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Effects of Planting Dates and Intra-Row Spacing on Field Infestation and Damage by Hemipteran Sucking Bugs on Soybean in Ibadan, Southwest Nigeria

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Abstract

Field experiments were conducted for two years in Ibadan, Southwest Nigeria to determine whether changing planting dates and intra-row spacing in sole soybean crop will reduce field infestation and seed damage by hemiptera sucking bugs. The layout was a split plot arranged in a randomized complete block. The main effects were three planting dates (mid-June, early July and late July), each consisting of four intra-row spacings (15, 20, 25, and 30cm). Results indicated lower ($p<0.05$) field infestation and seed damage in the early planted crop than in the late planted crop. A significantly higher ($p<0.05$) yield advantage (935.6 to 974.4 kg/a^{-1}) at the same spacing. However, adoption of these results should be balanced with local pest situation, agronomic and environmental considerations.

Introduction

Soybean, *Glycine max* (1) Merril, is an important grain legume in the drier parts of the tropics including Nigeria. Interest in production and utilization has tremendously increased in the past decade (Tijani-Eniola and Akinifesi, 1996). Nigeria is the largest producer of soybean in West and Central Africa, and the bulk of this local production is from Benue State (Root *et al.* 1987). However, few farmers have adopted this crop into traditional farming systems, probably due to difficulty in cooking and lack of familiar taste (Onochie, 1965, Tijani-Eniola and Akinifesi, 1996). There has been an increased awareness in the utilization of soybean, causing a surge in the demand as a source of edible oil and protein in human and livestock diet. A ban on importation of edible oil by the Nigerian government in 1986 also encouraged local production. Despite a great potential for cultivation provided by favourable environmental conditions, soybean production is low in Southwest Nigeria (Mutsaers, 1991). There is high variability in seed yield ranging between 50 and 1500kg/ha^{-1} with the upper limits achievable only with efficient pesticide application and management (Baten, 1991). Tropical agriculture is confronted with the challenges of maximizing options of sustainable pest management practices. A major constraint to desirable soybean yield output is the menace of the hemipteran sucking bugs especially at the podding stage. Chemical pesticides which are used in the commonest control practice are sold at prohibitive cost when available. This study therefore investigates the effects of varying planting dates and intra-row spacing on field infestation and damage caused by the hemipteran sucking bugs on sole soybean crop as a step towards the formulation of an integrated management of these insect pests of soybean.

Materials and Methods

The study was conducted at the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria between June and September for a period of two years. Ibadan is located within the rainforest belt of Nigeria on latitude 7.5^0N and longitude 3.90^0E. The summary of the weather data for the study period is presented in Table 1.

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The soybean variety TGX 1456-ZE used in this study was obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. All treatments were planted at two seeds per hill. The experiment was a split plot arranged in a randomized complete block. The main plots measured 16 x 4m each and these were assigned to three planting dates: Mid-June (13th June), early July (8th July) and late July (25th July) of each year. Each of the main plots consisted of four sub-plots to which different intra-row spacings of 15 x 50, 20 x 50, 25 x 50 and 30 x 50cm (within and between rows) were assigned, giving theoretical plant populations of 480,360,288 and 240 stands per $4m^2$. Weeding commenced two weeks after planting and all farm operations on the plots were manual. No pesticides were used. Population of infesting pod sucking bugs was determined by visual counting using the drop-cloth method. Sampling which was carried out between 7.00 and 10.00 hours (local time) commenced 10 weeks after planting (WAP) and lasted till harvesting. For each sampling, 20 hills were randomly selected from an intact 3m2 area of each sub-plot. Before sampling each hill, a 100 x 50cm white drop-cloth was laid on the soil surface below the soybean stand. Thereafter, the plants were vigorously but carefully jarred for five seconds to dislodge the insects onto the drop-cloth underneath. The cloth was wrapped, with the insects, almost immediately to prevent escape of adult bugs. The collected bugs were killed in a bottle, sorted and counted per hill for each sub-plot. Data on seed damage were collected at harvesting at 16 WAP. The pods were shelled and seeds from each sub-plot were sorted into damaged and undamaged. Thereafter, each lot was weighed using a Metler 1012 (0.01g) balance. All data collected were subjected to analysis of variance and where significant, means were separated using Least Significant Difference (LSD) at p=0.05 (Gomez and Gomez, 1984).

Results and Discussion

The time of planting significantly ($p<0.05$) affected species composition and incidence of pod sucking bugs on soybean (Table 2 and 3). Seven major species of pod-sucking bugs: *Clavigralla sp, Nezara viridula, Mirperus jaculus, Riptortus dentipes, Anoploenemis curvipe, Asparvia armigera* and *Piezodorus* sp were encountered on the soybean crop within the study period. Apart from *Asparvia armigera* and *Piezodorus* sp which were absent in the early planted crop, the same kind of species of hemipteran bugs were encountered at different planting dates (Table 2 and 3). However, the population of infesting bug species was significantly higher ($p<0.05$) at the late planting date (late July planting). Such high population of bugs in the late planting date could be due to a build-up of insect population partly because of availability of food provided for development by the early crop and presence of alternative host plants. The brief dry spell between July and August may also have reduced mortality of the developmental stages of the bugs which are prevalent during the period of continuous rainfall. Conversely, the different intra-row spacings did not significantly ($p<0.05$) affect species composition of pod-sucking bugs on soybean within each planting date (Table 2 and 3). Consequently, damage to soybean seeds varied significantly ($p<0.05$) due to the main effect of planting date as well as intra-row spacing. Generally, yield per hill was significantly ($p<0.05$) higher at wider spacing of 50 x 25cm and 50 x 30cm (Table 3). Also, damage, was lower at the early (mid-June) planting date. The higher seed yield per hill was attributed to less severity of competition for space and other growth resources which made assimilates more readily available for growth and biomass accumulation in the soybean plant (Grafton *et al,* 1988; Obuo *et al,* 1998). However, the over-all yield was higher at closer spacing (50 x 15cm) in each of the main effects of planting date. There was a significant linear relationship between plant density and yield ($r = 0.68$; $p<0.05$). The higher seed yield per sub-plot is attributed to higher number of stands harvested in the close spacing sub-plots (Boquet, 1990; Caravetta, 1990; Obuo *et al,* 1998). Since higher yield is the ultimate goal of crop protection and an increase or decrease in spacing did not significantly ($p<0.05$) cause an increase in bug infestation on soybean, it thus appears advantageous to plant relatively late in July but at close intra-row spacing of about 15cm to achieve a reasonable over-all yield. Adoption of the results obtained however requires a judicious compromise between the pest situation and agronomic and environmental considerations.

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Table 1: Summary of weather data for June-September, Year I; Year II

Month	Rainfall (mm)	Rainy days	Temperature (C)		Relative humidity
			Min.	Max.	
Year I					
June	177.3	19	22.5	29.9	82
July	71.7	12	21.9	28.1	84
August	96.0	17	22.0	27.9	86
September	1951.7	17	22.5	30.4	82
Year II					
June	157.6	17	22.9	31.0	82
July	71.9	17	22.8	28.3	87
August	50.8	14	22.2	28.1	86
September	143.6	16	23.0	29.0	85

Source: International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria

Table 2: Effect of Interaction between time of Planting and Intra-Row Spacing on Species Composition and Abundance of sucking bugs on Soybean in Ibadan, Southwest Nigeria (First Year)

Planting	Intra row spacing (cm)	Mean total number of sucking bugs encountered per hill during period of study						
		Clavigralla shadabbu	*Anoplocnemis curvipes*	*Nezara viridula*	*Mirperus jaculus*	*Riptortus dentipes*	*Asparvia armigera*	*Piezodorus sp*
	15	5.0	6.8	6.3	7.6	11	0	0
Mid June	20	6.0	7.2	6.7	6.3	9.4	0	0
	25	7.3	9.8	5.7	4.7	7.6	0	0
	30	5.0	6.8	6.7	4.3	8.4	0	0
	15	9.0	7.3	7.0	8.3	8.7	0	0
Early July	20	9.3	5.9	6.3	6.3	7.6	0	0
	25	10.3	5.4	7.3	4.7	6.8	0	0
	30	8.0	1.7	8.0	4.7	5.9	0	0
	15	10.3	3.6	13.6	9.0	6.8	2.3	2.4
Late July	20	12.7	1.6	9.0	12.3	7.7	4.3	2.6
	25	8.3	1.5	7.8	12.3	8.4	2.7	1.8
	30	8.7	1.6	7.3	7.3	7.4	2.7	3.2
LSD(0.05)	4.24	3.30	3.62	4.74	2.30	4.32	1.54	1.32
C.V.(%)	57.6	38.2	29.8	43.7	38.2	56.8	47.8	42.5

Table 3: Effect of Interaction between Time of Planting and Intra-Row Spacing on Species Composition and Abundance of Sucking bugs on Soybean in Ibadan, Southwest Nigeria (Year II)

Planting	Intra row spacing (cm)	Mean total number of sucking bugs encountered per hill during period of study						
		Clavigralla shadabbi	*Anoplocnemis curvipes*	*Nezara viridula*	*Mirperus jaculus*	*Riptortus dentipes*	*Aspervia armigera*	*Piezodorus sp*
	15	7.2	4.8	5.8	4.2	7.6	0	2.8
Mid June	20	7.8	2.8	6.2	3.8	7.4	0	2.2
	25	6.8	3.8	6.8	3.6	7.8	0.8	4.2
	30	6.8	3.6	4.8	3.8	7.4	0	2.6
	15	9.8	10.6	7.6	4.3	5.8	2.6	0.8
Early July	20	10.8	8.7	7.2	5.3	6.3	1.8	2.6
	25	9.6	7.2	6.8	3.8	8.7	0	2.4
	30	8.7	6.8	7.2	4.6	5.8	0	1.8
	15	14.2	13.2	11.3	6.8	9.8	3.3	1.8
Late July	20	13.8	11.8	7.4	5.4	6.6	1.6	1.6
	25	11.2	12.6	10.3	4.8	6.7	0.8	0
	30	10.6	11.4	8.6	4.2	8.2	0.6	0.8
LSD(0.05)		4.42	5.62	3.60	1.86	2.48	2.32	2.24
C.V.(%)		21.2	42.7	48.2	37.2	18.7	31.6	36.2

Table 4: Effect of Interaction between time of Planting and Intra-Row Spacing on Incidence and Damage by Hemiptera Sucking Bugs (HSB) on Soybean in Ibadan, Southwest Nigeria (Year II)

Planting	Intra row spacing (cm)	Total HSB/ infested hill		Undamaged seeds(g)/ infested hill		Damaged seeds(g)/ infested hill		Grain yield (kg/ha^{-1})	
		Yr I	Yr II	Yr I	Yr II	Yr I	Yr II	Yr I	Yr II
	15	37.2	32.4	69.6	71.4	11.6	9.2	574.4	567.2
Mid June	20	35.6	30.2	68.8	70.8	9.2	11.7	302.0	442.5
	25	35.1	33.8	63.6	74.2	16.4	14.6	276.0	394.0
	30	31.2	29.0	64.2	72.3	9.2	8.3	240.4	183.6
	15	48.6	41.5	71.2	73.6	22.9	25.9	729.2	794.0
Early July	20	35.4	42.7	72.4	68.8	23.9	22.4	566.7	620.8
	25	34.5	38.5	74.6	74.6	21.6	19.7	392.6	478.9
	30	28.3	34.9	72.3	74.8	22.3	26.4	267.6	307.2
	15	48.0	60.4	78.7	76.4	33.8	29.8	935.6	974.4
Late July	20	50.2	48.2	91.3	98.6	26.7	31.1	762.0	737.3
	25	42.8	46.4	94.3	99.3	25.6	28.6	563.3	620.9
	30	38.2	44.4	98.7	98.8	21.6	24.8	421.8	441.6
LSD(0.05)		7.6	9.8	5.4	6.3	2.1	2.4	142.6	228.6
C.V.(%)		36.6	26.2	44.8	22.8	18.6	21.7	86.5	68.4

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