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Mahesh V Ugale
PG Scholar, Department of Agricultural Entomology, COA, Badnapur, Jalna, VNMKV, Parbhani, Maharashtra, India

SD Bantewad
Head, Department of Agricultural Entomology, VNMKV, Parbhani, Maharashtra, India

AL Suradkar
Assistant Professor, Department of Agricultural Entomology, COA, Badnapur, Jalna, VNMKV, Parbhani, Maharashtra, India

Altaf B Shaikh
PG Scholar, Genetics & Plant Breeding, Department of Agricultural Botany, COA, Badnapur, Jalna, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
Mahesh V Ugale
PG Scholar, Department of Agricultural Entomology, COA, Badnapur, Jalna, VNMKV, Parbhani, Maharashtra, India

Studies on population dynamics of pigeonpea (*Cajanus cajan* L.) pod bugs, green stink bugs & leaf webber

Mahesh V Ugale, SD Bantewad, AL Suradkar and Altaf B Shaikh

Abstract
The investigation of "Population Dynamics of pod borer complex of pigeonpea" experiment was conducted at research farm of Pulse Entomology section at Agricultural Research Station, Badnapur Dist. Jalna during *kharif* season of 2019-2020.The studies on population dynamics indicated that the the maximum population of *H. armigera*, *E. atomosa*, *M. vitrata* and *M. obtusa* on pigeonpea to the extent of 4.10, 2.80, 3.80 and 2.60 larvae per plant, respectively was noticed during 52nd, 52nd, 51st and 1st standard meteorological weeks, respectively and population of *G. critica*, *C. gibbosa*, and *N. virudula* on pigeonpea to the extent of 1.98 larvae/plant, 7.60 nymph and adults/plant, and 6.03 nymph and adults/plant was noticed during 42nd, 51st and 52nd standard meteorological weeks, respectively.

Keywords: Population, dynamics, pigeonpea, pod, borer & complex

Introduction
Pigeon pea (*Cajanus cajan* (L.) Millspaugh) is one of the major grain legume crops in the tropical and subtropical regions of the Asia and Africa and it is considered to as a second important pulse crop of India after Chickpea. It is commonly known as arhar or red gram or tur in India, it offers nutritional security due to richness in protein (21%) along with mineral supplements *viz*., iron, iodine and also provides many benefits to poor families in way of fuel, fodder, fencing material and it enhance soil fertility and control of soil erosion (Siambi *et al*., 1992) [7]. It is hardy, widely adaptable and tolerant to temperature as high as 35^0C. It requires, an average rainfall between 600 and 1000 mm is most suitable and plant cannot be with stand under heavy frost and water logging. It can be grown in a wide range of soils, as it tolerates low fertility. According to Rangarao and Shanower (1999) [6] some cultivars are tolerant for salinity and aluminium. The soil pH range 4.5-8.4 is suitable for cultivation. It gives an average yield in areas where rainfall about 400 mmannually.
India is the largest producer of pigeon pea contributing more than 93 % of the global production; it is grown in an area of 4.46 million hectares with production of about 4.18 million tones and the productivity levels range from 937 kg/ ha during 2017-18 (DAC, 2018). The Pigeon pea can be grown on a wide range of soils in different cropping systems across varied agro-climatic regions of India, Whereas, in Maharashtra, pigeon pea is cultivated in an area of 12.28 lakh hectares with an annual production of 9.83 lakh tones and the average productivity is 800 kg/ha and Marathwada region, area under pigeonpea 4.56 lakh hectares with a annual production of 3.80 lakh tones and average productivity is 789 kg/ha., during 2017-18 (Anonymous, 2018) [1].
Among various constraints for low productivity, the insect pests are one of the major biotic constraints for the production. Lal and Katti (1998) [3] reported that over 250 species of insects belonging to 8 orders and 61 families have been found to attack the pigeonpea of these, the gram pod borer, *Helicpverpa armigera* (Hubner), pod fly, *Melanogromyza obtusa* (Malloch) and tur plume moth, *Exelastis atomosa* (Walsingham) are important feeder of pigeonpea which are collectively referred to as the pod borer complex which significantly reduces the crop yield to an extent of 60-90 per cent. Pigeonpea yields have remained stagnant for the past 3 to 4 decades, largely due to damage inflicted by insectpests.
Amongst many other insect pests attacking pigeonpea crop as legume pod borer, *Maruca vitrata* (Geyer) and tur pod bug, *Clavigralla gibbosa* (Spinola) causes significant reduction in the crop yield of pigeonpea (Sujithra and Chander, 2014) [9].
Pod borer's causes 60 to 90 % loss in the grain yield under favourable conditions. Economic losses due to biotic factors have been estimated to be US $ 8.48 billion. The pod fly, *Melanagromyza obtusa* alone causes a yield loss of 60 to 80% and the losses have been estimated at US $ 256 million annually. (Patange and Chiranjeevi, 2017) [4].

Pod borers have been estimated to cause 60 to 90 per cent loss in the grain yield of pigeonpea under favourable conditions and the damage of seeds by pod fly generally ranges between 14.3 to 46.6 per cent (Priyadarshini *et al.*, 2013) [5]. *H. armigera* and *M. obtuse* cause adequate economic damage leading to very low yield levels of 500 to 800 kg ha^{-1} as against the potential yield of 1800 to 2000 kg ha^{-1} (Durairaj and Shanower, 2003; Lal, 1996) [3]. Similarly, finding of Sharma and Franzmann (2000) and Mohapatra and Srivastava (2002) revealed that pigeonpea plants infested with 8 to 16 larvae of *M. vitrata* suffers huge grain yield losses ranging between 50 to 68 per cent. Out of these *H. armigera, E. atomosa, M. obtuse* and *M. vitrata* are the key pests. To meet the demand of increasing population the present area and production is inadequate. There is a great scope to increase the production by controlling the major pests. Yadav and Chaudhary (1993) studied that the extent of damage caused by *H. armigera and M. obtuse* in pigeonpea during *kharif* 1984 and 1985 in Hissar, Hariyana state was observed to be 13.6 and 13.7 percent to pods and 5.3 and 5.3 per cent to grains, respectively.

According to Sharma and Pandey (1993) losses due to pigeonpea pod borers during 1984-85 and 1985-86 were reported to be 52.74 and 8.33percent in cultivar UPSC 120, 62.02 and 56.83 per cent in cultivar BDN-1 and 64.37 and 58.35 percent in G3, respectively. Shrivastava *et al*., (1993) were reported the early, mid and late maturing cultivars of pigeonpea to be damaged by *M.obtusa* and *H.armigera* to the tune of 29.55 to 55.63, 20.95 to 57.00 and 32.92 to 56.56 percent, respectively, pigeonpea pod damage to the insects varied from 7.6 to 31 per cent.

Result & Discussion

Population dynamics of major pests of pigeonpea.

The population dynamics of pigeonpea pod borer complex *Grapholita critica, Clavigralla gibbosa, Nezara viridula* infesting pigeonpea was studied during *kharif* season 2019-2020.

The population of pigeonpea pod borer complex, *Grapholita critica, Clavigralla gibbosa, Nezara viridula* Linn, *Helicoverpa armigera, Melanagromyza obtusa, Exelastis atomosa* and *Maruca vitrata* was recorded along with its natural enemies in the untreated plot by using variety of pigeonpea as BDN-711 under natural field condition. The incidence was recorded on five randomly selected plants from 36th to 3rd meteorological week and is presented in Table-1.

Table 1: Population dynamics of major insect pests of pigeonpea during 2019-20.

SMW	Leaf webber/ plant	Pod bugs/ plant	Green stink bug/ plant
36	0.88	0.00	0.00
37	0.98	0.00	0.00
38	1.50	0.00	0.00
39	1.74	0.00	0.00
40	1.92	0.00	0.00
41	1.82	0.00	0.00
42	1.98	0.00	0.00
43	1.70	0.00	0.00
44	1.38	6.86	0.00
45	1.42	6.92	0.00
46	1.10	6.86	5.04
47	0.94	7.10	6.01
48	0.86	7.26	6.00
49	0.00	6.98	5.16
50	0.00	7.30	6.00
51	0.00	7.60	6.01
52	0.00	7.20	6.03
01	0.00	7.14	5.13
02	0.00	6.74	5.12
03	0.00	6.66	5.10
Mean	**1.40**	**7.05**	**5.56**

The result in respect of simple correlation between larval population of pigeonpea pod borer complex, *Grapholita critica, Clavigralla gibbosa, Nezara viridula* infesting pigeonpea and weather parameter during *kharif* season 2019-2020 are presented in Table - 2.

Table 2: Correlation and its regression coefficient of major insect-pest of pigeonpea.

Name of Pest	Correlation coefficient (r)				
	Temperature ^{0}C		Humidity %		Rainfall
	Maximum	Minimum	Morning	Evening	
G. critica	0.245	0.227	0.492	0.323	-0.020
C. gibbosa	-0.431	-0.887	-0.519	-0.723	0.053
N. viridula	-0.528	-0.930	-0.679	-0.736	0.022

Significant value (1 %) at (**r=0.500)

Population dynamics of Leaf Webber

First appearance of the leaf folder was observed on 5th September i.e., during the 36th SMW on pigeonpea. The number of leaf folder was worked out as weekly interval average larvae per plant and the data are presented in the Table 2. It is seen that the leaf folder larval population appeared from 36th to 48th SMW. Leaf folder larval population attained its peak incidence was (1.98 larvae/plant) during 42nd SW. The data pertaining to correlation coefficients between weather parameters and leaf webber population are presented in Table 3. Which showed that the correlation between leaf webber population on pigeonpea and maximum temperature (r= 0.245), minimum temperature (r= 0.227) were found positively non-significant, whereas with morning relative humidity (r= 0.492) found positive significant correlation and evening relative humidity (r= -0.323) were showed positive non-significant correlation. While rainfall (r= -0.020) exhibited negative non- significant correlation. Present findings are confirmed with of Kumar *et al.*, (2010) they also reported positive impact on the pest population by the above-mentioned weather factors but of the preceding week.

Population dynamics of *Clavigralla gibbosa* Spinola

The pod bug, *C. gibbosa* was first recorded during the last week of October i.e., on 30th October (44th SMW) was 6.86 bugs/plant. The activity of the pest continued from 30th October to third week of January. The peak population of the pest was observed during 48th to 51st SMW was 7.26 and 7.60 bugs/plant, respectively. It is evident that mean nymph and bug population was negatively correlated with maximum temperature (r= - 0.431), negatively correlated with minimum temperature (r= -0.887), negatively correlated with morning RH (r= - 0.519), negatively correlated with evening RH (r= -

0.723) and negatively non-significant correlated with rain fall (r= -0.053).In the present study two peaks were recorded during 48th and 51st SMW, whereas Mishra and Dash (2001) reported two peaks but during 50th and 4th SMW, respectively. In the present findings, evening relative humidity had negative impact on bug population. Similar, present findings confirm with of Mishra and Dash (2001) and Kaushik *et al.*, (2008), reported negative impact of relative humidity on the pestpop 3 u 3 lation. As well as findings maximum and minimum temperature showed negative effect on pest population but were non-significant. Kaushik *et al.*, (2008) reported maximum and minimum temperature to exhibit positive impact on the pest population.

Population dynamics of *Nezara viridula* Linn

The green stink bug, *N. viridula* was first recorded during the second week of November i.e., on 15th November (46th SMW) was 25.20 bugs/5plant. The activity of the pest continued from 15th November to third week of January. The peak population of the pest were observed during 52nd SMW was 30.15 bugs/5plant. Data indicate that *N. viridula* population was showed negative significant correlation with maximum temperature (r= -0.528) and minimum temperature (r= -0.930) and non-significant negative correlation with rainfall (r= 0.022). On the other hand, negatively significant correlation was observed in between morning RH (r= -0.679) and evening RH (r= - 0.736). Correlations between various abiotic factors and stink bug population exhibited significant influence on pest population. No report seems to be available on *N. viridula* on pigeonpea in the literature.

Conclusion

The larval population of leaf webber population on pigeonpea and maximum and minimum temperature was found positively on-significant, where as with morning relative humidity found positive significant correlation and evening relative humidity were showed positive non-significant correlation. While rainfall exhibited negative non-significant correlation. The population of pod bug and *N. viridula* was negatively correlated with maximum and minimum temperature, negatively correlated with morning RH and evening RH and negatively non-significant correlated with rain fall respectively.

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