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Evaluation of the Effect of Neem Plant on Insect Pests Control and Yield in Sweet Potato Production

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ABSTRACT

Sweet potato, *Ipomoea batatas* (L) Lam is a dicotyledonous plant with creeping vines and vegetative covering, and this can help in smothering weeds. Twenty-eight lines of sweet potato were evaluated for different quantitative characters such as number of vines, number of leaves, number of nodes and length of vine; and for qualitative characters of vine colour, leaf shape, and leaf colour in relation to tuber yield. Analysis of variance was used to know the significant effect of blocking and treatment on the various traits evaluated in relation to tuber yield. Correlation analysis was also carried out to determine relationships among the quantitative characters evaluated. Results showed that there were significant variations among the lines evaluated. Treatment was also significant on the characters evaluated at intervals. The correlation analysis showed that there was linear relationship between the number of leaves and number of nodes, days to 50% flowering, yield/plant and yield/plot; which implies that increase in the number of leaves is directly proportional to the number of nodes on the plant. Qualitative characters such as green vines and green petiole, which increases radiation interception also contributed significantly to biological yield of sweet potato.

1. Introduction

Sweet potato, *Ipomoea batatas* (L) Lam, is a dicotyledonous plant which belongs to the family Convolvulaceae. It has approximately 50 genera and more that 1,000 species of this family. *Ipomoea batatas* is the only crop plant whose large, starchy, sweet tasting tuberous is an important roots vegetable (Purseglove, 1991; Woolfe, 1992). The young leaves and shoots are sometimes eaten as green vegetable. Sweet potato is distantly related to the Irish potato, *Solanum tuberosum*. It is commonly confused with yam in some pats of North America, although they are only very distantly related to other tubers known as yams (in the discoreaceae family), which is native of Africa and Asia.

Sweet potatoes are native to the tropica parts of South America and were domesticated there at about 8,000 and 6,000 BC ago (Austin, 1988). The primary centre of diversity occurs in Columbia, Ecuador and Northern Peru while secondary centre were found in Central America (Yen, 1982). Sweet potato was introduced to Europe by Columbus. The movement of sweet potato to Africa and Asia was accomplished by the Spanish and the Portuguese people who introduced them to their trading settlements.

Sweet potato cultivars are grouped into various classes, namely: firm, dry mealy flesh (preferred in most countries of South East Asia, the pacific and East Africa); soft, moist gelatinous flesh (preferred in developed countries); and coarse, fibrous tubers for industrial uses as starch, snack foods, alcohol and animal feed (Onwueme, 1978).

Ipomoea batatas plant has a creeping stem above the ground called a “stolon” with the leaves arranged spirally on the stem. The leaves are simple and may have entire margins or may be digitally lobed. The flowers are regular with bell-shaped corolla and are solitary. The petiole varies in colour from green to purple which can be 5 – 30cm long and retains the ability to grow in a curved or twisted manner so as to expose the lamina to maximum light (IITA, 1982 and Yen, 1982).

Neem, *Azadirachta indica* (A. Juss) is a member of the mahogany family. Neem trees are attractive broad – leaved evergreens that can grow up to 30m tall and 2.5m in girth. Their spreading branches form rounded crowns as much as 20m across. They remain every green except during extreme drought, when the leaves may fall off. The short, usually straight trunk has a moderately thick, strongly furrowed bark. The roots penetrate the soil deeply; at least where the site permit, and particularly when injured, they produce suckers. This suckering tends to be especially prolific in dry locations. Neem secretes Azadirachtin which repel or reduce the feeding of many insects on crops (Stoll, 1986).

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Neem usually is easy to establish; it grows best on deep, well-drained sandy soils. It can be raised in nurseries and transplanted as seedlings but direct sowing on the sites is sometimes easier and more successful. Neem is also renowned for good growth on dry, infertile sites. It performs better than most tress where soils are sterile, stony and shallow, or where there is a hardpan near the surface. The tree also grows well on some acid soils. Indeed, it is said that the fallen neem leaves, which are slightly alkaline (PH 89.2), are good for neutralizing acidity in the soil. On the other hand, neem cannot stand "wet feet" and it quickly dies when site becomes water-logged.

Control of diseases and pests of sweet potato comes in diverse forms as most of them will not be sufficient on their own (Jacobson, 1987). To produce a good potato crop, a combination of various control methods is often applied.

One of the first active ingredients isolated from neem, azadirachtin, has proved to be the tree's main agent for battling insect pests. It appears to cause up to 90 percent of effective control on most pests. It does not kill insects – at least not immediately. Instead, it both repels and disrupts their growth and reproduction. Research over the past 20 years has shown that it is one of the most potent growth regulators and feeding deterrents ever assayed. It will repel or reduce the feeding of many species of insect pests as well as some nematodes. In fact, it is so potent that a mere trace of its presence prevents some insects from even touching plants (Jacobson, 1986b). This argument thus formed the technical basis for considering neem as an agent on managing insect pests in sweet potato cultivation.

The major objectives of this work were: to determine the influence of neem plant on the control of insect pests on some sweet potato lines and to evaluate selected sweet potato lines for early-maturing and high-yielding characteristics above other characteristics.

2. Materials and methods

The Vine and the Source

Twenty eight lines of sweet potato (Table 1) were used for this experiment. All the lines were sourced from the Department of Plant breeding and Seed Technology, University of Agriculture, Abeokuta. Neem was sourced from Forestry Research Institute of Nigeria (FRIN), Ibadan. Fifteen Neem seedlings were used per plot of $280m^2$.

Experimental Site

The experiment was carried out at Plant Breeding and Seed Technology Department farm site, Alabata Abeokuta. The soil is a well-drained sandy-loam soil with pH of 6.6 and conductivity of 50um (Table 2). Results of soil analysis indicated the Nitrogen content of the soil is 0.15%, available calcium is 1.16 Cmol, available phosphorous is 6.75ppm, available magnesium is 0.99 and potassium content of the soil is o.56 Cmol, manganese content is 56.60 mg/kg and sodium content of the soil is o.37 Cmol (Table 2). The annual rainfall in the experimental site was about 1,300 mm per annum with altitude of 7^o21^1N and longtitude 5^o25^1E.

Experimental Design and Planting

A Randomized Complete Block Design (RCBD) was used for the experiment. It consisted of 28 lines replicated 3 times to give a total of 84 experimental units, with a control block. A replicate comprised 28 ridges; a ridge having a dimension of 2m x 0.75m, with the space between two ridges along a row being 0.5m, and 1m gang way. Neem seedlings were planted 7m apart along the rows and 4m between rows. Planting of the neem was done in March, 2009 and that of Sweet potato was done in April of the same year. Weeding was the only cultural practice carried out on the plot. It was carried out twice and regular rouguing was also carried out to reduce effect of weeds.

Data collection

Data was collected forthnightly on two plants from each plot excluding the guard rows to eliminate boarder effect. Data on both qualitative and quantitative characters were collected. The qualitative characters that were evaluated are: leaf colour, vine colour, tuber skin colour, shape of the leaves. The quantitative characters that were evaluated are: number of leaves/stand, number of vines/stand, number of nodes/vine, length of the vine (cm), yield per plant (kg), yield per plot (kg) and yield per hectare (kg).

Statistical Analysis

Analysis of variance was carried out on the agronomic and yield data collected using SAS version 9.1 (SAS, 1999), in order to determine the effects of blocking and treatments on the overall performance of sweet potato lines evaluated. Means of treatments were separated using Duncan's Multiple Range Tests (DMRT). Correlation analysis was also carried out to determine relationships among the quantitative characters evaluated.

3. Results and discussion

Table 1 shows the different qualitative characters evaluated. The colours of the leaves are all deep green except TIS 8250 and BLESBOK which are light green in colour. The shape of the leaves vary among the lines. The leaf shape varies from lanceolate in BLESBOK, acute in IJ NOBLE, ovate in 440215, acuminate in NASPORT 5 to linear in MG; while 199062.1 and Arrow tip have renifirm and sagitate leaf shape, respectively. Table 1 also shows that vines colour ranges between green and purple. IJ NOBLE, 440216, 199062.1, Ex-OYUNGA, RESISTO, DCA 001 and DCA 003 are purple in vine colour while all other lines are green. The tubers skin colour ranges from cream in

SHABA, orange in DCA001, pink in SAUTI, and purple in NASPORT 6 (2), IJ Noble and arrow tip. The flesh colour also varied from one line to another (table 1).

Tables 3, 4 and 5 show mean square values of different parameters at eight, ten and twelve weeks respectively after planting. Table 6 shows the means of the quantitative characters of sweet potato evaluated under neem plant and control treatments. Sweet potato yields under these two treatments are also presented in table 7.

At 8 weeks after planting (WAP), blocking had no significant effect on number of vines, length of vines, number of nodes but significantly different with respect to the number of leaves, number of vines, length of vine and numbr of nodes at 5% level of probability (table 3). The neem treatment effect and interaction effect were also highly significant on all the characters evaluated.

Blocking was only significant for number of leaves (at 10 and 12 WAP) and not significant for the other variables evaluated. Lines and neem effects and their interactions were however highly significant for all the variables evaluated at 10 and 12 WAP (tables 4 and 5).

Means of quantitative characters of sweet potato evaluated under neem effect and control were statistically different for all the characters (table 6). SHABA recorded the highest yield (2.71kg/plot) under neem, while TIS 87/0087 also had the highest yield (1.25kg/plot) under the control plot (table 7).

Number of vines and the number of nodes on the vines significantly increased the number of leaves on sweet potato plant (table 8); the overall effect of which tuber yield also significantly increased.

Tuber yield may be as a result of genotype x environment interaction. Environmental factors such as daylenght, moisture regime and nutrient level of the soil greatly affect the tuber yield. Sweet potato as a short day plant will grow vegetatively without producing tubers during long day period (Onwueme, 1978).

Moisture stress also affects flower production, which in turn impedes tuber formation. Moisture stress results in flower abortion in the plants thus leading to vegetative development rather than tuber development. The leaf is the most important part of the plant as it is the major parameter of photosynthesis needed for plant growth and tuber development. Scott and Wilcockson (1978) thus argued that “any factor which leads to increase in radiation interception is likely to increase the biological yield commensurately”. For each variety, tuber dry matter yield will also increase proportionately. Thus, the lines with large number of leaves, green vines and green petioles which also take part in photosynthesis lead to increase in the assimilates partititoned to the storage organs. This was observed in TIS 87/0087 and SHABA with green vines and green petioles besides the green leaves which contributed greatly to the intercepted radiation thus increasing their tuber yield. This characteristic also makes planting materials available for the next planting season. SHABA and 199034.1 had high vegetative covering, which also contributed to their high tuber yield.

Time of maturity is also very important in selecting the best variety for farmers and consumers. The line 440216, in terms of maturity, is the earliest maturing line among the 28 lines evaluated. It matured 3 months after planting. It also has orange flesh tuber which is an indication of the presence of β carotene which can be used to combat vitamin A deficiency in little children, thus, increasing their maturity against infections. Lines EX-OYUNGA and 199034.1 also have orange flesh tuber.

Lines such as SPK 004 and DCA 002 are not well-adapted to environmental conditions of Abeokuta, while SHABA, TIS 87/0087 and NASPOT 6 (2) are the best lines for this environment in terms of yield.

Neem plant seems to have a remarkable control on spider, termites and grasshoppers. It plays essential role in combating pests by the presence of a compound called Azadirachtin. However, the product of neem plant can also favour worm production in the soil, which consequently influence increase in soil nutrient resulting in increased crop performance and yield (Rosner, 1987). According to Jacobson (1986a), neem had helped increasingly in improving the yield of some lines such as MGO, 40004 and EX-OYUNGA, compared to the control. Neem plant also increased significantly the agronomic performance of some of the lines evaluated.

4. Conclusion

From this work, it can be deduced that number of leaves, number of nodes, and number of vines and length of vines increase with the age of the plant. Sweet potato lines: SHABA, NASPOT 6 (2) and TIS 87/0089 performed better in terms of tuber yield and earliness to maturity under the neem treatments. Based on tuber yield, SHABA is recommended for cultivation by farmers, especially in Ogun state. In the improvement of sweet potato however, more lines with orange flesh tuber should be developed in order to reduce vitamin A deficiency. In a sweet potato production, there is need to effectively incorporate neem plant as a means of combating pests in sweet potato production as well boosting sweet potato yields.

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Table 1. Qualitative characters of the 28 sweet potato lines evaluated in the experiment.

LINES	LEAF COLOUR	VINE COLOUR	TUBER SKIN COLOUR	TUBER FLESH COLOUR	LEAF SHAPE
IJ NOBLE	GREEN	PURPLE	PURPLE	WHITE	ACUTE
SAUTI	GREEN	GREEN	CREAM	CREAM	ACUMUNATE
440216	GREEN	PURPLE	CREAM	ORANGE	ACUTE
199062.1	GREEN	PURPLE	CREAM	CREAM	RENIFORM
EX-OYUNGA	GREEN	PURPLE	ORANGE	ORANGE	ACUTE
TIS 87/0087	GREEN	GREEN	PINK	WHITE	ACUTE
440027	GREEN	GREEN	PURPLE	CREAM	LANCOLATE
BLESBOK	LIGHT GREEN	GREEN	ORANGE	CREAM	LANCOLATE
ARROW TIP	GREEN	GREEN	PURPLE	WHITE	SAGITATE
MG	GREEN	GREEN	PURPLE	WHITE	LENEAR
NASPOT 6 (2)	GREEN	GREEN	PURPLE	WHITE	LANCOTE
SHABA	GREEN	GREEN	CREAM	CREAM	ACUMULATE
SPK 004	GREEN	GREEN	CREAM	CREAM	LANCOTE
199034.1	GREEN	GREEN	YELLOW	YELLOW	LANCOTE
RESISTO	GREEN	PURPLE	CREAM	CREAM	ACUMILATE
NASPOT 2 (10)	GREEN	GREEN	PURPLE	CREAM	ACUMILATE
EJUMULA	GREEN	GREEN	PURPLE	WHITE	ACUMILATE
40004	GREEN	GREEN	CREAM	WHITE	ACUTE
440215	GREEN	GREEN	PURPLE	CREAM	ACUTE
440163	GREEN	GREEN	CREAM	ORANGE	OVATE
NASPOT 5	GREEN	GREEN	PURPLE	WHITE	ACUMILATE
BARTH	GREEN	GREEN	CREAM	ORANGE	AVATE
TIS 8250	GREEN	GREEN	PURPLE	WHITE	ACUMILATE
440168	GREEN	GREEN	ORANGE	CREAM	LINEAR
DCA 001	GREEN	GREEN	CREAM	CREAM	ACUTE
DCA 002	GREEN	GREEN	PURPLE	CREAM	ACUTE
DCA 003	GREEN	PURPLE	PURPLE	WHITE	OVATE
DCA 004	GREEN	GREEN	CREAM	CREAM	OVATE

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Table 2. Routine soil analysis of the Experiemental site.

Nutrient	Composition
Calcium	1.16cmol
Magnesium	0.99cmol
Sodium	0.37cmol
Available Potassium	0.56cmol
Phosphorus	6.75ppm
Manganese	56.69mg/kg
Nitrogen	0.15%
PH	6.6

Table 3. Analysis of variance of some Quantitative Characters of Sweet Potato at Eight Weeks after Planting.

S.V	d.f	No of vines	No of Leaves	Length of vines	No of nodes
Block (B)	2	0.82ns	530.76*	185.44ns	22.33ns
Lines (L)	27	4.71**	348.99**	2090.16**	94.37**
Neem (N)	1	29.17**	15260.01**	9997.71**	871.78**
L x N	27	2.38**	1487.87**	748.79**	68.64*
Error	110	0.49	12334.23	83.40	37.16
Total	167				

* - significant of 5% level of probability,

** - significant at 1% level of probability,

ns – not significant,

S. V. – sources of variation, d. f. – degrees of freedom.

Table 4. Analysis of variance of some Quantitative Characters of Sweet Potato at Ten Weeks after Planting.

S.V	d.f	No of vines	No of Leaves	Length of vines	No of nodes
Block (B)	2	1.47ns	549.57*	254.39ns	23.51ns
Lines (L)	27	10.14**	12487.28**	7075.72**	121.42**
Neem (N)	1	21.78**	92928.46**	18997.51**	703.97**
L x N	27	6.48**	3617.39**	3128.20**	25.53**
Error	160	0.77	310.99	809.56	12.61
Total	167				

* - significant of 5% level of probability

**- significant at 1% level of probability

ns – not significant,

S. V. – sources of variation, d. f. – degrees of freedom.

Table 5. Analysis of variance of some Quantitative Characters of Sweet Potato at Twelve Weeks after Planting.

S.V	d.f	No of vines	No of Leaves	Length of vines	No of nodes	Flowering	Yield
Block (B)	2	1.07ns	422.60*	1145.01ns	20.47ns	20.47ns	0.00085ns
Lines (L)	27	16.22**	17263.52**	6276.15**	127.99**	8233.79**	0.3026**
Neem (N)	1	14.88**	32824.48**	18270.86**	566.50**	210.38**	1.1503**
L x N	27	8.63**	3789.67**	1048.79**	38.41**	54.00**	0.1489**
Error	110	1.27	386.62	346.49	15.44	24.00	0.05
Total	167						

* - significant of 5% level of probability
**- significant at 1% level of probability
ns – not significant,

S. V. – sources of variation, d. f. – degrees of freedom.

Table 6. Means of Quantitative Characters of sweet potato lines evaluated at 12 Weeks after Planting.

Treatment	No of vines	No of Leaves	Length of vines	No of nodes	Flowering	Yield
Control	4.46[a]	121.88[a]	122.18[a]	31.45[a]	38.17[a]	0.44[a]
Neem	3.87[b]	93.92[b]	101.32[b]	27.77[b]	35.93[b]	0.27[b]

Table 7. Yield at harvest for 28 sweet potato lines evaluated under neem plant and control treatments.

Lines	Yield under neem plant (Kg/plot)	Yield under control plot (Kg/plot)
199034	0.57	0.33
199062.1	0.47	0.17
40004	0.79	0.34
440027	0.36	0.43
440163	0.57	0.27
440168	0.43	0.16
440215	0.74	0.25
440216	0.61	0.40
ARROWTIP	0.73	0.33
BARTH	0.63	0.44
BLESBOK	0.59	0.33
DCA 001	0.64	0.46
DCA 002	0.41	0.15
DCA 003	0.64	0.312
DCA 004	0.79	0.40
EJUMULA	0.70	0.25
EX – OYUNGA	0.71	0.31
IJ NOBLE	0.81	0.60
MG	0.62	0.37
NASPOT (2) 1	0.35	0.69
NASPOT 5	0.35	0.19
NASPOT 6 (2)	2.34	0.60
RESISTO	0.47	0.22
SAUTI	0.44	0.16
SHABA	2.71	1.18
SPK004	0.39	0.17
TIS8250	0.64	0.46
TIS87/0087	0.97	1.25

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Table 8. Correlation Coefficients of Yield and some Agronomic Characters of the 28 Sweet Potato Lines.

	No of vines	No of Leaves	Length of vines	No of nodes	Days to 50% Flowering	Yield
No of vines		0.532**	0.140ns	0.183*	0.037ns	0.099ns
No of leaves			0.310**	0.380**	-0.163*	0.041ns
Length of vines				0.448**	0.093ns	0.260**
No of nodes					-0.034ns	0.206**
Flowering						0.263ns
Yield						

* - significant of 5% level of probability

** - significant at 1% level of probability

ns - not significant.