International Journal of Agricultural Sciences ISSN: 2167-0447 Vol. 2 (1), pp. 090-093, February, 2012. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

A survey of insect pests of pigeonpea and their predators in Eastern Uttar Pradesh, India

Marimuthu Ramar[1], Siva Kamalakannan[2] and Anto Claver[1]

[1]Department of Zoology, St. Andrew's College, Gorakhpur 273 001, India.
[2]Division of Entomology, Department of Zoology, Bharathiar University, Coimbatore, India

Received 24 January, 2012; Accepted 27 February 2012

Pigeonpea (*Cajanus cajan*) is an important crop in semi-arid tropical and subtropical farming systems, providing high quality vegetable protein, animal feed, and firewood. Insect pests feeding on flowers, pods, and seeds are the most important biotic constraint affecting pigeonpea yields. Pigeonpea (*Cajanus cajan*) is an important crop in semi-arid tropical and subtropical farming systems, providing high quality vegetable protein, animal feed and firewood. Insect pests feeding on flowers, pods, and seeds are the most important biotic constraint affecting pigeonpea yields. This study summarizes the biology and ecology of the three most important groups of pests: flower- and pod-feeding Lepidoptera, pod-sucking Hemiptera, and seed-feeding Diptera and Hymenoptera. Recent research investigating the complex interactions among pigeonpea, its key pests, and their natural enemies is also studied. These relationships have implications on the pest status of individual species and on possible control strategies.

Key words: pigeonpea, Cajanus cajan, Pest, Natural Enemies

INTRODUCTION

Pigeonpea, an important pulse crop of the Indian sub-continent, is attacked by an array of insect pests, causing injuries not only to all parts of the plant but all life stages as well. The production of pigeonpea pulse is greatly reduced by the injurious activities of these pest complexes (Reddy *et al*., 1998; Kumar and Nath, 2004). This association of the pests with host plant is attracting a large number of natural enemies (Subharani and Singh, 2004). In Asia, which accounts for approximately 90% of world production, pigeonpea is the third most important pulse crop, where India, Myanmar, and Nepal are the largest producers (Minja *et al*., 1996). Pigeonpea is cultivated as an annual or semi-perennial crop, usually in mixed cropping systems. Traditional cultivars/landraces are medium-to-long–duration and are harvested 6–12 months after sowing. Pigeonpea is well suited to intercropping, as it is slow growing and does not compete with shorter-season crops (Alli, 1990). More recently short- and extra-short–duration genotypes have been developed that mature in as few as 90 days.

Yields of pigeonpea vary considerably among locations, cultivars, seasons, and cropping systems. In most areas, insects are the most important yield constraint and the greatest cause of yield variation. Diseases and the use of low yielding genotypes are also cited as constraints to improving pigeonpea yields (Manjunath et al., 1989 & Nene et al., 1990). More than 200 species of insects have been found feeding on pigeonpea, although only a few of these cause significant and consistent damage to the crop (Lateef *et al*., 1990); (Reed and Lateef, 1990)

Insects feed on all parts of the pigeonpea plant. The most serious pests, and the primary focus of pigeonpea pest management research, are those that attack reproductive structures, including buds, flowers, and pods. Pigeonpea has a great capacity to tolerate and recover from early season losses of flowers and young pods, provided the general health of the plant is good and that sufficient soil moisture is available. Removal of all flowers and pods for up to 5 weeks after flower initiation did not reduce seed yields in 10 short- and medium-duration pigeonpea cultivars (Sheldrake et al., 1979). Thus, only pests that are continuously present or that attack at the middle or end of the crop cycle are economically important. The key pests of pigeonpea can be grouped into three categories: flower- and pod-feeding Lepidoptera, pod-sucking Hemiptera, and seed-feeding Diptera and Hymenoptera. Presented a generalized

*Corresponding Author's E-mail: ramareri@gmail.com

Table 1: List of insect pest and predatory insects of pigeonpea agro-ecosystem in Eastern Uttar Pradesh

Categories	Order	Family	Insect species
Pests	Homoptera	Phididae	*Aphis fabae* Scopoli
		Membracidae	*Oxyrachis tarandus* F.
		Cicadellidae	*Empoasca kerri* Pruthi
	Orthoptera.	Acrididae	*Melanoplus bivittatus* (Say)
	Isoptera;	Termitidae	*Odontotermes obesus* (Ramber)
	Hemiptera.	Pentatomidae	*Nezara viridula* (L.)
		Coreidae	*Clavigralla gibbosa* Spinola
		Coreidae	*Leptocorisa varicornis* F.
		Coreidae	*Riptortus lineanus* Fabr.
		Coreidae	*Anoploenemis phsioana* (Fabr.)
	Coleoptera	Curculionidae	*Myllocerus unolecimpustulatus* Faust
		Buprestidae	*Mylabris pustulata* (Thunb.)
		Histeridae	*Gonocephalum macleaye* (Blackburn)
		Buprestidae	*Sphenoptera indica* Laporte&Gory
	Lepidoptera	Tortricidae	*Grapholita critca* Meyr
		Arctiidae	*Amsacta albistriga* Walker
		Noctuidae	*Helicoverpa armigera* (Hubner)
		Lycaenidae	*Lampides boeticus* (L.)
		Pterophoridae	*Exelastis atomosa* (Walsingham)
	Thysanoptera	Thripidae	*Megalurothrips usitatus* (Bagnall)
Predators	Hemiptera	Pentatomidae	*Andrallus spinidens* (Fabr.)
		Reduviidae	*Rhynocoris fuscipes* F.
	Coleoptera	Coccinellidae	*Coccinella septempunctata,(* Linnaeus)
	Hymenoptera	Formicidae	*Componotus sp.*
	Dictyoptera	Mantidae	*Mantis religiosa (couple)*

review of pigeonpea pests and control strategies. This study investigated the nature of occurrence of the key pests of pigeonpea, including crop–pest–natural enemy interactions and management.

METHODS

Insect pests and their natural enemies occurring on pigeonpea plants were observed weekly in three field sites (Khalilabad, Kauridam, Bardan at Easten Utter Pradesh,India) , during the period from August to December, 2010. population counts of insect individuals larvae, (weevils, aphids, bugs, coccinellid predators, ants) was performed on six randomly selected plants persite. The population interaction of wasps and grasshoppers was recorded from the entire field. In case of leaf webbers, leaf rollers and flower Webbers the population was recorded from 5 rows in 5 meters row length per field. The thrips population was recorded randomly from three hundred flowers in each field. The diversity of insects was measured using

Simpson Index (D) - a measurement that accounts for the richness and the percent of each subspecies from a biodiversity sample within a zone. The index assumes that the proportion of individuals in an area indicate their importance to diversity. Simpson's index of diversity: 1 - D

The probability that two randomly selected individuals in a zone belong to different subspecies.

Shannon-Wiener index (H) - Similar to the Simpson's index, this measurement takes into account subspecies richness and proportion of each subspecies within a zone. The index comes from information science. It has also been called the Shannon index and the Shannon-Weaver index in the ecological literature.

Shannon-Wiener index is defined as:

H = -sum (Pilog[Pi])

Using species richness (S) and the Shannon-Wiener index (H), you can also compute a measure of evenness:

E = H/log(S)

Evenness (E) is a measure of how similar the abundances of different species are. When there are similar proportions of all subspecies then evenness is one, but when the abundances are very dissimilar (some rare and some common species) then the value increases.

RESULTS AND DISCUSSION

Table 2: Abundance of insect pests and their predators collected from pigeonpea growing sites (India)

Categories	Rank[a]	species	Species abundance[b]			Total
			Sites			
			KD	KDM	BD	
Pests	1	*Aphis fabae*	325	310	282	917
	2	*Oxyrachis tarandus*	265	210	208	683
	3	*Myllocerus sps,*	185	178	155	518
	4	*Nezara viridula*	185	125	131	441
	5	*Odontotermes obesus*	148	121	118	387
	6	*Riptortus sp*	148	89	101	338
	7	*Clavigralla gibbosa*	121	108	85	314
	8	*Leptocorisa varicornis*	140	85	65	290
	9	*Empoasca kerri*	55	32	28	115
	10	*Exelastis atomose*	55	22	15	92
	11	*Gonocephalum sp*	34	22	18	74
	12	*Sphenoptera indica,*	55	10	08	73
	13	*Lampides beticus*	30	14	12	56
	14	*Megalurothrips usitatus*	33	08	13	54
	15	*Amsacta albistriga*	21	18	08	47
	16	*Melanoplus bivittatus*	21	08	04	33
	17	*Mylabris pustulata*	16	08	0	24
	18	*Helicoverpa armigera*	14	08	0	22
	19	*Grapholita critca*	04	0	02	06
	20	*Anoploenemis* sp	03	01	0	04
Predators	1	*Componotus sp.*	180	174	143	497
	2	*Coccinella septempunctata,*	121	85	69	275
	3	*Andrallus spinidens*	85	65	38	188
	4	*Mantis religiosa*	43	21	18	82
	5	*Rhynocoris fuscipes*	04	0	02	06

a- Cumulative importance of species collected.
b- Number of insect pests per 270 plants collected from 3 sites and 45 sampling dates

Insects of Pigeon pea

Nearly 20 insect pest species belonging to nine orders and families were identified from the study sites by sampling count method (Table 1)**.** About the maximum of 20 species observed in Khalilabad whereas other two sites are lesser about 19 species in Kauridam and 18 species in Bardan**.** Similarly, 31 insects' insect pest species from nine different orders were reported from eastern U.P by Yadav et al (2009). Based on species abundance and species diversity index (Table 2, 3) was calculated from the insect pest list (Table 1) and their presence was ranked by diversity index. The most abundant species was the aphid *Aphis fabae* (total no. 917=rank no.1) followed by *Oxyrachis tarandus* (total no 683, rank no. 2) and the least abundant species was *Anoploenemis* sp, (total no 04, rank no.20). The result indicated that *A. fabae* was considered as the most serious pest of pigeonpea followed by the cow bug *Oxyrachis tarandus* in eastern Uttar Pradesh**.** Such type of heavy injuring level (crop damage) of aphid population was reported in recent years in this region on pigeonpea (Kumar and Nath, 2003). However, Poole (1974) reported, that the diversity indices to be strongly affected by the abundances of the middle aged species of a community rather than by the common or rare species. It was reported that the increased diversity interaction of pest and predatory species may led to the increased stability (Poole, 1974; Singh and Singh 1978

Insect predators of Pigeonpea

Nearly five predatory insect species, belonging to four orders and families were collected from Khalilabad (5). Kauridam (5) and Bardan (4) sites) of eatern Utter Pradesh, India. Overall predatory insect species'

Table 3: Species richness, abundance, diversity indices and Shannon indices of insect pests and their predators within the study sites

Categories	Sites	Species richness[a]	Species abundance[b]	Diversity indices[c]	Shannon indices			
					H	N1	N2	E2[c]
Pest	KD	20	1908	0.32	3.01	1.44	2.13	0.32
	KDM	19	1377	0.75	3.86	1.69	1.23	0.75
	BD	18	1250	0.21	4.16	1.78	3.22	0.12
Predator	KD	05	433	0.34	3.24	3.21	1.24	0.34
	KDM	05	347	0.74	3.84	3.01	2.17	0.74
	BD	04	268	0.71	4.21	3.86	2.41	0.23

a- Number of species present; b- Number of individuals; c- Shannon- Weaver diversity index values

Khalilabad (KD), Kauri dam (KDM) and Bardan (BD)

Table 4: Climatic conditions reported in Khalilabad (KD), Kauri dam (KDM) and Bardan (BD)sites during the study period

Factors	sites	Months				
		August	September	October	November	December
Temperature (0^C) range	KD	42.5-33.8	41.0-29.2	38.9-30.3	37.3-29.2	24.2-21.1
	KDM	45.2-33.2	40.1-31.0	38.3-29.6	36.2-30.1	26.2-18.2
	BD	44.1-32.1	42.0-28.2	36.6-29.7	37.1-31.2	21.2-19.1
R. H (%) range	KD	88.1-70.2	88.2-71.2	86.3-70.2	90.1-74.2	98.1-76.2
	KDM	90.2-84.2	89.1-69.2	86.2-70.2	99.1-75.1	89.2-79.2
	BD	89.2-72.2	91.2-68.3	85.3-69.2	89.1-75.2	82.1-76.9
Total rain fall (mm)	KD	5.2	164.2	65.2	15.2	6.2
	KDM	6.2	163.2	59.3	15	4.1
	BD	5.1	173.5	62.2	13.2	5.2
Wind velocity (km/h)	KD	14.2	3.2	8.6	8.3	12.3
	KDM	13.0	4.2	10.2	9.3	14.2
	BD	16.2	8.1	11.1	8.5	13.1

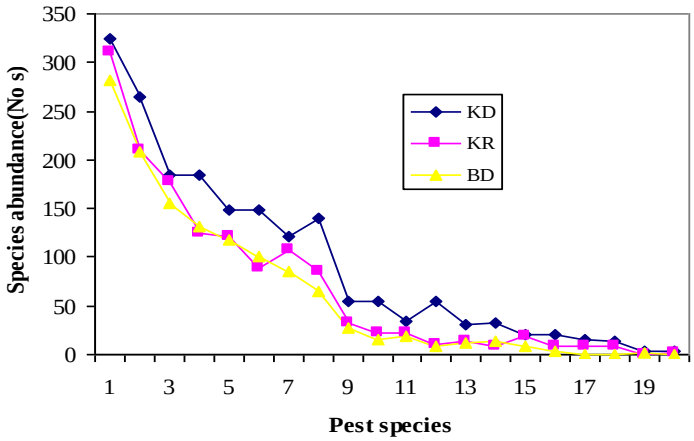

Figure1: The species abundant of all the 20 insect pests from the study sites of pigeonpea agro-ecosystem; species sequence arranged from the most to the least abundant species.

abundance on pigeonpea was from 06 to 497 predators in all the three sites. Shannon diversity indices of predator in the three investigated sites studied that Khalilabad had both high single species dominance and maximum evenness (Tables 3).

In general, insect predators' abundance at Khalilabad was 3 times higher than that of other two sites. It suggested that the Khalilabad was more diversity of species than other sites. It might be due to the interaction between food availability and abundance of natural resources. Similarly the result agreed with Duffield (1995) who reported that higher insect abundance might be due to soil quality and prevailing ecological factors and when the species richness was high, diversity index tended to have smaller values. It was assumed diversity indices from the three sites were distinct in terms of species abundance and the degree of dominance by the most to medium abundant species mainly determined by biotic and abiotic factors. Wang *et al*. (2000) stated that the reduction in species richness was mainly caused by the loss of the rarely encountered species; therefore, distribution of insect pests and predatory species in the selected study areas seemed to be dependent on climatic factors such as temperature, relative humidity, rain fall and wind (Table 4)

The dominant species of *Aphis fabae* exhibited the tendency to be the most serious key pest of pigeonpea in U.P. It was possible to assume that the abundance and status of insect pests could be changed over the season and species diversity was directly affected by the fluctuation of individual species population. Comparing the diversity indices of three sites, the Khalilabad seemed to have more diverse habitat. In the present study were observed the different insect species communities could be useful for a better understanding of insect biodiversity interaction and for enhancing pest management strategies in pigeonpea growing areas.

ACKNOWLEDGEMENT

We are deeply indebted to Dr. J. K. Lal, Principal, St. Andrew's College, Gorakhpur, for his interest to promote research activities. The research was supported by a grant in aid from Council of Scientific and Industrial Research (CSIR), Government of India.

REFERENCES

Ali M (1990). Pigeonpea: cropping systems. pp. 279–301.

Duffield SJ (1995). Crop-specific difference in the seasonal abundance of four major predatory groups on sorghum and short duration pigeonpea. ICPN 2: 74-75.

Kumar A, Nath P (2003). Pest complex and their population dynamics on medium-late variety of pigeon pea Bahar at Varanasi. Indian J. Pulse Res. 16(2): 150-154.

Lateef SS, Reed W (1990). Insect pests of pigeonpea. In Insect Pests of Tropical Food Legumes, ed. SR Singh, pp. 193– 242. Chichester, UK: Wiley. 451 pp.

Manjunath TM, Bhatnagar VS, Pawar CS, Sithanantham S (1989). Economic importance of Heliothis spp. in India and an assessment of their natural enemies and host plants. Proc. orkshop Biol. Control of Heliothis: Increasing the Effectiveness of Natural Enemies, ed. EG King, RD Jackson, pp. 197–228. New Delhi: Far East. Reg. Res. Off., US Dep. Agric. 550 pp.

Minja EM, Shanower TG, Songa JM, Ong'aro JM, Mviha P (1996). Pigeonpea seed damage from insect pests on farmers' fields in Kenya, Malawi, Tanzania and Uganda. Int. Chickpea Pigeonpea Newsl. 3:97–98.

Nene YL, Hall SD, Sheila VK eds (1990). The Pigeonpea. Wallingford: CAB Int. 490 pp.

pesticides. Env. Entomol. 29 (3): 579-586.

Pielou EC (1969). An induction to mathematical ecology John Wiley & New York .

Poole RW (1974). An Introduction to Quantitative Ecology. McGraw-Hill, New York. 532 p.

Price PW (1984). Insect Ecology. 2nd ed. Wiley, New York. 607 p.

Reddy CN, Singh Y, Singh VS (1998). Pest complex and their succession on pigeon pea variety P-33. Indian J. Ent. 60(4): 334-338.

Reed W, Lateef SS. (1990). Pigeonpea: pest management. See Ref. 56, pp. 349–74.

Sheldrake AR, Narayanan A, Venkataratnam N (1979). The effects of early flower removal on the seed yield of pigeonpea (Cajanus cajan). Ann. Appl. Biol. 91:383–90.

Singh RN, Singh KM (1978). Succession of insect pests in early varieties of redgram, *Cajanus cajan* (L.) Millsp. *Indian. J. Ent.* 40(1): 1-6.

Stingling G, Wilsey B (2001). Empirial relationships between species richness, eveness and proportional diversity. *The American Naturalist* 158 (3); 286-299.

Subharani S, Singh TK (2004). Insect pest complex of pigeon pea (*Cajanus cajan*) in agro-ecosystem of Manipur. Indian J. Entomol. 66 (3): 222-224.

Upadhyay RK, Mukherji KG, Rajak RI (1998). IPM System in Agriculture 4: pulses, New Delhi .99 pp .

Wang C, J Strazanac, L Butler (2000). Abundance, diversity, and activity of ants (Hymenoptera: Formicidae) in oak-dominated mixed Appalachian forest treated with microbial pesticides. Env. Entomol. 29 (3) : 579-586.

Wilsey BJ, Potvin C (2000). Biodiversity and ecosystem functioning. The importance of species. Evenness and identify in a Quebec old field. Ecology 81: 887-893.

Yadav RS, Rai SN, Prasad S, Sing J (2009). Diversity of insect pests in pigeonpea, *Cajanus cajan* (L.) Millsp, in eastern Uttar Pradesh. Appl. Zool. Res. 20 (1). 127-131.