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RESEARCH PAPER

Population dynamics of pod pest complex of pigeonpea

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Abstract: A field experiment was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, to study the population dynamics of pod pest complex of pigeonpea. The observations were recorded at fortnightly intervals starting from flower initiation stage upto the harvest of the crop. The peak activity of gram pod borer (3.63 larvae/plant), spotted pod borer (3.63 larvae/plant) and pod bugs (4.62 bugs/plant)was observed during 50th Standard Meteorological Week. The pod damage caused by *Helicoverpa armigera* (25.02%) and *Maruca vitrata* (16.77%) was also highest during 50th Standard Meteorological Week. The maximum pod damage by plume moth (12.02%) was noticed at 52nd Standard Meteorological Week. The 52nd Standard Meteorological Week witnessed highest pod fly population (10.80 maggots / 10 pods), per cent pod damage (27.75%), and per cent seed damage (17.51%).The correlation studies of incidence of pod pest to prevalent weather parameters revealed that, gram pod borer and the spotted pod borer were more prevalent as the minimum temperature rose, but pod fly and pod bugs population increased negatively. There was a negative correlation between the population of all pod pest, including gram pod borer, spotted pod borer, pod bugs and pod fly with maximum relative humidity, minimum relative humidity and rainfall.

Key words: Correlation, Pigeonpea, Pod pest, Population dynamics

Introduction

Pigeonpea, *Cajanus cajan* (L.) commonly known as redgram, tur, arhar is an erect and short lived perennial leguminous shrub. It belongs to the genus *Cajanus* of the family Fabaceae. It is originated in India and is having a chromosome number of 2n = 22. Because of its deep tap root system, resilience to heat and rapid growth pattern, this tropical and subtropical plant is well suited for rainfed agriculture in semiarid regions (Mallikarjuna *et al.*, 2011). It is a legume with 20 to 24 per cent proteins, 1.2 per cent fats, 66 per cent carbohydrates and 3.8 per cent ash (Aykroyd *et al*., 1982).

Pigeonpea is grown in an area of 69.93 lakh hectares across the world, producing 59.61 million tonnes and yielding 812.42 kg per ha. In terms of acreage, output and productivity, India comes in front. Pigeonpea is grown on 42.3 lakh hectares of land in India, with production and productivity of 38.9 lakh tonnes and 919 kg per ha respectively (Anon., 2019). Maharashtra, Madhya Pradesh, Uttar Pradesh, Gujarat, Jharkhand, Telangana and Andhra Pradesh are major pigeonpea growing states in India. In Karnataka, the principal pigeonpea growing areas are Kalburgi, Bidar, Vijaypura, Dharwad and Raichur.

Gram pod borer (*Helicoverpa armigera* Hubner), plume moth (*Exelastis atomosa* Walsingham) and pod fly (*Melanagromyza obtusa* Malloch) are members of the pod borer complex that severely damage pigeonpea pods and grains, causing a significant decrease in grain output. In ideal circumstances, pod borers reduced grain production by 60 per cent to 90 per cent (Lal *et al*., 1992). In contrast to the potential production, *Helicoverpa armigera* and *Melanagromyza obtusa* produce extremely low yield levels (Sarika *et al*., 2013). A yield loss of 60 to 80 per cent is caused by the pod fly *Melanagromyza obtusa* alone and the losses are estimated to reach US $ 256 million per year (Durairaj, 2006).

Comparing the average national output of pigeonpea (approximately 750 kg/ha) to the potential production of 1.2 to 1.5 tonnes per ha and 2.5 to 3.5 tonnes per ha in medium and long duration cultivars respectively, the yield is disappointingly low (Joshi and Shrivastava, 2006). Insect pest, especially pod-damaging insects, are a major productivity limitation.

The main biotic factor limiting pigeonpea yield are the insect pest that consume blooms, pods and the seeds.When compared with other nations, India's pigeonpea production is unsatisfactory. Among the major factors, attack of insect pest is one of the main causes of poor grain output. More than 200 species of insects infest pigeonpea. The pod borer complex typically causes 44.00 per cent damage to the pods and 39.88 per cent damage to the grain (Reed and Lateef, 1990).

Pigeonpea is an important crop grown in Northern transitional zone of Karnataka. It is attacked by a wide variety of insect pest both during field and in storage. Among the insect pest which causes damage to the crop the pest infesting during the reproductive phase of the crop are causing economic loss to the farmers by reducing grain yield. By studying the abundance and incidence of pod pest it will be easy to plan and to take up the control measures and these studies were not carried out in the recent past.In keeping the above background in view, the present study entitled "Population dynamics of pod pest complex of pigeonpea" was undertaken at College of Agriculture, Dharwad during 2022-23.

Material and methods

The studies on "Population dynamics of pod pest complex of pigeonpea" was carried out on pigeonpea variety TS-3R was raised in *kharif* 2022 under unprotected condition with a spacing of 90 cm x 30 cm in a plot size of 10 m x 10 mat Main Agricultural Research Station, University of Agricultural Sciences, Dharwad.

Observations were recorded at fortnightly intervals right from flower initiation stage till the harvest of crop. In order to assess the population of pod borer complex, five plants were selected and the observations on *Helicoverpa armigera*, *Exelastis atomosa*, *Melanagromyza obtusa* and *Maruca vitrata* were recorded.Among pod borers number of larvae per plant was assessed for *Helicoverpa armigera* and *Maruca vitrata*,number of maggots per ten pods was assessed for pod fly. Pods bugs population was also recorded. Further, the incidence of Maruca vitrata was assessed by counting number of webs in each plot.Data obtained were then subjected to statistical analysis for correlation and test of significance.The recommended package of practices of UAS, Dharwad was followed.

A total of 100 pods from five randomly selected plants were plucked and examined in the laboratory at fortnightly intervals from pod bearing stage for the damage caused by the insects. On the basis of external symptoms as well as the type of injury done to the grains, the pods were sorted out into five groups *viz.,* pods damaged by *Helicoverpa armigera*, *Maruca vitrata*, *Exelastis atomosa*, *Melanagromyza obtusa* and healthy pods. The percentage of pod damage was calculated on the basis of damaged pods to the total number of pods observed. Damaged grain was isolated from damaged pods to determine the grain infestation. The percentage of grain damage was estimated on the basis of damaged grains to the total number of grains for assessment of loss caused by pod fly.

Results and discussion

The data regarding the population dynamics of pod pest is represented in table 1 and the correlation of weather parameters with the incidence of pod pest is depicted in Table 2.

Gram pod borer

Gram pod borer, *H. armigera* was the major pod borer and the maximum pod damage was caused by this insect pest compared to other pod borers. The incidence of *H. armigera* was noticed from 44th SMW (October) and continued upto 2nd SMW (January). From third week of October to first week of December there was gradual increase in larval population but after December first week population showed decreasing trend upto second week of January. The per cent pod damage was highest during 50th SMW (25.02%) due to the prevalence of maximum larval population. At harvest 18.72 per cent of pods were found to be damaged by *H. armigera* (Table 1). The findings are in line with Chandel *et al*. (2005) reported that the infestation of *H. armigera* commenced from October onwards and Vennila *et al*. (2020) recorded the onset of *H. armigera* on 44th SMW.

Table 1. Population dynamics of pod pest complex of pigeonpea during 2022-23

SMW	Pest incidence					Per cent pod damage			Pod fly	
	Gram pod borer	Spotted pod borer		Pod bugs	Pod fly	Gram pod borer	Spotted pod borer	Plume moth	Per cent pod damage	Per cent seed damage
	Larvae/plant	Larvae/plant	Webs/plot	No/plant	Maggots /10 pods					
42	0	0	0	0	0	0	0	0	0	0
44	0.24	0.41	1.23	0.20	0	0	0	0	0	0
46	1.82	1.45	3.06	1.81	0	0	0	0	0	0
48	2.41	3.62	5.62	2.87	4.28	16.46	11.27	4.26	10.22	5.78
50	3.63	5.10	7.97	4.62	5.20	25.02	16.77	9.72	14.47	7.88
52	2.67	4.23	6.26	2.60	10.8	23.20	14.26	12.02	27.75	17.51
2	1.21	0.97	1.22	0	6.61	21.62	9.62	4.66	22.27	14.62
4	0	0	0	0	5.23	18.72	8.98	3.72	20.02	13.77

Note: SMW – Standard Meteorological Week

Table 2. Relationship of weather parameters with pod pest complex of pigeonpea during 2022-23

Insect pests	Correlation coefficient (r) Meteorological parameters					Co-efficient of determination (r^2)	Regression equation
	Temperature(°C)		Relative Humidity(%)		Rainfall (mm) (X_5)		
	Maximum (X_1)	Minimum (X_2)	Maximum (X_3)	Minimum (X_4)			
Gram pod borer	0.118	0.054	-0.168	-0.170	-0.436	0.578	$Y= -25.104 + 0.318 X_1 + 0.272 X_2 + 0.269 X_3 - 0.051 X_4 - 0.107 X_5 + 1.657$
Spotted pod borer	0.107	0.007	-0.100	-0.117	-0.381	0.642	$Y= -59.757 + 0.926 X_1 + 0.446 X_2 + 0.602 X_3 - 0.160 X_4 - 0.177 X_5 + 2.283$
Pod bugs	-0.181	-0.100	-0.017	-0.032	-0.340	0.786	$Y= -63.053 + 1.104 X_1 + 0.216 X_2 + 0.551 X_3 - 0.067 X_4 - 0.182 X_5 + 1.513$
Pod fly	0.269	-0.375	-0.365	-0.399	-0.379	0.216	$Y= -49.593 + 1.039 X_1 + 0.027 X_2 + 0.691 X_3 - 0.406 X_4 - 0.072 X_5 + 6.404$

According to the correlation studies, there was a non-significant positive correlation between *H. armigera* larval population and the minimum and maximum temperatures, but a non-significant negative correlation between the number of larvae and the weather elements, such as maximum relative humidity, minimum relative humidity and rainfall (Table 2).Rathore *et al*. (2017) reported non significant negative correlation of *H. armigera* with relative humidity while significant positive correlation with mean temperature.

Spotted pod borer

The population of spotted pod borer ranged from 0.41 (44th SMW) to 5.10 (50th SMW) larvae per plant. The incidence was noticed till the end of cropping period. Activity of spotted pod borer initiated from 44th SMW and reached it's peak during 50th SMW with the population of 5.10 larvae per plant, thereafter gradual decline in the population of spotted pod borer was noticed. The number of webs per plot (7.97) and per cent pod damage (16.77%) were also highest during the 50th SMW due to greater larval density. Pod damage of 8.98 per cent was noticed during harvest (Table 1). Similar findings were obtained by. According to Rachappa *et al*. (2016) the emergence of flower buds and blossoms on the crop signalled the beginning of the pest invasion.

The spotted pod borer showed a non-significant positive correlation with maximum temperature and zero correlation with minimum temperature. Maximum RH, minimum RH and rainfall showed non-significant negative correlation with the larval population of *Maruca vitrata* (Table 2). Similar results were obtained by Rathore *et al*. (2017) who found non-significant negative correlation of relative humidity with the larval population of *M. vitrata*. Sahoo and Behera (2001) noticed positive correlation of *Maruca vitrata* with maximum, minimum and average temperatures.

Pod bugs

Pod bugs *Clavigrella gibbosa*, *Riptortus pedestris, Nezara viridula* and *Anoplocnemis phasiana* were noticed from 44th SMW (October) and continued upto 52nd SMW (December). The pest reached the peak population during 50th SMW with a population of 4.62 bugs per plant. The current findings are consistent with Ka (2017) observation that pod bugs population peaked on 49th and 50th SMW (Table 1). *Clavigrella gibbosa* was most prevalent during the 51st SMW (December) in the Badnapur area of Jalna, according to Ugale *et al*. (2021). All the weather parameters (maximum temperature, minimum temperature, maximum RH, minimum RH and rainfall) were found to be non-significant and negatively correlated with pod bugs population (Table 2). The results are matching with the findings of Prajapati *et al*. (2023) who noticed non-significant negative correlation between *C. gibbosa* population and minimum RH.

Plume moth

Plume moth caused 4.26 per cent pod damage on 48th SMW. Thereafter there was an increase in the infestation of plume moth and 12.02 per cent pods were found to be damaged during 52nd SMW. At harvest 3.72 per cent pods were found to be damaged by plume moth (Table 1).The present results are in accordance with the findings of Ugale *et al*. (2021), reported 52nd SMW had the highest incidence of *E. atomosa.*

Pod fly

The incidence of the menace of pod fly coincides with the pod development and maturation. The maggot population per 10 pods prevailed from pod bearing stage (48th SMW) upto the harvest of the crop (4th SMW). The peak maggot population was noticed during 52nd SMW (10.8 maggots / 10 pods). Highest pod damage was noticed due to pod fly infestation. Due to the largest maggot population, up to 27.75 per cent of pods and 17.51 per cent of seeds were found to be damaged during 52nd SMW. At harvest 20.02 per cent pods and 13.77 per cent seeds were damaged by pod fly (Table 1). Sanap *et al*. (1995), reported the prevalence of *Melanagromyza obtusa* in the reproductive phase of the crop. Thilagam *et al*. (2020) concluded that at the time of harvest, among the pod borers, the pod damage caused by *Melanagromyza obtusa* (Malloch) was comparatively high.

Pod fly exhibited non-significant positive correlation with maximum temperature while the correlation between other weather parameters *i.e.,* minimum temperature, maximum RH, minimum RH and rainfall was found negative and non-significant (Table 2). The correlation studies are in agreement with the results of Ramkumar *et al*. (2023), reported significant positive correlation between pod fly and maximum temperature and negative correlation between pod fly population and evening relative humidity.

The crop stage had a significant impact on the prevalence of the afore mentioned pest that infest pods and they showed a clear temporal relationship with the crop.

Although the regression analysis indicated that the weather studies had a substantial impact on insect pest population fluctuation, the link between the incidence of pod pest and weather parameters was determined to be non-significant. It may be concluded that crop phenology, as opposed to usual meteorological circumstances, was more closely connected with the occurrence of pigeonpea pod pest.

Conclusion

The present investigation revealed that Pod bugs (*Clavigrella gibbosa*, *Riptortus pedestris, Nezara viridula* and *Anoplocnemis phasiana*), gram pod borer (*Helicoverpa armigera*) and spotted pod borer (*Maruca vitrata*), all reached their highest incidences during 50th SMW. During 50th SMW gram pod borer and spotted pod borer caused the most severe pod damage.

On the 52nd SMW, the plume moth (*Exelastis atomosa*) was reported to have caused the most pod damage. Pod fly (*Melanagromyza obtusa*) prevalence peaked during the 52nd SMW, which coincided with the period of pod formation and maturation. Due to the highest maggot population occurring during this time, higher percentage of pod and seed damage caused by pod fly was observed during the 52nd SMW.

All meteorological characteristics were non significantly associated with the occurrence of pigeonpea pod pest, according to the correlation coefficient between different weather parameters and those pest. Maximum temperature was positively correlated with the population of gram pod borer, spotted pod borer and pod fly but negatively correlated with the population of pod bugs.

The gram pod borer and the spotted pod borer were more prevalent as the minimum temperature rose, but pod fly and pod bugs population increased negatively. There was a negative correlation between the population of all pod pest, including gram pod borer, spotted pod borer, pod bugs and pod fly with maximum and minimum relative humidity and rainfall

References

Anonymous, 2019, Annual report (2020-21), All India Co-Ordinated Research on Pigeonpea, IIPR, Kalyanpur, Kanpur, p.249.

Aykroyd W R, Doughty J and Walker A F, 1982, Legumes in Human Nutrition (Vol. 20). Food & Agriculture Organization Publications, Rome.

Chandel S F, Singh P K and Ahmad R, 2005, Population dynamics of *Helicoverpa armigera* (Hübner) and *Campoletis chloridae* on different crops. *Annals of Plant Protection Sciences*, 13(2): 379-383.

Durairaj C, 2006, Evaluation of certain neem formulations and insecticides against pigeonpea pod fly. *Indian Journal of Pulses Research*, 19(2): 269-270.

Joshi N and C P Shrivastava, 2006, Yield maximization in pigeon pea through crop protection measures. *Indian Farming*, 76(3): 4-7.

Kar A, 2017, Seasonal incidence on population dynamics of pigeonpea pod bug, *Clavegralla gibbosa* (Spinola). *Journal of Entomological Research*, 41(4): 409-412.

Lal C, Sharma S K, Chahota R K, 1992, Oviposition response of pod fly (*Melanagromyza obtusa*) on resistant pigeonpea (*Cajanus cajan*) selections. *Indian Journal of AgriculturalScience*, 64: 658-660.

Mallikarjuna N, Saxena K B and Jadhav D R, 2011, Wild crop relatives: genomic and breeding resources – legume crops and forages. *Springer – Verlag*, 48: 12-15.

Prajapati K K, Keval R, Padwal K G and Srivastava C P, 2023, Seasonal incidence of pod pest complex of pigeonpea *Cajanus cajan* (L.) Millsp. *Journal of Experimental Zoology India*, 26(1): 1183-1186.

Rachappa V, Shekhara C, Rajput R, Paul C and Yelshetty S, 2016, Population dynamics and parasitoids activities of spotted pod borer (*Maruca vitrata*) in pigeonpea (*Cajanus cajan*). *Indian Journals*, 8(1): 100-102.

Ramkumar K K P, Keval R, Padwal K G and Srivastava C P, 2023, Seasonal incidence of pod pest complex of pigeonpea, *Cajanus cajan* (L.) Millsp. *Journal of Experimental Zoology*, 26(1): 1183-1186.

Rathore H K, Vyas A K, Ahir K C, Saini A and Kumar P, 2017, Population dynamics of major insect pest and their correlation with weather parameters in Pigeonpea (*Cajanus Cajan* [L.] Millsp.). *The Bioscan*, 12(1): 1-4.

Reed W and Lateef S S, 1990, Pigeonpea pest management. In: The Pigeonpea (Ed. Nene Y L, Hall S D and Sheila V K), CAB International Publishing Agency, Walingford, UK, pp. 349-374.

Sahoo B K and Behera U K, 2001, Influence of abiotic factors on the incidence of pigeonpea pod borers in coastal belt of Orissa. *Environment and Ecology*, 19(4): 882-884.

Sanap M M, Aher R P and Deshmukh R B, 1995, Incidence of major insect pest associated with pigeonpea at Rahuri. *Indian Journal of Pulses Research,* 8(2): 192-194.

Sarika, Arora V, Iquebal M A, Rai A, Kumar D, 2013, PIPEMicroDB: microsatellite database and primer generation tool for pigeonpea genome. Database, 2013, Article ID bas054, doi:10.1093/database/bas054.(http://database. Oxford journals. org)

Thilagam P, Dinakaran D and Gopikrishnan A, 2020, Identification of resistant genotypes against major podborers and diseases in pigeonpea (*Cajanus cajan* L.). *Journal of Pharmacognosy and Phytochemistry*, 9(5): 3002-3006.

Ugale M V, Bantewad S D, Suradkar A L and Shaikh A B, 2021, Studies on population dynamics of pigeonpea (*Cajanus cajan* L.) pod bugs, green stink bugs and leaf Webber.*Journal of Pharmacognosy and Phytochemistry*, 10(1): 1114-1116.

Vennila S, Zadda K, Chandra P and Nisar S, 2020, Status of pod borer *Helicoverpaarmigera* (Hubner) Pigeonpea and its association with climatic variations at a hot semi-arid eco-region of Southern India. *Annals of Plant Protection Sciences*, 28(3): 207-212.