INSECT PESTS OF COTTON

1. SCREENING OF NEW COTTON GENOTYPES AGAINST INSECT PESTS

Eleven Cotton genotypes were sown in the research area of Entomological Research Institute, Faisalabad. The trial was laid out in RCB Design having three replications. The population of Whitefly, Jassid and Thrips was recorded from 15 leaves of 15 plants selected at random from upper, middle and lower portions of plants. Dusky Cotton Bug population was assessed on per boll basis while Pink Bollworm damage was recorded on percentage basis dissecting 25 randomly selected bolls per plot. The data are as under:-

Table 1: Screening of new Cotton Genotypes against Insect Pests Complex

Varieties/Genotypes		Avg. Whitefly/ Leaf	Avg. Jassid/ Leaf	Avg. Thrips/ Leaf	Avg. Dusky Cotton Bug/Boll	%Damage of PBW
V1	FH-Lalazar	4.08 AB* (0.93-10.80)**	1.49 ABC* (0.20-6.00)**	4.29 AB* (0.60-7.07)**	5.04 AB* (0.00-12.66)**	8.86 ABC
V2	MNH-1016	4.03 AB* (0.80-13.93)	1.39 ABC* (0.73-4.13)	4.23 AB* (0.33-6.53)	4.70 AB* (0.00-11.47)	11.33 AB
V3	CM-616	3.83 AB* (0.80-11.00)	0.79 C* (0.40-3.93)	4.23 AB* (0.23-6.80)	4.21 B* (0.00-9.80)	8.86 ABC
V4	MNH-992	4.40 AB* (0.60-14.73) **	1.79 A* (0.53-5.73) **	5.03 A* (0.60-8.40) **	4.95 AB* (0.00-16.20) **	7.33 BC
V5	CYTO-179	5.37 A* (0.33-17.20) **	0.79 C* (0.40-5.13) **	4.66 AB* (0.20-7.53) **	6.25 A* (0.00-14.27) **	7.40 BC
V6	FH-142	4.32 AB* (0.53-11.93) **	0.95 BC* (0.87-4.07) **	3.75 AB* (0.16-4.40) **	5.05 AB* (0.00-17.20) **	12.29 A
V7	FH-312	4.43 AB (1.27-10.33) **	1.08 ABC (0.87-4.40) **	4.16 AB (0.27-6.87) **	4.42 AB (0.00-13.80) **	7.99 BC
V8	PB-896	3.27 B* (1.00-11.47) **	1.31 ABC* (0.80-4.73) **	3.84 AB* (0.27-6.73) **	5.43 AB* (0.00-18.93) **	6.00 C
V9	IR-NIBGE-9	4.31 AB* (0.66-10.93) **	1.06 ABC* (0.60-4.33) **	4.18 AB* (0.13-7.60) **	3.61 B* (0.00-14.33) **	10.18 ABC
V10	IR-NIBGE-8	4.04 AB* (1.00-8.80) **	1.72 AB* (0.60-4.80) **	3.94 AB* (0.20-7.87) **	4.64 AB* (0.00-9.81) **	7.170 C
V11	FH-Noor	2.82 B* (0.00-8.53) **	0.98 BC* (0.47-5.60) **	3.25B* (0.37-6.33) **	5.28 AB* (0.00-13.33) **	6.87 C
LSD at 5%		1.699	0.7938	1.7576	1.9921	4.2691

* Seasonal Average
** Range

Results indicated that average whitefly population/leaf differ significantly among treatments with minimum population (2.82/leaf) on FH-Noor followed by PB-896 with the pest population of 3.27/leaf whereas maximum pest population (5.37/leaf) was observed on genotype CYTO-179. In case of Jassid, minimum population (0.79) per leaf was recorded on genotypes CM-616 and CYTO-179 followed by FH-142 and FH-Noor with pest populations of 0.95/leaf and 0.98/leaf whereas maximum pest population (1.79/leaf) was observed on genotype MNH-992. Thrips population remained below ETL throughout the season with minimum 3.25/leaf on FH-Noor followed by FH-142, PB-896 and IR-NIBGE with populations 3.75, 3.84 and 3.94 per leaf; respectively where as maximum (5.03) thrips/leaf was recorded on genotype MNH-992. Minimum (3.61) dusky cotton bug/boll was recorded on genotype IR-NIBGE-9 whereas maximum (6.25/boll) was observed on genotype CYTO-179 followed by PB-896 and FH-Noor with populations of 5.43 and 5.28 per boll. In case of pink bollworm damage, minimum (6.00%) was observed on genotype PB-896 followed by FH-Noor and IR-NIBGE-8 whereas maximum (12.29%) was observed on genotype FH-142.

2. EFFECT OF DIFFERENT TIMES OF SOWING ON INSECT PESTS INCIDENCE IN COTTON CROP

Eight dates of sowing viz: 01 March, 15 March, 01 April, 15 April, 01 May, 15 May, 01 June and 15 June 2016 were evaluated against insect pest complex on cotton variety FH-Kehkashan, FH-NOOR and FH-490. Whitefly, Jassid and Thrips population was recorded from 15 leaves of 15 plants selected at random from upper, middle and lower portions of plants, percentage damage of Pink Bollworm was observed by dissecting 25 randomly selected bolls per plot. Bio-control agents population was recorded on per plant basis. The data recorded are as under:-

Table 2(a): Effect of different times of sowing on Insect Pests attack on variety FH-Kahkashan during 2016

Sr. #	Date of sowing	Whitefly (pop/leaf)	Jassid (Pop/leaf)	Thrips (Pop/leaf)	PBW Infestation %	Bio-control agents pop/plant
T1	01 March	4.41 AB (0.13-8.33)	1.71 B (0.07-4.80)	2.34 BC (0.20-5.07)	10.27 ABC	4.47 A (0.60-8.0)
T2	15 March	4.05 AB (0.33-7.60)	2.08 AB (0.13-5.00)	2.19 C (0.13-3.07)	13.81 A	4.07 AB 0.13-4.33)
T3	01 April	3.69 AB (0.13-8.67)	2.18 AB (0.13-6.07)	2.33 BC (0.40-7.00)	10.61 ABC	3.47 C (0.33-5.53)
T4	15 April	3.71 AB (0.13-8.40)	1.92 AB (0.27-5.60)	2.36 BC (0.70-4.60)	8.19 C	3.59 BC (0.33-7.00)
T5	01 May	3.69 AB ((0.33-7.60)	2.78 A (0.13-6.60)	2.83 A (0.07-5.87)	7.90 C	3.285 C (0.60-3.53)
T6	15 May	2.85 B (1.60-7.20)	2.22 AB (0.20-6.53)	2.58 AB (0.40-3.20)	7.00 C	3.50 BC (1.71-4.13)
T7	01 June	2.56 B (1.40-8.87)	2.46 AB (0.20-6.67)	2.64 AB (0.87-4.07)	9.4 BC	2.57 D (0.54-2.60)
T8	15 June	5.14 A (1.60-9.47)	2.59 AB (0.73-6.00)	2.42 BC (0.80-2.40)	12.33 AB	2.04 D (1.12-2.47)
LSD at 5%		2.179	1.0186	0.3659	4.0839	0.5924

Average Whitefly population remained below ETL on most of the dates of sowing. However maximum whitefly population (5.14/leaf) was observed on 15th June sowing while minimum whitefly population (2.56/leaf) was observed on 1st-June sowing. Maximum Jassid population (2.78/leaf) was observed on 1st May sowing while minimum Jassid population (1.71/leaf) was observes on 1st March sowing. Thrips population remained below ETL on all the dates of sowing. However maximum Thrips population (2.83/leaf) was observed on 1st May sowing while minimum Thrips population (2.19/leaf) was observed on 15 March sowing. Maximum Pink bollworm infestation (13.81%) was recorded on 15th March sowing while minimum PBW infestation (7.00%) was observed on 15th May sowing. Maximum population of bio-control agents (4.47/plant) was recorded on 1st March sowing while minimum population of bio-control agents (2.04/plant) was found on 15 June sowing.

Table 2(b): Effect of different times of sowing on Insect Pests attack on variety (Fh-Noor)

Sr. #	Date of sowing	Whitefly (pop/leaf)	Jassid (Pop/leaf)	Thrips (Pop/leaf)	Infestation % Of PBW	Bio-control pop./plant
T1	01 March	5.59 A (0.20-15.00)	1.77 AB (0.07-8.27)	1.50 AB (0.07-4.40)	8.94 ABC	3.87 A (0.91-6.73)
T2	15 March	5.00 AB (0.20-17.67)	2.29 A (0.13-6.73)	1.62 AB (0.13-4.60)	10.00 ABC	3.55 A (0.87-6.53)
T3	01 April	4.63 ABC (0.60-13.53)	1.73 AB (0.13-7.07)	1.46 AB (0.07-4.33)	5.95 C	3.76 A (0.40-5.53)
T4	15 April	2.29 D (0.33-5.33)	1.82 AB (0.07-6.87)	1.73 AB (0.13-6.00)	8.76 ABC	3.25 A (0.33-8.33)
T5	01 May	2.94 CD (0.6-5.40)	1.66 AB (1.35-7.60)	1.78 AB (0.13-4.27)	7.479 BC	1.71 B (1.41-7.13)
T6	15 May	3.79 ABCD (0.80-9.67)	1.85 AB (0.40-6.27)	1.72 AB (0.27-4.13)	6.62 C	1.65 B (0.67-7.00)
T7	01 June	2.76 CD (1.53-8.20)	1.76 AB (0.87-6.33)	1.97 A (0.13-4.73)	10.78 AB	1.92 B (0.54-6.33)
T8	15 June	3.52 BCD (3.13-5.40)	1.58 B (1.00-5.67)	1.32 B (0.07-2.66)	12.73 A	1.78 B (0.12-5.40)
LSD at 5%		1.9404	0.6815	0.5122	4.1045	1.2396

Whitefly population remained below ETL on most of the dates of sowing. However maximum whitefly population (5.59/leaf) was observed on 1st March sowing while minimum whitefly population (2.29/leaf) was observed on 15th April sowing. Maximum Jassid population (2.29/leaf) was observed on 15th March sowing while minimum Jassid population (1.58/leaf) was observes on 15th June sowing. Thrips population remained below ETL on all the dates of sowing. However maximum Thrips population (1.97/leaf) was observed on 1st June sowing while minimum Thrips population (1.32/leaf) was observed on 15th June sowing. Maximum Pink bollworm infestation (12.73%) was recorded on 15th June sowing while minimum PBW infestation (5.95%) was observed on 1st April sowing. Maximum population of bio-control agents (3.87/plant) was recorded on 1st March sowing while minimum population of bio-control agents (1.65/plant) was found on 15th May sowing.

Table 2(c): Effect of different times of sowing on Insect Pests attack on variety (Fh-490)

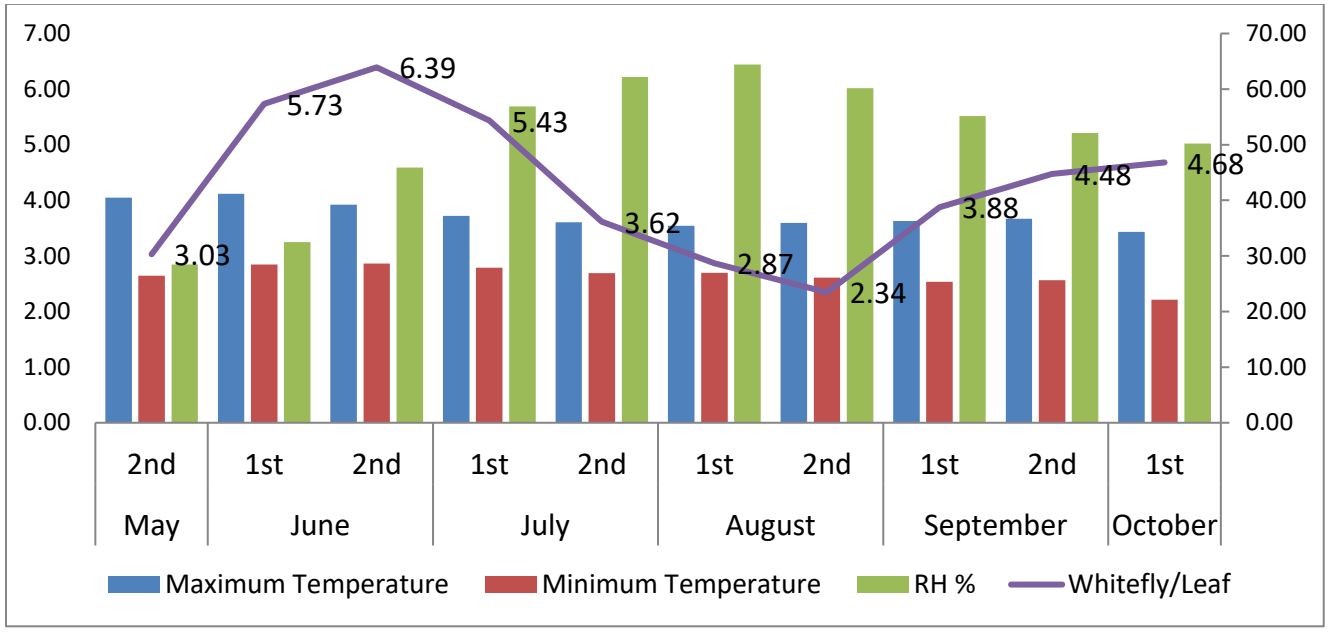
Sr. #	Date of sowing	Whitefly (pop/leaf)	Jassid (pop/leaf)	Thrips (pop/leaf)	Infestation % of PBW	Bio-control pop/plant
T1	01 March	2.89 CD (0.07-8.43)	2.05 A (0.13-9.67)	1.79 AB (0.20-3.87)	13.20 AB	3.43 A (0.87-8.20)
T2	15 March	5.57 A (0.33-9.01)	1.72 ABC (0.27-8.53)	2.36 AB (0.07-3.80)	13.46 A	2.60 B (0.53-7.40)
T3	01 April	4.16 ABC (0.47-9.27)	1.60 BC (0.07-6.60)	2.03 AB (0.33-5.27)	9.33 ABC	2.45 BC (0.40-6.47)
T4	15 April	2.22 D (0.39-4.87)	1.40 C (0.20-5.60)	2.68 A (0.20-6.13)	7.86 C	2.16 BC (0.33-4.67)
T5	01 May	2.18 D (0.67-4.73)	2.03 AB (0.20-6.53)	2.06 AB (0.20-7.20)	9.87 ABC	1.93 CD (0.40-6.67)
T6	15 May	3.39 BCD (0.13-6.80)	0.84 D (0.07-4.93)	1.78 AB (0.13-2.40)	8.66 BC	1.59 DE (0.43-5.40)
T7	01 June	3.12 BCD (0.66-9.93)	1.64 ABC (0.25-5.47)	1.61 B (0.38-4.13)	9.20 ABC	1.44 DE (0.26-5.33)
T8	15 June	4.77 AB (0.27-10.07)	1.34 C (1.00-4.47)	1.90 AB (0.20-2.93)	8.13 C	1.31 E (0.18-4.60)
LSD at 5%		1.8109	0.4422	1.0036	4.5451	0.5544

Whitefly population remained below ETL on most of the dates of sowing in Cotton (FH-490) crop. However maximum whitefly population (5.57/leaf) was observed on 15 th March sowing while minimum whitefly population (2.18/leaf) was observed on 1st-May sowing. Maximum Jassid population (2.05/leaf) was observed on 1st March sowing while minimum Jassid population (0.84/leaf) was observes on 15th May sowing. Thrips population remained below ETL on all the dates of sowing. However maximum Thrips population (2.68/leaf) was observed on 15th-April sowing while minimum Thrips population (1.61/leaf) was observed on 1st-June sowing. Maximum Pink bollworm infestation (13.46%) was recorded on 15th-March sowing while minimum PBW infestation (7.86%) was observed on 15th-April sowing. Maximum population of bio-control agents (3.43/plant) was recorded on 1st March sowing while minimum population of bio-control agents (1.31/plant) was found on 15th-June sowing.

3. STUDIES ON THE POPULATION DYNAMICS OF JASSID, THRIPS AND WHITEFLY ON BT COTTON

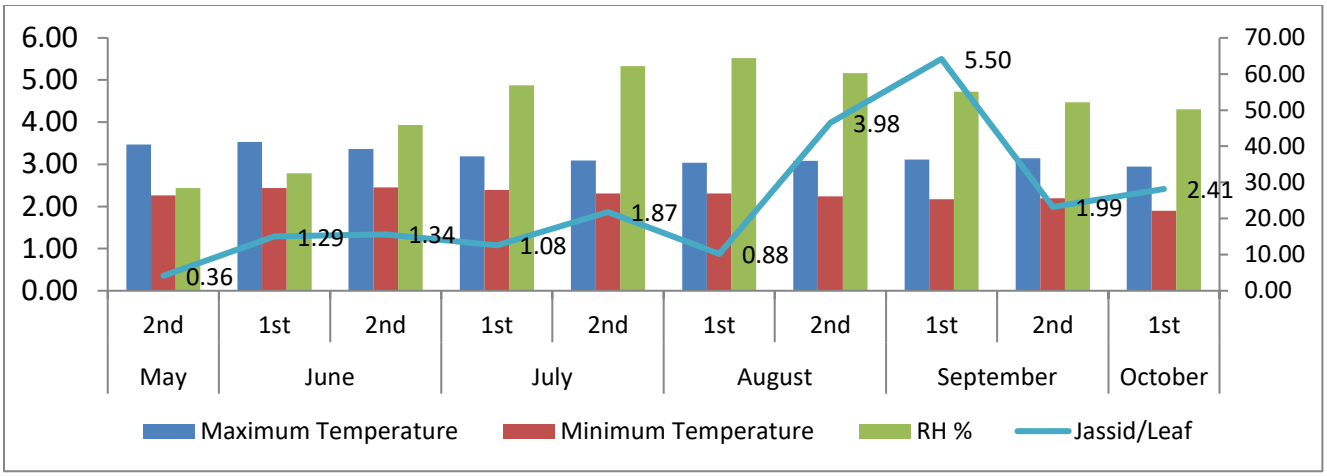
BT cotton crop was kept under observation throughout the crop season at Faisalabad. Data regarding Jassid, Thrips and whitefly population/leaf were recorded fortnightly by observing 15 randomly selected upper, middle and lower leaves of 15 plants per plot. Temperature and Relative Humidity data was also recorded.

Graph 3(a): Studies on the Population Dynamics of Whitefly on BT. Cotton



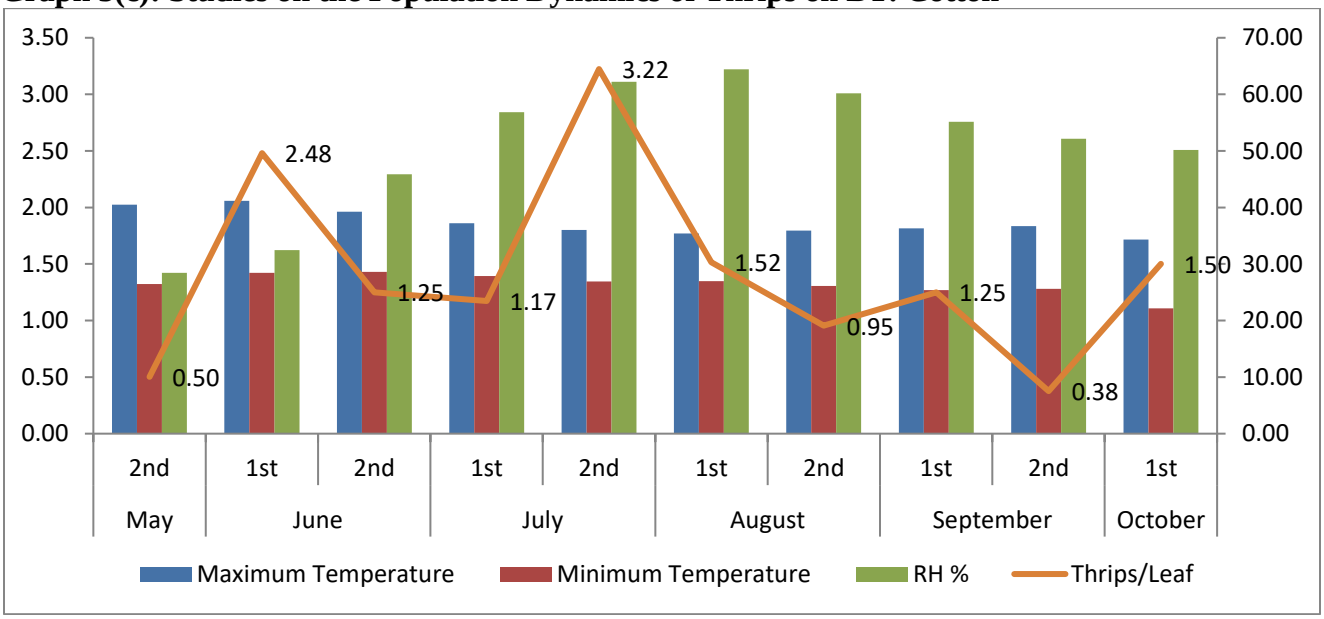
First peak in the season of Whitefly population (6.39/leaf) was observed in the second half of June. Later on slight decline in population was observed up to 2nd fortnight of August. After that pest's population increased again up to the end of season. minimum whitefly population was recorded during 2nd week of August.

Graph 3(b): Studies on the Population Dynamics of Jassid on BT. Cotton



Graph indicates that maximum population of Jassid (5.50/leaf) was observed in the first fortnight of September, while minimum jassid population (0.36/leaf) was observed in the 2nd fortnight of May.

Graph 3(c): Studies on the Population Dynamics of Thrips on BT. Cotton



Maximum population of Thrips (3.22/leaf) was observed in the second half of June, while minimum Thrips population (0.38/leaf) was observed in the 2nd half of September.

Correlation between weather factors and Sucking Insect Pests of Cotton

	Whitefly/Leaf	Jassid/ Leaf
Maximum Temperature	0.3455 (0.3282)	-0.4778 (0.1625)
Minimum Temperature	0.7737**	-0.3389

	(0.0086)	(0.3382)
Relative Humidity %	-0.0504 (0.890)	0.4318 (0.2127)

Average Jassid population per leaf showed significant and positive correlation with minimum temperature while positive and highly significant with percent relative humidity. Average thrips population per leaf showed significant and positive correlation with temperature while negative and non-significant with percent relative humidity. Average whitefly population per leaf showed +ve and non-significant correlation with temperature and –ve correlation with percent relative humidity

4. EFFICACY OF NEW INSECTICIDES AGAINST COTTON WHITEFLY (*BEMISIA TABACI*)

The efficacy of twenty new chemistry insecticides viz. Legend 0.5% AS (Matrine) Movento 240 SC (Spirotetramat), Alpine 20 SG (Dinotefuran), Marine 20 SC (Clothianidin), Red Card 75% SP (Acephate), Lanolax 30% WDG (Pyriproxyfen), Vapco 40 % WDG (Acetamiprid), Coniflex 50 % WP (imidacloprid), Coniflex 70 % WP (Imidacloprid), Priority 10.8 EC (Pyriproxyfen), Rani 20 % SL (Acetamiprid), Commando Plus 97 DF (Acephate), Coniflex 20 % SL (Imidacloprid), Tri Super 40% EC (Triazophos), Trizone 40% EC (Triazophos), Concept Plus 35% EC (Pyreproxyfen+ Acephate+Fenpyroximate), Confidor 20 SL (Imidacloprid), Talstar 10% EC (Bifenthrin) New recipe C9 solvent, Novastar 56EC Bifenthrin+Abamectin and Reznor 20% SL (Imidacloprid) were tested against white fly (*Bemisia tabaci*) on cotton crop. Trial was conducted in the research area of Entomological Res. Institute Faisalabad in RCB Design with three repeats. Treatments were applied when insect pest reached ETL. Whitefly population was recorded after 3 & 7 days of spray from 15 randomly selected upper, middle and lower leaves of 15 plants per plot. Beneficial insects data were recorded from randomly selected five plants per plot. The data recorded are as under:-

Table 4: Efficacy of new Insecticides against Cotton Whitefly (*Bemisia Tabaci*)

Treatments		**Dose/acre (ml/gm)**	**Post-Treatment Data of Whitefly pop./leaf**		**% Mortality**		**Beneficial After 7 Days of treatment**	**% Survival**
			72-HAA	**7-DAA**	**72-HAA**	**7-DAA**		
T1	Legend 0.5% AS (Matrine)	500 ml	0.92	1.51	86.15 A	81.46 AB	2.69	56.78 B

T2	Movento 240 SC (Spirotetramat)	125 ml	1.03	1.61	84.36 AB	80.53 ABC	2.78	58.64 B
T3	Alpine 20 SG (Dinotefuran)	120 gm	1.32	1.78	80.08 BCDE	78.64 ABC	2.82	59.63 B
T4	Marine 20 SC (Clothianidin)	100 gm	1.17	1.62	82.39 ABCD	80.51 ABC	2.65	55.37 B
T5	Red Card 75% SP (Acephate)	250 gm	1.52	2.07	77.01 E	75.27 BC	2.09	45.12 C
T6	Lanolax 30% WDG (Pyriproxyfen)	100 gm	1.32	2.06	79.95 BCDE	74.83 BC	2.56	53.83 BC
T7	Vapco 40 % WDG (Acetamiprid)	100 gm	1.37	1.79	79.37 DE	78.41 ABC	2.62	55.49 B
T8	Coniflex 50 % WP (imidacloprid)	100 gm	1.19	1.85	82.15 ABCD	77.68 ABC	2.82	60.49 B
T9	Coniflex 70 % WP (Imidacloprid)	100 gm	1.31	1.79	80.32 BCDE	78.67 ABC	2.62	55.49 B
T10	Priority 10.8 EC (Pyriproxyfen)	100 gm	1.32	1.42	80.15 BCDE	82.70 A	2.68	57.02 B
T11	Rani 20 % SL (Acetamiprid)	125 gm	1.20	1.66	81.84 ABCD	79.63 ABC	2.83	59.77 B
T12	Commando Plus 97 DF (Acephate)	300 gm	1.54	2.11	76.92 E	74.40 C	2.81	59.87 B
T13	Coniflex 20 % SL (Imidacloprid)	250 ml	1.28	1.75	80.79 BCDE	78.73 ABC	2.78	58.64 B
T14	Tri Super 40% EC (Triazophos)	1000 ml	1.36	1.97	79.52 CDE	75.67 BC	2.73	57.96 B
T15	Trizone 40% EC (Triazophos)	1000 ml	1.47	2.15	77.94 DE	73.79 C	2.58	54.94 B
T16	Concept Plus 35% EC (Pyreproxyfen+ Acephate+Fenpyroximate)	750 ml	1.07	1.60	84.00 ABC	80.67 ABC	2.62	55.49 B
T17	Confidor 20 SL (Imidacloprid)	250 gm	1.36	1.86	79.50 CDE	77.63 ABC	2.83	60.29 B
T18	Talstar 10% EC (Bifenthrin) New recipe C9 solvent	250 ml	1.40	1.97	78.91 DE	76.49 ABC	2.56	53.83 BC
T19	Novastar 56EC Bifenthrin+Abamectin	250 ml	1.38	1.86	79.08 DE	77.86 ABC	2.62	55.49 B
T20	Reznor 20% SL (Imidacloprid)	250 ml	1.42	1.99	78.59 DE	76.13ABC	2.69	57.16 B

T21	Check		6.63	8.28	0.00 F	0.00 D	4.73	100.00 A
	LSD at 5%				4.584	6.9325		8.9049

Results indicated that Legend 0.5% AS (Matrine) @ 500 gm/acre gave the maximum pest mortality (86.15%) followed by Movento 240 SC (Spirotetramat) with percentage mortality of 84.36 % while the minimum pest mortality (76.92%) was observed in plots treated with Commando Plus 97 DF (Acephate) @ 300 gm/acre after 72 hrs of application. After 7 days of application, maximum mortality (82.70%) was recorded in plots treated with Priority 10.8 EC (Pyriproxyfen) while minimum (73.79%) was recorded in Trizone 40% EC (Triazophos).

5. EFFICACY OF NEW ACARICIDES AGAINST MITES ON COTTON CROP

Thirteen new chemistry insecticides viz Concept Plus 35% EC (Pyriproxyfen+ Acephate+Fenproximate), Unique-M 5% EC (Fenproximate) Vibrant Super 23 % SC (Chlorfenapyr 18%+ Fenproximate 5%), Resham Plus 10.5% EC (Bifenthrin+Abamectin), Foxal 36% SC (Chlorfenapyr), Solvigo 108 SC (Abamectin 3.6% + Thiamethoxam 7.2%), Pirate 36% SC (Chlorfenapyr), Fighter 5% EC (Abamectin 1.85+ Imidacloprid 3.2%), Talstar 10% EC (Bifenthrin) New recipe C9 solvent, Novastar 56 EC (Bifenthrin+Abamectin), Polo 500 SC (Diafenthiuron), Fighter 13.3 EC (abamectin+ imidacloprid), Foxal 50% WDG (Chlorfenapyr) were tested against mites in cotton. Trial was conducted in the research area of Entomological Res. Institute Faisalabad in RCB Design with three repeats. Treatments were applied when insect pest reached ETL. Mite population was recorded after 3 & 7 days of spray from 15 randomly selected leaves of 15 plants per plot. The data recorded are as under:-

Table 5: Efficacy of new acaricides against Mites on Cotton crop

Treatments		Dose/acre (ml/gm)	Post-Treatment Data of Mite population/leaf		% Mortality		Beneficial After 7 Days of treatment	% Survival
			72-HAA	7-DAA	72-HAA	7-DAA		
T1	Concept Plus 35% EC (Pyriproxyfen+ Acephate+Fenproximate)	750 ml	2.35	3.19	86.05 A	83.91 A	3.42	56.67 C
T2	Unique-M 5% EC (Fenproximate)	200 ml	3.30	3.91	80.37 AB	80.36 A-E	3.47	57.31 C

T3	Vibrant Super 23 % SC (Chlorfenapyr 18%+ Fenproximate 5%)	200 ml	2.72	3.56	83.71 AB	82.05 A-D	3.42	56.47 C
T4	Resham Plus 10.5% EC (Bifenthrin+Abamectin)	400 ml	3.20	4.29	80.92 AB	78.36 BCDE	3.58	59.47 BC
T5	Foxal 36% SC (Chlorfenapyr)	100 ml	3.07	3.53	81.63 AB	82.19 ABC	3.30	54.39 C
T6	Solvigo 108 SC (Abamectin 3.6% + Thiamethoxam 7.2%)	500 ml	3.47	4.27	79.38 B	78.51 BCDE	3.45	56.99C
T7	Pirate 36% SC (Chlorfenapyr)	75 ml	2.87	3.38	82.90 AB	82.99 AB	3.29	54.46 C
T8	Fighter 5% EC (Abamectin 1.85+ Imidacloprid 3.2%)	400 ml	3.06	4.70	81.73 AB	76.32 EF	3.37	56.28 C
T9	TALSTAR 10% EC (Bifenthrin) New recipe C9 solvent	250 ml	3.26	4.89	80.57 AB	75.37 EF	3.29	54.50 C
T10	Novastar 56 EC (Bifenthrin+Abamectin)	250 ml	3.18	4.45	80.90 AB	77.64 CDEF	3.29	54.78 C
T11	Polo 500 SC (Diafenthiuron)	200 ml	3.64	5.45	78.32 B	72.59 F	3.89	64.76 B
T12	Fighter 13.3 EC (abamectin+ imidacloprid)	200 ml	3.57	4.56	78.69 B	77.06 DEF	3.56	58.65 BC
T13	Foxal 50% WDG (Chlorfenapyr)	75 ml	3.24	4.62	80.64 AB	76.72 EF	3.22	53.33 C
T14	Check		16.80	19.87	0.00 C	0.00 G	6.06	100.00 A
	LSD at 5%				6.5897	5.1101		6.2942

After 72 hours of treatment application, maximum mortality (86.05%) was observed in plot treated with Concept Plus 35% EC (Pyriproxyfen+ Acephate+Fenproximate) followed by Vibrant Super 23 % SC (Chlorfenapyr 18%+ Fenproximate 5%) with mortality of 83.71%, while minimum mortality (78.32%) was observed in plot treated with Polo 500 SC (Diafenthiuron). After 7 days of treatment, maximum mortality (83.91%) was observed in Concept Plus 35% EC (Pyriproxyfen+ Acephate+Fenproximate) and minimum (75.37%) was observed in Talstar 10% EC (Bifenthrin) New recipe C9 solvent.

6. EFFICACY OF NEW INSECTICIDES AGAINST ARMYWORM ON COTTON CROP

Fifteen new chemistry insecticides including Foxal 36% SC (Chlorfenapyr), Foxal 50% WDG (Chlorfenapyr), Deltamax 36% EC (Deltamethrin +Triazophos), Counter plus 36% EC (Deltamethrin+Triazophos), Checkworm 5% EC (Emmamectin benzoate), Timer 5% EC (Emmamectin benzoate), Latch 10% EC (Lufenuron), Track 10% EC (Lufenuron), Pirate 36%

SC (Chlorfenapyr) Proclaim 1.9 EC (Emmamectin Benzoate), X-Tall 43.6% EC (Leufenuron + Indoxacarb + Triazophos), Resham Plus 13.3% EC (Abamectin+ Imidacloprid) Fighter 13.3% EC Abamectin+ Imidacloprid), Takumi 20% SC (Flubendiamide) Belt 48% SC (Flubendiamide) were tested for standardization of insecticides against Army worm on cotton crop. Army worm population was recorded after 3 & 7 days of spray from 5 randomly selected plants. The data recorded are as under:-

Table 6: Efficacy of new Insecticides against Armyworm in Cotton Crop

Treatments		**Dose/hlw (ml/gm)**	**Post-Treatment Data of Armyworm larval pop/plant**		**% Mortality AFTER**		**Beneficial After 7 Days of treatment**	**% Survival**
			72-HAA	**7-DAA**	**72-HAA**	**7-DAA**		
T1	Foxal 36% SC (Chlorfenapyr)	100 ml	0.67	0.87	79.67 ABC	83.26 CDE	3.07	66.75 D
T2	Foxal 50% WDG (Chlorfenapyr)	75 gm	0.60	0.83	81.67 AB	84.16 BCDE	3.00	65.43 D
T3	Deltamax 36% EC (Deltamethrin + Triazophos)	600 ml	0.80	0.95	75.74 C	81.81 E	2.40	52.17 EF
T4	Counter plus 36% EC (Deltamethrin+Triazophos)	600 ml	0.73	0.93	77.22 BC	82.08 DE	2.20	47.95 F
T5	Checkworm 5% EC (Emmamectin benzoate)	75 ml	0.70	0.97	78.37 ABC	81.44 E	3.20	69.72 CD
T6	Timer 5% EC (Emmamectin benzoate)	75 ml	0.64	0.91	80.59 ABC	82.42 DE	3.13	68.26 CD
T7	Latch 10% EC (Lufenuron)	100 ml	0.70	0.89	78.62 ABC	82.88 DE	3.27	70.98 BCD
T8	Track 10% EC (Lufenuron)	100 ml	0.67	0.95	79.44 ABC	81.64 E	3.20	69.47 CD
T9	Pirate 36% SC (Chlorfenapyr)	330 ml	0.63	0.73	80.77 ABC	85.88 ABCD	3.13	68.08 D
T10	Proclaim 1.9 EC (Emmamectin Benzoate)	200 ml	0.71	0.95	78.17 ABC	81.61 E	3.27	70.98 BCD
T11	X-Tall 43.6% EC (Leufenuron + Indoxacarb + Triazophos)	1000 ml	0.53	0.69	83.38 A	86.74 ABC	2.67	58.04 E
T12	Resham Plus 13.3% EC (Abamectin+	200 ml	0.67	0.91	79.67 ABC	82.45 DE	2.53	55.20 E

	Imidacloprid)							
T13	Fighter 13.3% EC Abamectin+ Imidacloprid)	200 ml	0.63	0.83	80.78 ABC	84.13 BCDE	2.47	53.69 EF
T14	Takumi 20% SC (Flubendiamide)	120 ml	0.63	0.67	81.01 ABC	87.16 AB	3.47	75.27 BC
T15	Belt 48% SC (Flubendiamide)	50 ml	0.56	0.60	82.86 A	88.50 A	3.55	77.13 B
T16	Check		3.27	5.20	0.00 D	0.00 F	4.60	100.00 A
	Lsd at 5%				5.5564	3.8497		7.1695

Results indicated that maximum mortality (83.38%) was recorded in plot treated with X-Tall 43.6% EC (Leufenuron + Indoxacarb + Triazophos) followed by Belt 48% SC (Flubendiamide) with mortality of 82.86% while the minimum mortality (75.74%) was observed in plots treated with Deltamax 36% EC (Deltamethrin + Triazophos) after 72 hrs of application. After 7 days of application Belt 48% SC (Flubendiamide) gave the maximum mortality (88.50%) while the minimum mortality (81.44%) was observed in plot treated with Checkworm 5% EC (Emmamectin benzoate).

7. EFFICACY OF NEW INSECTICIDES AGAINST COTTON THRIPS ON COTTON CROP

Ten new chemistry insecticides including Octane 20 SG (Dinotefuran), Alpine 20 SG (Dinotefuran), Marine 20 SC (Clothianidin), Red Card 75% SP (Acephate), Vapco 40 % WDG (Acetamiprid), Coniflex 50 % WP (Imidacloprid), Foxal 50 % WDG (Chlorfenapyr), Coniflex 70 % WP (Imidacloprid), Rani 20 % SL (Acetamiprid), Commando Plus 97 DF (Acephate) were tested for standardization of insecticides against Thrips on cotton crop. Trail was conducted in the research area of Entomological Research Institute, Faisalabad in RCB Design with three repeats. Treatments were applied when pest population reached ETL. Thrips population was recorded after 3 & 7 days of spray from 15 randomly selected upper, middle and lower leaves of 15 plants per plot. Beneficial insects data were recorded from randomly selected five plants per plot. The data recorded are as under:-

Table 7: Efficacy of new Insecticides against Cotton Thrips on Cotton Crop

Treatments	Dose/hlw (ml/gm)	Post-Treatment Data of Thrips pop./ Leaf	% Mortality	Beneficial /Plant After 7	% Survival

			72-HAA	7-DAA	72-HAA	7-DAA	Days	
T1	Octane 20 SG (Dinotefuran)	200 ml/ac	2.60	3.40	82.27 AB	80.10 BC	4.27	64.63 B
T2	Commando Plus 97 DF (Acephate)	120 gm	2.27	3.27	84.57 A	80.86 BC	4.33	65.61 B
T3	Marine 20 SC (Clothianidin)	100 gm	2.60	3.40	82.34 AB	80.01 BC	4.47	67.63 B
T4	Red Card 75% SP (Acephate)	250 gm	1.87	2.87	87.34 A	83.13 AB	3.53	53.57 D
T5	Vapco 40 % WDG (Acetamiprid)	100 gm	2.53	3.33	82.91 AB	80.42 BC	4.13	62.64 B
T6	Coniflex 50 % WP (imidacloprid)	100 gm	2.60	3.40	82.14 AB	80.05 BC	4.27	64.59 B
T7	Foxal 50 % WDG (Chlorfenapyr)	100 gm	2.00	2.60	86.44 A	84.69 A	4.40	66.67 B
T8	Coniflex 70 % WP (Imidacloprid)	100 gm	2.60	3.53	82.22 AB	79.19 CD	4.20	63.67 B
T9	Rani 20 % SL (Acetamiprid)	125 gm	3.07	4.07	79.08 B	76.14 D	4.07	61.66 BC
T10	Commando Plus 97 DF (Acephate)	300 gm	1.93	3.13	86.91 A	81.62 ABC	3.60	54.55 CD
T11	Check	--	14.73	17.07	0.00 C	0.00 E	6.60	100.00 A
	LSD at 5%				5.2176	3.3471		7.4571

Results indicated that maximum mortality (87.34%) was recorded in the plot treated with Red Card 75% SP (Acephate) followed by Commando Plus 97 DF (Acephate) and Foxal 50 % WDG (Chlorfenapyr) with percentage mortalities 86.91% and 86.44%, respectively after 72 hrs of spray application, whereas minimum mortality (79.08%) was observed in plot treated with Rani 20 % SL (Acetamiprid). After 7 days of treatment application, Foxal 50 % WDG (Chlorfenapyr) gave the maximum mortality (84.69%) followed by Red Card 75% SP (Acephate) while the minimum mortality (76.14. %) was again observed in plot treated with Rani 20 % SL (Acetamiprid).

8. EFFICACY OF DIFFERENT INSECTICIDES AGAINST DUSKY COTTON BUG

Fifteen new insecticides Viz: Legend 0.5% AS (Matrine), X-Tall 43.6% EC (Leufenuron+Indoxacarb+Triazophos), Cydox 36% EC(Deltamethrin + Triazophos), Capital Plus 41.7% (Betacyfluthrin + Triazophos), Verdict 52 % EC (Profenofos + Lambda-cyhalothrin), Lesenta 80% WG (Fipronil+Imidacloprid), Picador 10% EC (Bifenthrin), Deltamax 36% EC (Deltamethrin+Triazophos), Radiant 120 SC (Spinetoram), Karate 2.5 EC (Lambda-Cyhalothrin), Lancer 10 EC (Lambdacyhalothrin), Lannate 20% SP (Methomyl), Fighter 13.3% EC (Abamectin+ Imidacloprid) , Talstar 10% EC (Bifenthrin), Novastar 56 EC (Bifenthrin+Abamectin) were tested in order to find out the efficacy of these insecticides against Dusky Cotton Bug. Insecticides were applied when insect pest reached ETL. For data recording, pest population was recorded after 72 hours and 7 days of treatment application by taking 15 bolls of 5 randomly selected plants per plot. Percentage mortalities were calculated and data so obtained was subjected to statistical analysis. The data recorded are as under:

Table 8: Efficacy of different Insecticides against Dusky Cotton Bug

Treatments		Dose/acre (ml/gm)	Post-Treatment Data of DCB pop/boll		% Mortality after		Beneficials After 7 Days of treatment	% Survival
			72-HAA	7-DAA	72-HAA	7-DAA		
T1	Legend 0.5% AS (Matrine)	500 ml	2.67	2.67	84.86 ABC	87.58 A	3.53	71.61 B
T2	X-Tall 43.6% EC (Leufenuron+Indoxacarb+Triazophos)	1000 ml	2.73	3.87	84.55 BC	81.91 BCD	2.87	58.17 CDEF
T3	Cydox 36% EC(Deltamethrin + Triazophos)	600 ml	3.47	4.87	80.39 DEF	77.34 EF	2.47	50.00 G
T4	Capital Plus 41.7% (Betacyfluthrin + Triazophos)	500 ml	2.07	3.73	88.25 AB	82.61 BC	2.60	52.72 EFG
T5	Verdict 52 % EC (Profenofos + Lambda-cyhalothrin)	1000 ml	3.80	3.80	78.54 EFG	82.38 BC	2.47	50.00 G
T6	Lesenta 80% WG (Fipronil+Imidacloprid)	60 gm	2.07	3.27	88.34 A	84.81 AB	2.67	54.06 DEFG
T7	Picador 10% EC (Bifenthrin)	330 ml	4.33	6.67	75.49 G	68.78 G	2.93	59.44 CDE
T8	Deltamax 36% EC (Deltamethrin+Triazophos)	600 ml	3.07	5.00	82.63 CD	76.76 EF	2.53	51.44 FG

T9	Radiant 120 SC (Spinetoram)	1000 ml	3.87	6.13	78.19 FG	71.21 G	3.73	75.67 B
T10	Karate 2.5 EC (Lambda-Cyhalothrin)	330 ml	3.87	6.47	78.08 FG	69.65 G	2.73	55.44 DEFG
T11	Lancer 10 EC (Lambdacyhalothrin)	60 ml	2.93	4.60	83.39 CD	78.52 DEF	2.60	52.78 EFG
T12	Lannate 20% SP (Methomyl)	250 gm	3.80	5.33	78.56 EFG	75.12 F	2.53	51.33 FG
T13	Fighter 13.3% EC (Abamectin+ Imidacloprid)	200 ml	3.60	6.33	79.67 DEF	70.43 G	3.13	63.50 C
T14	Talstar 10% EC (Bifenthrin)	250 ml	3.93	5.33	77.75 FG	75.12 F	2.87	58.06 CDEF
T15	Novastar 56 EC (Bifenthrin+Abamectin)	250 ml	3.13	4.27	82.26 CDE	80.09 CDE	3.00	60.89 CD
T16	Check		17.67	21.40	0.00 H	0.00 H	4.93	100.0 A
	Lsd 5%				3.7512	3.7729		7.5225

Lesenta 80% WG (Fipronil+Imidacloprid) gave the maximum mortality (88.34%) while the minimum mortality (75.49%) was observed in plot treated with Picador 10% EC (Bifenthrin) after 72 hrs of spray application. After 7 days of spray application, Legend 0.5% AS (Matrine) gave the maximum mortality (87.58%) while the minimum mortality (68.78%) was observed in plots treated with Picador 10% EC (Bifenthrin).

9. EFFICACY OF DIFFERENT SEED DRESSING INSECTICIDES AGAINST WHITEFLY, JASSID AND THRIPS ON COTTON CROP

Six new seed dressing insecticides Viz: Argyl Super (Azoxystrobin+Clothianidin), Actara 70WS (Thiamethoxam), Cruiser 350 TS (Thiamethoxam), Hombre 13.62 FS (Imidacloprid16.36%+Tebuconazole 0.57%), Coniflex 70 WS (Imidacloprid), Confidor 70 WS (Imidacloprid) were tested in order to find out their efficacy against whitefly, Jassid and Thrips on cotton. The insect pest populations were recorded from 15 leaves of 15 randomly selected plants. The percent reduction in insect pest population were calculated after 10, 20 and 30 days of germination. The data recorded are as under:

Table 9(a): Efficacy of different Seed Dressing Insecticide against Whitefly on Cotton Crop

Treatments		Dose gm/kg of seed	Cotton whitefly population/leaf			% reduction		
			10-DAG	20-DAG	30-DAG	10-DAG	20-DAG	30-DAG
T1	Argyl Super (Azoxystrobin + Clothianidin)	9 gm	0.25	0.78	1.13	83.41 AB	80.16 A	78.93 A
T2	Actara 70 WS	03 gm	0.31	0.93	1.33	79.21 B	76.06 B	75.21B

	(Thiamethoxam)							
T3	Cruiser 350 TS (Thiamethoxam)	10 ml	0.29	0.84	1.24	80.46 AB	78.53 AB	76.83 AB
T4	Hombre13.62 FS (Imidacloprid 16.36%+Tebuconazole 0.57%)	10 ml	0.24	0.78	1.13	83.82 A	80.19 A	78.93 A
T5	Talent 48C (Thiocloprid)	5 gm	0.29	0.89	1.27	80.57 AB	77.38 AB	76.55 AB
T6	Confidor70 WS Imidacloprid	5 gm	0.31	0.82	1.20	79.21B	78.90 AB	77.88 AB
T7	Check	_	1.49	3.93	5.40	0.00 C	0.00 C	0.00 C
LSD at 5%						4.3653	2.9296	3.5073

Hombre 13.62 FS (Imidacloprid16.36%+Tebuconazole 0.57%) gave the maximum mortality (83.82%), (80.19) and (78.93) while the minimum mortality (79.21%), (76.06%) and (75.21%) was observed in plot treated with Actara 70 WS (Thiamethoxam) after 10, 20 and 30-days of germination respectively.

Table 9(B): Efficacy of different Seed Dressing Insecticide against Jassid on Cotton Crop

Treatments		**Dose gm/kg of seed**	**Cotton Jassid population/leaf**			**% reduction**		
			10-DAG	**20-DAG**	**30-DAG**	**10-DAG**	**20-DAG**	**30-DAG**
T1	Argyl Super (Azoxystrobin+Clothianidin)	9 gm	0.13	0.15	0.40	82.24 A	84.77 A	79.06 A
T2	Actara 70 WS (Thiamethoxam)	03 gm	0.15	0.20	0.42	78.69 A	80.26 A	77.81 A
T3	Cruiser 350 TS (Thiamethoxam)	10 ml	0.12	0.18	0.40	83.76 A	82.44 A	79.14 A
T4	Hombre 13.62 FS (Imidacloprid16.36 % +Tebuconazole 0.57%)	10 ml	0.13	0.16	0.40	82.18 A	83.90 A	78.88 A
T5	Coniflex 70 WS (Imidacloprid)	5 gm	0.14	0.21	0.40	80.06 A	79.54 A	78.93 A
T6	Confidor70 WS Imidacloprid	5 gm	0.13	0.20	0.40	81.43 A	80.26 A	79.14 A
T7	Check		0.73	1.00	1.91	0.00 B	0.00 B	0.00 B
	LSD at 5%					11.617	5.9906	6.0016

Results indicated that percent mortalities did not differ significantly among treatments. However Cruiser 350 TS (Thiamethoxam) gave the maximum mortality (83.76%), (82.44%) and

(79.14%) while the minimum mortality (78.69%), (80.26%) and (77.81%) was observed in plot treated with Actara 70 WS (Thiamethoxam) after 10, 20 and 30-days of germination respectively.

Table 9(c): Efficacy of different Seed Dressing Insecticide against Thrips on Cotton Crop

Treatments		Dose gm/kg of seed	Cotton Thrips population/leaf			% reduction		
			10-DAG	20-DAG	30-DAG	10-DAG	20-DAG	30-DAG
T1	Argyl Super (Azoxystrobin+Clothianidin)	9 gm	0.73	1.53	2.87	85.31 AB	83.05 A	80.07 A
T2	Actara 70 WS (Thiamethoxam)	03 gm	0.89	1.69	3.07	82.20 B	81.22 A	78.67 A
T3	Cruiser 350 TS (Thiamethoxam)	10 ml	0.78	1.73	3.00	84.22 AB	80.75 A	79.14 A
T4	Hombre 13.62 FS (Imidacloprid16.36%+ Tebuconazole 0.57%)	10 ml	0.69	1.51	2.87	85.77 A	83.22 A	80.06 A
T5	Coniflex 70 WS (Imidacloprid)	5 gm	0.89	1.78	3.13	82.03 B	80.23 A	78.26 A
T6	Confidor70 WS Imidacloprid	5 gm	0.82	1.62	2.93	83.22 AB	81.98 A	79.62 A
T7	Check		5.07	9.04	14.40	0.00 C	0.00 B	0.00 B
	LSD 5 %					3.38	4.14	1.92

Hombre 13.62SFS (Imidacloprid16.36%+Tebuconazole 0.57%) gave the maximum mortalities (85.77%), (83.22) and (80.06) while the minimum mortalities (82.03%), (80.23%) and (78.26%) were observed in plot treated with Coniflex 70 WS (Imidacloprid) after 10, 20 and 30-days of germination respectively.

10. EFFECT OF SOME NEW CHEMISTRY INSECTICIDES AGAINST DUSKY COTTON BUG (OXYCARENUS LATEUS)

Six new insecticides having two doses each against dusky cotton bug at Cotton Research Station, Multan. The trial was conducted in RCBD with three repeats on cotton variety Bt. 886. Data of pest population was recorded from each plot before the treatment and then after 24 , 72 hours and 7 days of spray by counting both adults and nymphs from 5 opened bolls of five randomly selected plants per plot. Pest mortality was calculated on the basis of pre-treatment data. Data so obtained were finally analyzed statistically.

Table 10: Efficacy of New Chemistry Insecticides against Dusky Cotton Bug

Sr.No.	Insecticides	Dose/Acre	Percentage mortality of DCB after		
			24 HAA	72 HAA	7 DAA

1.	Imidacloprid 200SL	250ml	38.41d	40.68i	43.77d
	Imidacloprid 200SL	300ml	40.37d	42.16hi	46.14d
2.	Acetamiprid 20SP	125gm	48.03c	43.85gh	45.57d
	Acetamiprid 20SP	150gm	49.39c	46.28fg	46.17d
3.	Pyramid 10SL	100ml	50.53c	51.29de	58.07b
	Pyramid 10SL	125ml	48.35c	49.31ef	52.53c
4.	Tracer 240SC	40ml	51.29c	55.89c	52.51c
	Tracer 240SC	60ml	48.56c	50.80de	50.36c
5.	Pirate 360SC	100ml	47.65c	50.49de	46.68d
	Pirate 360SC	150ml	47.26c	52.68d	52.86c
6.	Lasenta 80WG	40gm	65.79b	70.61b	78.23a
	Lasenta 80WG	60gm	70.40a	77.89a	80.27a
7.	Control		7.14e	4.16e	5.15j
LSD @ 5%			4.06	3.16	3.34

After 24 hours maximum pest mortality 70.40% was observed in plot treated with Lasenta 80WG @ 60 gm/acre and it was statistically differed from all other treatments. Lasenta 80W G@ 40gm/acre gave good control of pest and it reduce pest population by 65.79% and it was statistically different from all other insecticides. Imidacloprid 200 SL at both doses did not perform well and cause only 38.41 and 40.37% mortality of insect pest respectively.

11. STUDIES ON THE POPULATION DYNAMICS OF DUSKY COTTON BUG ON BT. & NON BT. COTTON

The trial was laid out at Cotton Research Station, Multan. Bt. and Non Bt. cotton crop. The trial was conducted in RCBD with three repeats on cotton varieties Bt. MNH-886 and non-Bt. MNH-814. The population of Dusky Cotton Bug was recorded from each plot by counting both adults and nymphs from 5 opened bolls of five randomly selected plants per plot. Finally, the data was compiled and analyzed statistically and co related with meteorological factors.

Table 11: Population Dynamics of Dusky Cotton Bug on BT and Non BT Cotton

MONTH	WEEK	DCB/PLANT	METEROLOGICAL FACTORS

		BT.COTTON MNH-886	NON BT.COTTON MNH-814	MAX TEMP (C^O)	MINI TEMP (C^O)	R.H%	RAINFALL (mm)
July	1st	6.05	5.37	33.14	25.28	86	16.86
	2nd	7.01	5.38	36.71	26.28	79.57	0
	3rd	9.84	6.88	37.28	27.29	74.57	1.28
	4th	11.18	7.15	41.57	30.71	85.71	0.86
August	1st	13.41	8.23	36.14	25.57	82.57	0.85
	2nd	8.03	7.01	36.57	25.28	74.35	7.42
	3rd	8.34	6.4	38.51	26.57	76.54	0
	4th	7.69	6.46	35.42	25	73.14	2.71
Sept	1st	14.94	10.31	37	25.6	74	0
	2nd	15.48	9.74	35.1	24.5	74.6	0
	3rd	12.44	8.83	35.9	24.9	68.5	0
	4th	10.49	7.69	32.9	21	72.6	18
October	1st	10.48	8.23	31.9	18.6	78	0
	2nd	8.88	6.55	31.6	19.7	69.4	0
	3rd	8.73	9.21	29.4	16.7	72.4	0
	4th	16	11.02	28.5	11.3	76.8	0
Nov	1st	14.07	10.92	29	10	75	0
	2nd	18.54	11.87	28.5	10.5	74.6	0

DCB/ Open Boll	TEMPERATURE		RELATIVE HUMIDITY (%)	RAINFALL (MM)
	MAXIMUM TEMPERATURE (°C)	MINIMUM TEMPERATURE (°C)		
Bt. Cotton	-0.34 (0.17)	-0.51 (0.31)	-0.15 (0.56)	-0.39 (0.12)
Non Bt. Cotton	-0.57 (0.02)	0.94 (0.00)	0.31 (0.22)	-0.02 (0.94)

The results reveled that Dusky cotton bug appeared on Bt cotton during 1st week of July with 6.05/boll and it gradually increased in subsequent weeks and reached to its peak population

during 2nd week of September with average 15.48 insect /boll. 2nd maximum population was observed during 2nd week of November 18.54 insect /boll.

On Non Bt cotton variety Dusky cotton also appeared on 1st week of July with 5.37 insect /boll and its peak population was observed 10.31 insect /boll during 1st week of September with 10.31 insects/ boll and 2nd highest population 11.87 insect /boll was observed during 2nd week of November. The data reveals that all meteorological factors i.e. temperature, relative humidity and rainfall showed negative co-relation with dusky cotton bug population.

12. EVALUATION OF DIFFERENT IPM MODULES AGAINST SUCKING INSECT/PESTS ON BT COTTON

Three IPM modules viz., 1st Module, seed treatment with Confidor 70WS @ 7gm/Kg of seed + 3 releases of Chyrsoperla Larvae @ 4000/acre at pest appearance and then at 20 days interval + 5 spray of neem extract 5% solution at weekly interval, starting after 50 days of sowing. 2nd Module: Seed treatment with Confidor 70WS @ 7gm/Kg of seed +3 releases of Chrysoperla Larvae @ 4000/acre on pest appearance at 20 days interval + 5 spray of dhatura extract 5% solution at weekly interval, starting after 50 days of sowing + spray of insecticides as per pest situation. 3rd Module: Seed treatment with Confidor 70WS @ 7gm/Kg of seed + 5 spray of tobacco extract 5% solution at weekly interval, starting after 50 days of sowing + spray of recommended insecticide as per pest situation. 4th Module: Farmer practice spray of insecticides. Above mentioned modules were applied and data of sucking insect pests population (Jassid, Whitefly and Thrips) were recorded from 45 leaves selected at random from each module at weekly interval for 3 months. Cost benefit ratio of each module was also calculated. The data recorded are as under.

Table 12: Evaluation of different IPM modules against sucking insect/Pests of BT. Cotton

Modules	SUCKING INSECT PEST POPULATIION/ LEAF			YIELD	Income/Ac.	C.B Ratio
	Jassid	Whitefly	Thrips	Kg/Acre	Rs./Acre	
M1	1.00	22.60 a	2.18 b	982.7 bc	54048	1: 7.45
M2	1.04	22.53 a	2.28 b	953.3 c	52431	1: 7.28
M3	1.14	19.72 b	2.79 ab	1041.7 b	57293	1: 14.14
M4	1.01	16.21 c	2.93 a	1115.0 a	61325	1: 7.66
LSD @ 5%	N.S	2.50	0.62	67.44		

The result revealed that Jassid population per leaf was statistically non significant in all treatments ranging from 1.00 to 1.14 per leaf.

In case of whitefly 4th module showed minimum 16.21 per leaf followed by 3rd module i.e. 19.72 M1 and M2 showed maximum whitefly population i.e. 22.60 and 22.53 /leaf. Similarly minimum Thrips population was observed in M1 (2.18/leaf) and it was statistically at par with M2 and M3. The highest Thrips population 2.93/leaf was found in M4.

The yield data revealed that maximum yield was recorded in M4 1115.0 Kg/acre followed by M3 1041.7 Kg/acre respectively and minimum 953.3 Kg/acre obtained from M2.

The highest cost benefit ratio 1:14.14 was observed in M3 while all other modules had CBR 1:7.45 in M1, 1: 7.28 in M2 and 1:7.66 in M4 respectively.

13. SCREENING OF CODED NON-BT NEW GENOTYPES OF COTTON AGAINST INSECT PEST COMPLEX

The trial was conducted at CRS Multan. Four coded non-Bt genotypes were sown in RCBD, replicated thrice. The population of sucking insect pests i.e. Whitefly, Jassid and Thrips were recorded from 15 leaves (upper, middle and lower) selected randomly from 15 plants per plot. The data regarding larvae of Spotted bollworm was recorded from 10 randomly selected plants per plot at weekly intervals. Finally, the data was compiled and analyzed statistically. The data regarding pink bollworm infestation was recorded by dissecting 50 bolls per plot. The bolls were opened with knife and pink bollworm percent damage was calculated.

Table 13: Screening of Coded Non BT new Genotypes against Insect/Pest Complex

Cotton Genotypes	Average Population per Leaf			Bollworms	
	Jassids	Whitefly	Thrips	SBW L/P	PBW
Niab-444	3.24b	14.81a	3.32a	0.13c	22.00a
Vr-Thakar	3.99a	14.64a	3.97a	0.17b	15.01b
MNH-786	3.14c	11.29b	4.91a	0.13c	12.07b
RH-667	2.30d	9.19b	0.86b	0.20a	16.01b
LSD @ 5%	0.48	2.12	2.86	0.1	3.27

Average maximum population of Jassid was found on Vr-Thakar (3.99%) followed by NIAB-444 (3.24/leaf) while minimum on RH-667 (2.30/leaf). Maximum whitefly population was found on NIAB-444 (14.81%) and was at par with VR-Thakar (14.64/leaf) while minimum was on Rh-667(9.19%). The maximum thrips was found on MNH-786 (4.91/leaf) and was at par with NIAB-444 and Vr-Thakar (3.332 and 3.97/leaf) while minimum on Rh-667 (0.86/leaf). less

population of spotted bollworm was found low ranging from 0.13/plant to 0.20/plant. Maximum pink bollworm % infestation (22.00%) was recorded on NIAB-444 followed by remaining genotypes ranging from 12 to 16%.

14. STUDIES ON INCIDENCE OF PINK BOLLWORM ON THREE BT COTTON VARIETIES AND POPULATION DYNAMICS ON BT-886

The trial was conducted with the coordination of Cotton Botanist, CRS Multan. The BT genotypes (886, 992 and 142) were selected for this study. The data was recorded by observing 250 flowers (separate rosette and healthy and calculate percentage) from each variety, similarly population in bolls was recorded by plucking 20 bolls from randomly selected plants per plot at weekly intervals on the appearance of flowers and continued till the harvest of crop.

Table 14(a): Infestation of Pink Bollworm on three BT Genotypes of Cotton

Varieties	Total bolls plucked	No. of flowers checked	Percent rosette flowers recorded	% infested bolls due to PBW
Bt-886	20	250	4.92	47.46
Bt-992	20	250	2.06	26.56
Bt-142	20	250	5.70	25.13

Table 14(b): Population Dynamics of Pink Bollworm on BT 886 Genotypes of Cotton

Date observation	Percent rosette flowers	Percent damage PBW	Weather factors			
			Max	Mini	RH	Rainfall
20.7.16	0.00	0.00	36.60	28.80	76.90	0.00
3.8.16	0.00	0.00	35.30	27.00	86.40	110.00
10.8.16	0.00	0.00	34.30	26.10	89.30	34.00
17.8.16	0.00	1.39	37.80	26.80	72.60	0.00
26.8.16	0.22	2.22	36.10	26.70	77.70	9.00
4.9.16	3.76	21.01	36.70	25.40	77.90	58.00
11.9.16	2.51	44.44	35.70	25.90	77.00	0.00
18.9.16	0.67	50.19	38.00	26.10	69.20	0.00
23.9.16	1.13	40.44	36.90	26.10	62.60	19.00
2.10.16	3.03	1.39	34.60	23.50	74.80	0.00
8.10.16	3.27	26.22	36.60	23.90	61.80	0.00
16.10.16	1.59	30.35	36.90	21.90	57.60	0.00

22.10.16	0.00	41.33	34.10	20.40	67.10	0.00
29.10.16	0.00	49.33	29.29	18.57	76.86	0.00
5.11.16	34.52	49.33	31.29	16.00	70.64	0.00
12.11.16	0.00	72.00	30.00	15.00	70.00	0.00

Table 14(c): Simple Correlation between percent rosette flowers and weather factors during the study year

Years	**Flowers/bolls**	**r- values**			
		Weather Factors			
		Temperature		**R.H. (%)**	**Rainfall (mm)**
		Max ºC	**Mini ºC**		
2016	**Percent rosette flowers**	-0.4319 (0.1079)	-0.6406 (0.0101)	-0.1252 0.6565	-0.1411 (0.6158)
	Percent boll damage	-0.6100 (0.0157)	-0.5160 (0.0490)	-0.3784 (0.1642)	-0.3198 (0.2452)

The result**s** reveled that maximum pink bollworm infestation was observed in the genotype Bt 142 i.e. 47.46% followed by Bt 992 and Bt 142, both having 26.65 and 25.13 % infestation respectively. Data regarding infestation of pink bollworm started in 3rd week of august it increases gradually and reached maximum in the mid November i.e. 72%. Maximum rosset flower 34.52% was recorded on 15.11.2016. Data was correlated with the weather factors and showed negative correlation with temperature rainfall and relative humidity.

INSECT PESTS OF SUGARCANE

15. COMPARATIVE INCIDENCE OF BORERS AND PYRILLA ON DIFFERENT ADVANCE LINES OF SUGARCANE

The experiment was conducted in the research area of Sugarcane Research Institute, Faisalabad. The trial was laid out in RCBD with three replications. Different advanced lines of sugarcane were screened out against sugarcane borers and pyrilla. The data regarding the sugarcane borers, infestation was recorded from two central rows of each plot by counting all healthy and infested tillers and % infestation was calculated. At harvesting cumulative borers infestation was recorded by dissecting 10 randomly selected canes from each plot and inter node damage was calculated. The pyrilla population was recorded on per leaf basis. Finally the data were analyzed statistically. The data recorded are as under;

Table 15: Varietal screening of different advanced lines of sugarcane against

Sr. No.	Varieties /lines	avg . pyrilla pop/leaf	Tiller Infestation (%)	Top borer (%)	Root borer (%)	Stem Borer (%)	Response against stem borer	Cumulative borer attack (%)
1	S2008-FD-25	4.36 H	1.86 E	0.23	4.63	9.6 AB	MS	14.27 AB
2	S2008-AUS-134	6.39 GH	3.16 BCDE	0.44	3.96	8.04AB	MS	12.44 ABC
3	S2009-SA-8	7.16 FG	4.52 B	0.00	5.03	8.82AB	MS	13.85 ABC
4	S2011-FD-18	5.71 GH	3.72 BCD	0.00	3.39	7.45 B	MR	10.84 C
5	S2011-SL-62	6.55 G	4.07 BC	0.19	4.40	8.01AB	MS	12.60 ABC
6	M2238-89	5.86 GH	3.07 CDE	0.21	4.17	8.20AB	MS	12.58 ABC
7	RSR97-41	9.67 CDE	3.80 BCD	0.00	4.06	8.09AB	MS	12.15 ABC
8	VMC88-354	9.84 BCDE	2.71 CDE	0.48	4.82	9.35AB	MS	14.65 AB
9	S2012-SL-426	11.77ABC	6.93 A	0.23	4.09	9.02AB	MS	13.33 ABC
10	S2012-SL-443	9.68 CDE	4.02 BCD	0.00	4.93	10.53 A	S	15.46 A
11	S2012-SL-883	9.66 DE	4.53 B	0.20	4.88	8.10AB	MS	13.17 ABC
12	S2012-M-632	11.84AB	2.64 CDE	0.00	3.53	8.06AB	MS	11.60 BC
13	S2012-M-780	9.07 EF	4.55 B	0.00	3.40	9.69AB	MS	13.09 ABC
14	S2012-M-791	11.13 ABCD	3.20 BCDE	0.00	4.05	8.81AB	MS	12.87 ABC
15	S2012-M-136	11.25ABCD	2.60 DE	0.16	3.80	8.31AB	MS	12.27 ABC
16	S2012-M-137	12.89 A	3.89 BCD	0.62	4.79	8.88AB	MS	14.29 AB
	LSD @ 5%	2.04	1.46	NS	NS	2.72	-	3.35

R=Resistant (0.00-5.00%), MS=Moderately resistant (5.1-7.5%),MS=Moderately Susceptible (above7.6-10%),S= Susceptible (above10.01-12.5%)

In case of tiller infestation, the lowest infestation was recorded on S-2008-FD-25 (1.86%) and it was statistically similar with S2008-AUS-134, M2238-89, VMC 88-354, S2012-M-632, S2012-M-791 and S2012-M-136. In case of cumulative borer attack, the lowest infestation was recorded on S2011-FD-18 (10.84%). The highest cumulative borer attack was observed on S2012-SL-443 (15.46%). The sugarcane Pyrilla population was recorded from last week of July till last week of October by observing 10 randomly selected leaves per plot. The lowest average

Pyrilla population was recorded on S2008-FD-25 and it was statistically similar with S2008-AUS-134, S2011-FD-18, M2238-89. Highest Pyrilla population 12.89 per leaf was recorded on S2012-M-137 and it was statistically at par with S2012-M-136, S2012-M-791, S2012-M-632 and S2012-SL-426

16. EFFICACY OF DIFFERENT GRANUALR/SPRAY INSECTICIDES AGAINST SUGARCANE BORERS

The experiment was conducted at farmer field to test the efficacy of different granular insecticides against sugarcane borers. The trial was laid out in RCBD with three replications. Insecticides were applied at tillering stage and data regarding tillers infestation were recorded before treatment and then after 15 & 30 days of application of granular insecticides. Finally the data were analyzed statistically. The data recorded are as under;

Table 16: Sugarcane borer's infestation (%) after different time intervals

	Insecticides	Dose/acre	PRE-TREATMENT	After 15 DAYS	After 30DAYS
T1	LASSENTA 80WG	60gm	35.75	6.00 B	2.500 B
T2	FOUNTAIN 80WG	60gm	35.25	4.00 B	2.000 B
T3	REGENT 80WG	45gm	35.25	4.00 B	3.500 B
T4	CHLORPYRIPH0S 40EC	1000ml	34.75	4.00 B	2.750 B
	CONTROL	-	31.75	31.50 A	30.500 A
	LSD @ 5%	-	NS	3.08	2.59

The pre-treatment borer infestation was recorded as 31.75% to 35.75% on all the treatments. After 15 days of application, all treatments were found equally effective and statistically at par and they reduced borer infestation by 4.0-6.0%..

After 30 days of application, all treatments again were at par with borer infestation 2.0 -2.75% as compared to check having 30.5 % infestation.

17. EFFICACY OF DIFFERENT INSECTICIDES AGAINST SUGARCANE BLACK BUG

The experiment was conducted at farmer's field to test the efficacy of different insecticides against sugarcane Black bug. The trial was laid out in RCBD with three replications. Insecticides were applied at tillering stage and data regarding black bug population was recorded before treatment and then after 24 hours, 72 hours and 7 days of application insecticides by observing 10 randomly selected leaf sheaths per plot. Percent mortality was calculated for each

post treatment interval and finally the data were analyzed statistically. The results are given as under.

Table 17: Sugarcane Black Bug Percentage Mortality

Sr. No.	Treatments	Dose/ Acre	% Mortality After 24 H	% Mortality After 72 H	% Mortality After 7 Days
1	REGENT 80WG	45gm	50.73 BC	62.68 BC	80.96 A
2	LESSENTA 80WG	60gm	50.46 BC	62.34 BC	54.12 C
3	TALSTAR 10EC	250ml	65.53 A	74.76 A	70.17 B
4	ADVANTAGE 20EC	500ml	57.76 AB	54.12 C	69.80 B
5	LEGEND 0.5AS	500ml	44.07 C	61.86 BC	52.90 C
6	DIMETHOATE 40EC	300ml	40.86 C	72.14 AB	60.19 BC
7	KARATE 2.5EC	250ml	64.40 A	69.51 AB	80.86 A
8	CONTROL	-	0.00 D	8.19 D	0.00 D
	LSD @ 5%		10.4	10.74	1.35

The results (table 17) showed that after 24hours of spray maximum mortality of sugarcane black bug was observed in the plots treated with Tallstar 10EC i.e. 65.53% and it was statistically at par with Advantage 20EC (57.77%) and Karate 2.5EC (64.41%). After 72hours of spray Talstar again proved the most effective insecticide with 74.76% mortality followed by Dimethoate (72.14%) and Karate (69.51). after 7days Regent and karate proved the most effective treatment causing 80.96 to 80.86% mortality.

INSECT/ PESTS OF WHEAT

18. VARIETAL SCREENING OF WHEAT AGAINST APHIDS

The experiment was conducted in the research area of Entomological Research Institute, Faisalabad to check the susceptibility/ resistance response of 11 wheat varieties against aphid. The data regarding aphid population were recorded on per tiller bases while the population of natural enemies was counted per five plants at weekly interval. Finally the data were analyzed statistically. The data recorded are as under.

Table 18: Varietal Screening of Wheat Against Aphid

Sr. No.	Varieties Coded	Decoding	Mean Aphid Population Per Tiller				
			Jan	Feb	March	Season	Peak Period
1	KL-16	14225	1.26 A	8.24 EF	6.37 BCD	5.65 DE	8.87 DE
2	GH-16	14154	1.10 AB	11.00 CD	5.46 CDE	6.29 CD	9.59 CDE
3	CD-16	12066	0.48 D	12.55 BC	7.036 ABC	7.25 BC	11.99 BC
4	Shafaq-06	Shafaq-06	0.90 BC	14.42 B	7.95 AB	8.38 AB	13.69 AB
5	IJ-16	14170	0.64 CD	7.01 F	4.69 DE	4.43 E	6.88 E
6	MN-16	14168	0.58 CD	10.60 D	4.70 DE	5.72 DE	9.25 CDE
7	AB-16	11098	0.84 BC	8.04 F	4.70 DE	4.83 E	7.31 DE
8	OP-16	14227	0.61 CD	7.00 F	4.62 DE	4.39 E	6.84 E
9	EF-16	13348	0.58 CD	11.20 CD	6.17 BCDE	6.48 CD	10.27 CD
10	14C036	14C036	0.57 CD	16.80 A	8.29 A	9.28 A	15.46 A
11	14C040	14C040	0.40 D	10.00 DE	4.45 E	5.37 DE	8.84 DE
	LSD @ 5%		0.35	1.88	1.79	1.35	3.01

During the season, we observed the dominant population of *Rhopalosiphum padi* L. at tillering stage and *Sitobion avenae* F. during earing stage. The aphid population become visible in the last week of December and gradually increased on all the wheat genotypes. The data regarding aphid population per tiller basis were recorded throughout the season. In case of seasonal average population of aphid per tiller, the lowest aphid population 4.39 / tiller was recorded on advance line 14227 and it was statistically at par with 11098 (4.83/ Tiller), 14170 (4.43 / tiller), 14225 (5.65/ Tiller) and 14168 (5.72/ Tiller). In case of Peak season average aphid population, the lowest per tiller aphid population was again recorded on 14227 line that is 6.84 per tiller and it was statistically similar with 14170, 14225, 14168 and 11098.

19. STUDIES ON THE POPULATION DYNAMICS OF WHEAT APHID IN RELATION TO WEATHER FACTORS

A. Studies were carried out at Entomological Research Institute, Faisalabad. The collection of aphid was done from three trays each measuring 59cm x 46cm x 75 cm, painted with yellow colour inside. These trays were placed at three spots, two and half feet (75 cm) above the ground level on wooden stands at a distance of 100 feet from each other. Data on wheat aphids trapped in trays were recorded daily from 9-11 a.m. from each spot. Weather data, i.e., maximum and minimum temperature, R.H %, rainfall and wind velocity of the coinciding dates were also collected from the meteorological observatory of Ayub Agricultural Research Institute, Faisalabad and correlated with aphid density. The data was analyzed and presented in Table.

B. An experiment was conduct to check the fluctuation in the population of wheat aphid in relation to weather factors. Wheat crop was sown in the Entomological Research Institute, Ayub Agricultural Research Institute Faisalabad. The crop was kept under observation throughout the season to record fluctuation of wheat aphid. Crop was grown according to the standard agronomic practices. The data regarding aphid was recorded on per tiller bases at weekly interval. There were three replications in the Plot. The data was started during the month of February and continued till maturity of crop.

Table 19 (a): Aphid Population on Moericke Yellow Water Tray/ Week and Weather Data of Coinciding Weeks

Month	Week	Temperature (^{o}C)		Relative humidity (%)		Rainfall (mm)	Aphid pop.(per Week/per tray)
		Max	Min	8 am	5 pm		
January	1st week	18.76	10.17	91.43	78.29	0.00	3.32
	2nd week	18.06	4.16	84.25	51.13	0.00	9.31
	3rd week	18.25	4.98	86.88	56.88	4.80	20.98
	4th week	18.76	8.43	88.50	70.88	7.00	19.97
February	1st week	20.83	6.97	85.43	54.57	3.70	52.31
	2nd week	24.31	6.28	77.13	37.75	0.00	42.63
	3rd week	27.24	12.49	76.43	40.57	0.00	1081.33
	4th week	27.25	8.88	70.67	33.50	0.00	433.71
March	1st week	26.44	11.54	75.29	40.57	1.70	528.51

	2nd week	22.30	9.56	78.13	50.13	14.40	523.72
	3rd week	30.41	14.36	72.75	43.00	0.00	1202.31
	4th week	35.83	19.44	62.25	35.00	0.00	351.59

Aphid population on wheat crop appeared during the first week of January and gradually increased to its peak on 3rd week of March. The aphid population at that time was 1202.31 per tray/week when maximum temperature was 30.41 C˚ and relative humidity at 8 am was 72.75 %. When temperature increased and crop began to mature, the aphid population vertically decreased.

Table 19 (b): Average Aphid Population per Tiller and Weather Data of Coinciding Weeks

Month	Week	Temperature (°C)		Relative humidity %		Rainfall (mm)	Predator		Aphid population Per Tiller
		Max.	Min.	8 am	5 pm		Coccid	Syrphid	
January	1st week	18.76	10.17	91.43	78.29	0.00	0	0	0
	2nd week	18.06	4.16	84.25	51.13	0.00	0	0	0.33
	3rd week	18.25	4.98	86.88	56.88	4.80	0	0	0.30
	4th week	18.76	8.43	88.50	70.88	7.00	0	0	0.50
February	1st week	20.83	6.97	85.43	54.57	3.70	0.00	0.00	3.47
	2nd week	24.31	6.28	77.13	37.75	0.00	0.11	12.62	5.73
	3rd week	27.24	12.49	76.43	40.57	0.00	0.11	13.56	5.07
	4th week	27.25	8.88	70.67	33.50	0.00	0.33	11.28	26.87
March	1st week	26.44	11.54	75.29	40.57	1.70	8.88	31.61	6.40
	2nd week	22.30	9.56	78.13	50.13	14.40	11.00	38.41	5.73
	3rd week	30.41	14.36	72.75	43.00	0.00	5.33	30.27	4.10
	4th week	35.83	19.44	62.25	35.00	0.00	4.25	8.44	2.66

The highest per tiller aphid population was recorded during the 4th week of March (26.87 aphids/ tiller). Aphid attack was appeared during 2nd week of January and its population was increasing gradually and reached to its peak during 4th week of February. Subsequently its population decreased abruptly in the last week of March and reached at 2.10 Aphid / Tiller.

Table 19 (c): Correlations of Aphid between Weather Factors and Predators:

	Temperature (^{o}C)		Relative Humidity		Rain fall	Aphid
	Max.	Min.	8 am	5 pm		
Aphid	0.6368*	0.5925*	-0.5563	-0.5019	-0.1158	
P value	(0.026)	(0.0423)	(0.0603)	(0.0964)	(0.72)	
Coccinellid	0.3613	0.4217	-0.4162	-0.2815	0.4947	0.4328
P value	(0.2468)	(0.1721)	(0.1783)	(0.3755)	(0.1021)	(0.1599)
Syrphid Fly	0.5318	0.4004	-0.6085*	-0.5978*	0.28	0.6857*
P value	(0.0751)	(0.1972)	(0.0358)	(0.0401)	(0.3781)	(0.0138)

Aphid population has positive and significant correlation with maximum temperature (0.6368) and minimum temperature (0.5925). In case of relative humidity, a negative and significant correlation was observed having r value 0.5563.

20. EFFICACY OF SEED DRESSING INSECTICIDES AGAINST WHEAT APHID

The study was conducted at the research area of Wheat Research Institute, Faisalabad under RCBD with three replications to study the efficacy of different insecticides as seed dressers against wheat aphids. The treatments were applied at time of sowing by mixing each insecticide with seed. Seed required for each treatment were mixed with some amount of water for easy application and absorption of pesticides into seed. Measured amount of each pesticide was sprinkled on seeds and mixed thoroughly with stick so that complete covering of seed with insecticide was ensured. For each treatment new stick was used to avoid the mixing of effect of previous insecticide.

Data regarding aphid population was recorded at weekly interval started from first week of February till end of March. Counting of aphid from wheat crop was done from 10 randomly selected tillers per plot by observing from base of tiller to top. Aphid from spike was counted by using white paper and aphids were separated from spike with camel hair brush gently.

Table 20: Efficacy of Seed Dressing Insecticides against Aphid

Sr. No.	Seed Dressing Insecticide	Dose/ Kg Seed	Avg. Aphid /Tiller
1	Argyl Super 62.5WS	1gm/kg	2.63B
2	Combinex ultra 72WS	1gm/kg	2.66B
3	Hombre 186.25FS	2ml/Kg	2.18B
4	Control	-	6.33A

All the seed treatment insecticides were found effective and they reduced the aphid population from 2.17 per tiller to 2.66 per tiller as compared to control having aphid population 6.33 per tiller.

21. EFFECT OF DIFFERENT BOTANICALS ON WHEAT APHIDS

The trial was conducted at field area of Entomological research institute, AARI, Faisalabad. Six different botanicals (Knair, Neem, Tumma, Beeri Patta, Moringa and Eucalyptus) were selected against wheat aphids on wheat crop. Botanicals were sprayed at 10 days interval starting from 10th February to 30th March. Layout system was RCBD having three replications having 30 X 15 feet plot area. The data were recorded after 24 hours, 48 hours, 72 hours and 7 days after application.

Table 21: Effect of different botanicals on wheat Aphids

Plants Extracts @ 5 %	Percentage Reduction of Aphid population after			
	24 hrs	48 hrs	72 hrs	one week
Knair	49.16	67.20	63.35	65.93
Neem	60.36	70.47	63.45	59.57
Tumma	38.61	76.70	73.75	74.99
Beeri Patta	47.31	67.14	66.99	66.60
Moringa	38.15	60.78	58.28	52.95
Eucalyptus	39.46	56.46	49.94	50.87

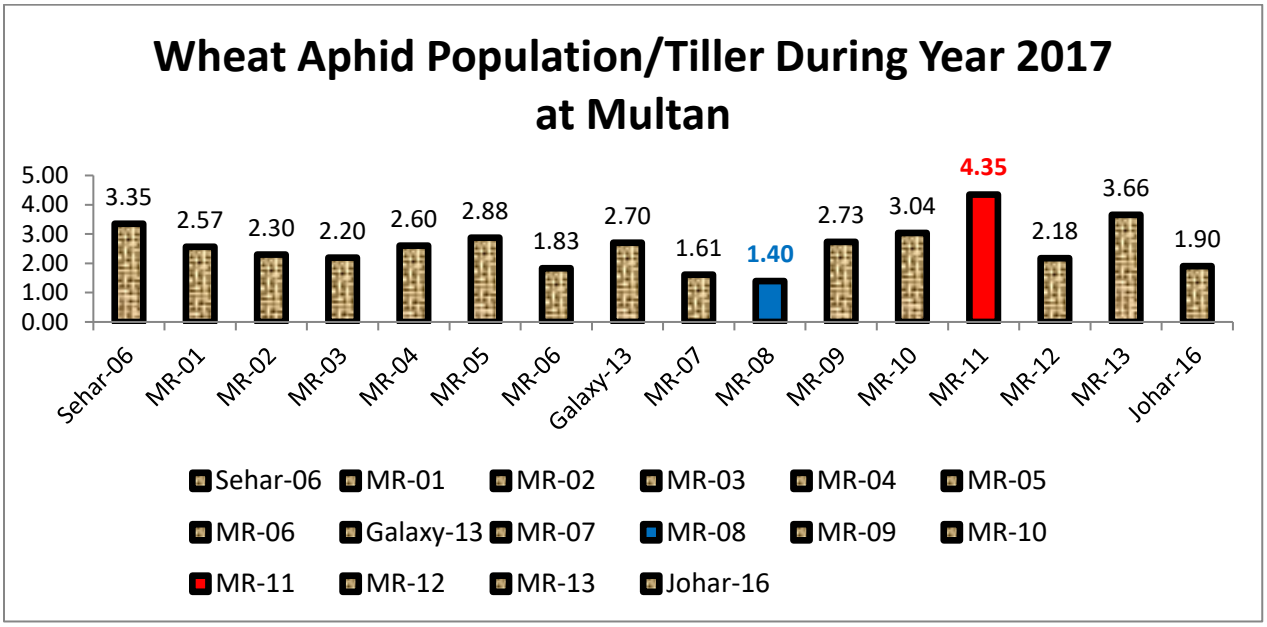
The results showed that Tumma, Beeri Patta and Knair extract found most effective and percent reduction of aphid population was 74.99 %, 66.60 % and 65.93 % respectively whereas Eucalyptus, Moringa and Neem showed least percent reduction of aphid population (50.87 %, 52.95 % and 59.57 % respectively).

22. SCREENING OF SOME ADVANCED WHEAT LINES/VARIETIES AGAINST APHIDS ATTACK

The experiment was laid out at Cotton Research Station, old Shujabad Road Multan. The coded newly developed advanced wheat lines/varieties were sown by CRI Multan under RCBD with three replications. The aphid population data was recorded from 10 tillers selected randomly from each line at weekly interval. The recorded data was further compiled and analyzed statistically.

Table 22: Screening of some advanced Wheat Lines/Varieties against aphids attack

Sr. No	Name of Varieties	Aphids Population/tiller
1	Sehar -06	3.35 bc
2	MR-01	2.57 de
3	MR-02	2.30 ef
4	MR-03	2.20 ef
5	MR-04	2.60 de
6	MR-05	2.88 cd
7	MR-06	1.83 fgh
8	GLAXY-13	2.70 de
9	MR-07	1.61 gh
10	MR-08	1.40 h
11	MR-09	2.73 de
12	MR-10	3.04 cd
13	MR-11	4.35 a
14	MR-12	2.18 efg
15	MR-13	3.66 b
16	Johar-16	1.90 fgh
	LSD@5%	0.56



Maximum aphid population (4.35)/tiller was recorded found on MR-11 followed by MR-13 (3.66)/tiller and minimum population ranging from 1.40 to 3.35/tiller in all other varieties.

INSECT/PPESTS OF MAIZE

23. SCREENING OF MAIZE HYBRIDS AGAINST INSECT PESTS

Nine maize hybrids viz. FH-793, FH-922, FH-929, FH-9492, FH-988, DK-6724, NK-8441, FH-1012, and FH-1046 were screened out against insect pests of maize. Experiment was laid out in RCB design with three repeats at the research area of Maize Section, AARI, Faisalabad. Attack of shoot fly, stem borer and Cob borer % infestations were recorded by examining 20 plants per plot. Chlorophyll Contents were recorded with the help of chlorophyll meter whereas stem diameter was recorded with the help of Vernier caliper. For leaf hair density, number of trichomes was counted by placing the leaf sample cutted with a cm^2 iron dye under microscope. The data recorded are as under:-

Table 23 (a): Screening of Maize Hybrids against Insect Pests

Genotypes		Shootfly infestation%	Jassid/ leaf	Stem borer infestation %	Cob Borer infestation %	Chlorophyll Contents (mg/$m^{2)}$	Leaf Hair Density/ cm^2	Stem Diameter cm
1	**FH-793**	8.33 BC	0.27 CDE	5.28 DE	2.52 E	56.90 AB	101.00 A	2.07 AB
2	**FH-922**	6.05 C	0.50 B	6.20 C	15.57 A	60.90 A	65.33 C	1.87 BCD
3	**FH-929**	7.64 BC	0.17 E	8.93 A	6.03 C	55.77 AB	38.33 F	1.53 E
4	**FH-9492**	5.84 C	0.33 CD	7.10 B	8.75 B	56.70 AB	44.00 E	1.87 BCD
5	**FH-988**	7.14 BC	0.27 CDE	7.25 B	4.53 D	60.87 A	89.00 B	1.67 CDE
6	**DK-6724**	6.87 BC	0.70 A	5.75 CD	5.01 D	57.03 AB	68.00 C	2.00 AB
7	**NK-8441**	9.07 B	0.23 DE	7.30 B	4.59D	53.30 B	66.67 C	1.60 DE
8	**FH-1012**	12.02 A	0.30 CDE	4.87 EF	7.00 C	57.00 AB	55.00 D	2.20 A
9	**FH-1046**	7.20 BC	0.40 BC	4.42 F	3.34 E	54.53 AB	90.00 B	1.93 ABC
LSD at 5%		2.7971	0.1452	0.579	0.975	7.1017	4.2136	0.268

Shootfly, infestation differ significantly among genotypes/hybrids. Minimum shootfly infestation (5.84 %) was recorded on hybrid FH-9492, that was found to be statistically at par

with the infestations recorded on hybrids FH-922(6.05%), DK-6724(6.87%), FH-988(7.14%) and FH-1046(7.20%). While the maximum shootfly infestation (12.02%) was recorded on hybrid NK-1012. In case of jassid, minimum population (0.17/leaf) was recorded on hybrid FH-929 followed by NK-8441 (0.23/leaf), FH-793 (0.27/leaf), FH-988 (0.27/leaf) and FH-1012 (0.30/leaf). Whereas maximum (0.70/leaf) jassid population was recorded on hybrid DK-6724. In case of stem borer, minimum percentage infestation (4.42 %) was recorded on hybrid FH-1046 which was statistically at par with the infestation recorded on FH-1012. Maximum stem borer infestation (8.93 %) was recorded on hybrid FH-929 followed by NK-8441 (7.30%), FH-988 (7.25%) and FH-9492 (7.10%). In case of Cob borer, minimum percentage infestation (2.52 %) was recorded on hybrid FH-793 followed by hybrid FH-1046 with infestation 3.34%. Maximum cob borer infestation (15.57 %) was recorded on hybrid FH-922.

Table 23 (b): Correlation of Shoot Fly and Stem Borer Infestation aith Physio-Morphic Characters

Parameters	Stem Borer	Shoot fly
Chlorophyll contents	-0.0015 (0.9939)	-0.0651 (0.7468)
Hair Density	-0.5414** (0.0035)	-0.0111 (0.9561)
Stem Diameter	-0.7557** (0.0001)	0.055 (0.7852)

Stem borer infestation was found non-significantly and negatively correlated with chlorophyll contents while highly significantly and negatively correlated with leaf hair density and plant stem diameter. Shootfly infestation was found to be negatively and non-significantly related with chlorophyll contents, leaf hair density and plant stem diameter.

24. EFFICACY OF DIFFERENT SEED DRESSING INSECTICIDES AGAINST SHOOT FLY ON SPRING MAIZE

The experiment was conducted in the research area of Entomological Research Institute, Faisalabad. The trial was laid out in RCBD with three replications. Six seed dressing insecticides viz: Cruiser 350 FS (Thiamethoxam), Poncho 600 FS (Clothianidin+ imidacloprid) at the rate of 15 ml per kg seed, Poncho 600 FS (Clothianidin+ imidacloprid) at the rate of 20 ml per kg seed, Actara 70 WS (Thiamethoxam), Hombre 372.5 FS (Imidacloprid+ Tebuconazole), Confidor 70 WP (Imidacloprid) were tested on spring maize against shoot fly. Data regarding % reduction in

shootfly infestation were recorded after 10, 20 and 30 days of germination. The data recorded are as under:-

Table 24: Efficacy of Seed Dressing Insecticides Against Shoot Fly on Spring Maize

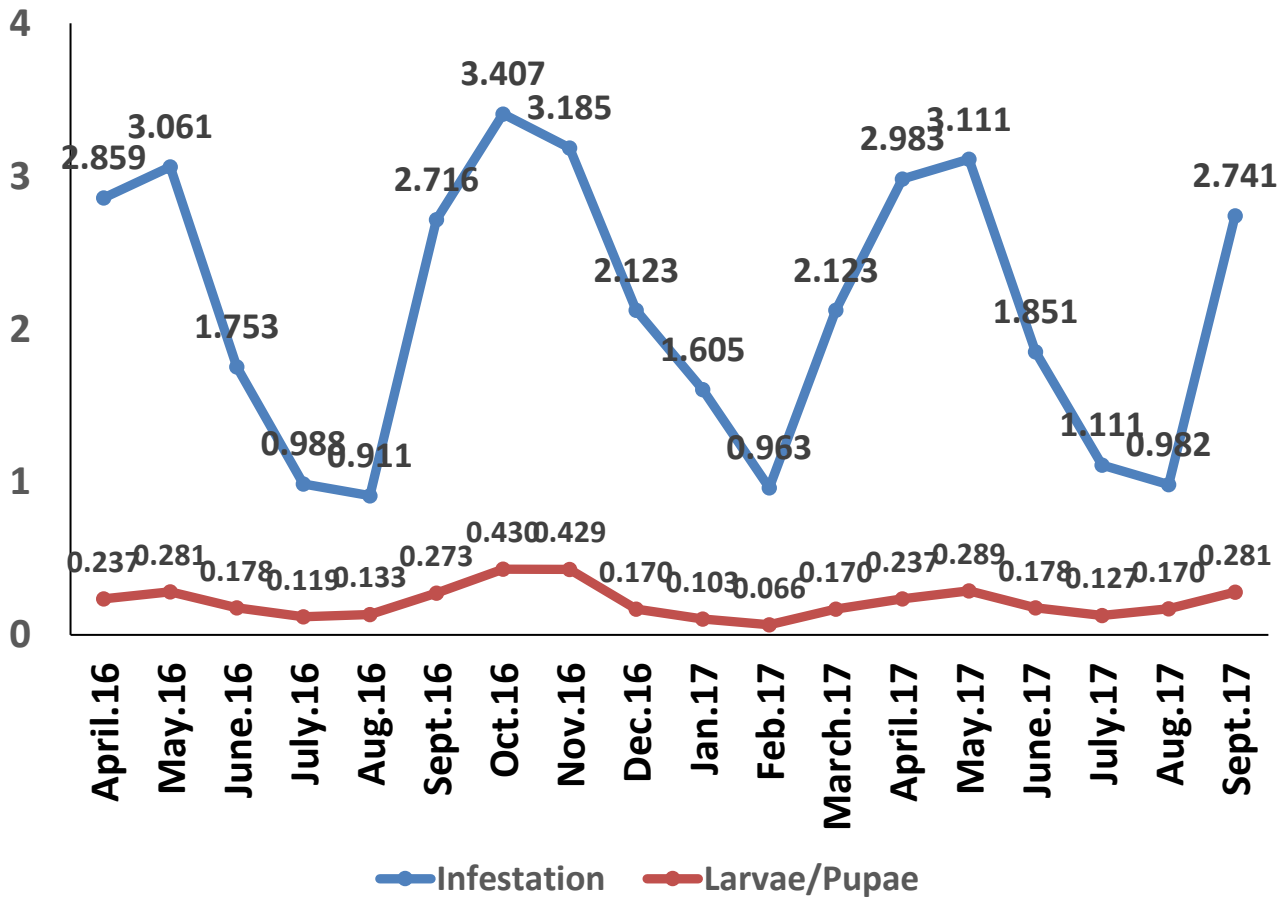
Treatments		Dose/kg seed	Shootfly infestation			Percentage reduction %		
			10 DAG	20 DAG	30 DAG	10 DAG	20 DAG	30 DAG
T1	Cruiser 350 FS (Thiamethoxam)	5 ml	4.85	6.43	10.22	83.01 BC	82.45BC	78.57 BC
T2	Poncho 600 FS (Clothianidin+ imidacloprid)	15 ml	4.27	4.41	8.96	84.94 AB	87.74 AB	81.17 AB
T3	Poncho 600 FS (Clothianidin+ imidacloprid)	20 ml	3.19	3.39	7.19	88.73 A	90.59 A	84.92 A
T4	Actara 70 WS (Thiamethoxam)	3 gm	5.83	8.18	11.04	79.94 CD	77.42 CD	76.85 BC
T5	Hombre 372.5 FS (Imidacloprid+ Tebuconazole)	10 ml	4.73	6.29	10.13	83.71 BC	82.70 BC	78.78 BC
T6	Confidor 70 WP (Imidacloprid)	5 gm	6.31	8.75	12.37	78.06D	76.00 D	74.08 C
T7	Check	__	29.25	36.41	47.68	0.00 E	0.00 E	0.00 D
	LSD at 5%					4.4109	5.4632	5.0107

All the treatments were found to be statistically different with one another after 10, 20 and 30 days of germination. Results indicated that maximum shootfly infestation reduction over control i.e. 88.73%, 90.59% and 84.92% was recorded in plot treated with (T3) Poncho 600 FS (Clothianidin+ imidacloprid) at the 20ml/kg seed after 10, 20 and 30 days of germination, respectively. That remained statistically same with the percentage reductions, 84.94%, 87.74% and 81.17% recorded in the plot where seeds were treated with Poncho 600 FS (Clothianidin+ imidacloprid) at the 15ml/kg seed after 10, 20 and 30 days of germination, respectively. Whereas, After 10, 20 and 30 days of germination minimum percantage reductions i.e. 78.06%, 76.00% and 74.08%, respectively was recorded in plot treated with Confidor 70 WP (Imidacloprid) at the rate of 5gm/kg seed.

INSECT/PEST OF FRUITS

25:INCIDENCE OF FRUIT BORER ON GUAVA

The experiment was conducted in different guava orchards at Sharakpur during 2016-17. Fortnightly surveys were conducted to find out the incidence and population level of fruit borer on guava. Fifty fruits were randomly examined from five randomly selected trees.

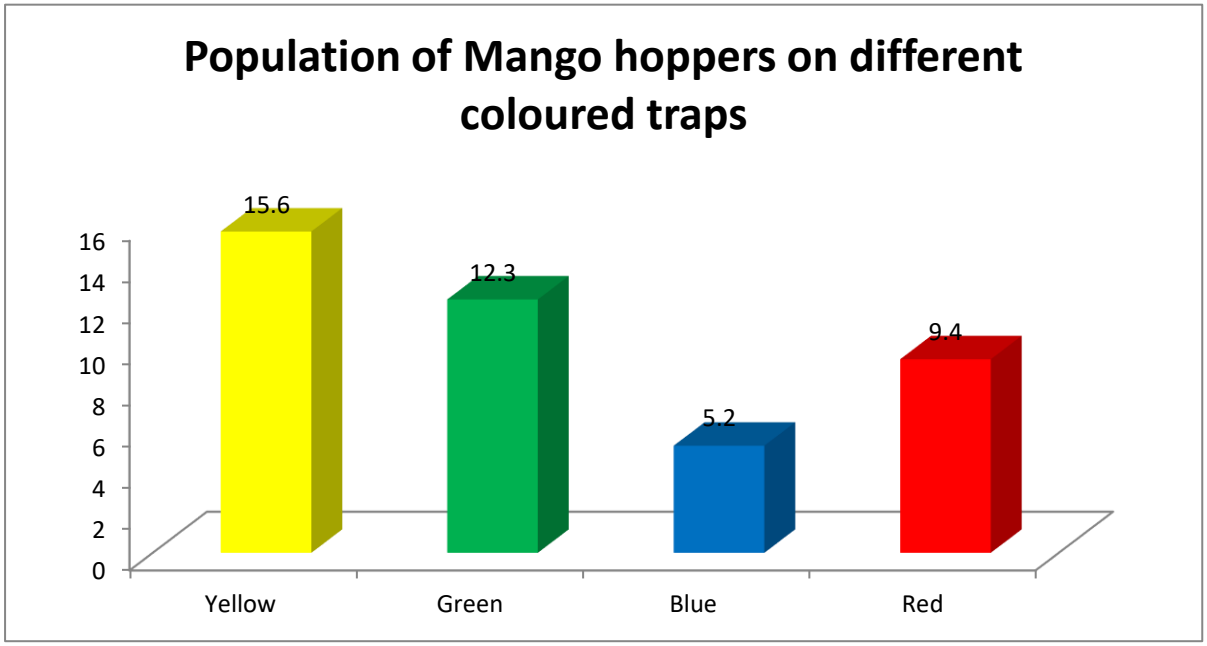


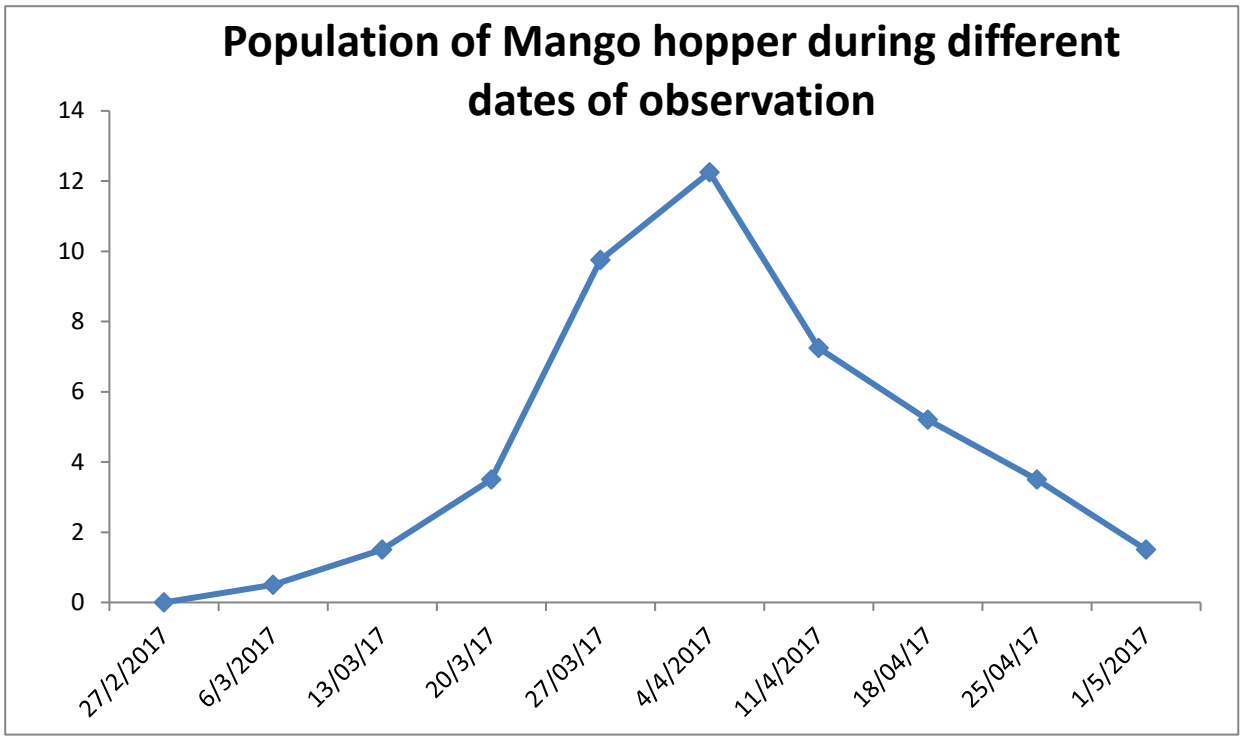
The results showed that the fruit borer infestation level was ranged from 0.911-3.407 % from Aug-Oct, 2016 and during this period highest larval population was 0.430%. While in year 2017 the fruit borer infestation level was ranged from 0.963-3.111% from Feb to May and crop was infested with highest larval population 0.289% in May, 2017.

26.EVALUATION OF DIFFERENT COLORED TRAPS FOR THE ATTRACTION OF MANGO HOPPER (*Ideoscopus clypealis* Leith) IN MANGO ORCHARDS

Colored sticky traps were prepared by cutting of hardboard cards with a paper cutter. These cards were covered by plain paper sheets of 4 different colors. Insect gum was used as a sticky material then a thin layer of polybutene insect gum was coated on both sides of the traps. The size of each sticky trap was about 10 × 10 inches. The population of mango hopper captured in traps was counted.

Population of mango hopper was recorded from the inflorescence wrapped with polythene bags. The bags along with inflorescence were kept in refrigerator to in activate the hopper for the period of 2 to 3 hrs and then counted during Feb-May 2017.





The result revealed that maximum population of mango hopper was observed on yellow sticky trap i.e. 15.6 mango hoppers/trap followed by 12.3 mango hoppers and 9.4 hoppers/ trap on green and red colored sticky traps respectively. However minimum i.e. 5.2 mango hopper population was observed on blue sticky trap. The results regarding population fluctuation of mango hopper was observed on 2nd week of March then it increased gradually and reached on peak in 1st week of April and in 3rd week of April then it gradually decline.

27:STUDIES OF POPULATION FLUCTUATION OF FRUITFLY IN DIFFERENT TYPES OF TRAPS DURING 2016-17

Three different types of traps i.e. pheromones traps, bottle traps and jar traps were installed in the orchard at five different places of each type. Methyl eugenol capsules were placed in the traps. Population of fruitfly captured in the traps was recorded from 2016 till June 2017. The septa were changed on fortnightly basis.

Table 27:Population fluctuation of fruit fly in pheromone traps during 2016-17

a. Average population of Fruit flies per Trap during 2016			
Date	**Pheromones Traps**	**Bottle Traps**	**Jar Traps**
01.01.16	0.00	0.00	0.00
15.01.16	0.00	0.00	0.00

01.02.16	1.00	3.00	0.00
16.02.16	13.16	12.00	6.00
01.03.16	4.83	10.83	12.00
16.03.16	15.83	14.66	81.00
01.04.16	34.50	33.16	16.00
15.04.16	68.10	64.20	37.00
02.05.16	77.40	71.12	51.00
18.05.16	109.50	87.66	69.00
01.06.16	125.66	139.50	81.00
15.06.16	200.33	184.16	76.00
01.07.16	119.00	108.50	112.33
15.07.16	142.66	194.33	132.83
01.08.16	92.83	102.50	95.50
16.08.16	90.50	84.16	61.00
01.09.16	89.50	84.16	47.00
16.09.16	87.00	75.88	66.00
03.10.16	81.00	118.55	18.50
18.10.16	16.00	27.27	17.00
01.11.16	17.00	12.90	12.00
15.11.16	11.00	9.00	3.00
02.12.16	9.00	7.00	0.00
16.12.16	1.00	0.50	0.00
30.12.16	0.00	0.00	0.00

2017

b. Average population of Fruit flies per Trap during 2017			
Date	**Pheromones Traps**	**Bottle Traps**	**Jar Traps**
16.01.17	0.00	0.00	0.00
31.01.17	12.00	10.00	15.00
17.02.17	14.00	8.00	9.00
03.03.17	15.00	17.00	8.00
17.03.17	21.00	23.00	11.00
03.04.17	27.00	29.00	21.00
18.04.17	23.00	21.00	17.00
02.05.17	37.00	33.00	23.00
15.05.17	71.00	59.00	43.00
02.06.17	91.10	74.50	5710
19.06.17	138.50	107.25	73.20

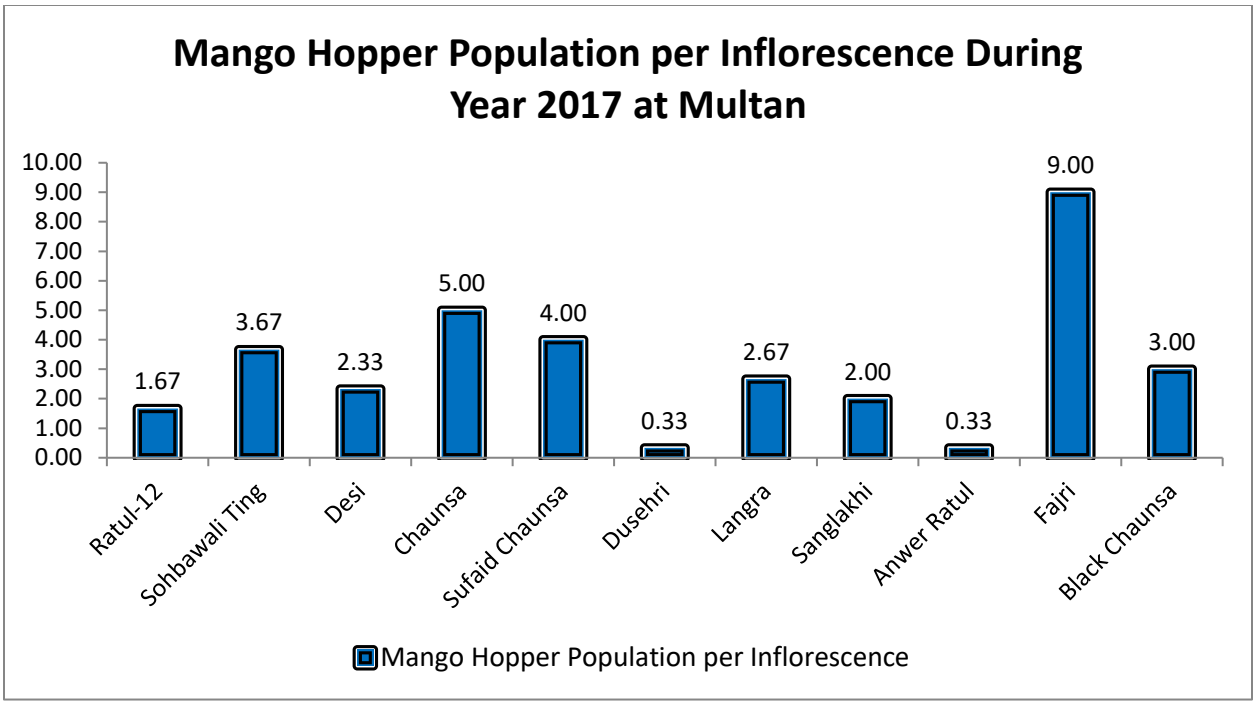
During 2016, maximum population of fruit fly was recorded in pheromone trap (200 fruit fly / Trap on 15.06.16), in Bottle traps (194.33 fruit fly/ trap on 15.07.16) and in Jar Traps population (132 fruit fly/ trap on 15.07.16) while in the year of 2017 till month of June average population of fruit fly was recorded in pheromone trap (138.50 fruit fly / Trap on 19.06.17), in Bottle traps (107.25 fruit fly/ trap on 19.06.17) and in Jar Traps population (73.20 fruit fly/ trap on 19.06.17) respectively.

28:INCIDENCE OF MANGO HOPPER ON DIFFERENT VARIETIES OF MANGO IN DISTRICT MULTAN

The experiment was conducted in farmer's field located in Distt. Multan. High value commercial mango varieties were selected. The population of mango hoppers was recorded from the inflorescence wrapped with polythene bag during peak season i.e. in the month of March. The bags along with the inflorescence were kept in the refrigerator till mortality of hoppers for 2-3 hours. Then the bags were taken out and open the bags on white paper placed in trays. The populations of mango hoppers were counted from white paper.

TABLE 28 POPULATION OF MANGO HOPPER ON DIFFERENT VARIETIES OF MANGO

Sr. No	**Name of Varieties**	**Mango Hoppers Population/Inflorescence**
1	Ratul-12	1.67 cd
2	Sohbawali ting	3.67 bc
3	Desi	.2.33 cd
4	Chaunsa	5.00 b
5	Sufaid Chaunsa	4.00 bc
6	Dusehri	0.33 d
7	Langra	2.67 bcd
8	Sanglakhi	2.00 cd
9	Anwer Ratul	0.33 d
10	Fajri	9.00 a
11	Black Chaunsa	3.00 bc
	LSD@5%	2.5676



RESULTS:

The results revealed that maximum population of mango hopper i.e. 9.00/ inflorescence was recorded on Fajri variety followed by Chaunsa, Sufaid chaunsa, Sohbawali ting, Langra & Black chaunsa ranging from 5.00 to 2.67 mango hopper /inflorescence respectively. Meanwhile minimum population of mango hopper weas observed on Dusehri and Anwer ratul i.e. 0.33% & 1.67/inflorescence respectively.

29: STUDIES ON EFFECTIVENESS OF DIFFERENT DOSES OF PROTEIN HYDROLYSATE AGAINST FRUIT FLY ON BER (KHEERI VARIETY)

The experiment was conducted at Agriculture Extension Farm Old Shujabad Road, Multan. The susceptible variety of ber i.e. Kheeri ber verity was selected for spray with different doses of protein hydrolysate and GF-120 with three replicates. After fruit setting the variety was sprayed weekly on north side area of one square meter of the tree. Ten fruits bearing branches of one foot was selected and counted fruits (damaged and healthy) before and after spray.

T1= Protein hydrolysate + Malathion @ 200ml+ 10ml /10L of water
T2= Protein hydrolysate + Malathion @ 300ml+ 10ml /10Lof water
T3=Protein hydrolysate + Malathion @ 400ml+ 10ml /10L of water
T4=Protein hydrolysate + Malathion @ 500ml+ 10ml /10L of water
T5=GF-120 @ 500ml/7.5 liters of water

Table: 29. Percent reduction of fruit fly damage on Ber by 5 different treatments of protein hydrolysate.

Sr. No	Treatment	% Damage Before treatment	% Damage Reduction 7 days of application	% Damage Reduction 15 days of application
1	Protein hydrolysate + Malathion@ 200ml+10ml per 10 liter of water	28.47	25.46 c	9.23 b
2	Protein hydrolysate + Malathion@ 300ml+10ml per 10 liter of water	27.57	24.71 c	9.15 b
3	Protein hydrolysate + Malathion @ 400ml+10ml per 10 liter of water	30.52	43.42 a	25.13 a
4	Protein hydrolysate + Malathion @ 500ml+10ml per 10 liter of water	34.74	33.43 b	22.29 a
5	GF-120 @ 500ml	28.10	37.04 b	24.72 a
	LSD@5%		5.92	5.34

RESULTS:

The maximum percentage reduction of fruit damage by fruit fly after 7 and 15 days of spray application was observed in Protein hydrolysate + Malathion@ 400ml+ 10ml /10L of water i.e. 43.42% and 25.13% and GF-120 @ 500ml/7.5 liters of water i.e. 37.04% and 24.72% respectively while minimum reduction was found in Protein hydrolysate + Malathion @ 200ml+ 10ml /10L of water i.e. 25.46% and 9.23% respectively.

INSECT PESTS OF PULSES

30. SCREENING OF DESI GRAM GENOTYPES AGAINST INSECT PESTS IN RESPONSE TO PHYSIO-MORPHIC CHARACTERS

Six Desi gram genotypes viz; D-12011, D-10039, D09027, D-097-10, D-11030, D-10008 were screened out against insect pests. Experiment was laid out in RCB Design with three repeats in the research area of Entomological Research Institute, Faisalabad. Data regarding termite infestation was recorded by observing total and damage plants. Aphid population was recorded by observing 10 cm length of 15 twigs selected randomly. Beneficial's data were recorded per plant basis. For pod borer, total number of pod and number of damaged pods were observed from randomly selected five plants to calculate the percent pod damage by using formula given below,

$$\text{Pod damage (\%)} = \frac{\text{No. of damaged pod} \times 100}{\text{No. of total pods}}$$

Data regarding physio-morphic characters like pod trichome density and pod wall thickness was recorded at podding stage of gram plants. The data recorded are as under:-

Table: 30.SCREENING OF DESI GRAM GENOTYPES AGAINST INSECT PESTS IN RESPONSE TO PHYSIO-MORPHIC CHARACTERS

	Treatments	Termite infestation %	Aphid/ branch	Gram pod borer infestation %	Bio Control *(LBB, SF & CC)*	Gram pod wall thickness (mm)	Gram pod hair density (per cm^2)
1	D-12011	7.75 A	2.86	10.33 AB	0.66	0.30 B	125.26 A
2	D-10039	2.20 B	1.60	9.66 B	1.03	0.33 AB	127.83 A
3	D09027	1.57 B	2.53	7.33 C	1.83	0.31 B	94.97 B
4	D-097-10	2.32 B	3.13	11.33 A	1.13	0.25 C	95.36 B
5	D-11030	2.00 B	2.66	6.66 C	0.76	0.35 A	129.24 A
6	D-10008	1.00 B	2.40	6.33 C	0.76	0.30 B	132.67 A
LSD @ 0.05		2.1094	NS	1.356	NS	0.0365	7.7834

Minimum Termite percent infestation (1.00%) was observed in genotype D-10008 followed by D09027, D 11030, and D-10039 with termite infestations of 1.57%, 2.00% and 2.20%, respectively. Whereas maximum termite infestation (7.75%) was recorded on genotype D-12011. Aphid and

beneficial insects population was found to be statistically non-significant among all the tested genotypes. Minimum aphid population (1.60/twig) was recorded on D-10039 followed by D-10008(2.40/twig) and D09027 (2.53/twig) while maximum aphid population (2.86/twig) was observed on D-12011. Pod borer infestation were found to be statistically different among the genotypes. In the present study, minimum pod borer damage (6.33%) was recorded on D-10008 that was statitically at par with the observed infestations on D-11.030 (6.66%) and D09027 (7.33%). Maximum pod borer infestation of 11.33% was recorded on D-097-10 followed by D-12011 with the infestation of 10.33%. Maximum population of beneficial insects (1.83/ plant) was recorded on D09027 while minimum (0.66/plant) was recorded on D-12011.

CORRELATION OF GRAM POD BORER % INFESTATION WITH PHYSIO-MORPHIC CHARACTERS

	Pod borer % infestation
Pod hair density (per cm^2)	-0.3511 (0.4951)
Pod Wall Thickness (mm)	-0.5964 (0.2115)

Correlation analysis between gram pod borer infestation and plant physio-morphic characters indicated that pest infestation was non-significantly and negatively correlated with pod wall thickness and pod hair density in chickpea crop.

31:SCREENING OF KABULI GRAM (*CICER ARIETINUM L)* GENOTYPES AGAINST INSECT PESTS

The experiment was conducted in the research area of Entomological Research Institute, Faisalabad. The trial was laid in RCBD with three replications. Six Kabuli gram genotypes viz; Noor-91, Noor-09, K-70005, K-70008, K-101015 and K-01014 were screened out against gram insect pests. Aphid population was recorded by observing 10 cm lenth of 15 twigs selected randomly. For gram pod borer infestation, total and damaged pods from 5 randomly selected plants per plot were counted and percentage infestation was calculated by formula:

$$\text{Pod damage (\%)} = \frac{\text{No. of damaged pod}}{\text{No. of total pods}} \times 100$$

Biocontrols population was recorded on per plant basis. Data regarding physio-morphic characters i.e. pod trichome density and pod wall thickness were calculated at podding stage of gram plants. Finally the data were statistically analyzed. The data recorded are as under:-

TABLE:31(a) SCREENING OF KABULI GRAM (*CICER ARIETINUM L.*) GENOTYPES AGAINST INSECT PESTS

Treatments		Aphid/ Twig	Gram pod borer % infestation	Bio Control *(LBB, SF & CC)*	Gram pod wall thickness (mm)	Gram pod hair density (per cm^2)
1	Noor-91	3.08 AB	8.00 BC	1.63	0.30 AB	136.36 C
2	Noor-09	4.27 A	6.00 D	1.26	0.32 AB	156.28 B
3	K-70005	2.13 B	6.33 CD	2.26	0.33 A	164.67 AB
4	K-70008	3.73 AB	8.67 AB	1.13	0.30 AB	140.25 C
5	K-101015	2.57 AB	8.00 BC	1.73	0.34 A	175.82 A
6	K-01014	4.00 A	10.33 A	1.6	0.29 B	134.07 C
LSD @ 0.05		1.7579	1.6828	NS	0.0462	13.206

Minimum population of aphid (2.13/twig) was recorded on K-70005 followed by populations on K-101015 (2.57/twig) and Noor-91 (3.08/twig). While maximum aphid population (4.27/twig) was recorded on Noor-09. Minimum Pod borer damage (6.00%) was recorded on Noor-09 while maximum (10.33%) on K-01014. Maximum population of beneficial insects (2.26/plant) was recorded on K-70005 while minimum (1.13/plant) was found on K-70008.

Table: 31(b):CORRELATION BETWEEN GRAM POD BORER INFESTATION AND PLANT PHYSIOMORPHIC CHARACTERS OF KABULI GRAM

	Pod borer % infestation
Pod hair density (per cm^2)	**-0.5917 (0.2160)**
Pod Wall Thickness (mm)	**-0.6719 (0.1438)**

Correlation coefficients between pod borer damage percentage infestation and gram plant physio-morphic characters indicated that Pod borer damage percentage was non-significantly and negatively correlated with pod hair density and pod wall thickness.

32:EFFECT OF DIFFERENT DATES OF SOWING OF CHICKPEA ON POD BORER (*HELICOVERPA ARMIGERA*) INFESTATION

The experiment was conducted in the research area of Entomological Research Institute, Faisalabad. The trial was laid in RCB Design with three replications. Different dates of sowing viz; 20-Oct, 30-Oct, 09-Nov and 20-Nov were evaluated against gram pod borer damage percentage and other pests on chickpea crop. Aphid population was recorded by observing 10 cm length of 15 twigs selected randomly. For gram pod borer infestation, total and damaged pods from 5 randomly selected plants per plot were counted and percentage infestation was calculated by formula:

$$\text{Pod damage (\%)} = \frac{\text{No. of damaged pod}}{\text{No. of total pods}} \times 100$$

TABLE:32 EFFECT OF DIFFERENT DATES OF SOWING OF CHICKPEA ON POD BORER (*HELICOVERPA ARMIGERA*) INFESTATION.

Date of sowing		Aphids/ Twig (10cm)	Gram pod borer damage (%)
T1	20th October	7.50 B	6.09 C
T2	30th October	7.93 B	6.67 BC
T3	9th November	8.56 AB	7.33 B
T4	20th November	10.80 A	8.57 A
LSD at 5%		2.4276	0.9131

Results indicated that minimum (6.09%) infestation of gram pod borer was recorded in crop sown on 20th Oct that is statistically at par with crops sown on 30th October with infestation 6.67%. Whereas maximum (8.57%) pod borer infestation was recorded in crop sown on 20th November. Maximum aphid/twig (10.80) was observed on crop sown on 20th November followed by crop sown on 9th November (8.56 Aphids/twig) while minimum were recorded on the crop sown on 20th October (7.50 Aphids/twig).

INSECT/PESTS OF VEGETABLES

33: COMPARATIVE EFFICACY OF VARIOUS INSECTICIDES AGAINST JASSID ON OKRA

Six insecticides were tested against jassid on okra crop. The experiment was laid out in Randomize Complete Block Design with three replications at farmer's field. Data regarding jassid population was calculated before and after 24hrs, 72hrs and 7days from 15 randomly selected leaves (upper, middle & lower) portion of 15 selected plants per plot. The data was compiled and percentage mortality was calculated.

TABLE:33 EFFICACY OF Some INSECTICIDES AGAINST JASSID ON OKRA

Sr. No.	INSECTICIDES		DOSE/ ACRE	PERCENTAGE MORTALITY OF JASSID AFTER		
	COMMON NAME	TRADE NAME		24 hrs	72 hrs	7 Days
1.	Momentum	nitenpyram+chlorofenapyr	250ml	53.86b	65.01ab	68.49a
2.	Commondo 97%	Acephate	250gm	61.20a	68.79a	72.48a
3.	Lasenta 80%WG	imidacloprid+fipronil	60gm	66.32a	70.18a	76.55a
4	Imidacloprid 200SL	Imidacloprid	250ml	52.50b	42.74d	54.95b
5.	Pyramid 10%AS	Nytenpyram	200ml	48.48bc	56.70bc	54.98b
6	Bifenthrin 10EC	Talstar	100ml	41.65c	48.82cd	49.23b
7	Control			6.40	7.39	6.047
Tuckey's HSD at 5%.				7.05	9.14	11.21

The result showed that Lasenta 80%WG gave maximum mortality 66.32% followed by Momentum, Imidacloprid and Pyramid 10%AS with 53.86%, 52.40 and 48.48% after 24hrs of spray. Minimum mortality was recorded in Bifenthrin 10EC i.e. 41.65%. after 72hrs and 7days of spray. Maximum mortality (70.18% & 76.55) was recorded in Lasenta 80%WG followed by Pyramid 10%AS (56.70% & 54.98%). Minimum mortality was recorded in Bifenthrin 10EC i.e. 48.82% & 49.23 after 72 hours and 7-days of spray, respectively.

34:COMPARATIVE EFFICACY OF VARIOUS INSECTICIDES AND ACARICIDES AGAINST MITES ON BRINJAL

Eight insecticides & acaricides were tested against mites on brinjal crop at research area of Vegetable Research Sub-station Multan. The experiment was laid out in RCBD with three replications. Data was recorded before and after 03, 05 & 7 Days of spray application from each plot .The data regarding mite population was recorded by randomly selected three plants from

each plot. From each plant, one leaf was selected from upper portion, one from middle portion and one from lower portion was selected for data recording of mites. So, total nine leaves were selected from three randomly selected plants from each treatment. Finally percentage reduction of mite population was calculated.

Table:34. Efficacy Of Some Insecticides And Acaricides Against Mites On Brinjal.

Sr. No.	Insceciticides		Dose (100 liter of water)	PERCENTAGE REDUCTION OF MITES		
	Common Name	Trade name		3 DAS	5 DAS	7 DAS
1	Azocyclotine 25% WP	Gallop	75 gm	29.88b	26.62b	48.81b
2	fenpyroximate5% SC	Unique-M	200 ml	60.77a	69.49a	76.71a
3	Hexythiazon 10% WP	Nissoran	200 gm	30.43b	32.20b	52.01b
4	Abamectin 1.8% EC	Abamectin	300 ml	10.79c	16.89c	30.98c
5	Diafenthiuron 500 SC	Trophy	200 ml	13.56c	22.78c	38.47c
	Control		---	0.00d	0.00d	0.00d
Tuckey's HSD @ 5%				11.91	8.13	6.74

RESULTS:

The result showed that maximum mite population reduction was recorded in Fenpyroximate5% SC ranging from 60.77% to 76.71% followed by Azocyclotine 25% WP & Hexythiazon 10% WP ranging from 29.88% to 52.01% after 3, 5 and 7 days of spray application. Minimum percentage reduction of mites was recoreded in Diafenthiuron 500 SC and Abamectin 1.8% EC respectively.

35:VARIETAL SCREENING OF TOMATO AGAINST TOMATO FRUIT BORER (*HELICOVERPA ARMIGERA*)

The experiment was laid out in RCBD with three replication at Vegetable Research Sub Station, Multan. Eight varieties of tomato were screened against tomato fruit borer. The data of fruit borer infestation was recorded from ten randomly selected plants from each plot. The fruits from each plant were examined and percent infestation of *H. armigera* was recorded by counting the healthy and infested fruits. Percentage of fruit damage was calculated.

Table: 35. **Vatietal Screening of Tomato Against Tomato Fruit Borer**

Average Tomato Fruit Borer damage at different dates/plant basis									
Varities	**09.02.1**	**15.02.1**	**22.02.1**	**01.03.1**	**08.03.1**	**15.03.1**	**22.03.1**	**29.03.1**	**Averag**

	7	7	7	7	7	7	7	7	e
Salar	3.00	1.10	2.70	1.60	2.90	1.20	1.90	0.60	1.87
Sahel	2.60	1.10	1.80	1.70	3.40	1.00	0.90	0.70	1.67
LITTH-765	2.40	0.90	1.90	2.80	4.20	1.60	0.40	0.80	1.88
LITTH-710	1.50	0.70	3.50	2.40	3.90	1.20	1.00	0.40	1.83
LITTH-707	1.60	1.50	2.70	1.60	4.80	1.40	1.10	0.60	1.90
LITTH-691	2.90	1.50	1.80	2.00	4.90	2.40	1.60	0.60	2.23
LITTH-682	3.90	3.20	3.30	3.30	3.40	2.00	1.30	1.30	2.72
Saandal	2.40	3.50	2.30	3.50	3.10	2.30	2.00	2.40	2.70
									NS

RESULTS:

Percentage of Fruit damage on all varieties of tomato was statistically non significant ranging from 1.67 to 2.72% respectively.

36:SCREENING OF TOMATO GENOTYPES AGAINST INSECT PESTS

The experiment was conducted in the research area of Vegetable Research Institute, Faisalabad. The trial was laid out in RCBD with three replications. Seven tomato genotypes viz: LITHH-691, 08594, 13189, 10139, Sahel F1, T-1359 F1 and Naqeeb were screened out against insect pests. Aphid population was recorded from 15 randomly selected upper, middle and lower leaves of 15 plants per plot. Attack of fruit borer was recorded by examining all healthy and infested fruits of 5 randomly selected plants per plot. Physio morphic characters as thickness of leaf lamina (mm), hair density on leaf (cm^2) and stem diameter (cm) were also recorded. The data recorded are as under:-

TABLE: 36. SCREENING OF TOMATO GENOTYPES AGAINST INSECT PESTS

Varieties		**Aphids pop/Leaf**	**Fruit Borer Damage (%)**	**Bio control agents/plant (coccinelid, syrphid fly)**	**Leaf Hair density (per cm^2)**	**Leaf lamina thickness (mm)**
1	LITHH-691	1.73 B	3.97 C	1.33	206.67 AB	0.21 ABC

2	08594	2.50 B	4.47 BC	1.46	221.67 A	0.24 A
3	13189	2.70 B	5.63 ABC	1.22	195.33 ABC	0.22 AB
4	10139	4.33 A	6.53 AB	1.26	182.33 BC	0.17 C
5	Sahel F1	4.40 A	5.157 ABC	1.22	168.33 C	0.19 BC
6	T-1359 F1	2.63 B	5.83 ABC	1.14	202.67 AB	0.19 BC
7	Naqeeb	4.33 A	6.87 A	1.17	196.33 ABC	0.21 ABC
LSD@5%		1.3056	2.2688	NS	28.317	0.0383

Minimum aphid population (1.73 aphid /leaf) was recorded on genotype LITHH-691. Maximum aphid population (4.40 aphid/ leaf) was recorded on Sahel F1 that is statistically at par with aphid populations recorded on genotypes 10139 and Naqeeb. Minimum fruit borer infestation (3.97%) was recorded on LITTH-691 followed by genotype 08594 with pests infestation of 4.47%. Whereas, the maximum fruit borer infestation (6.87 %) was recorded on Naqeeb that was found to be statistically at par with infestations in genotypes 13189, 10139, Sahel F1 and T-1359 F1. Maximum population of beneficial insects (1.46/plant) was recorded on 08594 while minimum (1.14/plant) was found on T-1359 F1.

TABLE: CORRELATION COEFFICIENTS OF INSECT PESTS OF TOMATO WITH PLANT PHYSIO-MORPHIC CHARACTERS

	Tomato Fruit borer % Infestation
Leaf Hair density (per cm^2)	-0.4155 0.3539
Leaf lamina thickness (mm)	-0.5251 0.2262

Correlation coefficients between fruit borer damage percentage infestation and plant physio-morphic characters indicated that fruit borer was negatively and non-significantly correlated with leaf hair density and leaf lamina thickness of tomato plants.

37: SCREENING OF DRY PEAS GENOTYPES AGAINST INSECT PESTS

Twelve peas genotypes viz; DP-09-08, DP-09-22, DP-01-12, DP-01-13, DP-01-14, DP-06-14, DP-08-14, DP-09-14, DP-11-14, DP-12-14, No. 267 and PF-400 were sown at the research area of ERI, Faisalabad for screening against insect pests. The trial was laid out in RCBD with three replications. Aphid population was recorded from 15

leaves of 15 plants selected at random per plot. Data regarding gram pod borer was recorded by observing total and infested pods of 5 randomly selected plants from each plot. Percent infestation was calculated and data so obtained was statistically analyzed.

TABLE:37. SCREENING OF DRY PEAS GENOTYPES AGAINST INSECT PESTS

Genotypes		Aphids/leaf	Pod borer % Damage	Bio-controls/plant
V1	DP-09-08	0.69 BCD	2.22 A	0.56 EF
V2	DP-09-22	1.01 A	1.87 AB	0.31 F
V3	DP-01-12	1.03 A	1.46 BCD	0.45 EF
V4	DP-01-13	0.55 D	1.87 AB	1.42 BCD
V5	DP-01-14	0.67 CD	1.45 CD	2.23 A
V6	DP-06-14	0.82 ABCD	1.42 CD	0.96 DE
V7	DP-08-14	0.96 ABC	1.16 D	0.53 EF
V8	DP-09-14	0.86 ABC	1.50 BCD	1.49 BC
V9	DP-11-14	1.11 A	1.80 BC	1.36 CD
V10	DP-12-14	0.98 AB	1.46 BCD	0.30 F
V11	No. 267	1.00 A	1.41 CD	0.63 EF
V12	PF-400	0.98 AB	1.51 BCD	1.90 AB
LSD at 5%		0.2937	0.4137	0.5174

Means of aphid/leaf, pod borer infestation percentage and bio-controls per plant were found to be statistically different from each other. Minimum aphids population (0.55 aphids/leaf) was recorded on genotype DP-01-13 followed by DP-01-14 and DP-09-08 with aphid population of 0.67 and 0.69 per leaf, respectively, whereas maximum (1.11aphid/leaf) population was recorded on genotype DP-11-14. In case of pod borer damage percent, minimum (1.16%) infestation was recorded on genotype DP-08-14 followed by genotypes No. 267, DP-06-14, DP-01-14, DP-01-12 and DP-12-14 with percentage infestations 1.41, 1.42, 1.45, 1.46 and 1.46, respectively. Maximum (2.22%) pod borer damage was recorded on genotype DP-09-08. Maximum (2.23/plant) . Biocontrol agents were recorded on genotype DP-01 14 which was statistically at par with population on PF-400 while minimum (0.30/plant) were recorded on V1 genotype DP-12-14.

INSECT/ PESTS OF OIL SEED CROPS

38:EFFECT OF DIFFERENT SOWING DATES ON BRASSCA APHID AND ITS NATURAL ENEMIES (CHARYSOPERLA, COCCINELIDS AND SYRPHID FLY)

The experiment was laid out in RCBD with four repeats at Entomological Research Institute Risala No.15, Faisalabad. DGL sarsoon was sown at fortnightly interval i.e. 15-10-2016, 1-11-2016 and 15-11-2016. Data of aphid population was recorded from 10 randomly selected 10cm long shoot/plot throughout crop season till maturity at weekly intervals. Data regarding beneficial insects Coccinellids, Chrysoperla and Syrphid was recorded from 10 randomly selected plants/ plot. Data were statistically analyzed.

Table:38.Incidence Of Aphid And Its Natural Predators On Different Sowing Dates

Sr. No.	Treatment	Average Aphid Population/ 10cm long shoot	Average coccinellids population/ 10 plants	Yield Kg/acre
1	15-10-2016	13.62 c	0.50 b	563.38 a
2	01-11-2016	33.97 b	0.67 b	498.76 b
3	15-11-2016	82.52 a	1.57 a	400.75
	LSD @ 5%	17.63	0.31	58.94

Data revealed that maximum aphid population 82.52 / 10cm long shoot was recorded in plot sown on 15-11-2016 followed by 33.97 aphid/10cm long shoot in plot sown on 01-11-2016. Minimum aphid population 13.62 was recorded in plot sown on 15-11-2016. Early grown crop escaped from aphid attack.

Data regarding beneficial insects i.e. maximum population of coccinellids 1.57/10plants was recorded in 15-11-2016 sown crop while syrphid and chrysoperla population was negligible.

Maximum yield was recorded in early crop sown on 15-10-2016.

INSECTICIDE RESISTANCE

39: MONITORING OF INSECTICIDE RESISTANCE IN WHITE FLY

Seven insecticides viz., Confider 200SL, Confidor 70WS, Rani 20SL, Dinogreen 40EC (Dimethoate), Polo 500SC (Diafenthoran), Priorty 10.8EC (Pyriproxifen), and Movento 240 SC (Spirotetramate) were tested for the monitoring of insecticide resistance under lab condition.

Table 39: Insecticide Resistance In White Fly

Insecticides	LC50	Base Line Values	R. Factor	R. Level
Confidor 200 SL	587.97	8.17	71.96	High
Confidor 70 WS	499.21	4.91	101.67	V. High
Rani 20SL	305.62	4.03	75.83	High
Dimogreen 4EC	39.78	0.74	53.76	High
Polo 500SC	84.14	4.09	20.57	Low
Priorty 10.8 AS	3.90	0.81	4.81	V. Low
Movento 240SC	3.12	1.07	2.94	V. Low

The results in table 1 shows that Confidor 200SL, Confidor 70WS,Rani 20Sl and Dimogreen 4EC have high to very high level of resistance with resistance factor 71.96, 101.67, 75.83, and 53.76 respectively, Polo 500 SC have low level of resistance with resistance factor 20.57, while Priorty 10.8EC and Movento 240SC have very low level of resistance with resistance factor 4.81 and 2.9.

40: MONITORING OF INSECTICIDE RESISTANCE IN COTTON JASSID

Six insecticides viz., Confider 200SL, Confidor 70WS, Rani20SL, Dinogreen 40EC (Dimethoate), Oshin 20SG and Pyramid 10AS were tested for the monitoring of insecticide resistance under lab condition, the results are given in

Table 40: Insecticide Resistance In Cotton Jassid

Insecticides	LC50	Base Line Values	R. Factor	R. Level
Confidor 200 SL	10.43	12.57	80.38	High
Confidor70 WS	917.24	8.31	110.18	V. High
Rani 20SL	521.11	3.72	140.08	V. High
Dimogreen 4EC	163.00	6.17	26.41	Moderate
Oshin20 SG	47.17	4.29	10.99	Low
Pyramid10AS	51.98	5.11	10.17	Low

The results in table 2 shows that Confidor 200SL, Confidor 70WS, Rani 20Sl have high to very high level of resistance with resistance factor 80.38, 110.18, and 140.08 respectively, The Dimogreen 40EC have moderate level with resistance factor 26.41, while Oshin 20SG and Pyramid10 AS have low level of resistance with resistance factor 10.99 and 10.17

41: MONITORING OF INSECTICIDE RESISTANCE IN COTTON THRIPS

Six insecticides viz., Confider 200SL, Confidor 70WS, Rani 20SL, Dinogreen 40EC (Dimethoate), Tracer 240 SC and Thimet25WP were tested for the monitoring of insecticide resistance under lab condition, the results are given in

Table: 41. Insecticide Resistance In Cotton Thrips

Insecticides	**LC50**	**Base Line Values**	**R. Factor**	**R. Level**
Confidor 200SL	1931.48	10.37	186	V.High
Confidor 70WS	1391.96	8.98	154	V.High
Rani 20SL	868.11	8.34	104	V.High
Dimogreen 4EC	265.17	6.31	42	Moderate
Tracer 240SC	56.93	5.71	9.97	Low
Thimet 25WP	78.37	6.77	12	Low

The results in table 3 shows that Confidor 200SL, Confidor 70WS, Rani 20SL have very high level of resistance with resistance factor 186, 154,and 104 respectively, The Dimogreen 40EC have moderate level with resistance factor 42, while Tracer 240SC and Thimet 25 WP have low level of resistance with resistance factor 9.97 and 10.17.

42: MONITORING OF INSECTICIDE RESISTANCE IN HELICOVERPA ARMIGERA

Five insecticides viz., Belt 48 SC, Match 50EC, Proclaim 1.9 EC, Lorsban 40EC and Curacron 50EC, were tested for the monitoring of insecticide resistance under lab condition, the results are given in

Table:42. **Insecticide Resistance In Helicoverpa Armigera**

Insecticides	**LC50 Field Strain**	**LC50 Susceptible Strain**	**Resistance Factor**	**Resistance Level**
Belt 48 SC	5.11	0.83	6.15	V. Low
Match 50EC	21.37	3.19	6.70	V. Low
Proclaim 1.9EC	6.72	0.53	12.68	Low
Curacron 50 EC	61.21	4.98	12.29	Low

Lorsban 40EC	7.38	1.21	6.10	V.Low

The results in table 4 shows that Belt 48 SC, Match 50SC and Lorsban shows very low level of resistance with resistance factor 6.15, 6.70, and 6.10 respectively, while Curacron 50EC and Proclaim 1.9EC have low level of resistance with resistance factor 12.29 and 12.68 respectively.

43:MONITORING OF INSECTICIDE RESISTANCE IN ARMY WORM

Five insecticides viz., Belt 48 SC, Match 50EC, Proclaim 1.9 EC, Lorsban 40EC and Curacron 50EC, were tested for the monitoring of insecticide resistance under lab condition, the results are given in

Table: 43. Insecticide Resistance In Army Worm

Insecticides	LC50 Field Strain	LC50 Susceptible Strain	Resistance Factor	Resistance Level
Belt 48SC	19.71	2.29	8.6	V. Low
Match 50EC	15.37	0.90	17.07	Low
Proclaim 1.9EC	18.21	1.27	14.34	Low
Lorsban 40EC	17.34	5.01	3.46	V. Low
Curacron 50EC	66.36	2.98	22.28	Low

The results in table 5 shows that Belt 48 SC, Lorsban 50 EC very low level of resistance with resistance factor 8.6 , and 3.46 respectively, while Match 50 EC , Proclaim 1.9EC and Curacron 50 EC have low level of resistance with resistance factor 17.07, 14.34 and 22.28 respectively.

BIO-CONTROL AGENTS

44: STUDIES ON THE COCCINELLID FAUNA OF FAISALABAD

Weekly surveys were conducted from November-April, in 2016-17 to explore, identify and check the intensity of Coccinellid beetles on different host plants by aerial sweep net method and hand picking per plant basis. A total of 2394 specimens of cocccinellid predators were captured out of which five species were identified and their numbers of specimens were as followed *Coccinella septempunctata* (1077), *C. tranversalis* (210), *Hippodamia convergens* (457), *Menochilus sexmaculatus* (530) and *Brumoides suturalis* (119) (Table 44 a). Among all five species *C. septempunctata* was more abundant with 55.068% on wheat following *M. sexmaculatus* (41.666%) on onion and (41.666%) on spinach, *H. convergens* (33.333%) on cabbage, *C. transversalis* (16.666%) on pea and *B. suturalis* (9.615%) on cucumber (Table 44 b).

Table:44 (a). *Cocccinellid* predators species were identified and their numbers of specimens.

Sr. No.	**Common Name**	**Scientific Name**	**number**	**Head**	**Pronotum**	**Elytra**
1	Seven spotted ladybug	*Coccinella septempunctata*	1077	Black	Black, anterio-laterally orange-yellow	Yellowish brown to reddish brown
2	Transverse Ladybird	*Coccinella transversalis*	210	Black	Black, anterio-laterally orange	Dull orange to yellowish brown
3	Convergent ladybeetle	*Hippodamia convergens*	457	Black	Yellowish white black large areas in form of four finger like projection in center	Yellow to orange
4	Six-spotted zigzag beetle	*Menochilus sexmaculatus*	530	Yellowish brown	Yellowish brown with transverse black band in the middle near the Posterior margin	Generally brownish yellow
5	Three-striped ladybeetle	*Brumoides suturalis*	119	Black	Straw yellow, black	Brownish

Table:44 b. Species abundance on different host plants.

Crops	***Coccinella***	***Coccinella***	***Hippodamia***	***Menochilus***	***Brumoides***

	septempunctata	*transversalis*	*convergens*	*semaculatus*	*suturalis*
Wheat	**55.068**	**6.575**	**16.894**	**13.789**	**7.671**
Brassica	**42.342**	**15.315**	**12.162**	**30.180**	**0**
Safflower	**48.148**	**12.962**	**15.740**	**25**	**0**
Linseed	**40.740**	**7.407**	**18.518**	**33.333**	**0**
Cabbage	**27.272**	**14.141**	**33.333**	**20.202**	**5.050**
Cauliflower	**34.959**	**14.634**	**17.073**	**30.894**	**2.439**
Radish pod	**37.5**	**8.333**	**29.166**	**20.833**	**4.166**
Spinach	**41.666**	**0**	**16.666**	**41.666**	**0**
Turnip	**29.166**	**0**	**30.555**	**40.277**	**0**
Brinjal	**35.185**	**14.197**	**19.753**	**29.0123**	**1.851**
Broccoli	**39.285**	**0**	**29.761**	**30.952**	**0**
Onion	**51.333**	**0**	**0**	**41.666**	**0**
Pea	**31.25**	**16.666**	**16.666**	**27.083**	**8.333**
Tomato	**30.769**	**0**	**30.769**	**38.461**	**7.692**
Cucumber	**46.153**	**0**	**21.1538**	**15.384**	**9.615**
Citrus	**26.562**	**9.375**	**28.125**	**35.937**	**0**
Sugarcane	**31.073**	**9.604**	**22.598**	**29.378**	**7.344**

45: ROLE OF JASMINE OIL SPRAY IN WHEAT TO ATTRACT NATURAL ENEMIES TO CONTROL APHIDS

The experiment was conducted in the Entomology area of Ayub Agriculture research Institute, Faisalabad during 2017. Different concentrations (5%, 2.5%, 1.25% and Control) of Jasmine oil were sprayed in wheat crop after 30-45 days of sowing to attract bio-control agents for insect management, especially aphids. The experiment was conducted under field conditions in Randomized Complete Block Design (RCBD) with three replications. The data was recorded before treatment, after 24 hours, 48 hours and 7 days after spray. The results (from pretreatment data) showed that percent parasitism were maximum in 5% concentration while the predator population was maximum in 1.25 % concentration. The results revealed that maximum percent parasitism (10.5%) was recorded in 5% concentration of jasmine oil after 7 days of application while the minimum percent parasitism (4%) was recorded in control after 7 days. In case of predators maximum population was observed in treatment 2.5% concentration i.e. 2.00 / tiller after 48 hours of application whereas after 24 hours of application minimum predator population (0.867 / tiller) was observed in treatment 5%.

Table:45. **Attraction of bio-control agents after application of Jasmine oil on Wheat**

Con.	**Insect**	**Pretreatment**	**24 h**	**48 h**	**7 DAS**
5%	Parasitized aphid	0.433±0.33b	0.967±0.03d	1.733±0.12b	1.300±0.05d

	Percent Parasitism	2.6%	9.2%	8.4%	**10.5**%
	Predators	0.533±0.08b	0.867±0.14d	1.733±0.20b	1.267±0.12d
2.5%	Parasitized aphid	0.467±0.33b	1.200±0.15cd	1.433±0.06b	2.067±0.26d
	Percent Parasitism	3.2%	7.2%	7.2%	**8.4**%
	Predators	0.467±0.06b	1.133±0.12cd	1.533±0.12b	2.000±0.15d
1.25%	Parasitized aphid	0.433±0.06b	1.433±0.12cd	1.633±3.81a	1.933±0.06d
	Percent Parasitism	2.0%	7.2%	7.3%	**7.9%**
	Predators	0.567±0.12a	1.333±0.18cd	1.667±0.17b	1.700±0.2d
Control	Parasitized aphid	0.433±0.06b	1.400±0.11cd	0.767±0.06b	1.500±0.1d
	Percent Parasitism	2.2%	4.7%	4.3%	4%
	Predators	0.767±0.88a	1.167±0.21cd	0.900±0.1b	1.400±0.17d
		5.784	6.328	8.383	7.279

46:EXPLORATION OF NATURAL ENEMIES OF WHITEFLY

Weekly surveys were conducted to record natural enemies of whitefly and their abundance. For this purpose leaves were collected from different Kharif crops sown in AARI research area infested with whitefly nymphs. Leaves were kept in jars to allow parasitoids for emergence. Different types of parasitoids were recovered from already parasitized leaves of cotton, cucumber, okra and brinjal and their abundance on respective hosts were as followed 375, 15, 10 and 02 respectively. Parasitoids emergence were low on vegetables due to extensive spray of insecticides on vegetables. The parasitoid specimens were preserved in alcohol for further identification of species.

47:EFFECT OF INSECTICIDAL SPRAY ON THE NATURAL ENEMIES OF INSECT PESTS OF COTTON

Eleven insecticides viz. Flunicamid 50% WG, Dinotefuran 20% SG, Nitenpyram 10% AS, Thiamethoxam 25 WG, Acephate 75 SP, Dimethoate 40 EC, Imidacloprid 20% SL, Methomyl 40 SP, Thiachloprid 480 SC, Acetamiprid 20 SP and Check, respectively were tested against natural enemies of insect pests of cotton. The data were recorded after 24 hrs, 48 hrs and 7 days after application. The recorded data were under as followed:

Table: 47. Effect Of Insecticidal Spray On The Natural Enemies Of Insect Pests Of Cotton

Treatments			**Dose rate**		**Pre-Treatment**	**Post-Treatment**		
						24 hrs	**48 hrs**	**7 Days**
1	Flunicamid 50% WG	Ulala 50% WG	60-80 gm	Parasitoid	3.90 bcd	1.56 cde	0.93 bc	0.30 cde
				Predator	3.46 bcd	2.26 bc	1.13 bc	0.96 a
2	Dinotefuran	Oshin	100 gm	Parasitoid	3.93 bcd	0.90 e	0.60 c	0.26 de

	20% SG	20% SG		Predator	3.10 d	1.76 cde	1.13 bc	0.70 bcde
3	Nitenpyram 10% AS	Pyramid 10% AS	200 ml	Parasitoid	5.33 abcd	1.53 cde	0.73 bc	0.50 bcde
				Predator	3.83 bcd	2.43 bc	1.43 bc	0.83 bcd
4	Thiamethoxam 25 WG	Actara 25 WG	24 gm	Parasitoid	6.60 a	1.60 cde	0.96 bc	0.00 e
				Predator	5.93 abc	2.26 c	1.06 bc	0.86 bc
5.	Acephate 75	Acephate 75 SP	250-300 gm	Parasitoid	5.06 abcd	1.46 cde	0.86 bc	0.00 bcde
				Predator	3.76 bcd	1.900 cde	1.13 bc	0.70 bcde
6	Dimethoate 40 EC	Dimethate 40 EC	400 ml	Parasitoid	3.93 bcd	1.36 cde	0.63 c	0.00 e
				Predator	4.80 abcd	1.900 cde	1.00 bc	0.50 bcde
7	Imidacloprid	Confidor 20% SL	70 gm	Parasitoid	6.03 ab	1.00 de	0.73 bc	0.16 e
				Predator	3.40 bcd	1.73 cde	1.06 bc	0.56 bcde
8	Methomyl	Lannate 40 SP	250 gm	Parasitoid	3.50 bcd	1.60 cde	0.76 bc	0.00 e
				Predator	3.10 d	1.90 cde	1.06 bc	0.60 bcde
9	Thiachloprid	Garner 480 SC	250 ml	Parasitoid	3.86 bcd	1.50 cde	0.70 bc	0.23 e
				Predator	3.36 cd	2.00 cde	0.93 bc	0.53 bcde
10	Acetamiprid 20 SP	Mospilan 20 SP	125 gm	Parasitoid	3.36 cd	1.46 cde	0.80 bc	0.30 cde
				Predator	3.16 d	2.06 cd	1.13 bc	0.66 bcde
11	Check		_	Parasitoid	3.31 cd	3.60 a	3.60 a	2.93 a
				Predator	3.59 bcd	3.40 ab	3.86 a	3.50 a
LSD					2.649	1.121	0.736	0.592

The results revealed that maximum population of parasitoids 0.50 / plant was recorded in plots treated with Nitenpyram 10% AS after 7 days of application while Thiamethoxam 25 WG, Acephate 75 SP, Dimethoate 40 EC and Methomyl 40 SP showed 0 populations of parasitoids. In case of predators' maximum population was observed 0.96 / plant in plot treated with Flunicamid 50% WG after 7 days of application whereas minimum predator population 0.50 / plant was observed in Dimethoate 40 EC.

STORED GRAIN

48:EFFICACY OF PLANT OILS AGAINST THE LARVAE OF KHAPRA BEETLE (TROGODERMA GRANARIUM)

The trial was planned in CRD in stored grain laboratory ERI, Faisalabad. There were 3 treatments including control with three replications. Plant oils were dissolved in acetone to make concentrations (12, 10, 8, and 6 ul/ml) and 1 ml of each concentration was applied in each petri dish to make a thin film. 10 3rd instar larvae of *T. granarium* were released in each petri dish of each concentration. Data regarding mortaliy % was recorded and analyzed statistically.

Table: 48.Effect of plant oils at different concentrations on mortality of khapra larvae at different intervals

Plant oils	Concentration (ul/ml)	Mortality (%)		
		3 days	6 days	9 days
Olive oil	12	23.3a	46.7a	63.3a
	10	13.3b	26.7b	53.3a
	8	6.67bc	16.7c	30.0b
	6	3.33c	7.7d	13.3c
LSD at 5%		9.39	9.39	11.51
LC 50		18.90	18.90	18.90
Jamba seed oil	12	46.7a	60.0a	73.3a
	10	36.7b	43.3b	50.0b
	8	23.3c	33.3b	43.3bc
	6	10.0d	33.3b	36.7d
LSD at 5%		8.14e	11.51	11.51
LC50		12.541	12.541	12.541

It is evident from the results that jamba seed oil showed maximum efficacy against the larvae of khapra beetle by exhibiting 73.3% mortality at 12ul/ml concentration that was significantly different from other concentrations. Concentration 10ul/ml with 50.0% mortality was non significantly different from 8ul/ml showing 43.3% mortality.

In case of olive oil maximum mortality % (63.3) was recorded after 9 days interval at 12ul/ml concentration that was significantly different from 10ul/ml (53.3%).

49: EFFICACY OF INSECT GROWTH REGULATORS AGAINST STORED GRAIN INSECTS

The trial was planned in CRD in stored grain laboratory ERI, Faisalabad. There were 5 treatments including control with three replications. 10 gm. Diet containing Wheat flour+ brewer's yeast (9:1) was added in each replicate. Flour was treated with 20, 15 and 10 and 5 ppm doses of each IGRs. 10 3rd instar larvae of *Tribolium castanium* were released in each replicate. Data regarding larval motality and seed viability was recorded and analyzed statistically.

Table: 49. EFFICACY OF INSECT GROWTH REGULATORS AGAINST *Tribolium castanium*

IGRs	Concentrations (ppm)			
	20	15	10	5
Lufenuron 5%EC	96.30a	89.27a	85.57a	74.47a
Pyriproxifen 10.8EC	85.57ab	64.10b	53.70bc	46.67b
Lufenuron+ Methoxyfenozide	96.30a	85.57a	67.43ab	52.97ab
Methoxyfenozide 480SC	79.63b	67.80b	42.57c	28.50b
LSD at 5%	13.87	14.27	23.97	25.66

It is evident from the results that Lufenuron gave maximum mortality % against the larvae of red flour beetle at all concentrations. It showed maximum mortality % (96.30) at 20% concentration followed by 89.27, 85.57 and 74.47% mortality at 15, 10 and 5 ppm respectively. In case of pyriproxifen maximum (85.57%) mortality was recorded at 20 ppm followed by 64.10, 53.70 and 46.67% mortality at 15, 10 and 5 ppm respectively. Mixture of Lufenuron+ Methoxyfenozide showed synergistic effect with 96.30 % mortality at 20ppm followed by 85.57 and 67.43% at 15 and 10 ppm and least 52.97% at 5ppm. Methoxyfenozide depicted 79.63%, 67.80, 42.5 and 28.50% mortality at 20. 15. 10 and 5ppm dose respectively.

Germination percentage at different concentrations of insect growth regulators

IGR's	Germination %				T_{50} (Days)
	5ppm	10ppm	15ppm	20ppm	
Control	100	100	100	100	3
Runner	100	100	100	99	2
Index	100	100	99	99	2
Poker	100	100	100	100	2
Index+Poker	100	100	100	98	2

T_{50}= days after sowing that give 50% germination of total seeds.

Germination of all treated seeds was >98% and didn't show any significant difference between control and the treated seeds.

BEEKEEPING & HILL FRUIT PESTS

RESEARCH EXPERIMENTS

1:QUANTITATIVE ASSESSMENT OF POLLEN COLLECTED AT DIFFERENT TIME INTERVALS IN *APIS MELLIFERA L.*

At Rawalpindi

Pollen trap have been fitted/fixed at the entrance of three beehives during different time interval of a day i.e. 09:00 – 12:00, 12.00 – 14:00 and 14:00 - 16:00 hours. The experiment conducted during spring season. The pollen collected at above mentioned time in a day, stored in plastic bottles and weighed. Finally the maximum collection during the specific month/week has been recorded. Quantity of pollen collected of each time interval weighed with a scientific balance and determined the best time interval that receive maximum pollen load

The data revealed that time interval (9.00 to 12.00) gave the best results and showed maximum pollen collection (13.418gm) at the time interval as compared to others.

2: EVALUATION OF DIFFERENT POLLEN SUPPLEMENT AND POLLEN SUBSTITUTE DURING DEARTH PERIOD

At Rawalpindi

Twenty one bee colonies have been selected having equal strength. Treatments applied from October to November. Pollen substitute provided at fortnight interval except control. Each treatment except control before application kneaded into dough by mixing sugar syrup. The pre-treatment observation recorded just before application and post treatment data recorded after 15

Sr. No.	Treatments
T_1 =	Soyabeanflour(200 gm)+pollen pellet(50 gm) + sucrose solution (200 ml)
T_2 =	Brewer yeast(200 gm)+pollen pellets(50gm) +sucrose solution(200ml)
T_3 =	Gram flour(200 gm)+pollen pellets(50gm) +sucrose solution(200ml)
T_4 =	Soyabeanflour(200 gm)+ sucrose syrup(200 ml)
T_5 =	Brewer yeast(200 gm)+ sucrose solution(200ml)
T_6 =	Gram flour(200 gm) +sucrose solution(200ml)
T_7 =	Control

days of time interval. The efficacy of each treatment recorded on the basis of sealed brood area measurement in sq inches by using wire grid.

DEVELOPMENT OF HONEY BEES ON ARTERIAL DIET

The results showed that T_1(Soybean flour (200 gm)+pollen pellet(50 gm)+Sucrose syrup (200 ml) gave the better results, resulted in 66.59 % increase in brood as compared to control followed by T_3Gram flour(200 gm)+pollen pellets(50gm) +sucrose solution(200ml) resulted in 51.44% in brood increase.

3.COMPARISON OF HYGIENIC AND GROOMING BEHAVIOUR OF HONEY BEES (*APIS MELLIFERA*) RACES AGAINEST VARROA MITES IN RAWALPINDI

At Rawalpindi

Two groups of equal strength honey bee colonies reared in wooden langstroth hives were tested. The 1st group was headed by queens of *Apis mellifera carniolan* and the 2nd group with *Apis mellifera caucasica*. Ordinarily beekeeping practices including necessary supplementary feeding was conducted. The tested colonies were naturally infested with varroa mites and no varroa control treatments were applied.

ASSESMENT OF HYGIENIC BEHAVIOUR: Four honey bee colonies / race was experimented for their hygienic behavior. An area (2.5 X 2.5 cm) of centered sealed worker brood (100cell/1 comb/colony) was bordered and killed by piercing a fine wooden pin into each cell and, then the comb was returned to its hive. The percentages of brood removal in each colony was recorded after.24,48 and 72 hours. Three experiments were conducted consequently with one week interval.

ASSESSMENT OF GROOMING BEHAVOUR: The former four honey bee colonies were also experimented three times with one week interval for their grooming behaviors. A plastic sheet coated with vacelinewas placed onto each hive bottom board and separated with a screen mesh to prevent varroa individuals from escape or climbing back to the brood frames. After 3 days, dropped mites was separated, counted and examined for any deformity using a microscopic magnification at Beekeeping Research Station, Rawalpindi.

4: STUDIES ON THE SCENARIO OF AMERICAN FOUL BROOD AND HONEYBEE MITE IN THE APIARIES

At Rawalpindi

Survey of different apiaries in the Province of Punjab carried out. The infection and infestation of honey bee disease and mite recorded to ascertain the extent of damage done to the

honey bees by inspecting bee colonies of the total stock. Advisory services have also been provided as per pest situation to beekeepers.

Twenty beekeepers/farmers were contacted in this respect and their apiaries were observed, with respect to mite and AFB infestation from October 2016 to March 2017.

It was observed that 5%-48% infestation of honeybee mite and nil infection of American Foul Brood were recorded.

5:QUANTITATIVE ASSESSMENT OF PROPOLIS EXTRACTED IN DIFFERENT SEASONS BY BEE COLONIES *APIS MELLIFERA*

At Rawalpindi

Nine bee colonies of same population were selected. Propolis trap was fitted above top bar of the frames in the beehive. Propolis traps was removed after two months and put into the freezer for freezing propolis. Propolis was extracted from propolis traps and weighed for comparison.

DATA SHOWING THE PERCENTAGE PROPOLIS COLLECTED DURING FOLLOWING MONTHS

Months	Average Weight/ Trap(gm)
October, 2016	14.47 F
November, 2016	19.24 E
December, 2016	31.18 D
January, 2017	37.15 C
February, 2017	53.60 B
March, 2017	59.82 A
LSD @0.05	**1.161**
CV	**2.587**

Quantity of propolis collected during (March.2017) was more i.e. 59.82 gm/ trap as compared to other treatments.

6:STUDIES ON THE EFFECT OF BEEWAX FOUNDATION ADULTRATED WITH PARAFFIN ON COMB CONSTRUCTION AND BROOD DEVELOPMENT

At Rawalpindi

Twelve bee colonies have been selected having equal strength. Treatments applied from February to March. The pre-treatment observation was recorded just before application and post treatment data recorded after 15 days interval. The efficacy of each treatment was recorded on

the basis of sealed brood area measurement in sq inches by using wire grid and comb foundation acceptance rate.

Sr. No.	TREATMENT	PRE-TREATMENT DATA	POST TREATMENT DATA	
			MEAN	%AGE OVER CONTROL
T_1	**Bee wax foundation sheets with 10% paraffin.**	**370.75**	**475.75 c**	**7.65**
T_2	**Bee wax foundation sheets with 30% paraffin**	**371.45**	**645.34 a**	**48.66**
T_3	**Bee wax foundation sheets with 50% paraffin**	**365.67**	**536.25 b**	**22.33**
T_4	**Bee wax foundation sheets (Control).**	**388.25**	**438.66 d**	**-**

The results revealed that bee wax foundation with 30 % paraffin gave better results than other treatments.

7:Capacity Building & Training Program For Beekeepers & Interested Persons

At Rawalpindi

Beekeepers and the general public have been trained in the enterprise of beekeeping.

Syllabi for the subject training are as under.

1. Introduction to beekeeping
2. Colony System
3. Food (Nectar & Pollen) sources.
4. Beekeeping equipments
5. Bee management in winter.
6. Bee management in the spring.
7. Artificial queen rearing.
8. Honeybee diseases & enemies.
9. Bee products.

Two beekeeping training course of 5 days interval were organized at Rawalpindi. 26 persons participated in these training courses. They were imparted theoretical and practical training in bee management and others related topics.

8:Effect Of Different Stimulant Feeding On Colony Strength Of *Apis Mellifera* L.

At Rawalpindi

The experiment was laid out by using RCBD with three replicates. For this purpose fifteen even populated bee colonies was selected. The feeding was done at the week interval. Observation on

brood rearing was recorded 24 hours before the treatment and 15 days after the treatment application on per square inch basis with the help of wire grid.

The data revealed that T_3 (500ml High Fructose corn syrup/week) gave best result 63.83% more brood and T_4 (500ml High D corn syrup/week) 39.54% as compare to control followed by T_2 (500ml Glucose syrup/week) 43.55% and T_1 (500ml sugar syrup/week (Standard) 35.79%.

RESULTS

Sr. No.	Treatments	Pre-Treatment Data	Post Treatment Data	% age Increase in brood over control
			Mean	
T1	500 ml sugar syrup / week (standard)	255	381.66c	30.86
T2	500 ml glucose syrup per week	260	412.33b	41.37
T3	500 ml high fructose corn syrup per week	258	469.66a	61.03
T4	500 ml high D. corn syrup per week	256	392.66d	34.63
T5	Control no feeding	260	291.66	-

Data revealed that T3 (500 ml high fructose corn syrup per week) gave better results i.e 61.03% increase in brood area over control.

9:COMPARISON OF HYGIENIC AND GROOMING BEHAVIOURS OF HONEY BEES (*APIS MELLIFERA*) RACES AGAINEST VARROA MITES IN RAWALPINDI

At Rawalpindi

Two groups of equal strength honey bee colonies reared in wooden langstroth hives were tested. The 1st group was headed by queens of *Apis melliferacarniolan* and the 2nd group with *Apis mellifera caucasica*. Ordinarily beekeeping practices including necessary supplementary feeding was conducted. The tested colonies were naturally infested with varroa mites and no varroa control treatments were applied.

ASSESMENT OF HYGIENIC BEHAVIOUR: Four honey bee colonies / race was experimented for their hygienic behavior. An area (2.5 X 2.5 cm) of centered sealed worker brood

(100cell/1 comb/colony) was bordered and killed by piercing a fine wooden pin into each cell and, then the comb was returned to its hive. The percentages of brood removal in each colony was recorded after.24,48 and 72 hours. Three experiments were conducted consequently with one week interval.

ASSESSMENT OF GROOMING BEHAVOUR: The former four honey bee was also experimented three times with one week interval for their grooming behaviors. A plastic sheet coated with vaceline was placed onto each hive bottom board and separated with a screen mesh to prevent varroa individuals from escape or climbing back to the brood frames After 3 days, dropped mites was separated, counted and examined for any deformity using a microscopic magnification at Beekeeping Research Station, Rawalpindi.

ASSESMENT OF HYGIENIC BEHAVIOUR:

Races	**General means of 3 experiments (%)**		
	24 hours	**48 hours**	**74 hours**
Apis melliferacarniolan	**75.48**	**87.82**	**90.87**
Apis mellifera caucasica	**34.15**	**69.63**	**83.60**

ASSESSMENT OF GROOMING BEHAVOUR:

Races	**1st**	**2nd**	**3rd**	**General mean**
Apis melliferacarniolan	67.23	40.12	43.64	50.33
Apis mellifera caucasica	34.15	69.63	83.60	56.92

10:COMPARATIVE STUDY OF OILS EXTRACTS VS POWDERS DUST FOR THE CONTROL OF *VARROA DESTRUCTOR*

OBJECTIVE: To determine the efficacy of oil extracts and powder form of different organic compounds for the control of *varroa destructor.*

T1= vegetable oil @15 ml/ hive	TI = garlic powder @ 5 g/hive
T2= clove oil 15 ml /	T2 = ginger powder 5 g/ hive
T3= tobacco oil 15ml/hive	T3 = niazboo powder5g/ hive
T4= control	T4 = control

The experiments were conducted in the private apiary of Mr M. Aslam Awan on twenty four *Apis mellifera* colonies naturally infested with varroa destructor with three repeats. The bottom board of the hives was covered with sheet of white paper . Powders form was applied to each treatment in the form of dusting, while the oils were applied to each treatment in the form of spraying with ordinary plastic sprinkler. The rate of varroa destructor infestation and treatment efficacy was estimated by counting the falling mites on the sheet of paper by counting the dead mites in the sealed worker and drone brood cells before and after treatment.

PREVIOUS YEAR'S RESULTS:-

PERCENTAGE MORTALITY OF MITES AT DIFFERENT INTERVAL (OIL GROUP)

Treatment	Before Treatment application	After 24 hours	After 48 hours
T_1	7.75	22.75	25.5
T_2	10.75	24.75	26.75
T_3	11.50	7.00	8.00

The maximum percentage of mite mortality (26.75) was achieved from clove oil in group I (oils)

PERCENTAGE MORTALITY OF MITES AT DIFFERENT INTERVAL (POWDER GROUP)

Treatment	Before Treatment application	After 24 hours	After 48 hours
T_1	6.12	70.50	73.00
T_2	8.25	53.75	55.50
T_3	6.75	42.25	44.25
T_4	8.00	11.50	11.50

The maximum percentage of mite mortality (73.00%) was achieved from garlic powder (powder group) following by ginger powder (55.50%).It revealed from the experiment that overall maximum (73.00 %) mortality was achieved from powder treatments.

11: EFFECT OF SUPPLEMENTAL FEEDING ON THE DEVELOPMENT OF ARTIFICIALLY REARED QUEEN BEES

An experiment was conducted to study the effect of supplemental feeding on the morphology and performance of artificially reared queen bees. Fifteen even populated bee colonies were selected. The colonies were queen less twenty four hours before the introduction

of grafted queen cups and were called as cell raiser colonies. In each colony, sixteen young larvae (twenty four hours old) of worker bees were introduced. Different treatments i.e. T_1 (250 ml sucrose syrup per week), T_2 (500 ml sucrose syrup per week), T_3 (750 ml sucrose syrup per week), T_4 (1000 ml sucrose syrup per week), T_5 (no feeding control). The supplemental feeding in the form of sugar syrup (1:1) was provided to these bee colonies. On the emergence of the queen bees, the weight and size of each queen bee was measured for comparison. The performance in terms of brood area and honey production per colony was evaluated for each treatment.

DATA SHOWING EFFECT OF SUPPLEMENTAL FEEDING ON DEVELOPMENT OF ARTIFICIALLY REARED QUEEN BEES

Sr. No.	Treatment	Size of queen bee(mm)	Weight of queen bee(mg)	Brood area (Sq. inch)	Honey production (Kg)
T_1	250 ml sucrose syrup per week	17.50	177.00	1270.00	6.00
T_2	500 ml sucrose syrup per week	18.25	186.00	1587.00	7.50
T_3	750 ml sucrose syrup per week	19.00	190.00	1899.00	8.75
T_4	1000 ml sucrose syrup per week	23.50	196.00	2200.00	15.00
T_5	Control(no feeding)	14.00	162.00	975.00	1.85

The data revealed that bee colonies with 1000 ml sucrose syrup per week (T_4) supplemental feeding gave the best result as compared with other treatments.

12: QUANTITATIVE ASSESSMENT OF ROYAL JELLY COLLECTED AT DIFFERENT TIME INTERVAL IN HONEYBEES *APIS MELLIFERA* L.

An experiment was conducted to produce royal jelly to explore its economic potential in the selected population. Artificially made queen cups from bees wax with a special cell forming die were fitted in a wooden hive frame. In each queen cup, twenty four hours old young larvae of worker bee from a best performing colony were grafted with the help of grafting needle. A drop or two of dilute royal jelly were provided to each young larva. The frame was put gently in a strong bee colony, dequeened twenty four hours before the introduction of the frame. Accepted queen cups were removed 48, 72and 96 hours after grafting. The queen cups were cut open a few millimeters above the larvae present in the cell. The larvae was gently removed and discarded. Royal jelly was extracted with a spatula and weighed with an electronic balance.

DATA SHOWING ROYAL JELLY PRODUCTION IN *APIS MELLIFERA* L.

No. of Larvae grafted.	Weight of royal jelly/cup extracted 48 hours after grafting (mg).	Weight of royal jelly/cup extracted 72 hours after grafting (mg).	Weight of royal jelly/cup extracted 96 hours after grafting (mg).
20	170.00	204.00	165.00
20	165.00	190.00	156.00
20	160.00	185.00	135.00
Average	**165.00**	**193.00**	**152.00**

The data revealed that weight of royal jelly/cup extracted 72 hours after grafting is more i.e 193.00 mg as compared with extracted 48 hours after grafting i.e 165 mg and 96 hour after grafting i.e 152.00 mg.

13: STUDIES ON THE EFFECT OF LIQUID PROTEIN (PEPTONE) ON HONEYBEE COLONIES DEVELOPMENT

An experiment was conducted to find out the effect of liquid protein (Peptone) on the development of bee colonies. Twelve even populated bee colonies were selected. The experiment was laid out under RCBD with three repeats. Different treatments i.e. T_1 (Peptone (Liquid protein + Sucrose syrup/week, T_2 (Peptone + yeast + Sucrose syrup/week), T_3 (Yeast + Sucrose syrup/week), T_4 (control) were provided to the bee colonies during the period of mal nutrition. The pre-treatment observations were recorded just before the provision of liquid protein (peptone) and post treatment data was recorded at 15 days interval after treatment application. The efficacy of each treatment was recorded on the brood area measurement is square inch by using wire grid.

DATA SHOWING EFFECT OF LIQUID PROTEIN (PEPTONE) ON HONEY BEE COLONIES DEVELOPMENT

Sr. No.	Treatments	Pre-treatment brood area (Sq. inch)	Post treatment brood area (Sq. inch)	%age increase/ control
T_1	Peptone liquid protein+ sucrose syrup/week.	4800 a	7300 a	49.59 a
T_2	Peptone liquid protein+ yeast + sucrose syrup/week.	4750 a	7110 a	45.69 b
T_3	Yeast + sucrose syrup/week.	4850 a	5520 b	13.11 c
T_4	Control (No feeding)	4800 a	4880 c	

LSD @ .05% 194.20 359.60 1.720

The data revealed that T_1 **(**Peptone liquid protein+ sucrose syrup/week.) gave the best result (49.59 %) more brood as compared to the rest of the treatments.

14: EFFECT OF ESSENTIAL OIL FOR THE CONTROL OF HONEYBEE MITE

An experiment was conducted to determine the most suitable essential oil for the control of bee mite. Twelve bee colonies of same population were selected at random. Different treatment i.e. T_1 (Citronella oil (25 drops add in one liter sugar syrup), T_2 (Eucalyptus oil (25 drops add in one liter sugar syrup), T_3 (Peppermint oil (25 drops add in one liter sugar syrup), T_4 (control) were applied one at 10 days interval. Pre-treatment data of 50 honeybees taken out from each colony were put in bottle containing tap water and then population of mite was counted. Post treatment data was recorded after 24 hours of treatment application by taking out 50 honeybees as per procedure mentioned in pre-treatment. Data regarding reduced percentage of mite population was worked out for comparison.

PERCENTAGE MORTALITY OF PARASITIC MITE

Sr. No.	**Name of different Essential oil.**	**Pre-treatment data (1_o)**	**Post treatment data (1_i)**	**Efficacy E=100-$1_i/1_o$ x100**
T_1	Citronella Oil (25 drops add in one litre Sugar Syrup)	35.00	15.00	57.14
T_2	Eucalyptus Oil (25 drops add in one litre sugar syrup)	36.00	26.00	27.78
T_3	Peppermint Oil (25 drops add in one litre sugar syrup)	36.00	20.00	44.45
T_4	Control (No feeding).	35.00	40.00	-

The data depicted that T1 (Citronella Oil (25 drops add in one liter Sugar Syrup) was found the most effective resulted 57.14 % reduction in bee mite population followed by T3 (Peppermint Oil (25 drops add in one liter sugar syrup) (44.45 %) and T2 (Eucalyptus Oil (25 drops add in one liter sugar syrup) (27.78 %).

15: EFFECT OF DIFFERENT METHOD FOR THE CONTROL OF HORNETS

Vespa velutinapruthii and *Vespa orientalis*

An experiment was conducted to find out the most effected method for the control of hornets. Experiment was laid out in CRBD with three repeats. Different treatments i.e. T1

(Tripod with Tub along with poultry lever), T_2 (Tripod with plastic jar along with damaged Grapes), T_3 (Tripod with small bucket along with poultry lever damaged Grape), T_4 (Tripod with Plastic Jar containing vinegar), T_5 (Tripod with Jar have nothing).All the treatments were filled with soapy water and piece of poultry lever and damaged Grape were suspended 1"-2" above the water with the help of tripod. Tripod was covered with screen having inlet & outlet. Hornets were removed the piece of poultry lever or Grape. They fly down and become trapped in the soapy water. The mortality of hornets was worked out by counting the number of hornets drop in soapy water after 24 hours.

PERCENTAGE MORTALITY OF HORNET

Sr. No.	Treatments	Population of Hornets
T_1	Tripod with Tub along with poultry lever	25.00
T_2	Tripod with plastic jar along with damaged Grapes.	30.00
T_3	Tripod with small bucket along with poultry lever+damaged Grape	35.00
T_4	Tripod with Plastic Jar containing vinegar.	05.00
T_5	Tripod with Jar has nothing.	0.00

Maximum 35 hornets were attracted towards T_3 followed by T_2 (30) T_1 (250) and T_4 (5) while in the control. No hornet was attracted.

16: SURVEY OF EUCALYPTUS SPECIES WITH REGARDS HONEY AND POLLEN VALUES IN THE PROVINCE OF PUNJAB

An experiment was conducted to collect and identify the best Eucalyptus species as valuable to honeybees. Survey and collection of different Eucalyptus species were done in the province of Punjab. These were got identified from Quaid-i-Azam University, Islamabad and Punjab University. Lahore. Period of flowering was also noted. Three Eucalyptus species i.e. Eucalyptus albens, Eucalyptus camaldulensis, Eucalyptus citriodora were collected, preserved and identified as a source of nectar and pollen for honeybees.

Eucalyptus albens Benth:

Family: Myrtaceae

Common Name: White box tree, most prolific for nectar production.

Description: **Tree Trunk**: 25 meter high, bark persistent on full trunk, grey with whitish patches.

Leaves: Juvenile leaves disjunct, ovate to orbiculate, glaucous. Adult leaves disjunct, lanceolate or broad-lanceolate, 9–15 cm long, 2–5.5 cm wide, grey-green to glaucous, dull,

discolorous. Conflorescence compound; umbellasters 7-flowered; peduncle narrowly flattened or angular, 10–18 mm long; pedicels terete, 0–5 mm long. Buds cylindrical or fusiform, glaucous, 10–18 mm long, 4–7 mm diam., scar absent; calyptra conical, as long and as wide as hypanthium. All stamens fertile.

Fruit: Fruit cylindrical or urceolate, 6–15 mm long, 5–10 mm diam.; disc depressed; valves enclosed.

***Eucalyptus Camaldulensis Dehnh.*:**

Family: Myrtaceae:

Common Name: River Gum, River Red Gum, most prolific for nectar and pollen production**.**

Description: Tree: 30 meter high (occasionally taller), bark smooth, white, grey to red brown, shedding in short ribbons or flakes.

Leaves: Juvenile Leaves; Disjunct, broad lanceolate to ovate dull grey-green.

Adults Leaves: Adult leaves disjunct, narrow-lanceolate or lanceolate, 8–30 cm long, 1–2.5 cm wide, green or grey-green, dull, concolorous. Umbellasters 7–11-flowered; peduncle terete, 7–25 mm long; pedicels terete, 5–12 mm long. Buds ovoid, 6–11 mm long, 3–6 mm diam., scar present; calyptra hemispherical and rostrate, longer than and as wide as hypanthium.

Fruit: Fruit globose or ovoid, 3–5-locular, 5–7 mm long, 5–7 mm diam.; disc raised; valves exerted.

Eucalyptus citriodora Hook.

Family: Myrtaceae

Common Name: Lemon scented gum tree, most important for nectar production.

Tree: 50 meter tall, forming a lignotuber, bark smooth throughout, white to pink or coppery, often powdery, shedding in thin curling flakes, mottling of trunk often not pronounced.

Leaves: Juvenile Leaves always petiolate, opposite for 2 or 3 pairs then alternate, ovate to lanceolate, 14-21cm long, 4.5=8cm wide, the base usually peltate for many nodes, green, petiole and lamina scrabrid for may nodes.

Adult leaves alternate, petiole 1–2.5 cm long; blade narrowly lanceolate to falcate, (7)10–23 cm long, 0.6–2.8(3.5) cm wide, base tapering to petiole, concolorous, glossy, green, strongly penniveined, very densely reticulate, intramarginal vein parallel to and just within margin, oil glandsisland. Leaves lemon-scented when crushed or not so.

Fruit: Fruit pedicellate (pedicels 0.1–0.7 cm long), urceolate or barrel-shaped, 0.8–1.5 cm long, 0.7–1.2 cm wide, discdescending, valves 3, enclosed.

BIOLOGICAL IMPACT OF WEATHER ON HONEYBEE ACTIVITIES

Period	Impact of weather on honeybee activities developed.
July, 13	The weather remained extreme hot and humid followed by rainfall at Rawalpindi, Hasanabdal and Lahore where as at Murree Hill it remained partially sunny with heavy showers of rains. Minimum and Maximum temperature from 22 c and 45 c average relative humidity 40 to60% was reported at Rawalpindi. Average relative humidity 45 to 80 % and temperature remained swinging with minimum 12 c and maximum 30 c at Murree.Such weather conditions are not much supportive for better bee development. The bee activity remained below normal at BahtarMusafarBaba .The nectar deficiency was covered by providing sugar syrup (1:1) ratio to bee colonies as supplementary food.
Aug, 13	The weather remained mostly hot and cloudy followed by heavy showers of rains resulting in hot and humid condition at Rawalpindi, Hasanabdal and Lahore where as at Murree Hill it remained somewhat cold and heavy showers of rains were also received. Maximum rainfall i.e. 624.86mm, minimum and maximum temperature from $20C^0$ to $37C^0$ average relative humidity 60 to 90% was reported at Rawalpindi. The bee activity remained below normal during rainy days due to depletion of nectar and washing away of pollen from available bee flora. The bee activity remained below normal at (BahtarMusafar Baba) .The nectar deficiency was covered by providing sugar syrup (1:1) ratio to bee colonies as supplementary food.
Sept, 13	The weather remained mostly hot and humid with some heavy showers of rains resulting in hot and humid condition at Rawalpindi, Hasanabdal & Lahore, whereas at Murree hills it remained somewhat cold and heavy showers of rains were also received. 190.30mm rainfalls were received up till now. Average relative humidity 60 to 80% was recorded. Maximum $36C^0$ and minimum $18.5C^0$ temperature was reported during the month under report. The bee activity remained below normal at Kot Fateh (Lilla). The nectar deficiency was covered by providing sugar syrup (1:1) ratio to bee colonies as supplementary food.
Oct, 13	The weather remained hot and humid with a few light and scattered showers of rain at Rawalpindi, Hasanabdal& Lahore, whereas at Murree hills it remained cold. 37.40mm of rainfall were received during the month under report. Average relative humidity 50 to 70% was recorded. Maximum $35.50C^0$ and minimum $16.50C^0$ temperature was reported during the month.The overall bee activity remained satisfac 19. Fateh (Lilla) on Ber bee flora.
Nov, 13	The weather remained old with traces of rains at Rawalpindi, Hasanabdal& Lahore, w urree it remained sunny with little showers of rains. Total rainfall received 30.00mm at Rawalpindi & 10mm at Murree. Average relative humidity recorded was ranged from 40-80% at Rawalpindi and 30 to 50% at Murree. Maximum $33C^0$ and minimum $16.5C^0$ temperature at Rawalpindi & $20C^0$ to $7C^0$ at Murree was reported during the month. The overall

	bee activity remained satisfactory at BheerBhall Sharif, Sargodha on Sarsoon Brassica flora.
Dec,13	The weather remained dry and cold with few rainfall traces at Rawalpindi, Hasanabdal & Lahore, whereas at Murree it remained cold with snowfall. Total rainfall received 2.1mm at Rawalpindi. Average relative humidity recorded was ranged from 50-70% at Rawalpindi and 70 to 90% at Murree. Maximum $18C^0$ and minimum $1C^0$ temperature at Rawalpindi & $20C^0$ to $-2C^0$ at Murree was reported. The overall bee activity remained satisfactory on Brassica flora.
Jan, 14	The weather remained dry, cold and foggy with traces of rainfall at Rawalpindi, Hasanabdal& Lahore, whereas at Murree it remained very cold. Total rainfall received 7.4mm. Average relative humidity was recorded ranged from 50 to 70% at Rawalpindi and 85% to 90% at Murree. Minimum $-2C^0$ and maximum $19.5C^0$ temperature was reported at Rawalpindi whereas at Murree minimum $-0.5C^0$ and maximum $12C^0$ was recorded. The bee activity remained normal at Khanewal on Brassica flora. However, the feeding requirements fulfilled by supplying the sugar syrup with regular interval of time by requesting the Pioneer Seed Limited, Multan.
Feb, 14	The weather remained dry, cold with traces of rainfall at Rawalpindi, Hasanabdal & Lahore, whereas at Murree it remained chilling cold. Snowfall up to 3 feet was received in the valley and up to 6 feet on the hilly areas of Murree.Total rainfall received 50.5 mm. Average relative humidity was recorded ranged from 40 to 70% at Rawalpindi and 80% to 90% at Murree. Minimum $2.50C^0$ and maximum $23.5C^0$ temperature was reported at Rawalpindi whereas at Murree minimum $-3C^0$ and maximum $14C^0$ was recorded. The bee activity remained normal at Khanewal on Brassica flora. However, the feeding requirements fulfilled by supplying the sugar syrup with regular interval of time by requesting the Pioneer Seed Limited, Multan.
Mar, 14	The weather remained cold, cloudy with heavy showers of rain at Rawalpindi, Hasanabdal& Lahore, whereas at Murree it remained very cold with snowfall ranging from 2 to 3 feet. Total rainfall 183.5mm was received. Average relative humidity was recorded ranged from 40 to 80% at Rawalpindi and 75% to 90% at Murree. Minimum $3.5C^0$ and maximum $28C^0$ temperature was reported at Rawalpindi whereas at Murree minimum $-3C^0$ and maximum $17C^0$ was reported. The bee activity remained normal at by pass Gujrat andJhangBhattar on Brassica and Eucalyptus flora. However, the feeding requirements fulfilled by supplying the sugar syrup with regular interval of time.
Apr, 14	The weather remained hot and dry with few showers of rain at Rawalpindi and Hasanabdal. At Lahore it remained very uncertain during first fortnight with fluctuations in temperature alongwith rains, thunder storms, whereas at Murree it remained moderate. Total rainfall 11.5mm was received. Average relative humidity was recorded ranged from 40% to 70% at Rawalpindi, 375% to 50% at Murree. Minimum $9.5C^0$ and maximum $31.5C^0$ temperature was reported at Rawalpindi whereas at Murree minimum $10C^0$ and maximum $24C^0$ was reported. The bee activity remained normal at DhalaChapperLehtrar Road on Bhaiker and wild flora. In order to obtain best result stimulative sugar feeding was given to the bee colonies

May, 14	The weather remained bit hot and slightly dry with showers of rain at Rawalpindi and Hassanabdal and Lahore, whereas at Murree it remained mild to warm. Total rainfall 96.0 mm was received at Rawalpindi and 50 mm at Murree. Average relative humidity was recorded ranged from 50% to 70% at Rawalpindi, 50% to 60 % at Murree. Minimum 14.5C^0 and maximum 38.0C^0 temperature was reported at Rawalpindi whereas at Murree minimum 9C^0 and maximum 27C^0 was reported. The bee activity remained normal at DhalaChapperLehtrar Road on Phulai and wild flora. In order to obtain best result stimulative sugar feeding was given to the bee colonies.
Jun, 14.	The weather remained extreme hot and dry followed by light showers of rains with wind storms at Rawalpindi, Hassanabdal and Lahore whereas; at Murree it remained sunny and cloudy. Total rainfalls i.e. 14.20 mm was received. Maximum temperature 43 C^0 and minimum 18 C^0 was reported. Average relative humidity 20-40% was recorded. The bee activities remained normal and satisfactory on wild flora at MorhriSayyadanlahtar Road . The nectar deficiency was covered by providing sugar syrup as supplementary food.

C- BEE MANAGEMENT PRACTICES ADOPTED DURING THE PERIOD UNDER REPORT.

The following bee management practices were under taken for better bee development at the sectional apiaries.

- The bee colonies were checked regularly and necessary manipulation of frames was made.
- The bottom boards were cleaned regularly and necessary manipulation of frames was made.
- Sugar feeding in 1:1 ratio w/v was provided as supplementary food to all bee colonies.
- Earthen cups filled with water were kept under the hive stands to avoid the attack of black ants.
- Inner tat coverings were dried during shiny days to provide the hygienic condition to honeybees.
- The cracks and crevices of beehives as well as open space at the junctions of different hive parts were closed with mud plaster to check the entry of wax moth. It was also helped in discouraging robbing instinct of honeybees.
- Supplementary feed of sugar syrup mixed with vitamin B-complex was done to the bee colonies facing starvation.
- Packing pads were provided to the bee colonies cope with cold weather.
- Wet packing was dried in the sun to provide hygienic condition in the beehives.
- The spare combs drawn out and fumigated in the fumigation chamber with Phostoxin tablets to protect against wax moth.
- The week and queen less bee colonies were united to strengthen the bee population in the bee colonies.
- Drawn combs were provided to the needy bee colonies for the storage of surplus honey and rearing of brood.

- Pollen substitutes of gram flour were provided to all the bee colonies as a bee food.
- Fluvalinate strips/ Thymol/ Formic acid were applied to the bee colonies to control the bee mite. Supers alongwith frames were provided to the needy bee colonies for expansion of bee colonies.
- Hive frames with comb foundation sheets were provided to the needy bee colonies for brood rearing and collection of honey.
- Brood frames from strong colonies were taken out and provided to the weak colonies.

D. MIGRATION OF BEE COLONIES.

The headquarter and sub-stations out apiaries were migrated from KotaliSattin to Musafer Baba (Bahtar) on Miaze flora to Lilla (Kot Fateh) on Ber flora to BheerBhall, Sargodha on Brassica and Citrus flora to Khanewal on Brassica flora to Bypass Gujrat on Brassica flora to JhangBahter on Brassica flora to ChapperDehla on Bhaikar and Phulai flora to ,MohriSayyedan (Lehtrar Road) on Grunda flora on wild bee flora for better bee development and experimental purpose.

E. BEE FLORA.

Major bee flora which remained available throughout the year as a source of bee food i.e. nectar and pollen is as under:

S No.	Common/Local Name	Technical/Botanical Name
Crops		
1.	Maize	Zea mays
2.	Sorghum(Chari)	Sorghum bicolor
3.	Sarson	Brassica campestris
4.	Shaftal	Trifolimrepens
5.	Toria/Raya	B.juncea.
6.	Lucern	Medicago sativa.
7.	Sweet clover.	Melilotus spp.
Ornamental Plants.		
1.	Bottle brush	Callistemon Citrinus
2.	Coral ceaper	Antigononleptopus
3.	Corn flower	Centureacyanus
4.	Cosmos	Cosmos bipinnatus.
5.	Sunflower	Helianthus annuus
6.	Gul-i-Khaira	Althaea rosea.
7.	Rose.	Rosa spp.
Ever green fruits.		
1.	Avocado	Persea Americana.
2.	Ber	Zizyphus jujube

3.	Grape fruit	Citrus paradise
4.	Jaman	Eugenia jambolana
5.	KinnoMandrin.	Citrus reticulate.
6.	Lemon.	Citrus limon.
7.	Loquat,	Eriobotrya japonica.
8.	Sweet lime (Mitha)	Citrus limettioides.
9.	Sweet Oranges.	Citrus sinensis.
Vegetables		
1.	Brinjal	Abelmoschusesculentus.
2.	Cabbage	Brassica oleracea.
3.	Carrot	Dacuscarota
4.	Shaljum	Brassica napus
5.	Sweet Potato	Ipomeabatatus.
6.	Brinjal	Abelmoschusesculentus.
Forest Plants		
1.	Amaltas	Cassia fistula
2.	Asi-e-Amir	Vitex negunda
3.	Burna	Crataevaaddansonii.
4.	IppleIpple	Lucaenaleucocephala
5.	Keekar	Accacia Arabica.
6.	Mesquite	Prosopis spp.
7.	Phulai	Accaciamodesta.
8.	Rubinia	Rubiniapseudoacacia.
9.	Sheshum	Dalbergiasisso
12.	Siris	Albizialebbek.
12.	Sufaida.	Eucalyptus spp.
Deciduous fruits.		
1.	Almond	Prunus amygdalus.
2.	Apple	Pyrus malus.
3.	Apricot.	Prunus armeniaca.
4.	Peach.	Prunus persica.
5.	Pear	Pyruscommunis.
6.	Persian walnut.	Juglans regia.
7.	Persimon	Diospyros kaki
8.	Plum	Prunus domestica.
9.	Pomegranate.	Punicagranatum.

F. BEE DISEASE.

No serious attack of any bee diseases has been observed in any bee colony. However, Fluvalinate strips, formic acid (80%), menthol crystals and Thymol were used in the colonies to eliminate negligible infestation of bee mite. A water spray mixed with Ampicillin was done as precautionary measures against American Foul Brood in the bee colonies after fifteen days interval.

G. BEE ENEMIES.

The attack of bee enemies viz: hornets, black ants, green bee eater and wax moth were observed during period under report. The following control measures were adopted to control attack of the bee enemy mentioned against each.

HONEY BEES ENEMY AND THEIR CONTRL MEASURES

Sr.No.	Name of Enemy	Control Measures.
1.	Hornet.	Killed by wooden stick and nests of hornets were burned.
2.	Black ants.	Earthen cups filled with water were put beneath the legs of beehives to avoid the attack of black ants.
3.	Green bee eater.	Shooting with air gun.
4.	Alpine Swift predatory bird.	Shooting with air gun.
6.	Wax moth.	Kept the beehives clean from debris and fumigated with Phostoxin tablets.

H. VISIT OF CLASS

Two classes of B.Sc. (Hons) Agri. Entomology 5th & 8thsemester from PMAS Arid Agriculture University, Rawalpindi comprising 100 students male & female students and a class of 20 students of Field Assistant from Daghal Training Institute visited the research station. They were briefed about the research station and modern beekeeping techniques of bee management.

I. HONEY EXTRACTION

133.00 Kg surplus honey was extracted from the headquarter and sub-station out apiaries camped at different bee flora as details below:

Kind of Honey Flora	Kg
Ber	28.00
Phulai	41.00
Garunda	30.00
Citrus	14.50
Berseem	19.50
TOTAL:	**133.00**

VI. HILL FRUIT PESTS:

1:STUDIES ON POPULATION DYNAMICS OF CODLING MOTH (*Cydia pomonella L*)

An experiment was conducted for studied on population dynamics of codling moth. Pheromone traps were installed in various localities in apple growing areas of Murree viz. sunny bank, Tret and lower Topato monitor/forecast its attack. Weekly observation was made to see if there was any adult capture. Three pheromone traps were installed at each site. The results revealed that there were very small numbers of adults captured at each site. The reason may be high weather fluctuations in past years. Less effective nature of the pheromones in the market or some pest escape/behavioral modification may not be ignored.

AVERAGE NUMBER OF CODLING MOTH (*CYDIA POMONELLA* L.) CAPTURE IN PHEROMONE TRAP

Sr. No.	Locality	Average no of moths captured
01	Sunny Bank	0.20
02	Lower Topa	0.50
03	Tret	0.50

2: SOME STUDIES ON THE INSECTS PESTS ATTACKING STORED HILL FRUITS IN MURREE HILLS

Sample collection was made from local dry fruit market and local storage was carried out to study the insect pests attacking dry hill fruits (walnut, almonds, apricot and peaches). Ten samples were taken randomly for each fruit. The infested dry fruits having larval and egg forms of the pests were kept in the laboratory to get adult stage. The adults of the pest species were identified to possible limit. The results showed that there was attack of some *Tribolium spp.* It was observed that there was 6.6% to 15% infestation of various fruits.

COMPARED MEAN TABLE FOR THE AVERAGE INFESTATION IN STORED DRY HILL FRUITS

Treatment	Mean
Walnut	06.00 C
Almond	13.20 A
Apricot	02.8 0 D
Peach	12.20 B

@ LSDValue =0.6848

As per data in the table above reflects that walnut, almond dried apricot and dried peaches all are attacked during storage. It has been observed that there is a significant difference among the treatments. Maximum attack occurs on almond followed by peaches. Walnut and apricot showed little lower infestation by the insects. It was observed that fruit kernels/nuts were more severely attacked. The observed pests were small white grubs and upon rearing some of them did not made it to adult stage. Those who did were beetles *Tribolium spp*.

3: OCCURRENCE OF APHIDS ON THE HILL FRUIT NURSERY PLANTS

Hill fruit nursery plants viz.Apricot, Peach, Plum, Apple and Avocado were selected at Pail Nursery for the studies. Three plants were observed for the infestation of aphids. The fortnightly data for the occurrence of aphid population on the host plants was collected and analyzed, to ascertain the population buildup of aphid as a potential pest on different host plants.

COMPARED MEAN TABLE FOR THE AVERAGE NO OF APHIDS ON HILL FRUIT NURSERY PLANTS

Treatment	Mean
Apricot	05.00 B
Peach	07.40 A
Plum	03.00 C
Apple	05.60 B
Avocado	02.00 C

@ LSD value = 1.29

Results showed that maximum number of the aphid was recorded on peach plants followed by apple and apricot. While very small number of aphids was recorded on plum and avocado. The population dropped to zero during the months of December 2013 to January 2014. While again aphids started appearing during February 2014 with bud break in fruit plants at lower heights. The aphid population remains suppressed during season because of cold and senescence of leaves during fall.

4:STUDIES ON DIFFERENT CONTROL MEASURES AGAINST SNAILS

The experiment was conducted to control snails four different treatments were applied i.e**.** T_1 = Metaldehyde (2.5%) @ 2 Kg/acre.T2 = Copper foil@ 1 foot high around/tree, T3 = sugar water + yeast bait (1:1) @ ½ liter /10 plants, T_4 = Control. Using randomized complete block design (RCBD) with four (4) treatment and 4 replications were applied in a plot size of 3×9

meters. Before the application of treatment the pre-treatment data of number of snail/plants were obtained. The post treatment data was obtained fortnightly by counting the number of snails. The percentage decrease/increase in number of snails (number of snails before treatment-number of snail after treatment x 100) was worked out comparison of different control measures against snail.

COMPARED MEAN TABLE FOR DIFFERENT CONTROL MEASURES AGAINST SNAILS

Treatment	Mean
T_1 = Metaldehyde	52.20 A
T_2 = Copper foil	38.66 B
T_3 = sugar water + yeast bait	34.06 C
T_4 = Control	14.66 D

@ LSD = 4.0993

As the data presented table above shows that the snail population responded to different treatments in dissimilar way. There was a significant difference in effectiveness among treatments. The data recorded over a period of six months indicated that the control measures were effective snail's population to a significant level. The control measures have showed more than 50% efficient control over the control. The most effective control measure was Metaldehyde 2.5% @2kg/Acre with 52.20 % control followed by Copper foil 38.66%. Although the results for Sugar solution + yeast based bait remained low i.e. 34.06 %. The possible reason could be weather situations which cause different levels of yeast activity and mobility of its fumes. While copper file also proved to be a good control measure to some extent.

PASRUR

1:VARIETAL RESISTANCE / SUSCEPTIBILITY OF RICE TO DIFFERENT INSECTS

Transplanted crop was kept under observation during the season to record the insect/ pest population. In this regard data was recorded at weakly interval till maturity of crop. Borer, leaf and plant hopper infestation was observed on tillers per plant basis and grass hopper population/ net sweep basis also calculated.

RESULTS:

Table: GRASS HOPPERS POPULATION OF ALL NURSERIES PER NET SWEEP

Date of Observation	Basmati Super	Basmati 515
11-07-2016	0.33	0.33
18-07-2016	0.66	0.33
25-07-2016	0.33	0

Table: GRASS HOPPER POPULATIOIN ON CROP

Date of Observation	Basmati Super	Basmati 515
01-09-2016	0.66	0.33
08-09-2016	0.66	0.33
15-09-2016	0	0.33
22-09-2016	0	0
29-09-2016	0.33	0
06-10-2016	0.33	0.33
13-10-2016	0.66	0.66
20-10-2016	0	0.33
27-10-2016	0.33	0

Table: LEAF OF PLANT HOPPER/ TILLER BASIS

Date of Observation	Basmati Super	Basmati 515
15-09-2016	0.40	0.40
22-09-2016	0.40	0.46
29-09-2016	0.46	1.00
06-10-2016	0.40	0.26
13-10-2016	1.00	0.40
20-10-2016	2.40	2.00
27-10-2016	1.13	2.00

On 27-10-2016 the field was sprayed with imidacloprid and bifentherin. During Kharif 2016 no attack of borer and leaf folder was observed.

2: OF DIFFERENT INSECTICIDES AGAINST BROWN PLANT HOPPER ATTACKING ON RICE CROP

Table: TREATMENT/ METHODOLOGY

Treatment	Insecticides	Dose Rate
T1	Lambda Cyhalothrin 2.5EC	250ml/Acre
T2	Pyramid 10SL	200ml/Acre
T3	Imidacloprid 200SL	250ml/Acre
T4	Aspire	200gm/Acre
T5	Control	

The trial was conducted in RCBD design with three replications. Four different treatments along with control applied on the appearance of the pest. Data recording regarding pest population was recorded before and after 24, 72 hours and 7 days of application of spray by observing 15 randomly selected tillers per plant.

Table: POPULATION / 15 TLLERS

Sr. No.	Treatment	Dose/ Acre	Hopper Population/tiller				% Mortality after		
			Pre-Treatment	24 Hours	72 Hours	7 Days	24 hour	72hour	7 days
1	Lambda Cyhalothrin	250ml	6.55	4.66	3.53	2.81	28.24 B	43.08 C	55.63 B
2	Pyramid	200ml	7.88	4.70	3.28	2.13	41.61 A	55.82 B	70.98 A
3	Imidaclopri d	250ml	7.11	4.72	3.13	2.37	33.10 AB	55.46 B	66.64 AB
4	Aspire	200gm	7.06	3.62	2.39	1.40	44.19 A	66.05 A	80.22 A
5	Control		6.66	7.71	10.11	13.46	0.00 C	0.00 D	0.00 C
		LSD 5%	-	-	-	-	11.42	10.0	14.60

During Kharif 2016 after spray of Lamda Cyhalothrin 2.81, Pyramid 2.13, Imidacloprid 2.37 and aspire 1.40 on an average no. of rice browN hopper after 7 days of spray. Aspire showed more control as compared to other pesticides.

3: CROSS INOCULTION OF LAC STRAINS ON DIFFERENT LAC INSECTS PLANTS

Methodology

The ungrafted ber lac strain was tested and evaluated by cross inoculating them on grafted ber, ungrafted ber and on Dhak plants. Efficiency of lac strains on these hosts was evaluated in terms of number of lac cells produce per 2.5cm length of branch of each inoculated host plant.

Results:

Table: AVERAGE NO. LAC CELLS ON GRAFTED BER, UNGRAFTED BER AND ON DHAK PER 2.5CM OF LENGTH

Sr. No.	Treatment	R1	R2	R3	Total	Average
1	Grafted Ber	23.95	22.67	21.75	68.37	22.79
2	Ungrafted Ber	24.85	22.87	19.90	67.62	22.54
3	Dhak	222.52	28.35	22.67	73.54	24.51
TOTAL		71.32	73.89	64.32	209.53	

Conclusion:

During Kharif 2016 Lac strain ungrafted ber successfully produced 22.79, 22.54 and 24.51 average number of lac cells on grafted ber, ungrafted ber and on Dhak respectively.

4: EFFECT OF BIOTIC AND ABIOTIC ON THE LAC INSECT DEVELOPMENT

Methodology

To evaluate the effect of cold weather on the mortality of lac insects developing on Dhak Grafetd Ber, Ungrafted ber and Valayti Kikar. Observation was recorded at 15Days interval from one inch 2.5cm marked area of branch of the above mentioned trees during the months of December 2016 and January 2017, by examining the dead and alive insects, the mortality % was marked out.

RESULTS:

December 2016							
Sr. No.	Treatment	16-12-2016			30-12-2016		
		Total	Dead	Mortality%	Total	Dead	Mortality%
1	Dhak	27	2	7.41	27	4	14.81
2	Grafted Ber	24	2	8.83	24	3	12.50

3	Ungrafted Ber	22	2	13.64	22	5	22.72
4	Vallayti Kikar	18	3	16.67	18	7	38.88

January 2016							
Sr. No.	**Treatment**	**16-12-2016**			**30-12-2016**		
		Total	**Dead**	**Mortality%**	**Total**	**Dead**	**Mortality%**
1	Dhak	27	2	7.41	27	4	14.81
2	Grafted Ber	24	2	8.83	24	3	12.50
3	Ungrafted Ber	22	2	13.64	22	5	22.72
4	Vallayti Kikar	18	3	16.67	18	7	38.88

5: VARIETAL SCREENING OF WHEAT AGAINST APHIDS AND THEIR RELATIONSHIP WITH PREDATORS

Table: TREATMENTS

TREATMENTS					
1	AB-16	4	CD-16	7	EF-16
2	GH-16	5	IJ-16	8	KL-16
3	MN-16	6	OP-16	9	Shafaq-06

The experiment was conducted in RCBD design having three repeats with plot size 48x120 feets. The data regarding aphid, coccinellids beetles and syrphid fly was recorded from 18th February 2017, till crop maturity at weekly interval on per tillers basis for aphids and on per plant basis for predators (coccenelids & syrphidfly). Fifteen randomly selected tillers per plot were examined. The correlations between aphid and predators population was studied.

Result:

Table: APHID/ TILLER

Treatment	**R1**	**R2**	**R3**	**Total**	**Average**
T1	3.93	4.42	4.08	12.43	4.14
T2	8.04	8.09	8.08	24.21	8.07
T3	7.79	7.87	8.02	23.68	7.89
T4	7.32	7.89	7.58	22.79	7.59
T5	6.89	7.42	7.39	21.70	7.23
T6	8.15	8.60	7.93	24.68	8.22
T7	8.02	8.36	7.58	23.96	7.98
T8	8.04	8.32	7.92	24..28	8.09

T9	8.89	7.59	8.70	25.18	8.39
Total	67.07	68.56	67.28	178.63	

Table: PREDATOR POPULATION/ PLANT

Varieties/ Lines	Aphid Population/Tillers	Coccinellids	Syrphid fly
AB-16	4.14	0.18	0.17
CD-16	8.07	0.14	0.12
EF-16	7.89	0.20	0.13
GH-16	7.59	0.06	0.15
IJ-16	7.23	0.16	0.16
KL-16	8.22	0.17	0.15
MN-16	7.98	0.18	0.10
OP-16	8.09	0.17	0.13
Shafaq-06	8.39	0.20	0.14

CONCLUSION:

On all the wheat varieties lines the aphid population was almost equal except AB-16. Aphid population was high on shafaq-06 which was 8.39/tiller and low on line AB-16 i.e 4.14/Tiller.

Similarly coccinellids beetle was maximum on EF-16 and Shafaq-06 i.e. 0.20/plant, but the Syrphid fly was maximum on AB-16 i.e. 0.17 and low on MN-16 i.e. 0.10 per plant respectively.

6: STUDIES ON THE POPULATION DYNAMICS OF WHEAT APHID IN RELATION TO WEATHER FACTORS AT VARIOUS LOCALITIES OF PUNJAB

The population fluctuation of aphid attacking wheat crop was studied by observing field population of aphid throughout the crop season. Data was recorded on the basis of per tiller aphid population at weekly interval. The observed data was correlated with weather i.e. rainfall, relative humidity and temperature.

Table:

Month	Date	Aphid /Tiller	Average Temperature		Average Relative Humidity (%) 8:00am	Rainfall (mm)
			Max	Min		
February 2017	03.02.17 to 09.02.17	0.95	19.26	10.15	93.92	1.85
	10.02.17 to 16.02.17	4.75	22.32	8.40	89.57	0
	17.02.17 to 23.02.17	8.84	25.25	14.77	83.0	0.27
March 2017	03.03.17 to 09.03.17	10.43	24.02	9.80	81.14	2.18
	10.03.17 to 16.03.17	3.52	20.67	8.61	81.42	1.27

	17.03.17 to 23.03.17	3.42	27.25	13.45	78.42	0
	24.03.17 to 30.03.17	2.40	28.74	16.18	77.71	0

Conclusion:

Aphid population was maximum during the 1st week of March 2017 i.e. 10.48/tiller with maximum temperature 24.02, minimum temperature 9.80, with 81.14% relative humidity and 2.18mm rainfall. In the last week of March 2017 population of aphid was at decline i.e. 2.40/tiller.

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LECTURES DELIVERED

- Delivered a lecture on "**Insect Pests of Vegetables and their Management**" to the farmers at Agronomy Research Institute, AARI, Faisalabad on dated July 21, 2017.

- Delivered a lecture on one day training workshop/seminar on topic entitled, "**Stored Grain Pest Management**", at Arid zone Research Institute, Bhakhar dated 28.02.2017.

RADIO TALKS

- Recorded radio talk on Mango mealybug and its Integrated Pest Management. (13.10.2017)
- Recorded radio talk on Insect pests of Sarsoon, Toria, Canola and their Management. (14.11.2017).
- Shahed de makhian de bamarinteyunatwonbachawndeytarekey.
- Sardiandeymousimwichshaheddianmakhian de daikhbhal.
- Delivered following 30 radio talks including radio interviews to disseminate the updated knowledge of insect pests of economic importance of field crops.
- Importance of removal of crop stubbles (19-07-2016)
- Insect pests of maize and their control (19-07-2016)
- Cotton bollworms and their management (19-07-2016)
- Non-chemical Control of insect pests of cotton and vegetables (22-07-2016)
- American Bollworm and its management (23-07-2016)
- Non- chemical measures to manage cotton insect pests (29-07-2016)
- Precautionary measures during insecticide application on cotton crop (29-07-2016)
- Cotton bollworms and their management (29-07-2016)
- Maize shootfly and its control (20-08-2016)
- Insect pests of vegetables and their control (26-08-2016)
- Insect pests of summer vegetables and their control (20-08-2016)
- Armyworm and its control (20-08-2016)
- Precautionary measures during insecticide application (26-08-2016)
- Insect pests of potato and their control (27-09-2016)
- Importance of removal of crop stubbles (05-10-2016)
- Insect pests of mustard crop and their control (24-10-2016)
- Importance of removal of cotton crop stubbles (01-11-2016)
- Insect pests of stored grains and their control(June 2017)
- Pink bollworm and its management (June 2017)
- Fruitfly and its control (May 2017)
- Wheat grain storage in gowdowns (May 2017)
- Insect pests of summer vegetables and their control (May 2017)
- Insect pests of maize and their control (April 2017)
- Insect pests of mung and their control. (April 2017)
- Motivation for cotton sowing (April 2017)
- Insect pests of germinating cotton crop (April 2017)
- Motivation for cotton sowing (March 2017)
- Management of insect pests on germinating cotton. (March 2017)

- Tax exemption on cotton insecticides to boost crop production (March 2017)
- Insect pests of summer vegetables and their control. (March 2017)
- Mango mealybug and its control (March 2017)
- Importance of insecticide application (Feburary 2017)
- Insect pests of spring maize and their management (Feburary 2017)
- Insect pests of mastard and their control (January 2017)
- Mango Mealy bug and its management (January 2017)

- Mango Mealy bug and its management (January 2017)

CONFERENCES/SEMINARS

1. Attended one day seminar on "DNA Barcoding: Concept, Development and Applications" at main Library, AARI, Faisalabad, organized by Agricultural Biotechnology Research Institute, Faisalabad on December 18, 2017.
2. Attended the Partnership training workshop on GCRF food security, safety and sustainability: exploiting synergies to optimize impact HUB at LUMS, Lahore and back. Being organized by PARB 27 October, 2017
3. Attended one day seminar on "Cotton Crop Management" at Shah jahan Banquet Bahawalpur being organized by Pakistan Crop Protection Association on August 17, 2017.
4. Attended one day seminar on "Cotton Crop Management with special reference to Pink Bollworm" at Piplan, Mianwali being organized by Pakistan Crop Protection Association on August 1, 2017.
5. Attended one day seminar on "Nematodes Growing Problems & Management" Held on July 24, 2017 being organized by Plant pathological Research Institute at Ayub Agricultural Research Institute, Faisalabad.
6. Attended one day seminar on "Cotton Crop Management" at Multan Gerizon Mess, AR Marki 58, Sher Shah Road, Multan being organized by Crop Life Pakistan on July 20, 2017.
7. Participated in two day national conference on "Challenges and Opportunities to Boost Agriculture in Changing Climate" at College of Agriculture, BZU, Bahadur Sub Campus, Layyah being held on March 29-30, 2017.
8. Participated in one day conference on "Enhancement of Chickpea Productivity in Thal through Integrated Pest Management (IPM)" Arid Zone Research Institute, Bhakkar, on February, 28, 2017.
9. Participated in one day conference on, "Recent Advances and Strategies for Management of Cotton Whitefly in Pakistan" on 23rd February, 2017 at Auditorium Hall, Ayub Agricultural Research Institute Faisalabad.
10. Attended one day seminar on, "Weeds and Importance of its Effective Control" on 21-02-2017 at main Library, AARI, Faisalabad.

11. Attended one day seminar on, "Potential & Prospects of Sustainable Agriculture in Pakistan" on 13-01-2017 at main Library, AARI, Faisalabad, organized by Soil Science Society of Pakistan.
12. Attended the two day workshop on "Biotechnology and bio safety" held at Pakistan academy of science Islamabad on January, 2014 by Assistant Research Officer Murree.
13. Attended two days workshop on "PEST AND PATHOGEN CONTROL" by SATNET ASIA held at NARC Islamabad on 19th March to 21th March 2014 was attended by Assistant Research Officer Murree.
14. Four seminars on dengue surveillance were attended and delivered lectures by Dr. Khawar Jawad Ahmad.
15. 10 thnationalhoney bee farming and management training workshop organized by department of zoology university of the Punjab from 17th March to 21th March 2014 was attended by Assistant Entomologist Rawalpindi.
16. Delivered Lecture in one day training seminar on "Enhancement of chickpea productivity in Thal through Integrated Pest Management (IPM)" at Arid Zone Research Institute, Bhakkar during February-2017.
17. IPM of Cotton Pink Bollworm held at Kamalia Tehsil Hall.
18. Delivered lecture in seminar on rats infestation in sugarcane crop and their control held at seminar hall district officer Chiniot, 2017.
19. Presentation on cotton production technology with respect to IPM Part-IV (Crop insects' videos), 2017.

BEEKEEPING ADVISORY SERVICES.

Beekeeping advisory services were regularly provided to 418 progressive and amateur beekeepers fallen within the jurisdiction of the head quarter and its substations located at Murree, Hasanabdal and Lahore. The problems faced by the beekeepers in the management of the apiaries were attended and necessary advice was given, as and when it required. Moreover, persons who visited the research stations from far-flung areas of Punjab, N.W.F.P and Azad Jammu Kashmir were also attended and redressed their beekeeping problems.

LEAFLET.

Dr Khawar Jawwad Ahmed, Dr Qurban Ali, Riaz Ahmed, Imran Nadeem, Muhammad Faheem Akhtar, Najuf Awais Anjum, Aqsa Abbas 2017. Production technology of Bt cotton with respect to insect pests control. Leaflet, 1-6.