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Infestation of Major Insect Pests on Different Groundnut (*Arachis hypogaea*) Cultivars and Yield Losses in Baffa District, Mansehra Khyber Pakhtunkhwa

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Abstract:

Studies regarding the determination of population trend of major insect pests in different groundnut varieties were conducted at Agricultural Research Station, Baffa (Mansehra). Eleven different groundnut varieties i.e. ICGR-93123, BARD-92, Chinees, ICGR-93163, BARI-2000, BARD-479, ICGR-93023, Australian, ICGR-92028, ICGR-7326 and Golden were used, replicated three times in RCB design. The data revealed that the Aphid (Aphis craccivora) infestation invariably started in all varieties during last week of July. The peak population of

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3.533 aphids plant^{-1} was recorded on cultivar Chinees and the lowest population of 0.400 aphids plant^{-1} on BARI-2000. Leaf miner (Aproaerema modicella) infestation started in the first week of September 2010. The peak population of 2.200 leaf miner plant^{-1} was recorded on Chineese and lowest population 0.800 leaf miner plant^{-1} on BARI-2000. The predominant specie recorded during the period was tobacco caterpiller (Spodopetra litura) infesting groundnut crop during the month of June. The peak population of 2.100 caterpillar plant^{-1} was recorded on Chinees and lowest population 0.666 caterpillar plant^{-1} on BARI-2000. The results further revealed that highest yield of the crop were obtained from BARI-2000, 3.466 tones hectare^{-1} and was significantly different from that of Chinees variety which gave the yield of 1.416 tones hectare^{-1}. It was concluded that variety Chinees was most preferred by aphids, leaf miner and tobacco caterpiller, while variety BARI-2000 was least preferred by these insects.

Key words: teacher-taught relation, trust, task, quality of relation, relation ladder

Introduction

Groundnut, (*Arachis hypogaea* L.) belongs to the plant family Leguminosae and subfamily Papilonaceae. Groundnut is also known as peanut or earthnut. Local names for groundnut include moong phalli in Urdu and Panjabi, moom phalli in Pashto, and bohi monga in Sindhi (Shafi and Nazir, 1994). It is one of the important oilseed and food crop. As a crop, groundnut ranks 13th importance in the world. In Pakistan more than 85% of the area under groundnut lies in the province of Punjab, 10% in Khyber Pukhtunkhwa, and 5%in Sindhi. According to Agricultural Statistics of Pakistan 2008-09 annual report area under groundnut crop is 92.8 thousand hectares with annual production of 85.5 thousand tones. The province wise distribution showed that about 82.8 thousand hectares area lies in Punjab 7.8 thousand hectares in Khyber Pukhtunkhwa, and

2.2 thousand hectares in Sindh with annual production of 69, 11.8, and 4.7 thousand tones respectively.

Peanuts are rich in nutrients, providing over 30 essential nutrients and phyto nutrients. It is a good source of niacin, folate, fiber, magnesium, vitamin E, manganese and phosphorus. Peanut are also naturally free of trans-fats and sodium, and contain about 25% protein (FAO, 2005).

The crop is attacked by many insects pest species throughout the country at different stages of plant growth, but only a few of the over 100 insects associated with this crop are economically important (Wightman *et al.,* 1993).

The groundnut leaf miner, *Aproaerema modicella* (Deventer) (Lepidoptera: Gelechiidae), is a major insect pest of groundnut whose larvae cause damage by direct feeding. Leaf miner larvae mine the leaves and feed inside the leaflets The leaf mine areas become dry in case of severe infestation and give a burnt appearance (Vander *at al* ., 2009).

The aphid, *Aphis craccivora***,** (Hemiptera: Aphididae) is also major pest occurring on groundnut and cause pod losses up to 40%. *A .craccivora* has been found to transmit and spread about 23 viral diseases. They cause serious damage and infect all stages of growth when conditions are favorable. The affected leaves attain curling shapes and the plant show stunted growth. Both adults and nymphs feed mostly on growing tips and young foliage by sucking plant sap (Amin, 1988).

Tobacco caterpillar, *spodopetra litura* (Lepidoptera: Noctuidae) has also been included in the category of serious pests and larvae cause damage by consuming foliage. Young larvae initially consume leaf tissue from one side, leaving the opposite epidermal layer intact. By the second or third instar, larvae begin to make holes in leaves, and eat from the edge of the leaves inward. Feeding in the whorl of corn often produces a characteristic row of perforations in the leaves (Capinera., 2001).

The lesser cornstalk borer**,** *Elasmopalpus lignosellus* (Lepidoptera: Pyralidae) has also been noticed as minor pest of groundnut. The larvae make tunnels into the crown of host plants, epidemics. Out break cause weakening large plants and often killing young seedlings. The borer may feed on any portion of the plant that contacts the soil including limbs, pegs and pods. Peanut pods damaged by this insect have been shown to have significantly more aflatoxin contamination than undamaged pods (Steve and Hudson 2010).

Leafhoppers, *Empoasca kerri* (Homoptera: Cicadeellidae) are major group of small insects with piercing-sucking type of mouthparts. Both adult and nymphs puncture the underside of leaves and suck out plant juices. Feeding injury causes stunting and leaf curl. Damage can cause the leaf to eventually scorch and drop from the plant (Hudson and Adam, 2008).

Termites are a group of social insect. The microtermes and odontotermes species seriously attack groundnut. Microtermes kill plants directly by destroying the root system. Odontotermes feed on soft corky portion of the pods causing scarification and bore in to the pod (Amin., 1988).

Hairy caterpillar, *Amsacta albictriga* (Lepidoptera: Noctuidae) is a polyphagous pest of groundnut. This insect feeds on the foliage and growing tips, causing defoliation of the plant. Continues feeding by young larvae from the under surface of the leaves result in dried scraped patches. Mature larvae disperse and feed individually by devouring leaves, flowers, and growing points (Nagrajan *et al.,* 1957).

The present research provides description of the most important species, their distribution, and nature of damage and yield losses based on the field experiment conducted at the Agriculture Research Station Baffa (Mansehra).

Material and Methods

An experiment was conducted to determine the infestation and yield loss due to major insect pest of groundnut (*Arachis hypogaea*) at Agricultural Research Station Baffa Mansehra (Hazara) Khyber Pukhtunkhwa. A brief account of procedure of the experiment is given in the following paragraphs.

Layout of the experiment:

Eleven different varieties of groundnut namely ICGR-93123, BARD-92, Chinees, ICGR-93163, BARI-2000, BARD-479, ICGR-93023, Australian, ICGR-92028, ICGR-7326 and Golden were sown in field already prepare for the purpose. The plant to plant and Row to row distance were kept, 25cm and 75 cm respectively. The experiment was laid out as randomized complete block design with three replications. Size of each sub plot was $15m^2$ and total experimental area was $6m^2$.

Procedure for data collection:

In order to find prevalence and population trend of groundnut insects (Aphid, Leaf miner, & tobacco caterpillar), number of insects per leaf were counted and converted in to percent infestation $plant^{-1}$. To achieve accurate results with minimum errors, the data were recorded from the 3 randomly selected plants, avoiding the border rows. The selected plants were properly tagged for future observations. The number of insect was counted on three parts of the plant viz top, middle, and lower region. The observations were repeated at weekly intervals till maturity of the crop. The data of rainfall and temperature were also recorded during the course of time know their effects on crop as well as on pest population (Appendix-6).

Data parameters

The following parameters were used for data collection.

1. Level of plant damage

2. Prevalence of insect pests population.
3. Losses in crop yield caused by insect infestation.

Data Analysis

The data obtained were subjected to ANOVA for the interpretation of specific result by using the statistical package M Stat-C. LSD test was applied at 5% level of significance ($P<0.05$) for separation of Means. (Steel and Torrie, 1997)

Results

The data regarding mean number of major insect pests (Aphid, Leaf miner & Tobacco caterpillar), pods formation and yield losses of groundnut were recorded at Agriculture Research Station Baffa Mansehra, during June-Oct 2010. The results have been briefly discussed below.

Data (Table-1) regarding the population density of aphids in the tested varieties of groundnut revealed that the lowest population was found on variety BARI-2000 which gives the significant result with average number of 0.400 aphids plant^{-1}. Whereas it was followed by ICGR-92028(0.766), Australian (1.333), BARD-92(1.433), BARD-479(1.467), ICGR-93023(1.533), Golden (1.567), ICGR-93123(1.800), ICGR-93163(2.133), ICGR-7326(2.667) and highest population was recorded on variety Chinees (3.533) aphids' plant^{-1}.

The result (Table-1) further revealed that population density of leaf miner in all varieties was at low level. However, it increased the threshold level so, attained the position of economic pest. The lowest population was found on variety BARI-2000 which gave the significant difference showing the mean number of 0.80 leaf miner plant^{-1} followed by ICGR-92028(1.000), Australian (1.233), ICGR-93023(1.266), ICGR-93163(1.300), BARD-92(1.333), BARD-479(1.433), ICGR-93123(1.437), Golden (1.467), ICGR-7326(1.867) and highest

population was recorded on variety Chinees (2.200) leaf miner plant^{-1}.

It is evident from the data (Table-1) that the lowest population of Tobacco Caterpillar was found in variety BARI-2000 (0.666 tobacco caterpillar plant^{-1}), which was significantly different from the other cultivars. Population in other cultivars was ICGR-92028 (1.100), Australian (1.200), ICGR-93123 (1.213), ICGR-93163 (1.333), BARD-479 (1.647), BARD-92 (1.800), Golden (1.900), ICGR-93023 (1.900), and ICGR-7326 (2.000) in ascending order. The highest population was record in cultivar Chinees (2.100) tobacco caterpillar larvae plant^{-1}.

The data further revealed that Chinees was the most preferred variety by aphids, leaf miner and tobacco caterpiller, while variety namely BARI-2000 was least preferred by all the recorded insects. All other mean of the population densities were significantly different from each other but significantly lower than that of Chinees cultivar.

Table-1: Mean No. of insects (*Aphis craccivora, Aproaerema modicella* and *Spodopetra litura*) plant^{-1} on different varieties of groundnut grown at Agricultural Research Station, Baffa during the cropping season 2010

Name of Cultivar	Mean No of Aphids plant^{-1}	Mean No of Leaf miner plant^{-1}	Mean No of Tobacco Caterpillar plant^{-1}
ICGR – 93123	1.800 – C	1.437 – BC	1.213 – B
BARD – 92	1.433 – CD	1.333 – CD	1.800 – AB
CHINEES	3.533 – A	2.000 – A	2.100 – A
ICGR – 93163	2.133 – BC	1.300 – CD	1.333 – AB
BARI – 2000	0.400 – E	0.800 – C	0.666 – C
BARD – 479	1.467 – CD	1.433 – BC	1.647 – CD
ICGR – 93023	1.533 – CD	1.266 – B	1.900 – AB
AUSTRALIAN	1.333 – CD	1.233 – B	1.200 – B
ICGR – 92028	0.766 – DE	1.000 – C	1.100 – C
ICGR – 7326	2.667 – B	1.867 – AB	2.000 – A
GOLDEN	1.567 – CD	1.467 – BC	1.900 – AB
Seasonal Mean	1.693-C	1.360-CD	1.245-B
LSD Value	0.776	0.628	0.533

Means followed by same letter within column are not significantly different for each other (P < 0.05; DMRT method)

Table-2 shows the data on pod formation in all varieties, which reveals that lowest number of pod formation was found on Chinees cultivar, which gave number of 70.23 pods plant^{-1}. Pod formation in other cultivars was noted as ICGR-7326 (72.90), ICGR-93023 (73.33), Golden (73.47), BARD-479 (74.57), Australian (78.87), ICGR-93123 (79.53), ICGR-93163(79.90), ICGR-92028 (81.77), and BARD-92 (84.53) in ascending order. The highest number of pod formation was recorded in variety BARI-2000 (86.00) pods plant^{-1}.

Table-2: The effect of insect pest complex on mean number of pods and total yield (tones hectare^{-1}) recorded on different groundnut varieties during the experimental period of July – October 2010

Name of Cultivar	Mean No of pods plant^{-1}	Yield tones hectare^{-1}
ICGR – 93123	79.53 – ABC	2.166 – CD
BARD – 92	84.53 – A	2.527 – B
CHINEES	70.23 – E	1.416 – F
ICGR – 93163	79.90 – ABC	2.222 – BCD
BARI – 2000	86.00 – A	3.466 – A
BARD – 479	74.57 – CD	1.944 – DB
ICGR – 93023	73.33 – DE	2.416 – BC
AUSTRALIAN	78.87 – BC	3.111 – A
ICGR – 92028	81.77 AB	3.361 – A
ICGR – 7326	72.90 – DE	1.833 – E
GOLDEN	73.47 – DE	2.389 – BC
Seasonal Mean	77.73-BC	2.413 – BC
LSD values	5.090	0.3094

Means followed by same letter within column are not significantly different for each other (P<0.05; DMRT method).

It is further evident from the data (Table-2) that the lowest yield was obtained from Chinees variety which gave significant differences from the other varieties. The average yield was obtained as 1.416 tons hectare^{-1}. The yield found in the other cultivars is arranged in ascending order as, ICGR-92028 (3.361), Australian (3.111), BARD-92 (2.527), ICGR-93023

(2.416), Golden (2.389), ICGR-93163 (2.222), ICGR-93123 (2.166), BARD-479 (1.944), and ICGR-7326 (1.833). The highest yield produced by BARI-2000 (3.466) tones hectare^{-1}

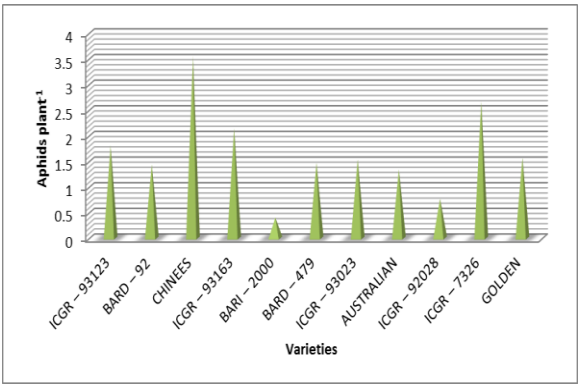

Figure 1: Population Density of Aphids (*Aphis craccivora*) in different groundnut varieties at Agri. Research Station Baffa during July – October 2010

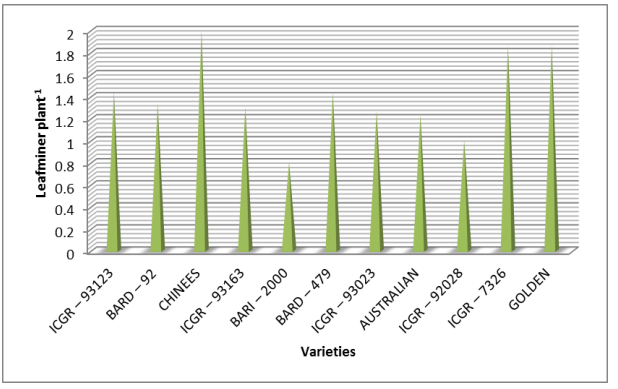

Figure 2: Population Density of Leaf miner (*Aproaerema modicella*)in different groundnut varieties at Agric. Research Station Baffa during July – October 2010

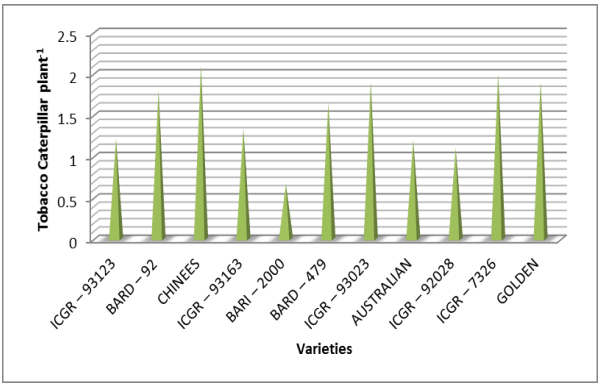

Figure 3: Population Density of Tobacco Caterpillar (*Spodopetra litura*) in different groundnut varieties at Agric. Research Station Baffa during July – October 2010

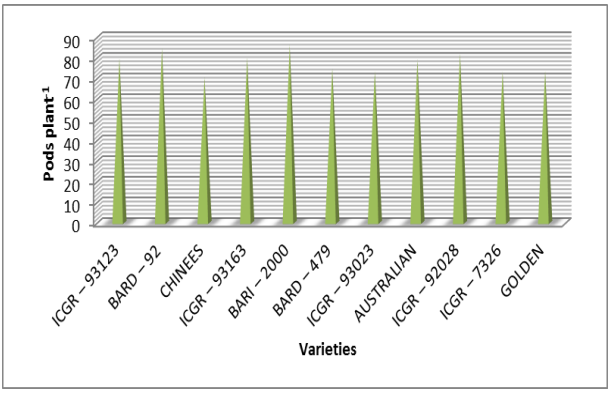

Figure 4: Pods formation in different groundnut varieties at Agric. Research Station Baffa during July – October 2010

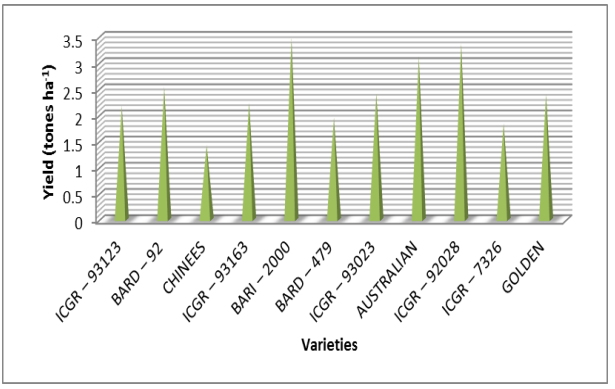

Figure 5: Yield obtained in different varieties of groundnut at Agric. Research Station Baffa during July – October 2010

Discussion

During course of this research, major insect pests (Aphids, Leaf miner and Tobacco caterpillar) were observed causing direct and indirect injuries to the groundnut crop. Aphids caused direct injuries through sucking plant sap resulting in shortage of plant nutrients, which affected the process of photosynthesis. Groundnut leaf miner and tobacco caterpillar caused direct injuries by feeding on plant leaves with the help of chewing types of larval mouth parts. The experiment was performed on 11 cultivar of groundnut at the Agriculture Research Station Baffa (Mansehra).

It was found that high population of groundnut aphid (*Aphis craccivora*) caused colossal damage to the crop. Amount of damage was higher at low temperature as compared to high temperature in the experimental field. Our result are confirmatory with Amin.,(1988) who reported *Aphis craccivora* a sporadic pest of groundnut. During low rainfall they build-up large population. There feeding caused the leaves curl and growth be stunted. Feeding was preferred mostly on growing tips and young foliage by sucking plant sap. Reduction in crop yield was noticed up to the level of 40%. In present study, increase of aphid (*Aphis craccivora*) population was noted in 40-49 days after crop sowing and in rainy season population was comparatively low. These results are conformity with Rao, (1991) who observed that *Aphis craccivora* population increased 40 days after sowing and much higher in plant that had sufficient moisture.

Additionally, results of present studies revealed that aphid (*Aphis craccivora*) were recorded during the month of September-October when crop was at flowering stage and after two weeks population was found decreased. Similar results

were obtained by Bottenberg and Subrahmayan., (1997) who reported the incidence and population of *Aphis craccivora* during the last week of October in flowering field but population disappear two weeks later.

Investigations of present study revealed that leaf miner (larvae) caused high damage to leaves of groundnut, which resulted in dry up of plants. Our findings are confirmatory with Jyothi *et al*., (2008) who reported that the groundnut leaf miner was a serious pest of groundnut crop. The damage is characterized by making mines in plant leaves through feeding between the epidermis and longitudinal folding of individual leaves. The tunnels (mines) expand as larvae progress in feeding with the passage of time. The affected leaves get distorted and finally dry up. The pest prevailed in different envirmental conditions. Present results are in accordance with those obtained by Shanower *at al.,* (1992). The authors reported that the high population level of the pest species in the area of invasion was able to successfully adapt the environmental field conditions.

In groundnut field infestation levels of groundnut leaf miner were between 0.8 and 2.2 per plant. Our results are confirmatory with Vander *at al*.,(2009) who reported the infestation levels between 1.2 and 1.9 per plant. In survey result of the present study, a high level of the pest population was observed, which caused (29-33 leaf miner larvae plant^{-1}) tremendous losses. These results are confirmatory with Cugala *et al*.,(1999) who reported that the groundnut leaf miner level of infestation was 100%, which caused complete losses of the crop. The population density of *A. modicella was* more than 30 larvae plant^{-1}.

Similarly the leaf miner caused 80-100 % losses in cultivar Chinees as observed during the present course of study. These findings are similar to those reported by Epieru.,(2004). The author stated that the groundnut leaf miner was capable of causing up to 100% yield loss. Moth

deadly threatened to groundnut plants and larvae hatch, tunneled into the leaves and feed between the upper and lower epidermis of the leaf. The damaged leaf rolled and dried up resulting in premature fall of leaves. Loss of leaves resulted in reduction of the breathing area for the plant and ability to prepare food, which ultimately caused yield loss.

Studies on the population density of the tobacco caterpillar approached to peak and our results are confirmatory with Amin., (1983) who reported that tobacco caterpillar was a foliage-feeding insect of groundnut and remained an increasingly important pest during the rainy season causing yield losses. The results of present study are also supported by those reported by Sahayaraj., (2002) who mentioned that in groundnut field *spodopetra litura* incidence was 0.78 per plant.

In early and final stages of groundnut crop, infestation level of tobacco caterpillar was observed as 1-5 larva/plant. These results are conformity with Kulkarni., (1989**)** who reported that infestation level of tobacco caterpillar (*S.litura)* during the seedling or flowering stage. Severe outbreak of the pest can result heavy loss in pod formation.

In field survey it is noticed that tobacco caterpillar was hidden during day time but at evening time they found in field, and caused damage in growing tips of the plants. Our result are corroborative with Rao *et al.,* (1992) who reported that tobacco caterpillar are nocturnal in habit. During the day they hide in the leaf little near the base of the stem and feed on the foliage and growing tip which causes total defoliation.

Tobacco caterpillar was found in field from start to end of crop with different levels of population density in all tested varieties. These results are confirmatory with Rao and Wightman, (1994) who stated that tobacco caterpillar (*S.litura*) overlapped and all the stages of the insect were found at the same time and emergence took place in large number during the breeding season in favorable environment.

Conclusion and Recommendations

Conclusion:

Aphid (*Aphis craccivora*) is predominant specie of groundnut (*Arachis hypogaea*), at Agriculture Research Station Baffa, Mansehra. The highest population of *Aphis craccivora* was found on Chinees variety while lowest population was attained on BARI-2000 variety with means numbers of 3.533 and 0.400 aphids plant^{-1} respectively.

Leaf miner (*Aproaerema modicella*) also caused yield losses up to 100 % and highest population was observed on Chinees variety while lowest population was attained on BARI-2000 variety with means numbers of 2.200 and 0.800 leaf miner plant^{-1} respectively.

Similar observations were obtained in case of infestation caused by tobacco caterpillar (*Spodoptera litura*) which is a nocturnal insect in natural behavior and caused highest population density in Chinees variety and lowest population in BARI-2000 variety with means numbers of 2.100 and 0.666 tobacco caterpillar plant^{-1} respectively.

Population densities of all the three pests were positively correlated with the yield of the tested cultivars. Average yield was significantly highest in BARI-2000 while lowest in Chinees with mean numbers of 3.466 and 1.416 tones hectare^{-1} respectively.

Recommendations:

- The groundnut variety BARI-2000 should be cultivated in Mansehra because of the least preference by the insect pests (Aphid, Leaf miner and Tobacco caterpillar).
- The groundnut variety chineese should not be cultivated due to its susceptibility to the insect pests.

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APPENDICES

Appendix 1: Analysis of Variance for Aphids population on different groundnut varieties at ARS Baffa during July – October 2010

K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
1	Replication	2	0.510	0.255	1.2281	0.3140
2	Factor A	10	22.079	2.208	10.6396	0.0000
3	Error	20	4.150	0.208		
	Total	32	26.739			

Appendix 2: Analysis of Variance for Leaf miner population on different groundnut varieties at ARS Baffa during July – October 2010

K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
1	Replication	2	0.297	0.148	1.0872	0.3563
2	Factor A	10	4.740	0.478	3.4743	0.0085
3	Error	20	2.729	0.136		
	Total	32	7.766			

Appendix 3: Analysis of Variance for Tobacco Caterpillar population on different groundnut varieties at ARS Baffa during July – October 2010

K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
1	Replication	2	0.611	0.350	3.1236	0.0660
2	Factor A	10	6.155	0.616	6.2944	0.002
3	Error	20	1.956	0.098		
	Total	32	8.722			

Appendix 4: Analysis of Variance for Pods formation on different groundnut varieties at ARS Baffa during July – October 2010

K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
1	Replication	2	4.910	2.455	0.0510	
2	Factor A	10	617.166	61.717	1.2816	0.3043
3	Error	20	963.144	48.157		
	Total	32	1585.219			

Appendix 5: Analysis of Variance for Yield obtained from different groundnut varieties at ARS Baffa during July – October 2010

K Value	Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Prob
1	Replication	2	0.026	0.013	0.3840	
2	Factor A	10	10.841	1.084	32.4428	0.0000
3	Error	20	0.668	0.033		
	Total	32	11.534			

Appendix 6: Amount of relative humidity and temperature recorded on the observation dates at Agricultural Research Station Baffa (Mansehra) during experimental period of July to October 2010.

S. No	Dates of observations	Temperature °C		Humidity %	
		Min	Max	Dry	Wet
1	29-07-2010	14	27	20	19.5
2	05-08-2010	16	26	25	24.5
3	12-08-2010	21	32	25	21
4	19-08-2010	20	29	23	21
5	26-08-2010	21	33	30	27
6	02-08-2010	19	32	22	19
7	09-09-2010	24	33	29	26
8	16-09-2010	20	32	25	22
9	23-09-2010	19	31	25	20
10	30-09-2010	13	29	25	19
11	08-10-2010	14	30	25	19
12	17-10-2010	20	30	25	21