significantly effective in reducing the aphid population as compared to the control ($P < 0.05$). The statistical analysis shows that potato berseem mixed cropping was found to be the most effective in reducing the number of *M. persicae* ($P < 0.05$) followed by Acetamaprid 20 SP , Imidacloprid 25% WP, potato + yellow sticky plastic sheet traps and potato berseem mixed cropping + yellow sticky plastic sheet traps. Tracer 240 EC was found the least effective among all the treatments ($P < 0.05$).

Lowest mean aphid population was recorded on the first day which increased with the passage of time and reached to its peak on the 17th day ($P < 0.05$). The aphid population then started decreasing onward and then significantly reduced on 38th day ($P < 0.05$). Table I also shows the interaction of treatments and time intervals. Among the interactions significant differences were observed. The aphid population was lowest on the first and second day which increased with the passage of time up to the 17th day. Peak population was observed on the 17th day in almost all the treatments. After that the population decreased with the passage of time. The same trend was observed in almost all the treatments.

The possible explanation for the highest reduction in the population of *M. persicae* in Potato berseem mixed cropping might be attributed to the fact that the pests face difficulty in finding the host crop because of dense growth of alternate crop. Besides the natural enemies of the aphid are attracted in higher number which will reduce the aphid population. Inter crop might secrete some compounds which affect the behaviour and biology of aphid. This phenomenon is supported by the findings of Root, 1973; Andow, 1992, who observed that herbivores were more likely to find and remain on host plants that occur in large, dense and pure stands due to the resource concentration factor. Saljoqi and van Emden, (2003 a). reported that the reason for the least number of aphids in potato berseem mixed cropping is the visual and olfactory effects produced by the mixed cropping which affect the behaviour and colonization of *M. persicae*. It may be because of the dilution effect of having more plants to choose from, because the aphids were also observed on berseem crop.

Saljoqi and van Emden, (2003 a), investigated that the reduction of *M. persicae* in the inter crop potato plots may be because of the reduced contrast between the crop (potato berseem mixed crop) and the soil, causing a lower immigration of alate into the crop. Saljoqi and van Emden, (2003) a also confirm our present findings. They found 90 % reducation in the aphid population by mixed cropping of cardinal and berseem with the sole crop. Koestoni and Sastrosiswojo (1985) also found 76 % fewer aphids on potato leaves when intercropped with maize or sunflower. Acetamaprid 20 SP, a naturalyte insecticide was observed the next more effective insecticide for the management of *M. persicae,* which resulted in lowest infestation of the pest. Imidacloprid 25 % WP also (Confidor) had almost the same effect as Acetamaprid. Both the insecticides are very effective against sucking pests. These results have also been confirmed by other previous workers like Jarande and Dethe (1994) who reported that Confidor SL20 (Imidachloprid) was effective in reducing the incidence of white flies.

Yellow sticky plastic sheet traps were found a good management technique in suppressing the aphid population. Our results can be supported from Saljoqi and van Emden, (2003 a), who also found yellow sticky plastic sheet traps helpful in suppressing the aphid population in the potato berseem mixed cropping plots. Rehman and Shahid (1988) also found Yellow traps very effective against aphids.

Table I ***Effect of different treatments on the number of*** **Myzus persicae (Sulzer)** ***per potato leaf (means of 4 replicates) in the spring potato field at NWFP Agric. University, Peshawar Research Farm during 2006***

*	Time interval (Days)								
Treatments	**1**	**2**	**3**	**10**	**17**	**24**	**31**	**38**	**Means**
T_1	1.27 q	1.96 l-n	2.60 d-h	2.81 b-f	3.38 a	2.22 i-m	1.39 pq	0.50 rs	2.01 bc
T_2	1.71n-p	2.0 j-m	2.50 f-i	2.90 b-d	3.11 ab	2.37 g-j	1.39 pq	0.50 rs	2.07 ab
T_3	1.53 o-q	2.20 i-m	2.50 f-i	2.79 b-f	3.05 b	2.24 i-l	1.26 q	0.50 rs	2.01 bc
T_4	1.97 l-n	1.76 no	2.11 j-m	2.52 e-i	2.81 b-f	2.41 g-j	1.41 pq	0.42 s	1.92 c
T_5	2.0 k-n	2.09 j-m	2.62 c-h	2.83 b-e	2.94 bc	2.12 j-m	1.21 q	0.47 s	2.03 bc
T_6	1.97 k-n	1.92 l-n	2.31h-k	2.70 c-g	2.93 bc	2.31 h-k	1.43 pq	0.81 r	2.04 bc
T_7	1.90 m-n	2.3 h-j	2.60 d-h	2.93 bc	3.04 b	2.35 g-j	1.42 pq	0.60 rs	2.16 a
Means	1.80 f	2.05 e	2.50 c	2.80 b	3.04 a	2.29 d	1.36 g	0.54 h	

LSD for Treatments (T) = 0.33;
LSD for Time interval, days (D) = 0.125
LSD for D x T interaction = 0.116
T_1= Immidacloprid 25% WP
T_2= Tracer 240 EC
T_3= Acetamaprid 20 SP
T_4= Potato-berseem mix cropping (PBM)
T_5= Potato+Yellow sticky plastic sheet traps (P+YSPST)
T_6= Yellow sticky plastic sheet traps+ Potato-berseem mix cropping (YSPST+PBM)
T_7= Check
Means followed by a different letter(s) are significantly different from one another (P<0.05), using DMR-tes

Effect of different Treatments on the number of Ladybird Beetle, Coccinella septempuntata (Linnaeus) per Potato Plant in the Spring Potato Field Crop

The results of statistical analysis reveal that potato-berseem mixed cropping was seen the best among all the treatments in encouraging the population of ladybird beetles (P < 0.05) (Table II). Immidacloprid 25 % WP and potato-berseem mix cropping + yellow sticky plastic sheet traps were found next effective ones followed by Tracer 240 EC and Acetamaprid 20 SP. Potato + yellow sheet traps was observed to be the least effective among all the treatments (P < 0.05) (Table II). The lowest mean ladybird beetles population was recorded on the 1st day but was found comparatively higher on the 2nd and 3rd day which then kept on increasing until it reached to its highest on the 17th day (Table II). After then it started declining with the passage of time and significantly reduced on 38th day (P < 0.05). Table II indicates the effect of interaction of treatments and time intervals. The data shows that lowest average population of ladybird beetles was recorded on the Ist day which increased steadily and highest population was observed on the 17th day in almost all the treatments. Then with the passage of time the population decreased.

Table II ***Effect of different treatments on the number of ladybird beetle,*** **Coccinella septempunctata (Linnaeus)** ***per potato plant (means of 4 replicates) in the spring potato field crop at NWFP Agric. University, Peshawar Research Farm during 2006***

*Treatments	Time interval (Days)								
	1	**2**	**3**	**10**	**17**	**24**	**31**	**38**	**Means**
T_1	5.25 m-s	9.50 e-k	6.50 i-p	13.25 a-e	13.80 a-d	10.0 d-i	5.0 m-t	2.50 q-v	8.21ab
T_2	2.80 p-v	6.0 j-r	8.80 f-p	12.25 b-f	15.0 ab	11.0 c-g	5.50 l-s	2.50 q-v	8.0 ab
T_3	4.50 n-u	7.0 h-o	8.25 g-n	10.75 c-h	13.25a-e	9.25 f-l	5.25 m-s	2.50 q-v	7.60 b
T_4	5.0 m-t	6.50 i-p	10.50 c-h	13.25a-e	16.50 a	10.80 c-h	7.0 h-o	3.00 p-v	9.06 a
T_5	0.75 u-v	2.25 r-v	4.0 o-v	6.25 i-q	9.25 f-l	5.80 k-s	3.80 o-v	2.00 s-u	4.25 c
T_6	7.25 g-o	8.80 f-m	7.50 g-o	14.0 a-c	16.50 a	9.80 e-j	4.50 n-v	2.75 p-v	8.90 ab
T_7	0.50 v	1.0 uv	3.0 p-v	4.25 o-v	7.25 g-o	4.50 s-u	3.0 p-v	1.25 t-v	3.09 c
Means	3.71 f-g	5.85de	6.92 d	10.60 b	13.07 a	8.71 c	4.85 ef	2.35 g	

LSD for Treatments (T) = 3.80
LSD for Time interval, days (D) = 1.423
LSD for DxT interaction = 1.331
T_1= Immidacloprid 25% WP
T_2= Tracer 240 EC
T_3= Acetamaprid 20 SP
T_4= Potato-berseem mix cropping (PBM)
T_5= Potato+Yellow sticky plastic sheet traps (P+YSPST)
T_6= Yellow sticky plastic sheet traps+ Potato-berseem mix cropping (YSPST+PBM)
T_7= Check
Means followed by a different letter(s) are significantly different from one another (P<0.05), using DMR-test.

Effect of different Treatments on the Number of Syrphid Fly,* Episyrphus balteatus (de Geer) *per Potato Plant in the Spring Potato Field Crop

Table III indicates that all the treatments were found significantly more effective than the control ($P < 0.05$). Again highest population of syrphid fly was recorded in potato-berseem mixed cropping followed by Tracer 240 EC, Imidacloprid 25 % WP and Acetamaprid 20 SP ($P < 0.05$). Table III shows that lowest population of syrphid fly was recorded on the 1st day but it increased significantly with the passage of time and peak population was observed on the 17th day. The population then started declining gradually ($P < 0.05$).

Table III ***Effect of different treatments on the number of syrphid fly,* Episyrphus balteatus (de Geer) *per potato plant (means of 4 replicates) in the spring potato field crop at NWFP Agric. University, Peshawar Research Farm during 2006***

*Treatments	Time interval (Days)								
	1	2	3	10	17	24	31	38	Means
T_1	0.50	3.25	4.25	6.50	6.0	4.0	2.0	0.50	3.37a-c
T_2	0.50	2.0	4.0	6.50	7.80	6.0	2.50	1.50	3.84ab
T_3	0.50	2.0	3.0	5.0	7.0	4.80	2.50	0.80	3.18a-c
T_4	1.25	23.50	5.50	7.0	8.0	5.20	1.80	1.0	4.18a
T_5	0.25	0.75	2.50	3.80	4.25	1.80	1.50	0.80	1.93d
T_6	2.0	3.50	4.80	3.80	5.25	2.85	1.0	0.25	2.90b-d
T_7	0.0	1.0	3.0	4.25	5.80	2.25	1.25	0.80	2.28cd
Means	0.71d	2.28c	3.90b	5.26a	6.28a	3.85b	1.78cd	0.78d	

LSD for Treatments (T) = 0.93; LSD for Time interval, days (D) = 1.20; LSD for DxT interaction = 1.117

Effect of different Treatments on the Population of Green Lacewing,* Chyrsoperla cornea (Stephens) *per Potato plant in the Spring Potato Field Crop

Table IV reveals that all the treatments were more effective on the number of *C. cornea* as compared to the control ($P < 0.05$). The statistical analysis illustrates that potato-berseem mixed cropping was highly effective in increasing the number of *C. cornea*. Rest of the treatments had almost the same effect ($P > 0.05$). Table IV shows that the population of *C. cornea* was lowest on the 1st day but then significantly increased on the 2nd day. The population was lower on 3rd day than 2nd day. The population started increasing and reached to its peak level on the 17th day. After that it started decreasing and then was significantly reduced on 38th day ($P < 0.05$). The highest population of natural predators i.e. ladybird beeltles, syrphidfly, and Green Lacewing feeding on aphids was recorded in potato berseem mixed cropping with or without traps. This might be due to the attraction of green colour of berseem, dense growth and realease of some volatile compounds from the alternate host. As the aphids are attracted towards the green colour and some sweet smell of berseem, its natural enemies make move towards the inter cropping. This phenomenon was also supported by (Kennedy *et al*., 1959 a, b; Dethier and Schoonhoven, 1969).

Table IV ***Effect of different treatments on the number of green lacewing, Chrysoperla cornea (Stephens) per potato plant (means of 4 replicates) in the spring potato field crop at NWFP Agric. University, Peshawar Research Farm during, 2006***

*Treatment	Time interval (Days)								
	1	2	3	10	17	24	31	38	Means
T_1	4.80	7.50	7.0	7.80	8.80	5.50	2.80	1.25	5.70 b
T_2	4.80	9.0	8.0	8.50	10.25	6.0	2.80	0.80	6.25 b
T_3	4.25	7.0	7.80	8.80	10.50	6.50	3.0	1.75	6.18 b
T_4	8.50	10.0	9.50	13.25	14.50	8.25	4.50	1.50	8.80 a
T_5	5.25	5.80	6.0	7.25	8.25	5.25	3.0	1.50	5.28 b
T_6	4.0	5.25	5.25	7.80	9.50	5.50	3.0	1.0	5.15 b
T_7	2.75	3.50	3.50	2.80	3.80	2.50	1.0	0.25	2.50 c
Means	5.0 d	7.0 bc	6.71 bc	8.0 ab	9.35 a	5.64 cd	2.8 e	1.14 e	

LSD for Treatments (T) = 0.90; LSD for Time interval, days (D) = 1.80; LSD for D x Tinteraction = 1.63

T1= Immidacolprid 25% WP

T_2= Tracer 240 EC

T_3= Acetamaprid 20 SP

T4= Potato-berseem mix cropping (PBM)

T5= Potato+Yellow sticky plastic sheet traps (P+YSPST)

T6= Yellow sticky plastic sheet traps+ Potato-berseem mix cropping(YSPST+PBM)

T7= Check

Means followed by a different letter(s) are significantly different from one another ($P<0.05$), using DMR-test

Effect of different Treatments on the number of Parasitoid mummies,* Aphidius matricariae (Haliday) *per Potato Plant in the Spring Potato Field Crop

Highest mean parasitoid population was found in potato-berseem mixed cropping followed by Acetamaprid 20 SP, Tracer 240 EC and Potato-berseem mix-cropping + yellow sticky plastic sheet traps, potato + yellow traps and Imidacloprid 25% WP respectively ($P < 0.05$) (Table V). Lowest number of parasitoid mummies was recorded on 1st day (Table V). The number then increased onward and highest numbers of mummies were recorded on 17th day in almost all treatments. The number then gradually decreased and reduced significantly on the 38th day. The same trend was found in almost all the treatments. Highest number of Parasitoid mummies was found in potato berseem mixed cropping. It might be due to the berseem volatile compounds which attract other adult parasitoids. Also because of the green colour and dense growth of berseem, the natural enemies find it as their alternative host. Saljoqi and van Emden, (2003 a), also described that natural enemies, parasitoids and predators are attracted to inter cropping because of shelter, humidity, alternative prey and flowers. Marcovitch (1935) found that strawberries attract parasitoids when undersown below with peaches, and then reduce levels of *Ancylis comptana*. Price and Waldbauer (1975) oserved that there are more alternative preys for natural enemies in mixed cropping thus increasing the number of natural enemies.

Table V ***Effect of different treatments on the number of parasitoids mummies, Aphidius matricariae (Haliday) per potato plant (means of 4 replicates) in the spring potato field crop at NWFP Agric. University, Peshawar Research Farm during 2006***

*Treatments	Time interval (Days)								
	1	2	3	10	17	24	31	38	Means
T_1	1.80	4.80	5.80	10.50	12.25	8.25	4.80	1.80	6.21c
T_2	3.50	4.50	7.80	11.25	15.0	10.25	4.80	2.0	7.37ab
T_3	4.25	6.0	7.80	11.60	13.80	9.00	4.80	2.25	7.40ab
T_4	4.25	7.25	9.50	12.50	16.0	10.0	3.80	2.5	8.18a
T_5	3.50	4.80	7.0	9.25	11.80	8.05	3.50	2.21	6.28c
T_6	3.80	4.80	6.50	10.80	13.80	8.0	3.50	1.50	6.60bc
T_7	4.0	4.80	6.80	12.25	14.25	9.25	4.0	1.80	7.15bc
Means	3.60 f	5.25 e	7.28 d	11.14 b	13.82a	9.0c	4.14f	2.0g	

LSD for Treatments (T) = 0.96; LSD for Time interval, days (D) = 1.04; LSD for D x T interaction = 1.0

Yield

The statistical analysis reveals that Potato berseem mix cropping with or without Yellow sticky plastic sheet traps resulted in the highest yield, followed by Tracer 240 EC, potato + Yellow traps and Imidacloprid 25 % WP respectively. The lowest yield was recorded in Acetamaprid 20 SP (Table VII). The highest yield was recorded in the intercrop plots i.e. potato berseem mixed cropping + yellow sticky traps, followed by potato berseem mixed cropping, Tracer 240 EC, potato + yellow traps and imidacloprid 20 SP. The plausible explanation for this is the leguminous nodules, which stores nitrogen. There's likelihood that this nitrogen might have been used by the potato crop for growth and development. Wilson and Burton (1938) reported that legumes produce nitrogen during growth, which benefit non-legume. Willey and Osiru (1972) also observed highest yield of maize per plant in the maize – bean intercrop than mono crop maize. Saljoqi and van Emden (2003 a), also found that in potato berseem mixed cropping with or without yellow traps, yield was increased significantly as compared to all other treatments. It may be concluded from the above study that potato berseem mixed cropping with or without yellow sticky plastic sheet traps is the most effective way of suppressing *M. persicae*, thus encouraging and increasing the number of natural enemies, per cent parasitism and resulting in high yield.

Table VI ***Yield of potato at harvest with different treatments in NWFP Agric. Univ. Peshawar, Research Farm during 2006***

S. No.	*Treatments	Yield (tones ha^{-1})
1	T_1	10.33 ab
2	T_2	10.42 ab
3	T_3	10.01 ab
4	T_4	11.17a
5	T_5	10.35 ab
6	T_6	12.42 a
7	T_7	8.14 b

LSD value for treatments = 3.02, T1= Immidacolprid 25% WP, T_2= Tracer 240 EC
T_3= Acetamaprid 20 SP T4= Potato-berseem mix cropping (PBM)
T5= Potato+Yellow sticky plastic sheet traps (P+YSPST)
T6= Yellow sticky plastic sheet traps+ Potato-berseem mix cropping (YSPST+PBM)
T7= Check
Means followed by a different letter(s) are significantly different from one another ($P<0.05$), using DMR-test

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