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Studies on population dynamics of *Helicoverpa armigera* and *Melanagromyza obtusa* in pigeon pea

Kapil Kumar Soni, Akhilesh Kumar, Prakhar Srivastava, Pushpendra Singh Sahu and Hadi Husain Khan

Abstract
Population dynamics of two important insects of Pigeonpea belonging to the order Lepidoptera i.e Pigeonpea pod borer, *Helicoverpa armigera* and Diptera order i.e Pigeonpea pod fly, *Melanagromyza obtusa* was studied in Pigeonpea under the condition of Rewa district during the *Kharif* 2016-2017. Studies conducted on the population dynamics of Pigeonpea pod borer in the agro climatic condition of Rewa region indicated its incidence from 1st week of October 2016 to 4th week of December 2016. The initial average population of 0.13 pigeonpea pod borer per five plants/week and 0.72 per five plants was recorded in the month of October 2016 which rose to 0.44 to 0.79 pigeonpea pod borer per five plants/week and 0.61 pigeonpea pod borer per five plants in the month of November 2016. The peak of the population was recorded in the fourth week of October 2016. There after the population of the pest started decreasing gradually and mostly disappeared in the 1st week of January, 2017. Studies conducted on the population dynamics of Pigeonpea pod fly in the agro climatic condition of Rewa region indicated its incidence from 4th week of October 2016 to 4th week of December 2016. Pigeonpea pod fly infestation was noted late in the *Kharif* season and also its sequence among defoliating insects marked as a late comer but continued to persist up to harvesting of the crop. The initial average maggot population of 0.10 larvae/ 4th week and 0.06 maggot/10 pods/month was recorded in the month of October 2016 which rose to 0.10 to 0.67 maggot/10 pods/week and 0.36 maggot/10 pods in the month of November 2016 which gradual increased up to 49th week (Dec. 1st week 2016) the number of the maggots in per 10 pods was recorded between 0.03 to 1.2 maggots/week with an average of 0.70 maggot/10 pods/ in the month of December 2016.

Keywords: Pigeonpea, population, *Helicoverpa armigera, Melanagromyza obtusa*

Introduction
Pigeonpea (*Cajanus cajan* (L.) Millsp.) Is an important pulse crop and forms major constituent of our daily vegetarian diet. Pigeonpea is not only rich source of protein but also enrich the soil through biological nitrogen fixation and also fit in various cropping system without disturbing the main cereal and oilseed crops, while the other plant parts are used as a valuable fodder. Among the *Kharif* pulses, pigeonpea rank first, and it has great significance in Indian agriculture because of its multiple use as food, feed, fodder and fuel and its role in sustaining agricultural productivity. It is a drought resistant crop and suitable for dry land farming besides bring used as an intercrop with other crops. It is being cultivated in approximated 36.3 lakh ha land in India 24.30 lakh ha in Madhya Pradesh and 36900 ha In Rewa district. The productivity of the crop in state and district is about 792 kg/ha, and 510 kg/ha, respectively (Anonymous, 2014) [2].

Nearly 300 species of insects are known which infest on pigeonpea crop at its various growth stages in India (Lal and Singh, 1998) [17]. Pod borers caused 60 to 90 % loss in the grain yield under favourable conditions and damage of seed by pod fly ranged from 14.3 to 46.6 % (Lal *et al*, 1992). *Helicoverpa armigera* and *Melanagromyza obtusa* 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 (Lal *et al*, 1997) [16]. An yield loss of 60 to 80 % was recorded due to the podfly (Durairaj, 2006) [5].

Among the several insect pests attacking different parts of pigeonpea plants, pod borers are most injurious attacking the flowers as well as pods and cause major losses, often threatening the cultivation of this crop (Prasana and Bhalani, 1994 and Mittal and Ujagir, 2005) [24, 21]. Despite high crop losses, not more than five per cent of the farmers are using pesticides due to their economic conditions.

The stagnant production of pulses over the decades against the ever increasing growth of population has led to per capita availability of less than 40 g/day as against WHO recommendation of 80 g/day for the vegetarian population. To meet the growing demand of pulses by 2020, the target production of pulses is 27.8 million tonnes with the productivity of 1282 kg/ha estimated in India (Kumar, 1998) [10].

Among the important pulses grown in India, pigeonpea belongs to family Leguminosae, is a multipurpose grain legume crop. The green pods of pigeonpea are used as vegetables, grains used as split dal and are rich in protein, averaging a protein digestibility of 70% when cooked (Singh, 1991) [30]. Its leaves are an excellent fodder for animals and stems are an important source of domestic fuel and raw materials are used for thatching roofs and fencing fields. In a cropping season, pigeonpea plants fix about 40 kg/ha atmospheric nitrogen and add valuable organic matter to the soil through fallen leaves. Its roots help in releasing soil-bound Phosphorus to make it available for plant growth. With so many benefits at low cost, pigeonpea has become an ideal crop for sustainable agriculture systems in rain dependent areas.

Pigeonpea is cultivated in more than 25 countries of the world. As compared to the other pulses produced in the world, pigeonpea holds the sixth rank in production. It covers 6.5 percent of the world's total pulses area and contributes 5.7 percent to the total pulses production (Rao *et al*, 2010) [26] and is grown in an area of 4.7 million ha with a production of 3.69 million tonnes in the world with the productivity of 784 kg/ha (FAOSTAT, 2010) [6]. Among the pulses, pigeonpea is the second major pulse crop grown in India after chickpea (*Cicer arietinum* L.), accounting for 15.8% of total pulse production (Anonymous, 2012) [1], is an important drought tolerant pulse crop, grown mainly in the semi-arid tropics though it is well adopted to several environments (Treason *et al*, 1990) [32], lying between 30°S and 30°N of the world. The crop has its origin in India and spread to Africa more than 4000 years ago (Madsen, 1980) [18]. In Indian subcontinent, pigeonpea accounts for almost 90% of the world's crop and Kenya is the second largest pigeonpea producer. Other regions where pigeonpea is grown are Southeast Asia, Africa and America. There is substantial area of pigeonpea in Kenya, Uganda and Malawian eastern Africa and in the Dominican Republic and Puerto Rico in Central America. In most other countries pigeonpea is grown in small areas and as back yard crop.

Insect pests are major biological constraints to production of pigeonpea crop. However, the yield levels of this crop are not very encouraging. Among the factors responsible for low yield, the damage caused by insect pests is one of the major factors. It is attacked by several insect pests from seedling stage till harvesting. Pod borer complex is a major problem in production, among which *Helicoverpa armigera* is a key pest inflicting 80 to 90 percent of loss caused by pod borers (Kooner *et al*, 2006) [9] causing considerable yield loss of 2,50,000 tonnes of grain per annum worth more than 3750 million rupees per year. Pigeonpea yields have remained stagnant for the past 3 to 4 decades largely due to damage inflicted by insect pests (Sharma *et al*, 2010) [29].

Population dynamics of *Helicoverpa armigera* and *Melanagromyza obtusa*

Akhauri *et al.* (1994) [3] studied the population build up and relative abundance of pod borer species *Maruca testulalis* (Gayers), *Melanagromyza obtusa* (Malloch) and *Helicoverpa armigera* (Hubner) in late maturing pigeonpea variety Bahar during two consecutive years. Among all the pod borers, *Melanagromyza obtusa* predominated throughout the reproductive phase of the crop with two peaks first in the second week of February and another in the first week of March, other members of the pod borer community remained active from January to March with their collective larval population being more during February end to third week of March.

Mathur *et al.* (1997) [19] studied the management of *Helicoverpa armigera* on tomato during *Rabi* 1993-94 and reported that 2 sprays of *Bacillus thuringiensis* var. Kurstaki (Dipel 500 ml/ha) in combination with Methyl (40SP@563 g/ha) at fortnightly intervals, were superior in protecting the crop from infestation and increasing the yield.

Prabhakara and Shrinivasa (1998) [23] reported that the Bt formulation caused 58.72% mortality of third instar *Helicoverpa armigera* larvae infesting pigeonpea while endosulfan and methomyl accounted for 82-90% mortality, residual activities of Bt formulation decreased more rapidly compared to that of endosulfan and methomyl.

Reddy *et al* (1998) [28] recorded thirty seven species of insect at various stages of crop growth in an over lapping manner of pigeonpea variety P-33. Among the various insect species, only seven species of insects attained major pest status. Two species, *Exelastis atomosa* and *Helicoverpa armigera* attained major pest status from the flowering to the pod maturing stage of the crop, while *Melanagromyza obtusa* attained major status from the pod filling to the pod maturity stage of the crop.

Minja *et al.* (1999) [20] reported three group of insects which included five pests on pigeonpea from Kenya viz., pod borers (*Helicoverpa armigera*, *Maruca vitrata* and *Etiella zinckenella*), pod sucking bug (*Clavigralla tomento sicallis*) and pod fly (*Melanagromyza chalcosoma*). Natural enemies observed included insects from order Coleopteran, Hymenoptera, Diptera and Hemiptera.

Patel and Koshiya (1999) [22] studied the population dynamics of *Helicoverpa armigera* in pigeonpea crop and observed that pest was active from the first week of October to last week of November and the maximum population was recorded during the last week of October.

Dhar *et al* (2003) [4] reported that increase in minimum temperature during 7^{th} - 8^{th} SW with presence of base population of the pest during 5^{th} - 7^{th} SW and rainfall during 1^{st} - 9^{th} SW favoured the *H. armigera* infestation during 10^{th} - 14^{th} SW in pigeonpea.

Kumar and Nath (2003a) reported that all the weather parameter showed non-significant negative impact on population buildup of jassid and thrips except maximum temperature, water evaporation and sunshine of the preceding week which had significant negative effect on insect population.

Kumar and Nath (2003b) studied that the twenty-six species of pest belonging to two classes of the animalia Kingdom i.e. Insecta and Aves were recorded at various stages of crop, growth in an over lapping manner right from seedling to harvesting stage of the crop, the diversity of pests indicated seven insect orders having 21 families infesting various parts of pigeonpea plant while a bird pest belonging to Avian order Psittaciformes and family Psittacidae was observed damaging pigeonpea pods. The insect pests of major significance were. *Grapholita critica* Meyr., *Empoasca kerri* Pruthi,

Indozocladius asperulus (Faust), *Lampides boeticus* (L.), *Megalurothrips usitatus* (Bagnall), *Mylabris pustulata* Thunberg, *Exelastis atomosa* (Wals.), *Clavigralla gibbosa* Spinola, *Maruca testulalis* (Geyer) and *Melanagromyza obtusa* Malloch.

Ram *et al* (2003) [25] correlated weekly population of *H. armigera* with abiotic factors and reported that population of *H. armigera* had significant negative correlation with minimum temperature while maximum temperature and sunshine hours were positively correlated Rainfall and relative humidity showed non-significant positive correlation and favoured the population buildup of pest.

Kumar (2004) [11] recorded pest population at fortnight interval. UPAS-120 was severely infested by *Indozocladius asperulus, Lampides boeticus, Megalurothrips usitatus, Mylabris pustulata, Exelastis atomosa, Clavigralla gibbosa, Maruca testulalis [Maruca vitrata]* and *Melanagromyza obtusa.* Bahar (Medium late) was infested by *Helicoverpa armigera* a side from the other species recorded on UPAS-120.

Jain (2006) [7] reported three pigeon pea genotypes ICPL 13206, ICPL 13211, and ICPL 11965, as less susceptible to pod borer complex.

Subharani and Singh (2007) [31] reported the impact of various meteorological factors (temperature, relative humidity, rain, sunshine and wind speed) on the population buildup of pigeonpea pod fly, *M. obtusa.* The damage commenced in the pod filling stage (1.23 and 2.00%) in the third week of January in both years. The maximum infestation of the pest (15.56%) was recorded during the third week of February in the first year, whereas it was observed a week earlier, during the second week of February as 13.72% in the second year. Correlation studies showed that the infestation of the pest on the crop did not seem to be influenced significantly by any of the environmental factors, except for relative humidity, which exerted significant negative effect with the pest infestation in both the years.

Kaushik *et al* (2008) [8] carried out investigations for one cropping season on the impact of various abiotic factors on population build up of pigeonpea pests *viz. Helicoverpa armigera* (Hubn.), *Exelastis atomosa, Clavigralla gibbosa* (Spin.), *Melanagromyza obtusa* (Mall.), *Empoasca kerri* (Pruthi) on pigeonpea cultivar Asha. They reported that majority of insect showed positive correlation with maximum temperature (except jassids) minimum temperature (except thrips and plume moth) and morning relative humidity. A negative correlation was evident in case of all the pests with evening relative humidity (except jassid), wind speed (except blister beetle).

Rana *et al.* (2008a) [8] studied the population dynamics of insect pest of pigeonpea and reported that *Helicoverpa armigera, Exelastis atomosa, Claviaralla gibbossa* and *Melanagromyza obtusa* were noticed from the flowering to the podding stage to crop i.e, from December to February.

Kumar *et al.* (2010) [12] Impact of weather factors on population build up of four major insect pests i.e., leaf webber, (*Grapholita caritica* Meyr.), jassid (*Empoasca kerri* Pruthi), bud weevil *Indozocladius asperulus* (Faust.) and flower thrips *Megalurothrips usitatus* (Bagnall) on pigeonpea (cv Bahar) was studied under Varanasi condition. The activity of leaf webber was prevalent from 24 August to 22 November in both cropping seasons. The jassid was active from last week of September to first week of February, bud weevil activity was observed from last week of December to fourth week of February while flower thrips were active from fourth week of December to last week of March during the years of study. Among different abiotic factors, wind velocity of same week and water evaporation of preceding week showed significant positive impact on the population build of leaf webber. In jassid, bud weevil and flower thrips, all the weather parameters of the same population week had non-significant negative impact on their population buildup while maximum temperature, water evaporation and sunshine of preceding week had significant negative effect. The maximum, minimum, average and wind velocity of preceding week showed non-significant positive influence on population buildup of flower thrips in pigeonpea.

Yadav *et al* (2011) [33] A field experiment was carried out during rainy season of 2003 and 2004 at the research farm of Project Directorate Cropping System Research (PDCSR), Modipuruam, Meerut, Uttar Pradesh for development of early prediction system to optimize the application of insecticides for management of pod fly *Melanagromyza obtusa* (Malloch) in pigeon pea. Maggots were first observed in first week of October (90–100 days old crop) and peaked up to 47th week i.e. in first week of November when crop was 100 to 125 days old and thereafter population declined to zero level with maturity in the first week of December, and pest remains active for nearly two months. The maggot population started building up when the maximum temperature dropped below 32 °C and attained the peak when it further declined. The present findings suggest that maximum temperature below 30 °C and minimum temperature between 8.1–17.0 °C and average relative humidity around 60–70% is conducive for population build up of the pest. Correlation between maggot population and rainfall for current, one, two and three weeks before was found significant and negative indicating adverse effect of rainfall. A prediction equation using current week data prepared by stepwise multiple regression analysis revealed 0.48 R^2 value and considered as best fit for predicting population of pod fly, *M. obtusa.*

Rathore *et al* (2017) [27] revealed that the incidence of spotted pod borer *(M. testulalis)* and blue butterfly (*L. boeticus)* were commenced in the 39th Standard Meteorological Week (SMW) on pigeonpea crop, while pod borer (*H. armigera)*, plume moth (*E. atomosa*) and tur pod fly (*M. obtusa*) commenced during 32nd, 40th and 41st SMW, respectively**.** The peak larval population of pod borer (7.00/five plant) and blue butterfly (2.25/five plant) were recorded in 42nd SMW, while the plume moth (3.00/five plant) and spotted pod borer (5.00/five plant) attained their peak in 43rd SMW. The tur pod fly (6.00/five plant) population reached to its peak in the 46th SMW. The highest pod damage due to attack of pod borer was 14.32% in 42nd SMW followed by tur pod fly (8.47% in 46 SMW), spotted pod borer (7.38% in 43 SMW), plume moth (6.66% in 43 SMW) and blue butterfly (6.40% in 42 SMW). The larval population of pod borer had positive significant correlation with mean temperature, while negative non-significant correlation with relative humidity. In case of blue butterfly, plume moth, pod fly and spotted pod borer, all the abiotic parameters were non-significant at 5 % level.

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