Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 577-580
Received: 08-03-2020
Accepted: 12-04-2020

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Impact of climatic factors on the incidence of soybean leaf feeders

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Abstract
Present study was carried out at R.A.K. collage of agriculture, Sehore (M.P.) during experimental year *Kharif* 2016, four varieties of soybean JS-335, JS-9305, JS-9560 and RVS-2001-04 were studied upon the impact of climatic factors on the incidence of soybean's Grey semi-looper (*Gesonia gemma*) and Green semi-looper (*Chrysodeixis acuta*). Weather data of maximum, minimum temperature, rainfall, relative humidity of *Kharif*-2016 was collected (June standard weather week 26 to October Standard weather week 42) from the national observatory. Monsoon arrival and date of sowing and difference in number of days between these two parameters was also taken into consideration for correlation with the incidence of *Gesonia gemma* and *Chrysodeixis acuta*. Activity of the *Gesonia gemma* on different varieties of soybean was observed at low level. The season mean of pest population per 2 meter row length was 0.83 in JS–335, 0.69 in JS-95-60, 0.71 in JS-9305, and 1.12 in RVS-2001-04 varieties. Larval population of *Chrysodeixis actua* was also remained at very low level in all the four varieties of soybean. The correlation study revealed that the population of *Chrysodeixis acuta* was not correlated with date of sowing after monsoon. The maximum temperature in 2016 was negative but significantly correlated with the season mean larval population of both insects while larval population of only *Gesonia gemma* was negatively and significantly correlated with minimum temperature in 2016. Data of first appearance of pest in day after germination was correlated with the seasons mean larval population the correlation was negative and significant in case of *Gesonia gemma* while in *Chrysodeixis acuta* it was positively significant.

Keywords: Soybean, green semi looper, grey semilooper, temperature, rainfall, relative humidity

Introduction
Soybean [*Glycine max* (L.) Merrill] commonly known as Soya is a unique crop with nutritional value providing 40 percent protein and 20 percent edible oil beside minerals and vitamins. "Green semilooper" *Chrysodeixis acuta* (Walker) (Noctuidae, Lepidoptera) is a serious pest of soybean crop. In severe out beaks, the pest may cause reduction of about 50 per cent in grain yield (Singh and Singh, 1987) [9]. Grey semilooper, *Gesonia gemma* (Swinhoe),a serious and most regular defoliators of soybean causes maximum damage during the month of September, and significant reduces pod number, pod weight, grain weight and yield reduction of 3.94q/ha. (Singh and Singh, 1989) [11]. Khalid *et al.*, (2013) [3] studied the effect of the weather factors on incidence and development of *Helicoverpa armigera* on different sunflower genotypes during 2008-2009. Singh *et al.*, (2013) [10] observed 12 insect species during *Kharif* season of 2007 wherever 13 insect pests and one mite were observed on soybean during 2008 and 2009. These pests were identified as *Gesonia gemma* (Swinhoe), *Chrysodeixis acuta* (Walker), *Spodoptera litura* (Fab.), *Helicoverpa armigera* (Hub.), *Myllocerus maculosus* (Desbro). *Gryllus* sp.; *Cneorane* sp., *Luperu sclytie* (Wilcox) and *Mocis undata*, Stem borers *viz. Obereopsis brevis* (Swed.) and *Melanagromyza sojae* (Zehnt.); and sap feeders *Bemisia tabaci* (Gennadius), and *Chauliops fallax* (Scott.). Of these, *Cneorane* sp., *Gesonia gemma*, *Chrysodeixis acuta*, *Melanagromyza sojae* and *Obereopsis brevis* were recorded as major pests. During 2007 the infestation reached up to 13.5 per cent, however during 2008-09 it was upto 26.6 and 30.5 per cent, respectively before harvesting of the crop.

The earth temperature has increased by 0.74 degree Celsius during the last century (1906 to 2005) due to increase in greenhouse gases, through anthropogenic emissions as reported by IPCC. Thus the increase in temperature is likely to be 1.8-4.0 degree Celsius by the end on 21st century resulting in anticipated greater instability in food, feed and fiber production. Increase in temperature can reduce crop duration and change in pest population. Anthropogenically induced climatic change arising from increasing levels of atmospheric greenhouse gases would likely to have a significant effect on agricultural pests. Changes in climate may trigger changes in geographical distribution, increased overwintering, changes in population growth rates,

increases in the number of generations, extension of the development season, changes in crop-pest synchrony, changes in inter-specific interactions, pest biotypes, activity and abundance of natural enemies, species extinction, increased risk of invasion by migrant pests and efficacy of crop protection technologies. Global warming will also reduce the effectiveness of host plant resistance, transgenic plants, natural enemies, bio-pesticides, and synthetic chemicals for pest management. Therefore, there is a need to generate information on the likely effects of climate change on pests to develop robust technologies that will be effective in future under global warming and climate change. (Reddy 2013) [6]. Crop production in dry land is purely dependent on rainfall. Hence, for a successful cropping in dry land scientific evaluation of rainfall of a region is imperative (Kannan *et al.*, 2000) [2]. Increasing climatic variability associated with global warming will, nevertheless, result in considerable seasonal/ annual fluctuation in food production. (Verma *et al.*, 2010) [12, 13]. Looking to the above point of view, in present investigation impact of climate change on the status of soybean defoliators, namely *Chrysodeixis acuta* (Walker) and *Gesonia gemma* (Swinhoe) will be assessed with following.

The study was concentrated on given objectives that is, To find out the incidence of *Chrysodeixis acuta (*Walker*)* and *Gesonia gemma (*Swinhoe*)* in popular varieties on soybean and To work out the co-relation between weather fluctuations and incidence of *Chrysodeixis acuta* (Walker) and *Gesonia gemma* (Swinhoe) in soybean.

Materials and Methods

The experiment was conducted at the field experimental centre R.A.K. college of Agriculture during experimental year *Kharif* 2016, The infestation of *Chrysodeixis acuta* and *Gesonia gemma* was recorded from 6-8 DAS (days after sowing) till the maturity of soybean crop in *kharif*. Sample size were two rows each of one meter length**,** such ten random samples was recorded from general sowing in four varieties of soybean *viz*., RVS 2001-04, JS-335, JS-95-60 and JS 93-05. However, during later stage polythene sheet of size 100 x 35 cm was used to record larval population. Before taking the observations, the polythene sheet was placed in between the rows carefully and plants shaded by gentle cover of sheet. Larvae fallen over the sheet were counted species-wise. Infestation of *Chrysodeixis acuta* and *Gesonia gemma* was recorded thrice in a week and compile as per standard weather weeks. The pest population recorded during the season was compiled as per the standard weather week (SWW) 26 (June 25th to July 1st) to (SWW) 42 (October 15th to 21st). Incidence of pests was correlated with maximum temperature, minimum temperature, mean temperature difference of maximum temperature and minimum temperature, the deviations of maximum temperature, minimum temperature, mean temperature and difference of maximum and minimum temperature, relative humidity, rain fall, date of sowing after monsoon and appearance of pest in days after germination. The incidence of pest population was correlated with weather parameters. It is projected that by the end of the 21st century rainfall will increase by 15-31%, and the mean annual temperature will increase by 30 C to 60 C. Increasing climatic variability associated with global warming will, nevertheless, result in considerable seasonal/ annual fluctuation in food production. (Verma *et al.*, 2010) [12, 13].

Results and Discussion

In season 2016, the rise of maximum temperature over the normal temperature was observed by 0.32 ^{0}C over the normal maximum temperature. In season 2016 the mean deviation was 0.33^{0}C minimum temperature range from 19.01^{0}C recorded in (SWW 41) to 23.95 ^{0}C (SWW 26) respectively. Season 2016 received very less rainfall in SWW 36 (0mm) and SWW 41 (2.0mm) but SWW 26 to 35 and SWW 37 and 40 received most of the rainfall in these weeks. The total rainfall was 1861.5 mm which was 563.4mm high then the normal. Season Kharif 2016 was having 59 rainy days.

Weekly population of *Gesonia gemma* was recorded in four varieties of soybean Incidence of the *Gesonia gemma* on varieties of soybean was observed at low level, throughout the season. However, the pest population in different weather weeks differs significant from each other. Larval population of *Gesonia gemma* during the *Kharif* 2016 in four varieties of soybean remained below the economic injury level throughout the season. The pest population is appeared infestation found at 37 days after germination (DAG). The pests activity remained up to 4 week of *Gesonia gemma*. The season mean of pest population in JS-335 per 2 mrl is 0.83 (Table.1). Statistically the incidence of pest in different varieties is not significant.

Larval population of *Chrysodeixis acuta* was also remained at very low level. The difference was statically non significance. Similarly appearance and infestation of *Chrysodeixis actua* larval population is recorded on soybean, it also took the same interval of time for appearance after germination as in *Gesonia gemma*. The pests activity remained up to 6.25 week in *Chrysodeixis actua.* The season mean was 3.55 larvae per 2 mrl in JS-335, 3.33 larvae 2 mrl in JS-9560, 3.03 larvae per 2 mrl in JS-93-05 and 5.40 in RVS-2001-04 variety respectively (Table.1). The decreasing in larval population during the season 2016 of *Gesonia gemma* probably due to rise of maximum temperature (0.13^{0}C) over normal and the increase of intensity of very heavy to extraordinary rainfall during the *Kharif* season.

Table 1: Incidence of Green Semi-looper (*Gesonia gemma)* and Grey semi-looper (*Chrysodeixis acuta)* on different varieties of soybean during *Kharif* 2016.

Variety name	*Gesonia gemma*	*Chrysodeixis acuta*
JS 335	0.833	3.55
JS 9560	0.697	3.334
JS 9305	0.717	3.031
RVS 2001-04	1.128	5.401

Data further indicated that population of *Gesonia gemma* was decreased with the increase of maximum temperature same in case with *Chrysodeixis acuta*. Maximum temperature and larval population of *Gesonia gemma* and *Chrysodeixis acuta* was negativity correlated r = -604, -0.480 respectively (Table.2). Williams *et al.*, 2003 [14] reported that long term exposure to increased temperature 3.50C shortened the insect development. Minimum temperature during the study period and larval population of *Gesonia gemma* was negativity co related.r= -0.480 whereas it was not correlated in case of *Chrysodeixis acuta*. Mean temperature (maximum and minimum) during the study period the larval population of *Gesonia gemma* and *Chrysodeixis acuta* was negatively correlated r = -0.640 and r =-0.524, respectively (Table.2). The data indicated that the difference of maximum and minimum temperature was not correlated with larval population of *Gesonia gemma* and *Chrysodeixis acuta*. The difference of maximum and minimum temperature had no effect on the occurrence of the *Gesonia gemma*. Low mean

temperature in early part of the season coupled with the relative humidity 60% fevers the multiplication of mango leaf hopper Verma and Pandy 2007.

Relative humidity had positive and non significant correlation with the larval population of *Gesonia gemma* and *Chrysodeixis acuta* respectively in 2016. In season 2016 larval population of *Gesonia gemma* and *Chrysodeixis acuta* was not correlated with rainfall Shrinivasrao *et al.* (2010) [7] reported relative humidity had no correlated with the larval population of *Spodoptera litura* in soybean while Babu *et al*. (2016) reported the morning relative humidity showed significant and positive correlation with larval population of soybean defoliators. Singh (2010) recorded a total of sixteen insect-pests were recorded on *Vigna mungo* at different stages of crops growth during *Kharif* 1997 and 1998. The populations of grass hopper *Epilachna* beetle and leaf Webber were negatively correlated with relative humidity and rainfall during both the years.

The date of arrival of south-west monsoon was 25 june in 2016. The activity of *Chrysodeixis acuta* and *Gesonia gemma* effected directly or indirectly by the variation in date of sowing of soybean in relation to the arrival date of monsoon. Early and delay sowing of soybean crop affected the incidence of *Chrysodeixis acuta* and *Gesonia gemma*. Date of arrival of monsoon and activity of occurrence of *Gesonia gemma* and *Chrysodeixis acuta* in soybean was not correlated significant but the trend was negative.

Table 2: Corelation between weather parameters and larval population of Semi-looper (*Gesonia gemma)* and Grey semi-looper (*Chrysodeixis acuta)* during *Kharif* 2016.

Parameters	***Gesonia gemma***	***Chrysodeixis acuta***
Maximum Temperature	-0.604*	-0.480*
Minimum Temperature	-0.480*	-0.148
Mean Temperature	-0.640*	-0.524*
Difference between Maximum and Minimum Temperature	-0.393	-0.229
Relative Humidity	0.280	0.168
Rainfall	-0.085	-0.132
Deviation of Maximum Temperature	-0.180	-0.143
Deviation of Minimum Temperature	-0.173	-0.145
Deviation of Mean Temperature	-0.049	-0.065
Deviation of Difference between Maximum and Minimum Temperature	-0.044	-0.030
Date of sowing after monsoon	-0.121	-0.146
Appearance of pest in Days after Germination	-0.762*	0.542*

Our findings are similar as reported by Shrinivasrao *et al*, (2010) [7] reported that the larval population of *Spodoptera litura* in groundnut and adult population by pheromone trap had negative and significant correlation with weekly and monthly data distribution and the rainfall was not correlated with larval population of groundnut leaf miner.

Population of *Geosina gemma* was negativity correlated with day of germination of crop and first appearance of pest in different years under study, while in case of *Chrysodeixis acuta* first appearance of pest on soybean in different years (day of sowing) was positively correlated with the arrival day of monsoon in respective years. Rai and Singh (2012) [5] studied the effects of climatic factors on the incidence of jassid (*Amrsca bijuttula*) on okra (Kashi Pragati) in Uttar Pradesh, India, during the summer and rainy seasons of 2008 and 2009.

Summery and Conclusion

Incidence of the *Gesonia gemma* and *Chrysodeixis actua* on different varieties of soybean was observed at low level. Statistically the incidence of pest in difference varieties was not significant for both of the insects. The correlation study revealed that the population of *Chrysodeixis* acuta and *Gesonia gemma* decrease with the rise of maximum temperature. Larval population of *Gesonia gemma* was negatively correlated with minimum temperature. While it was not correlated with the larval population of *Chrysodeixis acuta*. Data of first appearance of pest in day after germination was correlated with the seasons mean larval population the correlation was negative and significant in case of *Gesonia gemma* while in *Chrysodeixis acuta* it was positively significant. Difference of maximum and minimum temperature had no impact on larval population of *Gesonia gemma.* Larval population of *Chrysodeixis acuta* was not correlated with relative humidity while correlation was positively in case of *Gesonia gemma*. Larval population of *Chrysodeixis acuta* and *Gesonia gemma* was not correlated with rainfall. The appearance of pest in days after germination of *Chrysodeixis acuta* was high when population appeard late in the season but population of *Gesonia gemma* was found low with the late appearance in the season.

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