THE POPULATION TREND OF ZONOCERUS VARIEGATUS FAB. (ORTHOPTERA: PYRGOMORPHIDAE) ON PIGEONPEA VEGETATIVE PHASE AT DIFFERENT PLANT SPACING AND TIME OF SOWING IN IMO STATE REPRESENTING THE SOUTH EASTERN ZONE OF NIGERIA.

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ABSRACT
This study was carried out during 2009 and 2010 at the Postgraduate Teaching and Research Farm, Department of Crop Science and Technology, Federal University of Technology, Owerri Imo State to determine the influence of short duration pigeonpea plant density and plant spacing on the population of Zonocerus variegatus nymphs. Experiment was a 3 x 4 factorial laid out in Randomized Block Complete Design with three replications. Treatments consisted of four plant spacing 15 cm x 35 cm, 20 cm x 40 cm, 25 cm x 50 cm, 30 cm x 60 cm, with three planting dates, April (early season), July (Mid-season), and October (late season). Differences in Zonocerus variegatus nymphs population were measured by the use of least significant differences (LSD) at 5% probability level. The result indicated that the nymphs of Z. variegatus Fab. were in abundance on the vegetation of early duration pigeonpea cultivar ICPL 84023, when the crop is sown in April at closer spacing of 15 cm x 35 cm but were minimized at wider spacing of 30 cm x 60 cm. The nymphs were not found on the pigeonpea plants during July and October plantings irrespective of the plant spacing. This result is useful as it could supply basal information to researchers in planning effective Z. variegatus nymphs control strategy in Rainforest zone of South eastern, Nigeria.

Keywords: Zonocerus variegatus,, planting dates, plant density, population.

INTRODUCTION.

Pigeonpea (Cajanus cajan (L.) Millspaugh) is a perennial shrub that is grown as an annual crop. It is eaten as a vegetable (commonly pods or green pea) or as dried grain cooked and eaten as dhal (dry split cotyledons) in India (Gopalan et.al, 1984). The branches, stems while still green can be very useful as folder for livestock feed and as green manure. Fallen leaves are used as mulch while the bacterium Rhizobium that lives in the roots of the pigeonpea is able to fix nitrogen so as to help improve soil fertility. Green pigeonpea is being exported from Kenya to Europe (Snapp et al. 2003). The dry grain is also an important local pulse and export commodity in several African countries (Kenya, Malawi, Mozambique, Tanzania, and Uganda (Minja, et al. (1999). Pigeonpea production in Africa contributes to 9.3 % of the world production, which is very little compared to the 74 % contribution from India alone (Damaries, 2007). Unfortunately, the vegetative yield levels of pigeonpea are not very encouraging as it is attacked by several insect pests. Among the vegetative pests, young variegated grasshopper referred to as the nymphs is populous and regarded as a notorious pest on pigeon pea in derived savannah zone of south Eastern, Nigeria (Dialoke, and Ezueh, 2003). Z. variegatus is reported in the literature as a pest of many crops in west and central Africa. Z. variegatus is currently the most important of grasshopper pests on crops in the humid forests of low altitude and savannah of West and Central Africa (Modder 1984, Chiffaud 1990, Modder 1994). The first reports on damages of grasshopper on crops were in 1910 by Peacock and Lamborns in Southern Nigeria, Schoutedem and Mayne in Zaire and Small in Uganda (Chiffaud, 1990). Its geographical range and impacts on pigeonpea crops increased with time. Due to the high damage it inflicts on crops, it is considered as an important agricultural pest in Nigeria (Chapman et.al 1986, Modder, 1994, Idowu and Modder, 1996) and Ghana (Modder, 1994). In garden eggs, it can cause 25-80 % yield loss, (Chiffaud, 1990). Zonocerus variegatus nymphs have been implicated in the transmission of the bacterial burn of cassava in Nigeria (Chiffaud, 1990, De Gregorio, 1989). The young specie (nymghs) of Z. variegatus damages pigeonpea plants extensively by skeletonizing, cutting and making circular holes on the leaves, thus reducing the photosynthetic capacity of the plant. It has been included as one of the 15 grasshopper species of economic importance in Argentina (Lange et al. 2005) due to damage historically reported from different areas of the country (Liebernann, 1972).

Determining the importance of an insect in any agro-systems contributes to the description of its pest status (Anonymous, 1998). Such information is needed by entomologists for the

formulation of a good pest management strategy. Thus information on crop spacing and time of sowing improved pigeonpea cultivar in Rainforest Zone, free from the period of grasshopper abundance is lacking. Therefore, the primary objective of this study was to determine the population dynamics of young .Z. variegatus (L.) on improved short duration pigeonpea crop planted at varying plant spacing and sowing season. This information can be incorporated into IPM strategy to reduce the Z. variegatus (L.) densities on improved pigeonpea to tolerable levels while maintaining a safe quality environment in Owerri, Rainforest Agro-ecosystems.

MATERIALS AND METHODS.

Field research was carried out in the Postgraduate Teaching and Research Farms, Department of Crop Science and Technology, Federal University of Technology, Owerri, Imo State Nigeria. Experiment was carried out in the months of April, July, and October, 2009 and repeated in 2010. The research field is located in the rain forest belt, longitude 7° 12′ E and latitude 5° 27′ N of equator. The mean annual temperature (33.55^{oC}), rainfall (281.72mm), and relative humidity (81.33%) of the study area were prevalent in year 2009. In 2010 planting season temperature of 34.03^{oC}, rainfall of 301.45mm, and relative humidity of 85.91% were obtained. All these weather records were collected from Federal Ministry of Aviation Owerri Meteorological Station, Imo State.

An area of land measuring 11.0 m × 10.0 m (110 m^2) was mapped out at Postgraduate and Research Farms, Department of Crop Science and Technology, Federal University of Technology, Owerri during each sowing time (April, July, October) in 2009 and 2010 planting seasons. The area was cleared of grasses, tilled manually, measured with tape.

The experimental Design was a 4 x 3 factorial laid down in a Randomized Complete Block Design (RCBD) with (3) replications. Treatments comprised of four plant spacing 15 cm x 35 cm, 20 cm x 40 cm, 25 cm x 50 cm, 30 cm x 60 cm (randomly allocated into 4 plots uniform size 3.0 m × 3.6 m (10.8 m^2), and three planting dates (April, July, October). The area was divided into 3 replications with 1m pathways between replications. Each plot contained 5 ridges with 12 rows of pigeonpea per plot to give a total of 60 plants per plot. The improved pigeonpea cultivar (ICPL 84023) used was seed-dressed with Apron-star before sowing at the rate of 2 kg of seeds per a sachet, to control fungal diseases. Planting was done using 3 seeds per hole at each sowing time and later thinned down two weeks after planting (WAP) to one stand per hole

During vegetative phase plants were carefully examined with unaided eyes for the presence of Zonocerus variegatus (nymphs) at weekly intervals each time between 7.00 a.m to 8.00 am and 5.30 pm to 6.30 pm. The grasshopper were also collected, preserved in 95% ethyl alcohol and later identified at the Insect Museum of the Institute of Agricultural Research (IAR) Ahmadu Bello University (ABU) Zaria. The populations of variegated grasshopper (Zonocerus nymphs) were assessed from four plants per row selected randomly from the three middles ridges giving a total of 12 sampled plants per plot. The Z. variegatus nymph counts were expressed as the number of pest per one metre row per plot. Weeding was manually done at two weeks and six weeks after planting. There was no application of either organic or inorganic fertilizers to the pigeonpea.

STATISTICAL ANALYSIS.

Data on Zonocerus variegatus nymph counts were subjected to square root transformation using Genstat Discovery Edition 3, (2009) before analysis of variance was carried out, while treatment means was separated by the use of Least Significant Difference at 5 % level of significance.

RESULT.

The result of the weather situations during the two year growing periods is presented in table 1. From the result During 2009 and 2010 planting periods the occurrence of Z. variegatus (nymphs), on pigeonpea vegetative parts at different plant densities and date of planting are presented in Figures 1 (a and b) and 2 (a and b). In 2009, Figure 1(a) shows that there was non-significant effect ($p>0.05$) of plant densities on population of Z. variegatus even though higher population of Z. variegatus occurred on pigeonpea plants at lower plant spacing of 15 cm x 35 cm, and 20 cm x 40 cm, and reached its peak at 28 DAP and 35 DAP in 2009. Lower population of the nymphs was observed at higher plant spacing of 25 cm x 50 cm and 30 cm x 60 cm.

Table 1. Summary of average monthly rainfall, temperature, relative Humidity,

Number of rain days, from a maximum of three months (from planting to harvest)

Cropping season **2009**	Rainfall (mm)	Maximum Temp.(oC)	Minimum Temp.(oC)	Relative Humidity (%)	No. of Rain days(day)
Early cropping					
April	232.30	34.67	15.33	79.67	11.33
Mid-cropping					
July	394.10	34.33	19.00	86.33	18.33
Late-cropping					
October	218.83	31.64	18.67	78.00	7.67
Mean	281.74	33.55	17.67	81.33	12.44
2010					
Early cropping					
April	237.90	33.17	22.47	87.09	10.67
Mid-cropping					
July	511.13	33.60	21.03	89.67	14.00
Late-cropping					
October	155.33	35.33	19.33	81.00	7.33
Mean	301.45	34.03	20.94	85.92	10.67

Planting dates significantly ($p<0.05$) affected the population of Z. variegatus. The population of Z. variegatus nymphs increased from 14 DAP during April, reached its peak at 28 and 35 DAP and thereafter declined at 42 DAP (Figure 1(b). The population of the nymphs during July and October planting were at the zero level, that is, there was absence of the nymphs at the periods

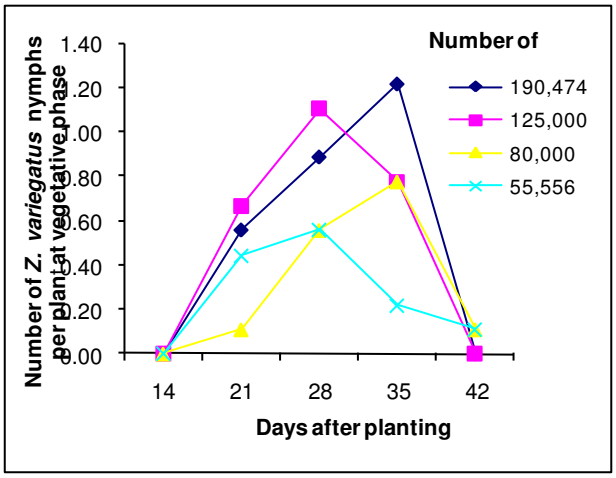

Figure 1 (a). Effect of plant density on number of Z. variegatus nymphs per plant at pigeonpea vegetative phase during **2009 season.**

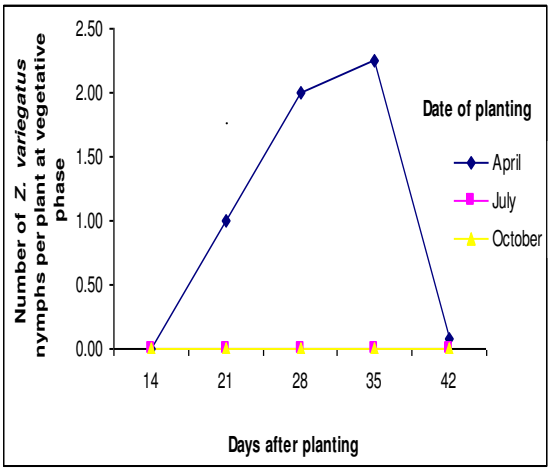

Figure 1(b). Effect of planting date on number of Z.variegatus nymphs per plant at pigeonpea vegetative phase during **2009 season**

Figure 2 (a) presents the population trend of Z. variegatus at vegetative phase in 2010 planting period. The result shows that more nymphs occurred on the plants at lower plant spacing of 15 cm x 35 cm, reached its peak at 28 DAP and thereafter decreased to zero at 35 DAP. The population of the nymphs was low at lower plant density and reached its peak at 28 DAP.

Fig. 2 (b) presents the population of Z. variegatus at different planting dates. During the April planting, there was gradual increase of the nymphs from 14 DAP with peak population at 28 DAP. Again there was absence of the nymphs during July and October planting periods.

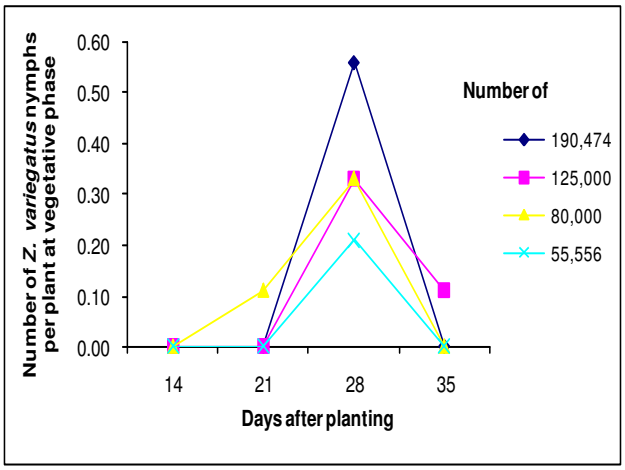

Figure .2 (a): Effect of plant density on the number of Z. variegatus nymphs per plant at pigeonpea vegetative phase during **2010 planting period.**

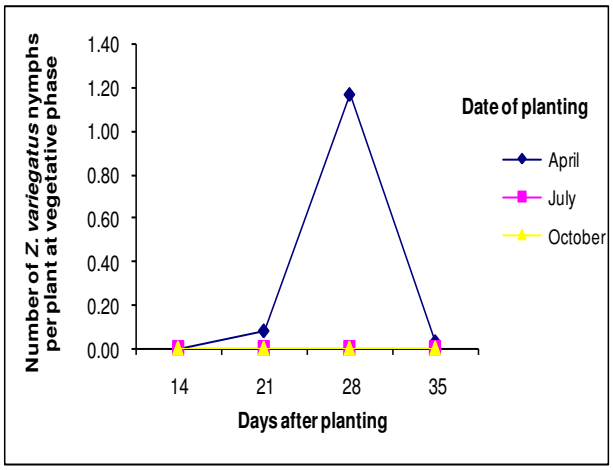

Figure .2 (b): Effect of planting date on the number of Z. variegatus nymphs per plant at pigeonpea vegetative phase during **2010 planting period**

DISCUSSION

From this study the pressure of Z. variegatus nymphs on improved pigeonpea vegetation is higher in the short dry season and highest in the great dry season. This report agreed with the findings of Patel and Shekh (2006) who reported increased pest population of Z. variegatus damage is very low in the fields during the rainy season. Probably rains (natural mortality factor) induce morbid fungicidal infections in the natural population of Z. variegatus among other mortality factor that would reduce the pest population.

The results revealed that the population of the nymphs in both years were more at lower plant spacing and subsequently got reduced when the plant spacing increased. This was probably due to occurrence of more abundant tender and succulent portions of the vegetative parts produced by plants at lower plant spacing with higher plant density. On the other hand, the low population of the nymphs at increased plant spacing could be due to the production of less abundant tender leaves which the nymphs feed on. Rao et al. (2002), Singh and Singh (1977) earlier had similar observation that high population of grasshoppers occur on pigeonpea plants at high plant density

Nevertheless, numerous biotic and abiotic factors (mainly temperature, precipitation, and food quality) affect the fecundity and the survival of grasshopper (Joern and Gaines, 1990). Nymphs of variegated grasshoppers normally developed during the warmth period of the year. They are defoliators consuming the leaf tissues of numerous plants. Hence, the high population of the nymphs on pigeonpea leaves in April, which reached its peak at 28 DAP, probably coincided with abundant tender leaves and stems, and decreased as days after planting increased. This finding is in agreement with the report of Dialoke and Ezueh (2003), who observed high population of grasshopper nymphs on pigeonpea at Nsukka in derived savannah agro-ecological zone, during April planting period. Also Sevilor et al. (2006) reported low incidence of grasshopper (Z. variegatus (L.) during long or short dry season in the survey carried out from 15 villages of humid forest zone of Southern, Cameroon. The increased population and damage observed in the dry season suggests that it is a seasonal pest as reported in other studies (De Gregoria, 1989).

The nymphs were virtually absent during July and October planting, probably due to humid weather at this periods (Danks, 2006,Tanaka, 2000). The adults are large grasshoppers and the damage also takes the form of leaf removal (Sorenson, 2003). Population of the adults increased with the abundance of grass weeds associated with the pigeonpea.

From the result of pests on vegetative parts, short duration pigeonpea could be grown in this locality, at higher plant spacing of 30 cm x 60 cm to help minimize the population of grasshopper nymphs.

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