Effect of time of planting on major insect pests and yield performance of three short duration pigeonpea (*Cajanus cajan* (L.) Millsp.) cultivars in Nsukka agro-ecological zone, Nigeria

SA Dialoke[1*], AA Ngwuta[1], NO Kabuo[2], MO Ofor[1] and CT Tom[1]

[1] Department of Crop Science and Technology (School of Agriculture and Agricultural Technology), Federal University of Technology PMB 1526, Owerri, Imo State, Nigeria

[2] Department of food Science and Technology, Federal University of Technology, PMB 1526, Owerri, Imo State, Nigeria.

*Corresponding Author: E-Mail: akuamka@yahoo.com Phone: +2348035266808

Abstract

Insect infestation and damage on pigeonpea was studied at Nsukka, Nigeria on three short duration cultivars namely, ICPL 84023, ICPL 87, ICPL 151 obtained from the International Crops Research Institute for Semi-Arid Tropics (ICRISAT). These cultivars were planted during first week in April, June and August in 2008 and 2009. The experiment was conducted using a 3 x 3 factorial arrangement in a randomized complete block design with three replications. The pod/Seed damage on the three cultivars by insect pests differed significantly. ICPL 87 was most vulnerable to insect pests as it suffered more damage by the pod borer (*Helicoverpa armigera* Hubner), pod sucking bugs (*Clavigralla tomentosicollis* Stal.) and podfly (*Melanagromyza obtusa* Malloch) than ICPL 151 and ICPL 84023. The pod borer caused the greatest pod/seed damage in April planted crop while the least damage was observed in June planted crop. Pod/seed damage by *C. tomentosicollis* was highest in the crop planted in August and least in crop planted in June, while *M. obtusa* damage was highest in April and least in August planting. ICPL 87 recorded the poorest seed yields and ICPL 151 gave higher seed yields 604.83 kg ha^{-1} in 2008, but got reduced to 579.59 kg ha^{-1} in 2009 compared with ICPL 84023. With respect to planting dates, the highest seed yields of 809.93 kg ha^{-1} in 2008 and 840.84 kg ha^{-1} in 2009 were recorded in June planted crop followed by the crop planted in April with seed yields of 656.24 kg ha^{-1} in 2008, and 716.70 kg ha^{-1} in 2009. August plantings had the least seed yield of 19.63 kg ha^{-1} in 2008 and 25.50 kg ha^{-1} in 2009 compared with yields from April and June planting seasons.

Keywords: Short duration, Pigeonpea, *Clavigralla tomentosicollis*, *Helicoverpa armigera*, *Melanagromyza obtusa*, planting dates.

Introduction

Pigeonpea has been reported as a minor grain legume crop in Nigeria (Ezueh 1978). Pigeonpea plays a very important role in the dietary needs of people in South Eastern Nigeria as a good source of digestible proteins. Dialoke et al. (2010) in his survey of pigeonpea pests in Nigeria observed that in some parts of Nsukka such as Aku in Igbo Etiti Local Government area, Enugu State, the dry pigeonpea seeds are cooked whole until tender and then mixed with dried cocoyam, maize or cooked yam nourished with palm oil, salt, onions and fermented sliced seeds of oil bean popularly known in Iboland as "ukpaka". Pigeonpea flour is an excellent component in the snack industry and has been recommended as an ingredient to increase the nutritional value of pasta without affecting its sensory properties (Torries et al. 2007). Millet mixed with pigeonpea is reportedly very nutritious and provide a cheaper alternative to wheat imports in Nigeria (Eneche 1999).

Pigeonpea is attacked by over 200 species of insects (Reed and Lateef 1990). Most of these insects are sporadic in their distribution, so they are not regarded as pests. Reed et al. (1989) compiled the list of pigeonpea insects and classified them as pests of roots, stems, foliage, flowers and pods. The damage caused by the insect pests to pods significantly reduces pigeonpea seed yield (Reed et al. 1989).

Investigators from India where the crop has received the greatest improvement focus have reported more than 200 species of insects on pigeonpea (Lateef and Reed, 1980). Materu, (1970) reported that more than 50% of pigeonpea seeds were damaged by pod bugs in Tanzania, while in Uganda, Koehler and Rachie, (1971) reported 5% damage due to pod borer (*Helicoverpa armigera*). In Kenya,

Okeyo Owuor and Khamala (1978) reported seed damage by Lepidoptera borers (13 %) and podfly (*Melanagromyza obtusa*) (11 %).

Pest appearance, population fluctuation, infestation rate and crop yield are very much dependent on sowing time. Most of the farmers in Nigeria usually plant short duration cultivars along with local pigeonpea cultivars usually around the month of May. As a result, the short duration cultivars were usually affected by unfavourable climatic condition. The improved cultivars also suffer from high pest infestation and accordingly yields were reduced, thereby discouraging farmers from cultivating improved cultivars.

Information on short duration pigeonpea cultivars with respect to pest infestation and severity of damage in relation to planting date is scarce in Nigeria. Therefore, present study was designed to determine infestation due to major insect pest and its effect on seed yield in relation to variation of planting dates in Nsukka representing the derived vegetation zone of South eastern, Nigeria.

Materials and Methods

Three short duration pigeonpea cultivars namely ICPL 84023, ICPL 87, and ICPL 151 obtained from International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India were planted in first week of April, June and August 2008 and 2009 cropping seasons at the Department of Crop Science, Postgraduate Teaching and Research farm, University of Nigeria Nsukka, having latitude 06^{o} 52‘N, and longitude 07^{o} 24‘E and altitude of 447.26 m above sea level. The mean total rainfall from April to October in the region was 174.44 mm while mean maximum temperature was 29.03 ^{o}C.

The experimental design was Randomized Complete Block Design (RCBD) with three replications. Each replication had nine plots (3 x 3 factorial) which gave a total of 27 plots, each measured 3.76 m x 6.0 m. Within row spacing of 20 cm and between row spacing of 40 cm were used. At harvest, 100 pods selected at random from the two border ridges were examined for damage by pod borer (*Helicoverpa armigera*) and later by pod sucking bugs (*C. tomentosicollis*) at all the dates. Thereafter, the 100 pods sample were hand threshed and 100 seeds selected at random for assessment of percentage seed damage due to *H. armigera, C. tomentosicollis* Stal. and *M. obtusa* Malloch infestations. The grain yield was obtained by weight estimation of the threshed grains obtained by harvesting three middle rows of each plot, and weighing using a sensitive top loading balance.

Data analysis: Data on insect damage were subjected to square root transformation according to Emerson and Stoto (1983) before analysis of variance was carried out using computer software (Genstat Discovery Edition 3 2009). The treatment means were tested using Least Significance difference at 5 % level of significance.

Results

Table 1 shows that, percentage pod and seed damage by *H. armigera* was high in ICPL 87 compared with damage on ICPL 84023 and ICPL 151 in 2008 and 2009 planting seasons. April planting recorded significant ($p<0.05$) damage (47.35 %) by *H. armigera* in 2008 which was higher damage as compared with June and August plantings while August planting recorded highest seed damage (55.5 %) in 2009 as compared with April and June plantings. June planting consistently had lower percentage damage by pod borer, 22.72 % in 2008 and 27.24 % in 2009. However, the damage to the pods also follow the same trend as the seed damage.

The cultivar ICPL 87 recorded the highest shriveled pods and seeds when compared with ICPL 84023 and ICPL 151 (Table 2). Planting dates significantly affected pods and seeds damage by *C. tomentosicollis*. June planting had the least percentage of shriveled seeds by *C. tomentosicollis* followed by April planting but the August planting had highest shriveled seeds. The percentage damage to pods by *C. tomentosicollis* was least in April which increased as planting was delayed till August.

Table 3, shows the seed damage by podfly (*M. obtusa*) which varied from year to year. On two years average, ICPL 87 recorded higher percentage seed damage by podfly followed by ICPL 84023 and ICPL 151. The seed damage was influenced by planting dates $p<0.05$. The highest percentage seed damage (19.30 % in 2008, 21.20 % in 2009) by podfly was in April and this damage decreased as planting was delayed till August (5.25 % in 2008, 5.36 % in 2009).

ICPL 87 had the poorest seed yields of 336.52 kg ha^{-1} in 2008 and 402.85 kg ha^{-1} in 2009 while ICPL 151 had the highest seed yields of 604.83 kg ha^{-1} in 2008, 579.59 kg ha^{-1} in 2009 followed by ICPL 84023 with seed yield of 544.44 kg ha^{-1} in 2008 and 600.61 kg ha^{-1} in 2009 (Table 4). The highest seed yields of 809.93 kg ha^{-1} in 2008 and 840.84 kg ha^{-1} in 2009 were recorded in June planted crop while April planted crop had seed yield of 656.24 kg ha^{-1} in 2008 and 716.70 kg ha^{-1} in 2009. August plantings had the least seed yield of 19.63 kg ha^{-1} in 2008 and 25.50 kg ha^{-1} in 2009.

Discussions

There was significant damage ($p<0.05$) to the seeds of the cultivars especially that of ICPL 87 by *H. armigera* and this finding agreed with the earlier work of Lateef and Reed (1980) in India who reported that the damage caused by *H. armigera* to the seeds of short and medium duration cultivars was high particularly to those of the determinate habit. This could be related to the cluster pod habit of the improved cultivars which helps to conceal the larvae of *H. armigera* from their preys and harsh weather.

Also the damage to the seeds of the cultivars was significant ($p<0.05$) by *Clavigralla* spp., confirming the findings of Odak et al. (1978), who reported that pod sucking bugs caused deformation and shriveling of grains resulting in substantial losses to pigeonpea. Damaged seeds are dark and shriveled, they do not germinate and are not acceptable for human consumption (Materu 1970). Crops planted in August had the highest seed damage while the least percentage seed damage was obtained from crop planted in June. Kyamanywa et al. (2001), reported in pigeonpea that late sowing increases damage by pod suckers. The significant planting date differences observed in this study could be related to the variation in weather conditions existing during the three planting periods which might have influenced the level of damage.

The variation in damage by podfly (*M. obtusa*) could be due to weather which probably favours the population build up of the podfly causing indiscriminate seed damage. None of the cultivars was immune to the attack by podfly. Under the period of low rainfall regime which was prevalent in April planting the average mean percentage seed damage by podfly was higher compared to June and August plantings. This suggests that dry spell encourages the build up and level of damage to seeds by *M. obtusa.*

Significant lower seed yield per hectare in ICPL 87 compared to ICPL 151 and 84023 could be ascribed to the high percentage seed damage sustained by the cultivar from the attack of *H. armigera, M. obtusa* and *C. tomentosicollis*. Higher significant seed yield obtained in June planting could be due to reduced level of pest infestation by pod sucking bugs, pod borers and podfly. These findings agreed with those of Asghar et al. (2006) in mungbean who observed that maximum pod and grain yield was obtained when the plants were sown between first to third week of June or July. Higher level of these pests particularly pod sucking bugs in August planting also could have resulted to the drastic reduction of yields compared to April and June plantings.

Recommendations

The pigeonpea cultivar recommended out of the three short duration for this zone is ICPL 151. In absence of this cultivar, ICPL 84023 is recommended and the best planting date for the recommended cultivars was June in respect of insect damage and seed yield achievable. However, drying facilities must be put in place as the pod harvests often take place during the rain. The efforts in breeding of ICPL 87 for resistance to insect problems in this locality need to be intensified.

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Table 1. Pod and seed damage (%) by pod borer in three short duration pigeon-pea cultivars in 2008 and 2009, Nsukka, Nigeria.

	2008		2009	
Treatments	Pod damage	Seed damage	Pod damage	Seed damage
Cultivars (C)				
ICPL 84023	45.37	19.68	55.07	17.42
ICPL 87	62.87	59.27	76.33	64.93
ICPL 151	39.82	21.95	41.53	28.80
LSD0.05	2.48	1.02	1.89	1.54
SE	2.49	1.03	1.91	1.55
CV (%)	5.00	3.10	3.30	4.30
Date (D)				
April	68.31	47.35	75.26	46.41
June	33.91	22.72	38.15	27.24
August	45.83	30.84	59.41	55.50
LSD0.05	2.48	1.03	1.89	1.54
C × D interactions	4.30	1.77	3.28	2.67

Table 2. Pod and seed damage (%) by pod sucking bug in three short duration pigeon-pea cultivars in 2008 and 2009, Nsukka, Nigeria.

	2008		2009	
Treatments	Pod damage	Seed damage	Pod damage	Seed damage
Cultivars (C)				
ICPL 84023	41.97	52.40	44.87	49.99
ICPL 87	52.98	62.07	64.19	59.40
ICPL 151	44.68	40.56	53.74	44.30
LSD0.05	2.70	1.55	0.94	1.27
SE	2.70	1.56	0.95	1.28
CV (%)	5.80	3.00	1.80	2.50
Date (D)				
April	22.38	46.18	31.21	46.21
June	56.56	33.75	60.40	32.74
August	60.69	75.11	71.18	74.74
LSD0.05	2.70	1.55	0.94	1.27
C × D interactions	4.68	2.69	1.63	2.21

Table 3. Seed damage (%) by podfly in three short duration pigeon-pea cultivars in 2008 and 2009, Nsukka, Nigeria.

Treatments	2008	2009
Cultivars (C)		
ICPL 84023	13.79	15.46
ICPL 87	15.48	14.25
ICPL 151	14.51	14.09
LSD0.05	0.81	0.54
SE	0.18	0.54
CV (%)	5.60	3.70
Date (D)		
April	19.30	21.20
June	18.73	17.24
August	5.25	5.36
LSD0.05	0.81	0.54
C × D interactions	1.40	0.93

Table 4. Pod and seed yield (kg ha^{-1}) of three short duration pigeon-pea cultivars in 2008 and 2009, Nsukka, Nigeria.

	2008		2009	
Treatments	Pod yield (kg ha^{-1})	Seed yield (kg ha^{-1})	Pod yield (kg ha^{-1})	Seed yield (kg ha^{-1})
Cultivars (C)				
ICPL 84023	820.20	544.44	950.10	600.61
ICPL 87	513.90	336.52	514.3	402.85
ICPL 151	1001.00	604.83	1070.6	579.59
LSD0.05	10.37	3.56	16.38	2.62
SE	10.37	3.57	16.54	2.64
CV (%)	1.30	0.70	1.90	0.05
Date (D)				
April	1052.00	656.24	1093.70	716.70
June	1152.40	809.93	1320.10	840.84
August	130.90	19.63	151.20	25.50
LSD0.05	10.37	3.57	16.68	2.62
C × D interactions	17.96	6.18	28.28	4.33

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