Asian Journal of Plant Sciences

ISSN 1682-3974

Asian Journal of Plant Sciences 10 (7): 370-375, 2011
ISSN 1682-3974 / DOI: 10.3923/ajps.2011.370.375

Assessing the Impact of Varietal Resistance and Planting Dates on the Incidence of African Yam Bean Flower Thrips (*Megalurothrips sjostedti*, Hochst. Ex. A. Rich) in Nigeria

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Abstract: African yam bean (*Sphenostylis stenocarpa*, Hochst. Ex. A. Rich) is one of the underutilized leguminous crops in the tropics despite its nutritional potentials. One of the major reasons for the gross neglect of this crop in many parts of Africa is its low grain yield when compared to other grain legumes under monocrop. The infestation of the plant by flower thrips *Megalurothrips sjostedti* has been recorded as the major causes of low yield of the crop. *M. sjostedti* can cause yield losses of up to 100%. Following its current status as a minor crop, only very few researches have been undertaken in its production especially as it relates to insect control. Hence, in this study we assessed the effect of varietal resistance and three planting dates on the incidence of the thrips and crop yields in Nigeria during 2009/2010 farming seasons. The results indicated that all the varieties planted in May of each season were less infested by *M. sjostedti* and differed significantly from those planted in June and July of each season. Amongst the varieties assessed, TSs9 was the most resistance and differed significantly from the rest of the varieties. The results of the grain yields showed that all the varieties performed better with higher grain yields when planted in May than those planted later. The flowering and podding formation stages of AYB planted in July coincided with the peak population densities of *M. sjostedti* resulting in a considerable reduction in grain yields. The highest grain yields were recorded under a combination of early planting with resistant varieties. It could therefore be concluded that planting African yam bean earlier in the season has significant effect on *M. sjostedti* incidence and grain yield.

Key words: *Sphenostylis stenocarpa* varieties, *Megalurothrips sjostedti*, grain yield, yam bean, leguminous crops

INTRODUCTION

African yam bean (*Megalurothrips sjostedti,* Hochst. Ex. A. Rich) is one of the underutilized grain leguminous plants in the tropics especially in Nigeria. It is cultivated by some subsistence farmers mainly in the southern parts of Nigeria. African Yam Bean (AYB) cultivation has also been reported in different parts of Africa (Porter, 1992; Amoatey *et al*., 2000; Klu *et al*., 2001). AYB under-exploitation has subjected to be classified as minor grain legumes (Saka *et al*., 2004). AYB is a vigorously climbing herbaceous vine whose height can reach 1.5-3 m or more. It flowers profusely in 100 to 150 days, producing brightly-colored flowers which may be pink, purple or greenish white depending on variety. The slightly woody pods contain 20 to 30 seeds are up to 30 cm long and mature within 170 days (Klu *et al*., 2001; Adewale and Dumet, 2011).

African yam bean is grown for both its edible seeds and its tubers (Ezueh, 1984; Ene-Obong and Okoye, 1992; Porter, 1992; Klu *et al*., 2001; Adewale and Dumet, 2011). The grain is a good source of proteins, fibre and carbohydrate. It is rich in minerals such as phosphorus, iron and potassium. It is cooked and eaten alone or with yam, maize and rice. Its underground tubers are used as food in some parts of Africa (Klu *et al*., 2001). AYB has been reported to thrive under marginal land with relative high yield (Anochili, 1984; Schippers, 2000; Adewale, 2010). This assertion is probably because AYB is always cultivated in the mixture of other crop and its yield potential could not be properly assessed. According to Adeniyan *et al*. (2007) and Saka *et al*. (2007) intercropping significantly increased seed yield in AYB. The said high grain yield could be improved if certain associated production constraints could be addressed using modern agricultural technology.

Amongst the limiting factors to the production of African yam bean is it low grain yield when compare with other legumes under monocrop conditions (Saka *et al*. 2007). Though, it has been reported that AYB contain lectin used in the control of so many insect pests, its grain yield has been reduced by insects (Ameh and Okezie, 2005). According to them so many insects pests have been recorded attacking the crop starting at the vegetative to reproductive stage. Some of the economic pests of AYB that attack it at the vegetative stage are cutworms (*Agrotis* sp.), aphids (*Aphis craccivora*), grasshopper (*Zonocerus variegates*), *Maruca testulalis, Cydia ptychora* and leaf-rolling caterpillars (*Sylepta derogate*). Both the larvae and adults of these pests infest the crop. At the reproductive stage, the following insects *Cydia ptychora, Helithis armigera, Riptortus dentipes, Apion varium, Nezara viridula* and *Megalurothrips sjostedti* were found infesting the crop. Of all the insect pests recorded in the crop, African yam bean flower thrips (*Megalurothrips sjostedti*) is the most serious pest. It attacks the plant from pre-flowering to flowering stages. During the pre-flowering period, nymphs and adults of this thrips may damage the terminal buds. However, the main damage is on the flower buds and flowers. Attacked flower buds become brown and eventually fall off (aborted), leaving behind dark red scares. Damaged flowers are distorted, malformed and show decolouration and may fall off. Infested pods are malformed with or without seeds and under severe infestation could result in total crop failure.

Following the status of this crop as a minor crop, very little is known about its insect pest control. Currently, there is no major crop protection research activities' going on in this crop as all efforts is focused on major legumes. Farmers that engage in the production of this crop make use of few old cultural control measures and insecticide application for the management of insects that infest this crop. Chemical control cannot be sustained by the fragile economies of most African state and most farmers in the semi-arid tropics are resource-poor and cannot afford the use of pesticides. Moreover, insecticides are toxic and when used excessively may be harmful to the environment (personal communications). There is, therefore, the need for other control measures that exclude the use of chemicals.

Global food security is becoming shaky with increasing dependence on a few major staple crops. The conservation and maintenance of agrobiodiversity of neglected and underutilized plant species such as African Yam Bean (AYB) could contribute in alleviating food insecurity and preventing a potential food crisis. Increasing the use of underutilized crops is one of the better ways to reduce nutritional, environmental and financial vulnerability in times of change (Jaenicke and Pasiecznik, 2009). The use of underutilized crops will be better appreciated by protecting, selecting and assessing the most promising varieties within a species. Although the vast genetic and economic potentials of AYB have been recognized and IITA Ibadan has conserved many accession of this crop, continuous assessment of their egional performance in relation to yield and other biotic stresses will assist in repositioning the status of this crop. Furthermore, following the high premium placed on the major legumes like cowpea (*Vigna unguiculata*,) groundnut (*Arachis hypogaea*) and lima bean (*Phaseolus lunatus*) and others such as soya bean, AYB is in danger of extinction despite its potentials if nothing is done (Klu *et al*., 2001; Saka *et al*., 2007).

There is therefore the need to adopt measures that will reposition the status of this crop through the control of this important pest that could result in total yield loss. Collection and evaluation of available varieties to exploit the benefit of resistance would serve as a source of materials for hybridization for improved crop yield. Furthermore, following the fact that the most recalcitrant pest of AYB is the flower thrips, knowledge of the phenomena that are involved in AYB resistance to the pest becomes quite significant. Hence, in this study, the objective was to assess the impact of varietal resistance and planting dates in the management of African yam bean flower thrips.

MATERIALS AND METHODS

Field experiments were conducted at the experimental farm of the Faculty of Agriculture and Natural Resources Management, Ebonyi Sate University Abakaliki during 2009 and 2010 farming season under rain fed conditions. Abakaliki lies within the derived savannah ecological zone of southeastern Nigeria on latitude 7° 30'E and longitude 5° 45'N with an average annual rainfall of 2000 mm. The fields were laid out in split-plots in randomized complete block design. Three different planting dates (May 4th, June 2nd and July 1st) for 2009/10 were used as the main-plot treatments. Seven promising varieties of African yam bean (TSs 9, TSs 48, TSs84, TSs86, TSs93, TSs94 and TSs166) collected from IITA genetic bank were randomly assigned to sub-plots. Each treatment was replicated three times. The AYB varieties seeds were planted in rows in each plot with a variety occupying a row. The seeds were sown at 2 seeds per hole at a planting spacing of 1 × 0.7 m inter and intra spacing's. Thinning was done three weeks after planting one seedling per stand. Forty kilograms per hectare of compound fertilizer 15 : 15 : 15 NPK was added to all the plots in three weeks after germination to boost growth. Staking was done three weeks after germination using strong stake each measuring about 3 m high. Each seedling was staked independent of another to avoid mixing the varietal yields. The experimental plots were weeded at three weeks intervals No insecticide was applied in order to have the study under perfectly natural conditions.

Daily meteorological data were collected from the Ebonyi State University meteorological station (Table 1).

Observations on the incidence of African yam bean flower thrips were recorded at weekly intervals starting from the onset of anthesis to 50% podding from each variety. Five stands per plot were randomly selected and tagged from each variety. From the tagged plants the population densities of *M. sjostedti* were estimated by randomly picking 20 flowers buds or flowers depending on the stage of growth. The buds or flowers were placed in glass vials containing 50% ethanol solution, subsequently, nymphs and adults of *M. sjostedti* were counted under binocular microscope in the laboratory.

Other data collected were number of aborted flowers and at harvest data were collected on total grain yield per variety from the tagged plants. Estimate of grain yield per unit area was done when the grains were dry using the tagged plants. The pods were threshed and winnowed. The results were extrapolated to kilogram per hectare for each variety at the different planting dates.

Statistical analysis: Damage percentages were subjected to Arcsine transformations before analyses of variance were carried on them through computer software (http://www.sas.com/). The mean separation was carried out by Fisher's protected LSD test. Pearson correlation coefficient (r) was used to determine the relationship between percent infestation and weather factors.

RESULTS AND DISCUSSION

The results indicated that AYB varieties and planting dates have significantly influence the incidence of African yam bean flower thrips and grain yield. The incidence of AYB flower thrips was highest on AYB planted on July of each season (Table 2). It differed significantly ($p<0.05$) from those planted earlier. In both seasons, the minimum incidence was recorded on AYB planted on May 4th. The reduction in thrips infestation with early planting observed could be attributed to the lower populations of the thrips early in the season which subsequently build-up as the season progresses. Similar results have been reported in cowpea in Uganda by Karungi *et al.* (2000). Other studies have also indicated that early planting reduces pest infestation. For example, early season planted groundnut has been shown to have low *A. craccivora* infestations and consequently, little or no groundnut rosette (Naidu *et al.*, 1998). Pest control tactics that involve manipulating the insect environment are well known among traditional farmers. They have practiced these tactics for ages, usually for different reasons than those proposed by scientist Rachie (1985). Several of these agronomic practices are used in different parts of the tropics especially in Africa (Okigbo and Greenland, 1976). One of the most valuable is the planting dates (Asante *et al.*, 2001). This is evident in the present result that showed significant differences on the rate of infestations recorded across the three planting dates. Improved crop cultivars and alteration in planting dates of crops have been reported as an effective strategy in reducing pest damage by a number of researchers (Akesi *et al.*, 1996; Prasa and Singh, 1997; Karungi *et al.*, 2000; Asante *et al.*, 2001). It has also been reported that planting date alteration is probably the most promising approach to the control of pod-sucking bugs at present, because of difficulty in finding resistance to the cowpea

Table 1: Monthly meteorological data of the experimental site for 2009 and 2010 farming seasons.

	2009			2010		
Month	Rain (mm)	Fall temp (°C)	Humidity	Rain (mm)	Fall temp (°C)	Humidity
January	92	30.5	55.44	Nil	27.8	55.8
February	Nil	31.4	8.39	Nil	32.6	29.8
March	202	32.2	83.45	176	32.5	58.5
April	127.1	31.5	81.15	134	30	58.9
May	361.7	30.2	70.37	282.5	27.3	56.2
June	216.13	28.8	86.04	394.8	28.6	64.5
July	381.21	27.8	83.5	159.8	28.3	84.3
August	475.1	28.3	94.17	397.3	28.7	91.7
September	386.3	28.6	93.36	432.1	28.5	93.2
October	438.2	29.2	93.93	420.7	30.1	92.5
November	91.3	30.5	91.9	78.3	30.2	89.2
December	Nil	30.1	66.76	Nil	30.3	54.6
Total	2771	359.1	979.4	2472.5	354.9	829.2
Mean	203.9	29.9	81.6	206	29.6	69.1

Table 2: Effect of varietal resistance and planting dates on mean number of *Megalurothrips sjostedti* population per 20 flower buds/flowers

Varieties	May	June	July	Mean
[a]Planting dates for 2009				
Tss 9	10.4±1.31	6.4±3.3	18.1±1.4	15
TSs 48	13.5±2.7	20.7±2.3	25.3±2.7	19.8
Tss84	25.9±3.1	27.9±1.7	35.2±2.6	29.7
Tss86	19.9±3.3	23.7±3.4	25.5±2.5	23.0
Tss93	31.9±3.2	34.1±2.0	40.3±2.8	35.4
Tss94	25.5±3.5	27.3±2.7	29.9±2.2	27.6
Tss166	18.2±2.5	24.5±2.3	30.2±2.0	24.3
Mean	20.7	24.9	29.2	
[b]Planting dates for 2010				
Tss 9	7.4±1.1	14.4±1.3	18.9±5.1	13.6
TSs 48	15.1±2.2	21.4±1.9	26.6±4.1	21.0
Tss84	21.7±2.2	27.1±1.6	28.6±3.7	25.8
Tss86	11.8±1.8	18.6±1.6	26.1±3.6	18.8
Tss93	26.4±2.4	30.4±1.6	34.1±2.8	30.3
Tss94	17.3±2.6	23.1±2.1	27.2±4.1	22.5
Tss166	15.3±2.1	21.9±1.7	25.4±4.0	20.9
Mean	16.42	2.4	26.7	

[a]LSD ($p<0.05$) for comparing two planting dates Means = 1.4, LSD ($p<0.05$) for comparing two AYB varieties means = 5.6. [b]LSD ($p<0.05$) for comparing two planting dates Means = 1.3, LSD, ($p<0.05$) for comparing two AYB varieties means = 4.9

hemipteran complex (Jackai, unpublished). There were negative correlations between *M. sjostedti* infestation and rainfall and relative humidity r = -0.78 and-0.67 (p<0.001) for rainfall and RH respectively, a positive correlation between *M. sjostedti* infestation and temperature (r = 0.62, p<0.001. The less infestation recorded for the earlier planted crops may therefore be attributed to frequent number of rain days and amount of rain with moderate temperature that was observed at the period of the flowering stage which does not favour the multiplication of thrips (Table 1).

There were consistent differences among entries in density of *Megalurothrips sjostedti*. Amongst the varieties assessed, TSs9 was the most resistance and differed significantly from the rest of the varieties, followed by TSs48 and TSs86 that also differed from other varieties. In the both wet seasons, the incidence of *M. sjostedti* was higher in 2009 than in 2010 across the varieties. In all the two seasons, varieties TSs84 and TSs93 had the higher proportions of number of infested flowers and aborted flowers, than did other varieties. All the varieties were less attacked during the raining period than at the drier period as indicated in the Table 2 and 3. These results differed from earlier research results that suggested low level of AYB infestation by pests. The low insect pest infestations recorded by many earlier research may be attributed to the mixed cropping system adopted for this crop and mixed cropping is a control measure that deter a potential pest from attacking a target crop. The high level of AYB infestation by *M. sjostedti* recorded in this work may therefore, be attributed to the fact that the crop was planted as a sole crop and created room for proper assessment of its pest load. Similar result has been reported in cowpea by Karungi *et al.* (2000). AYB is generally intercropped with other crops and several studies have shown that the population of flower thrips is consistently lower under intercrop (Matteson, 1982). Kyamanywa and Ampofo (1988) have shown convincingly that shade keep the population of thrips down in intercropped field. That is to say that intercrop causes the under estimation of insect infestation in AYB in almost all the cultivating areas. The differential resistance levels observed confirms the significant of this study for improved production of this crop.

The results of the grain yield indicated that AYB planted earlier gave higher yield across all the varieties than those planted later with the highest grain yield recorded in TSs86 and TSs48 that differed significantly from other varieties across the experimental periods (Table 4). This is probably due to the fact that early sown

Table 3: Mean number of aborted flowers by *M sjostedti* during 2009/2010 farming seasons

Varieties	Mean No. of Aborted flowers 2009	Mean No. of Aborted flowers 2010	Mean
TSs 9	13.5±3.2	8.9±1.9	11.2
2TSs 48	19.5±3.0	10.9±1.8	15.2
3TSs84	22.8±2.1	21.8±1.5	22.3
4TSs86	18.0±2.8	9.8±1.6	13.9
5TSs93	21.4±2.8	14.9±1.8	18.2
6TSs94	20.9±2.2	16.1±1.9	18.5
7TSs166	11.9±2.5	9.9±1.8	10.9
Mean	18.3	13.2	

LSD (p<0.05) for comparing two year Means = 3.3, LSD (p<0.05) for comparing two AYB varieties means = 4.2

Table 4: Effect of planting dates and variety on total grain yield (kg/ha) for 2009/2010 farming seasons

Varieties	May	June	July	Mean
[a]Planting dates 2009				
Tss 9	566.8	466.0	383.8	472.2
TSs 48	604.7	526.9	421.2	517.6
Tss84	434.2	328.82	86.2	349.7
Tss86	640.5	529.1	470.1	546.6
Tss93	521.2	450.73	21.3	431.1
Tss94	553.9	500.73	52.5	469.0
Tss166	534.7	403.03	62.7	433.5
Mean	550.9	457.9	371.1	
[b]Planting dates 2010				
1TSs 95	20.2	471.3	352.1	447.9
2TSs 48	600.1	501.3	393.1	498.2
3TSs844	28.3	412.6	213.9	351.6
4TSs86	530.7	471.7	353.9	452.1
5TSs93	500.1	375.5	352.8	409.5
6TSs94	457.2	320.9	299.1	359.1
7TSs166	400.7	353.1	300.7	351.5
Mean	491.0	415.2	323.7	

[a]LSD (p<0.05) for comparing two varieties of AYB means = 49.1, LSD (p<0.05) for comparing two planting dates means = 91.2. [b]LSD (p<0.05) for comparing two varieties of AYB means = 55.6, LSD (p<0.05) for comparing two planting dates means = 69.3

AYB may have passed the flowering stage before the peak infestation of *M. sjostedti* that occur from mid-September through November. The flowering and podding formation stages of AYB planted in July coincided with the peak population densities of *M. sjostedti* resulting in a considerable reduction in grain yields. This is in agreement with Akingbohungbe (1982) and Asante *et al.* (2001) who reported that cowpea planted in June or July in Southern Nigeria usually escape severe thrips infestation while those planted late in August coincide with the peak population densities of the major post-flower pests resulting in considerable reduction of grain yield. They maintained that cowpea yields depended on cowpea cultivars and planting dates. Similar results have also been reported by Karungi *et al.* (2000) in Uganda and for pod-sucking bugs in Nigeria (IITA, 1982). The fact that the highest resistant variety did not give the highest grain yield may be attributed the genetic makeup of these varieties. Regardless of the pest attack, there was an increase in yield when varieties with higher level of resistance were planted in May than when planted later.

The higher yields recorded in some varieties compared to others may be due to differential pest pressure and genetic make.

CONCLUSION

Although the future of the crop seems to be dwindling in popularity, AYB has great potential for development into a major cash crop and thereby contributing to food security in the country. This will only be visible through proper insect pests control with resultant increase in grain yield. The incidence of African yam bean flower thrips has been observed to be influenced by time of planting in association with the climatic factors (many rain days and high relative humidity). In effect, the micro climatic conditions of a place determine the degree of African yam bean flower thrips incidence. Proper planting time in association with resistance varieties could offer effective control measures of African yam bean flower thrips with optimum grain yield. Resistance should be tailored to suit different locations and needs rather than seeking to develop varieties that could be planted everywhere. In conclusion, these methods have significant effect in the management of *M. sjostedti* and if adopted as a component of IPM package for AYB flower thrip control, will result in an enhanced AYB production, utilization and food security in Nigeria.

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