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Influence of Abiotic Factors on the Incidence of Insect Pests of Groundnut with Special Reference to Groundnut Leaf Miner, *Approaerema modicella* Deventer in the Scarce Rainfall Zone of A P

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ABSTRACT

GLM incidence during *kharif*, 2011 in terms of percent damage showed significant negative correlation with Tmax (-0.50*)and Ssh (-0.618*) and significant positive correlation with rainy days (0.508*). However the no of webs showed significant negative correlation with Sun Shine Hours (-0.502*) and significant positive correlation with RH I (0.458*). The live pupae showed significant negative correlation with Tmax (-0.545*) and SSH(-0.553*) and significant positive correlation with RH-I(0.517*) during *kharif* 2011. The correlation studies with Pheromone trap catches of GLM, during 2011 and weather revealed significant positive correlation with RH-II(0.612*), and Rf(0.550*) and Rd(0.544*) and significant correlation Ssh (-0.653*). During *kharif* 2011 Thrips showed significant positive correlation with RH-I(0.516*) and significant negative correlation with Tmin (-0.50*). *Spodoptera litura* during *kharif* showed significant negative correlation with RH-I(-0.718*) and significant positive correlation with Evp(0.638*). Pheromone trap catches of *Spodoptera llitura* during *rabi* 2011 showed a negative correlation with Tmin (-0.569*). *Kharif* 2011, *Helicoverpa armigera* also showed negative correlation with RH-I(-0.533*) and positive correlation with Evp(0.529*).

Key words : *Aproaerema modicella*, Influence of weather, Seasonal incidence, *Spodoptera litura*, Sun Shine Hours, RH-I, RH-II, T max, T min, rainy days, rainfall

Groundnut is one of the principal oilseed crops grown in India (7.16 m tonnes), covering nearly half of the area (6.7 m ha) under oilseeds. Andhra Pradesh ranks first with an area of 1.76 m ha and annual production of 0.95 m tonnes. In southern districts of Andhra Pradesh, Anantapur is the largest producer of groundnut with a total production of 0.11m tonnes grown in an area of 0.89 m ha (CMIE, 2010).

The average yield in the state is lower than national average. Among the several reasons for this cause, poor plant protection measures especially in rainfed groundnut are important. Eight species of insect pests are considered to be economically important in Andhra Pradesh. They are gram caterpillar *Helicoverpa armigera* (Hubner), leaf miner *Aproaerema modicella* (Deventer), tobacco caterpillar *Spodoptera litura* (Fabricius) and thrips, Hence the present study was contemplated to know the influence of weather on the seasonal incidence of pests on rainfed groundnut, thus this information can be utilized in formulating pest management programme.

MATERIAL AND METHODS

The experiment was conducted during 2011-12 at Agricultural Research Station Anantapur. The Pheromone trap data of lepidopteran defoliators *viz., S. litura*, *H. armigera*, *A. modicella* were recorded. Incidence of leaf miner *A.modicella* assessed in terms of larvae, pupae, per cent damage and number of webs per plant present on 15 marked plants of each plot. The population of thrips was recorded by counting the number of thrips present in unopened tender leaves (terminal) on each of the five randomly selected plants per plot and presented std. week wise starting from 20 days after sowing to harvesting of the crop. The weather data was recorded from the meteorological observatory at the Agricultural Research Station, Ananthapuramu and incidence of insect pests was correlated with maximum temperature (Tmax) minimum temperature (Tmin), sun shine hours (Ssh) rainy days (Rd), rainfall (Rf) *etc.*

Table 1. Correlation coefficients between weather parameters and life stages of groundnut leaf miner 2011-12.

	Tmax		Tmin(^{0}c)		RH-I(%)		RH-II(%)		Ssh		RF		Rd		E (mm)	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
Live larva																
Live pupa	-0.545 *				0.517*	-0.568*		-0.503*	-0.553 *							0.637*
Dead larva		0.769*						-0.715*		0.553*						0.515*
Dead pupa								-0.584*								
Damage %	-0.50*								-0.618 *				0.508 *			
No.of webs		-0.50*			0.458*	0.451*		0.6205	-0.502 *	-0.511*						
Adult			0.794*										0.535*			

Table 2. Correlation coefficients between weather parameters and insect pests of groundnut 2011-12.

	Tmin(^{0}c)		RH-I(%)		RH-II(%)		Ssh		RF		Rd		Evaporation (mm)		Wv (Kmph)	
	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi
GLM						0.612*		-0.653*		0.550*		0.544*			0.506*	
Spodoptera			-0.569*	-0.718*									0.638*			
Helicoverpa				-0.533*									0.529*			
Thrips	-0.50*			0.5166*												

RESULTS AND DISCUSSION

Incidence of insects pests of groundnut during *kharif* 2011-12

Incidence of *A.modicella*: Pheromone trap catches of leaf miner was started in the 32nd Std. week with peak trap catch of 97 moths/trap during the first week of September (35th Std.week). During the months of October and November, the trap catch was around 89 to 41 moths/trap. Thus the moth activity was observed in the entire season during *Kharif* 2011, (Fig 1.).However, the incidence on the crop was observed on 31th Std.week with 11.13% damage. The No.of webs ranged from 0.78 to 9.1 per plant. The incidence was very high with 7.74 to 9.1 webs/plant during 33rd to 35th Std.week. During this period the live larvae and pupae were ranged from 1.4 to 8.55 and 1.21 to 7.05 per plant respectively (Fig.2). The same trend was not depicted with reference to adult trap catch because of the unfavorable condition *viz.,* peak rainfall of 53 mm (34th Std.week) in 3 rainy days and sudden decrease in Tmax from 33.5^0 C and 31.7^o C in 34th Std. week respectively. These results were in conformity with the findings of Bagmere *et al* (1995).

Incidence of *Spodoptera litura*: The incidence of *S.litura* in terms of moth catch was started in the 32nd Std.week. one peak was observed in 36th std.week and the other in the 39th std.week. The rainfall received during 33rd (10.4mm), 34th (53.2) and 37th std.week (27.0mm) might influenced the trap catch. After 40th std.week the trap catch was decreased to 0 (Fig.1). However there was no larval incidence on the groundnut crop.

Incidence of *Helicoverpa armigera*: The *H.armigera* trap catch was low during the entire

Table 3 Regression analysis of insect pests of groundnut (2011-12).

		Kharif		Rabi	
		Regression equation	R^2	**Regression equation**	R^2
Spodoptera	Full model	Y=1245.84-13.93 Tmax+30.75 Tmin-17.22 RHI-0.456RH2 4.094 Ssh+1.33 Rf-29.597 Rd	0.85	Y=42.97-0.911 Tmax – 0.243 Tmin – 0.010 RHI – 0.097 RH2 – 0.683 Wv – 0.133 Ssh+0.698 Rf+2.269 Rd+0.083 Evp	0.66
	Step down	Y=976.12-11.972 RHI+0.31 RH2+2.43 Wv1.99 Ssh+0.62Rf	0.80	Y=39.003-1.04 Tmax-0.96 Wv+0.94 Rf+0.124 Evp	0.57
Helicoverpa	Full model	Y=6036.06-109.3Tmax-37.42Tmin-19.60RHI-2.73RHI-20.89Wv-3.48Ssh-0.27Rf+70.39Evp	0.75	Y=28.30-0.331 Tmax-0.568 Tmin-0.146 RhI + 0.014 RH2-0.345 Wv+0.722 Ssh+3.163 Rf-1517 Rd+0.052 Evp	0.84
	Step down	Y=439.8-22.90Tmin-0.947RH2+24.08Evp	0.57	Y=24.40-0.782 Tmin-0.18RHI+0.69Ssh+0.71Rf	0.80
GLM	Full model	Y=66691.99-125.20Tmax-30.72Tmin-21.45RH1-1.139RH2-26.07Wv-9.98Ssh+0.09Rf+59.49Evp	0.99	Y=432.72-25.28 Tmax+19.418 Tmin+3.087 RHI-2.761 RH2-19.444 Wv-3.340 Ssh+155.71 Rf-905.0 Rd+2.006 Evp	0.88
	Step down	Y=6672.62-126.78Tmax-28.36Tmin-21.29RHI-122RH2-26.13EV-9.415Ssh+60.618Evp	0.99	Y=272.58-16.88 Tmax+11.29 Tmin+1.86 RHI-16.55 Wv+130.38Rf-785.68 Rd+1.93 Evp	0.84
Thrips	Full model	Y=30.20-1.750 Tmax+0.286 Tmin+0.107 RHI-0.014RH2-0.382 Wv-0.297 Ssh+0.059 Rf-0.349 Rd+3.276Evp	0.68	Y=55.54-3.076 Tmax+2.479 Tmin+0.341 RHI-0.494 RH2-1.247 Wv-0.926 Ssh+22.117 Rf-136.08 Rd+0.235 Evp	0.86
	Step down	Y=54.86-2.16Tmax-0.276wV+0.053Rf+3.28Ep	0.61	Y=5355-3.58Tmax+3.02Tmin+0.58RHI-0.554RH2-1.457Wv+25.9 Rf-158.29Rd+0.23Evp	0.82

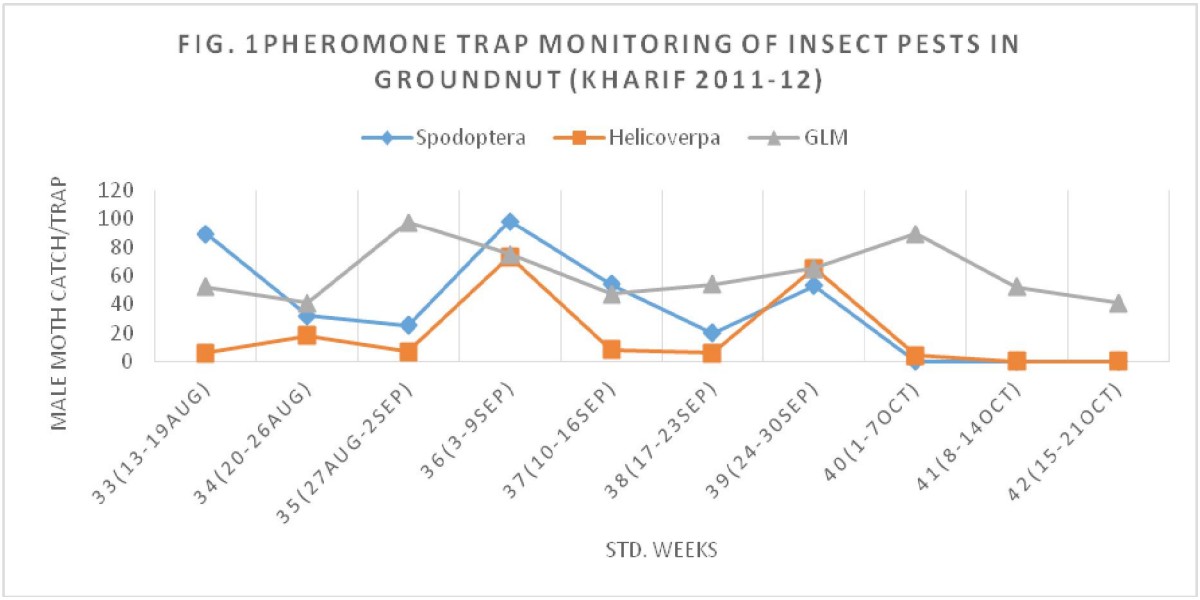


Table 4. Multiple Linear Regression Analysis of different stages of GLM 2011-12.

		Kharif		Rabi	R^2
		Regression equation	R^2	**Regression equation**	
Webs	Full model	Y=-256.72+6.73 Tmax-3.63 Tmin+1.583 RHI+0.12 RH2-2.18 Ssh-0.09 Rf+3.967 Rd	0.93	Y=4.610-0.355Tmax+0.347 Tmin+0.058 RHI-0.036 RH2-0.366 Wv-0.013 Ssh+1.056 Rf+0.024 Evo	0.78
	Step down	Y=-32.94+0.46RHI	0.21	Y=2.636-0.21Tmax+0.20Tmin+0.037RHI-0307 Wv+0.019Evp	0.76
Damage	Full model	Y=-1809.47+45.68 Tmax-16.001 Tmin+9.38 RHI+0.266 RH2-14.93 Ssh-0.70 Rf+28.015 Rd	0.94	Y=82.97+3.801 Tmax-2.035 Tmin-0.651 RHI-0.660 RH2+2.932 Wv-9.651 Ssh-32.453 Rf-0.423Evo	0.76
	Step down	Y=52.32-4.60Ssh	0.38	Y=136.18-1.07 RHII-9.804Ssh	0.60
Live larvae	Full model	Y=-292.4+8.17 Tmax-2.42 Tmin+1.062 RHI+0.088 RH2-2.316 Ssh-0.04 Rf+4.63 Rd	0.99	Y=-3.695-0.571 Tmax+0.680Tmin+0.131RHI-0.055RH2-0.636Wv+0.562Ssh + 3.271Rf+0.041Ev	0.88
	Step down	Y=-285.02+8.311 Tmax-2.47 Tmin+0.936 RHI+0.067 RH2-2.2481 Ssh+4.192 Rd	0.99	Y=-5793-0.257 Tmax+0.367 Tmin+0.090 RHI-0.496Wv+0.416Ssh+0.02Evp	0.81
Live pupae	Full model	Y=-11.69-0.082 Tmax-0.834 Tmin+0.449 RHI + 0.050 RH2-0.426 Ssh-0.038 Rf-0.017 Rd	0.66	Y=1.113+0.041Tmax-0.077Tmin-0.020RHI+0.022 RH2+0.015Wv0.024Ssh-0.344Rf+0.007Evp	0.61
	Step down	Y=-13.723-0.879 Tmin+0.455RHI+0.0503 RH2-0.453 Ssh-0.0383Rf	0.65	Y=0.050+0.00052Evp	0.41
Dead larvae	Full model	Y=1.603-0.034 Tmax+0.037 Tmin-0.023 RH1+0.008 RH2+0.022 Ssh+0.0134 Rf-0.076 Rd	0.99	Y=-3.261+0.168Tmax-0.074 Tmin+0.0001 RHI-0.007RH2+0.013Wv+0.004 Ssh-0.790 Rf-0.012Evo	0.85
	Step down	Y=0.764+0.018 Tmin-0.020RHI+0.008 RH2+0.009Ssh +0.013Rf-0.070Rd	0.99	Y=-3.428+0.163Tmax-0.071Tmin-0.007Evp	0.77
Dead pupae	Full model	Y=-5.808+0.188 Tmax-0.033 Tmin-0.0006 RHI+0.011 RH2-0.038 Ssh+0.009 Rf+0.113 Rd	0.99	Y=1.329+0.019Tmax-0.037Tmin+0.001RHI-0.015RH2-0.016Wv-0.071Ssh+0.147Rf+0.0001Evo	0.50
	Step down	Y=-5.752+0.160Tmax+0.011RH2-0.025Ssh+0.008Rf + 0.111Rd	0.99	Y=0.689-0.013RHII-0.021RHII-0.008Wv-0.07Ssh	0.34

period expect in 34th std.week (18 moths/trap) 36th std.week (73 moths/trap) and 39th std.week (65 moths/trap) under report. (Fig.1). Damage due to *H.armigera* was not observed during *kharif* 2011. Incidence of Thrips: The thrips incidence ranged from 0 to 4.0 per plant. Two peaks were observed *viz.,* during 34th std.week (3.21 thrips/plant) and 36th std.week (3.8/plant) (Fig.1). Harvir singh (2005) reported peak population of thrips during third and last week of August coinciding with dry spell after moderate rainfall.

Incidence of insects pests of groundnut *rabi* 2011-12

Incidence of *A.modicella*: Leaf miner and thrips are the important pests during *rabi*, 2011. The incidence of GLM in terms of trap catch was started in the month of November, 2011 (47th std. week) (1.33 moths/trap). The trap catch attained to its peak 48th std. week (81.83 moths/trap). During the three std. weeks *viz.,* 1st ,2nd ,3rd the trap catch was 47.5, 86.58 and 35.16 respectively and during the 5th std. week the trap catch was

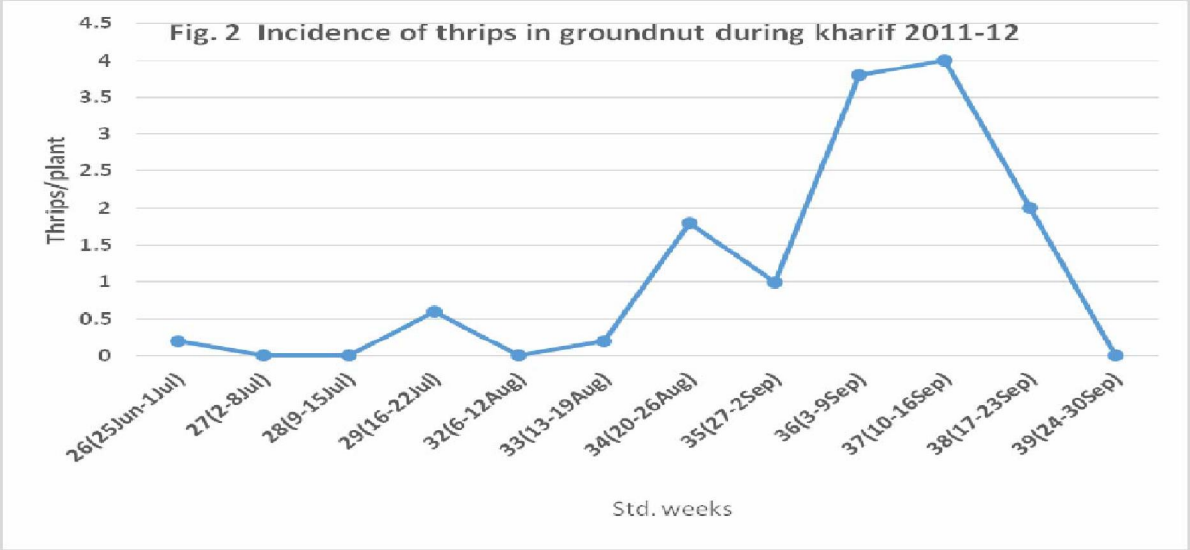


Fig. 2 Incidence of thrips in groundnut during kharif 2011-12
Thrips/plant
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
26(25Jun-1Jul)
27(2-8Jul)
28(9-15Jul)
29(16-22Jul)
32(6-12Aug)
33(13-19Aug)
34(20-26Aug)
35(27-2Sep)
36(3-9Sep)
37(10-16Sep)
38(17-23Sep)
39(24-30Sep)
Std. weeks

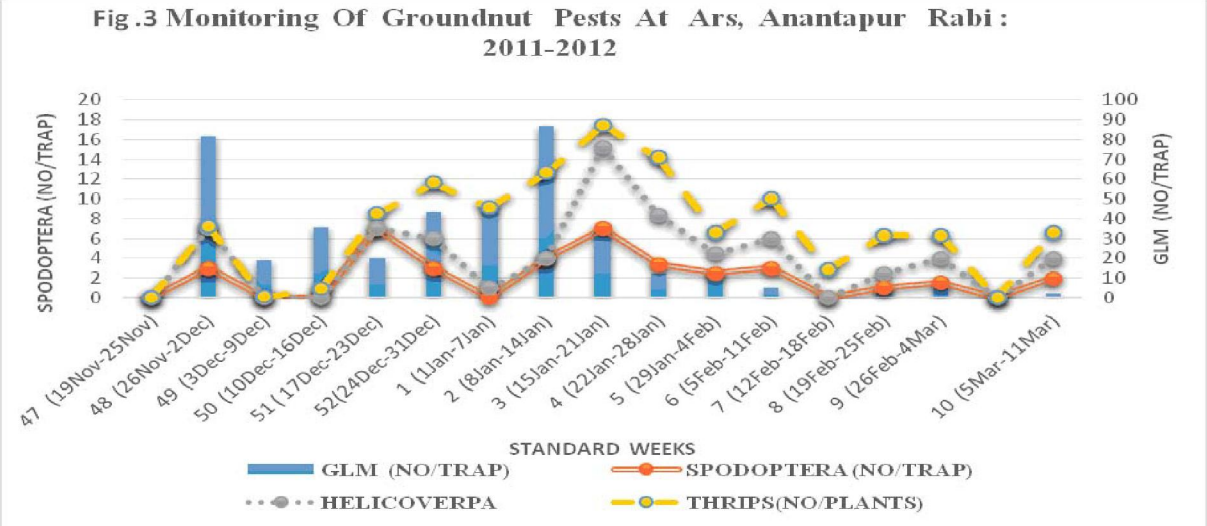


Fig .3 Monitoring Of Groundnut Pests At Ars, Anantapur Rabi : 2011-2012
SPODOPTERA (NO/TRAP)
GLM (NO/TRAP)
47 (19Nov-25Nov)
48 (26Nov-2Dec)
49 (3Dec-9Dec)
50 (10Dec-16Dec)
51 (17Dec-23Dec)
52(24Dec-31Dec)
1 (1Jan-7Jan)
2 (8Jan-14Jan)
3 (15Jan-21Jan)
4 (22Jan-28Jan)
5 (29Jan-4Feb)
6 (5Feb-11Feb)
7 (12Feb-18Feb)
8 (19Feb-25Feb)
9 (26Feb-4Mar)
10 (5Mar-11Mar)
STANDARD WEEKS
GLM (NO/TRAP)
SPODOPTERA (NO/TRAP)
HELICOVERPA
THRIPS(NO/PLANTS)

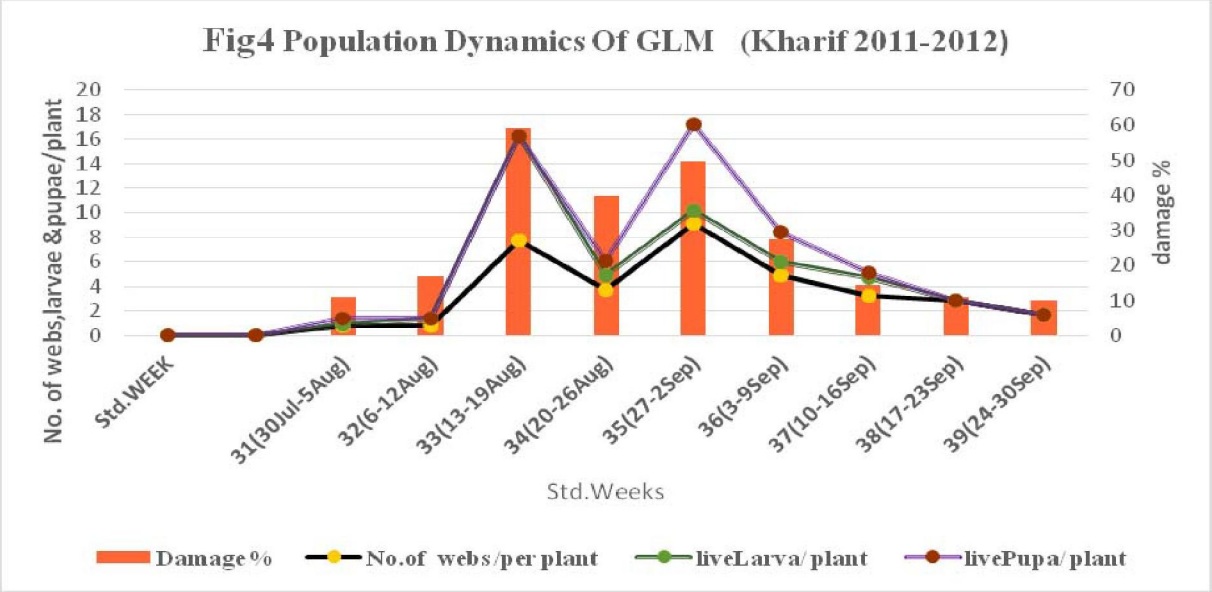


Fig4 Population Dynamics Of GLM (Kharif 2011-2012)
No. of webs,larvae &pupae/plant
damage %
Std.WEEK
31(30Jul-5Aug)
32(6-12Aug)
33(13-19Aug)
34(20-26Aug)
35(27-2Sep)
36(3-9Sep)
37(10-16Sep)
38(17-23Sep)
39(24-30Sep)
Std.Weeks
Damage %
No.of webs/per plant
liveLarva/plant
livePupa/plant

Fig. 5 INFLENCE OF WEATHER ON LARVAE & PUPAE OF GLM
(Kharif 2011-2012)

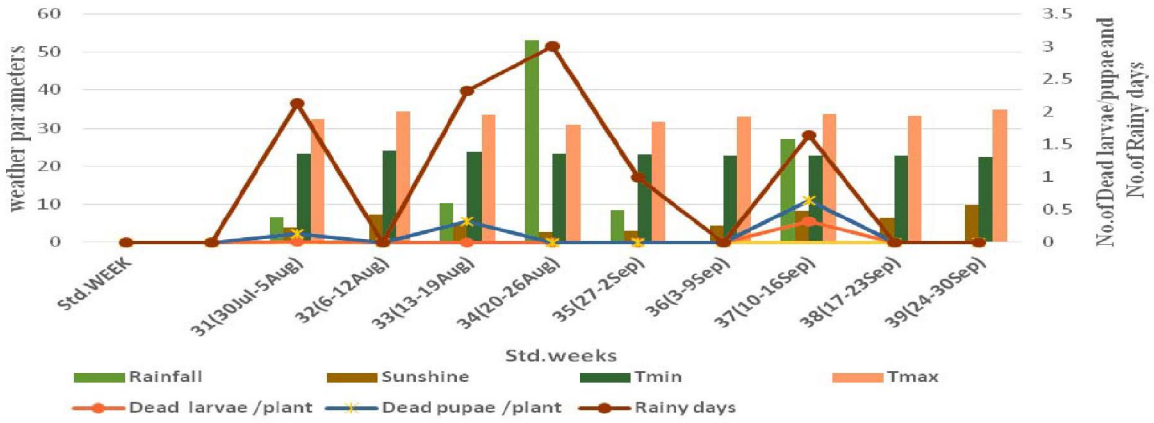


FIG. 6 POPULATION DYNAMICS OF GLM 2011-12
(RABI)

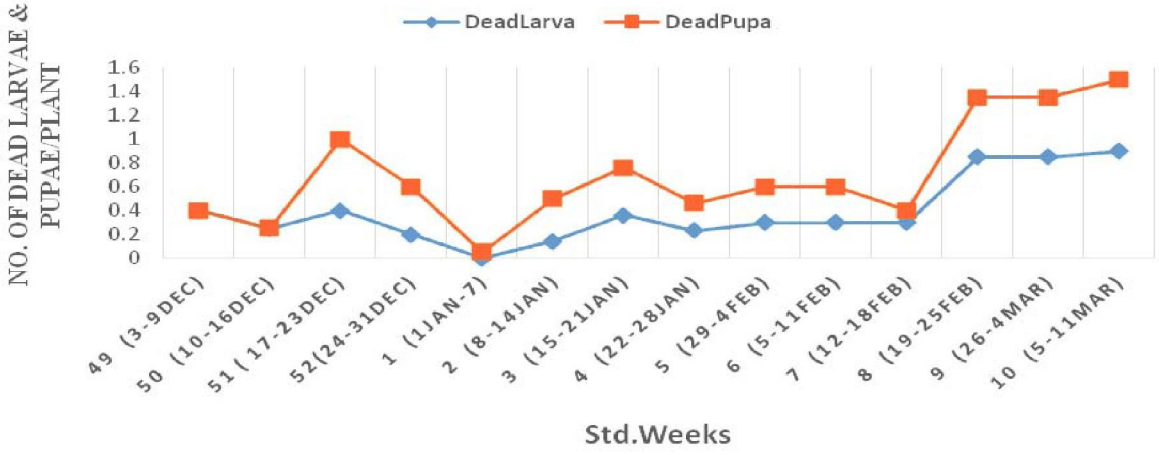
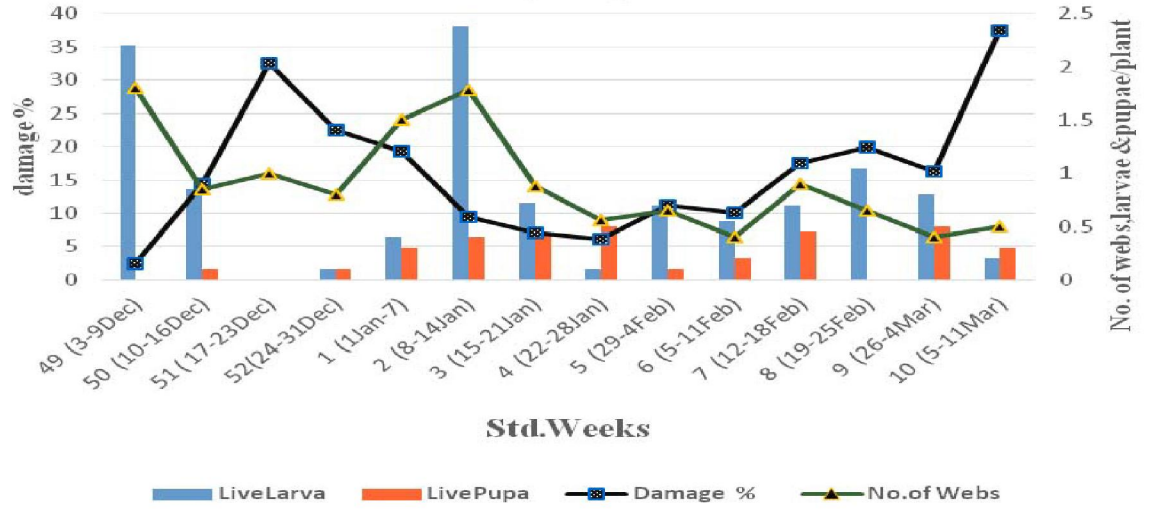


Fig. 7 POPULATION DYNAMICS OF GLM 2011-12
(Rabi)



decreased to 13.83 moths/trap . The population was suddenly declined from 7th started in the 49th std. week (5.15 moths/trap) and attained 2.16 at 10th std. week (Fig.3). The damage was started in the 49th std. week (2.5%) with 1.8 webs/plant. No. of webs ranged from 0.4 to 1.8/plant. Highest percent damage was observed in (32.5) 51st std. week and 37.5 in 10th std. week. The highest no. of webs/ plant (1.78) was observed in 2nd std. week with 2.38 live larvae/plant. During 49th std. week also 2.2 live larvae/plant was observed. The incidence of live larvae and live pupae ranged from 0.1 to 2.38 and 0.1 to 0.5 per plant respectively.

Incidence of thrips:

The incidence of thrips was ranged from zero to 8.60 thrips/plant during the period under report. The incidence started during 48th std.wek (0.23 thrips/plant) and increased from 51st to 6th std.week (1.5 to 4.5) and attained to its peak during the 2nd std.week (8.66 thrips/plant). (Fig.3).

Incidence of *S.litura* :

The incidence of *S.litura* was very low in terms of trap catch during the entire period under report and ranged from 0 to 7.0. Two small peaks were observed during 51st and 3rd std.week (7 moths/trap). The larval population was not observed (Fig.3).

Incidence of *H.armigera*:

The Incidence of *H.armigera* also very low ranged from 0 to 8.25 moths/trap. The peak was observed in 3rd std. week. The larval population was not observed (fig.3).

Influence of weather parameters on insect pests of groundnut:

GLM

Kharif 2011: GLM incidence during *kharif*, 2011 in terms of percent damage showed significant negative correlation with Tmax (-0.50*) and Ssh (-0.618*) and significant positive correlation with Rainy days (0.508*). The regression equation fitted by considering the data of percent damage per plant (Y) as dependent variable and weather parameters as independent variable was Y = -1809.4 + 45.68Tmax - 16.001Tmin + 9.38 RH *I* + 0.266RH2 - 14.93Ssh - 0.70Rf + 28.01Rd with 94% dependence on weather (R^2 = 0.94*). The step down regression analysis revealed that Y = 52.32 - 4.60Ssh influenced the damage to the extent of 38 percent while the rainy days with the above parameters to the extent of 75 percent. However the no.of webs showed significant negative correlation with Ssh (-0.502*) and significant positive correlation with RH I (0.458*) (Table 1). The regression equation fitted by considering the data on no. of webs per plant (Y) as dependent variables and weather parameters as independent variables was Y = 256.72 + 6.73Tmax - 3.63Tmin + 1.583RH I + 0.12RH2 - 2.18Ssh - 0.09Rf + 3.967RD with 93% dependence on weather (R^2 = 0.93). The step down regression analysis revealed that the no. of webs per plant was influenced by RH I to the extent of 21 percent Y = 32.94 + 0.46RH I) (Table 4).

The live pupae showed significant negative correlation with Tmax (-0.545*) and Ssh (-0.553*) and significant positive correlation with RH I (0.517*) during *kharif* 2011. The regression equation fitted by consideration the data of live pupae per plant (Y) as dependent variable and weather parameters as independent variable was Y = 11.69 - 0.082Tmax - 0.834Tmin + 0.449RH I + 0.50RH2 - 0.423Ssh - 0.038Rf - 0.017Rd with 60% dependence on weather (R^2 =0.66). The step down regression analysis revealed that the live pupae per plant was influenced by weather as Y = -13.72 - 0.879Tmin + 0.455RH I + 0.050RH2 - 0.453Ssh - 0.038Rf to the extent of 65 percent (Table 4).

***Rabi*, 2011**

The correlation studies with pheromone trap catches of GLM during *rabi*, 2011 with weather revealed significant positive correlation with RH II (0.612*), Rf (0.550*), Rd(0.544*) and significant negative correlation with Ssh (-0.653*). The MLR showed 88 percent dependence on weather factors with Y = 432.7 - 25.2 Tmax + 19.41Tmin + 3.087RH I - 2.761RH II - 19.44Wv - 3.340Ssh + 155.7Rf - 905.0Rd + 2.006Evp during *rabi*, 2011. The step down regression analysis revealed that the pheromone trap catches of GLM was influenced by Y = 272.5 - 16.88Tmax + 11.29Tmin + 1.86RH I - 16.55Wv + 130.38Rf-785.6 Rd + 1.93Evp to the extent of 84 percent in *rabi* (Table 3).

The GLM incidence in terms of no. of webs also showed significant positive correlation with *RH I* (0.45*) and significant negative correlation with

Ssh (-0.51*) during *rabi*, 2011. The regression analysis with weather parameters showed 78 percent dependence on weather factors with Y = 4.61 - 0.35Tmax + 0.347Tmin + 0.058RH I - 0.036RH2 - 0.366Wv - 0.013Ssh + 1.056Rf + 0.024Evp. These results are in conformity with the findings of Sherasiya and Butani (1998). Ghule *et al.,*(1989) also reported significant negative correlation with Ssh and positive correlation with RH I. The step down regression analysis revealed that, Y = 2.636 - 0.21Tmax + 0.20Tmin + 0.037RH I - 0.307Wv + 0.019Evp influenced the no of webs to the extent of 76 percent in *rabi* (Table 4).

However the live pupae showed significant negative correlation with (-0.568*) and RH 2(-0.503*) and significant positive correlation with Evp (0.637*) during *rabi* 2011. The regression Analysis with the weather parameters indicated that 61% of influence on live pupae with Y = 1.113 + 0.041Tmax - 0.077Tmin - 0.020RHI + 0.022RH2 + 0.015Wv - 0.024Ssh - 0.344Rf + 0.007 Evp. The step down regression revealed that Y = 0.050 + 0.005Evp and it influenced the live pupae to the extent of 41 percent.

Dead larvae showed significant positive correlation with Tmax(0.769*), Ssh(0.553*) and Evp (0.515*) and significant negative correlation with RH II (-0.715*) during *rabi* 2011. The regression analysis with the weather parameters indicated that 85% of influence on Y = -3.261 + 0.168Tmax - 0.074Tmin + 0.0001RH I - 0.007RH II + 0.013Wv + 0.004Ssh - 0.790Rf - 0.01Evp. The step down regression analysis revealed that Y = -3.42 + 0.163Tmax - 0.071Tmin - 0.007Evp influenced the dead larvae to the extent of 77%.

Dead pupae also showed significant negative correlation with RH II (-0.584*) during *rabi* 2011. The regression analysis with weather parameter indicated that influence of dead pupae with Y = 1.329 + 0.019Tmax - 0.037Tmin + 0.001RH I - 0.015RH2 - 0.016Wv - 0.071Ssh + 0.147Rf + 0.001Evp. The step down regression revealed that RH II influence the dead pupae to the extent of 34 percent in *rabi*, 2011 (Y = 0.689 - 0.013RH2).

Thrips

***Kharif* 2011**:

Thrips showed significant positive correlation with RH I (0.516*) and significant negative correlation with Tmin (-0.50*) (Table 2) during *kharif*, 2011. MLR with weather parameters on thrips incidence showed 68 percent dependence on weather showing Y = 30.2 - 1.75Tmax + 0.28Tmin + 0.10RH I - 0.014 RH II - 0.38Wv - 0.29Ssh + 0.059Rf - 0.349Rd + 3.27Evp. However the step down regression revealed that Y = 54.86 - 2.16Tmax - .0.27Wv + 0.053Rf + 3.28Evp and influenced the thrips population to the extent of 61 percent (Table 3).

***Rabi*,2011:**

Thrips also showed negative correlation with Tmax, Tmin RH-1,RH2 AND during *rabi*, 2011 rainfall. The MLR with thrips indicated 86 percent of influence on population of thrips per plant with Y = 55.54 - 3.07Tmax + 2.47Tmin + 0.34RH I - 0.49 RH II - 1.241Wv - 0.926Ssh + 22.1Rf - 136.08Rd + 0.235Evp. During *rabi*, the step down regression showed that Y = 53.55 - 3.58Tmax + 3.02Tmin + 0.58RH I - 0.55RH2 - 1.45Wv + 25.9Rf - 158.29Rd + 0.23Evp influencing the thrips population to the extent of 82 percent.

Spodoptera litura

***Kharif* 2011** *S. litura* during *kharif*, 2011showed significant negative correlation with *RH I*(-0.71*) and significant positive correlation with Evp (0.63*).The regression equation fitted by considering the data of pheromone trap catch of *S. litura* (Y) as dependent variable and weather parameters as independent variable was Y = 1245.84 - 13.93Tmax + 30.75Tmin - 17.22RH I - 0.45 RH II - 4.09Ssh + 1.33Rf - 29.5Rd with 85% dependence on weather (R^2=0.85) (Table 4). During *kharif*, 2011, the step down regression revealed that Y = 976.12 - 11.972RH I + 0.31RH II + 2.43Wv - 1.99 Ssh + 0.62 Rf contributing to the extent of 80 percent to the male moth catches of *S. litura*

***Rabi*,2011**

Pheromone trap catches of *S. litura rabi*, 2011 showed a negative correlation with Tmin (-0.569*). The regression Analysis with the weather parameters indicated 66% of influence on trap catches of *S. litura* with Y = 42.97 - 0.911Tmax - 0.243Tmin - 0.010RHI - 0.097RHII - 0.683Wv - 0.133SSH + 0.698Rf + 2.269Rd + 0.083Evp. These results were inconformity with the findings of Gedia *et al.,* (2007), and Monobrullah *et al.,* (2007). The results of the present investigation indicated that

various weather parameters influenced *S. litura* moth catches in pheromone trap as reported by Dubey et al.,(2003). However the three factors *viz.,* Y = 39.003 - 1.04Tmax - 0.96Wv + 0.94Rf + 0.124Evp influenced to an extent of 57 percent in step down regression analysis in r*abi*, 2011.

Helicoverpa armigera

***Kharif* 2011** *H. armigera* also showed negative correlation with RHI (-0.533*) and positive correlation with Evp (0.529*). However, these results were in conformity with the findings of Upadhyay *et al.,* (1989). The regression equation fitted by considering the data on pheromone trap catches of *H. armigera* (Y) as dependent variable and weather parameters as independent variable was Y - 6036.06 - 109.3Tmax - 37.42Tmin - 19.60RHI - 2.73RHII - 20.89Wv - 3.48SSH - 0.27Rf + 70.39Evp with 75% dependence on weather (R^2=0.75) (Table 4). Thus results were in confirmity with the findings of Krishna kant et al., 2004. The male moth catches of *H. armigera* was influenced by Y = 439.8 - 22.90Tmin - 0.94RH II + 24.08Evp to the extent of 57 percent in the step down regression.

***Rabi*,2011**

The correlation studies with weather parameters and pheromone trap catches of *H. armigera* revealed non significant negative correlation with Tmin, RHI,RH II and wind velocity during *rabi* 2011, but the regression analysis with weather parameters indicated 84 percent of influence on trap catches of *H. armigera* with Y = 28.30 - 0.331Tmax - 0.568Tmin - 0.146RH I + 0.014RH II - 0.345Wv + 0.722Ssh + 3.163Rf - 15.17Rd + 0.052Evp. (Krishna Kant *et al*.,2006). However in *rabi*, the moth catches were influenced by Y = 24.40 - 0.782Tmin - 0.18RHI + 0.69Ssh + 0.71Rf to the extent of 80 percent in the step down regression.

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