CARD International Journal of Agricultural Research and Food Production (IJARFP)
ISSN: 2536-7293 (Print): 2536-7307 (Online)
Volume 1, Number 3, December 2016
http://www.casirmediapublishing.com

Comparative Evaluation of the Contribution of Leguminous Crops to Soil conservation, productivity of Selected Advanced Pre Release Orange Fleshed Sweet Potato lines and the Profitability of the Cropping System

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ABSTRACT

Field experiments were conducted during the 2015 and 2016 rainy seasons at the Abuja University Research Farm, Federal Capital Territory, Nigeria, to evaluate the Contribution of Leguminous Crops to Soil conservation, productivity of Selected Advanced Pre Release Orange Fleshed Sweet Potato lines and the Profitability of the cropping System. Treatments consisted of Groundnut+ AYT/08/055, Groundnut+NRSP/11/097, Groundnut+EA/11/003, Groundnut+UM/SP/03, Groundnut+ Kwara, Soybean+AYT/08/055, Soybean+NRSP/11/097, Soybean+EA/11/003, Soybean+UM/SP/03, Soybean+AYT/08 Soybean+ Kwara, Cow pea+ AYT/08/055, Cow pea+NRSP/11/097, Cow pea+ EA/11/003, Cow pea+ UM/SP/03, Cow pea+ Kwara, Pigion pea+ AYT/08/055, Pigion pea+NRSP/11/097, Pigeon pea+ EA/11/003, Pigion pea+ UM/SP/03, Pigion pea+Kwara. combined factorially in a Randomized Complete Block Design. Results revealed that the status of some basic elements which was very poor before the experiment commenced was enhanced significantly (P>0.05) especially in Groundnut/Potato and Cowpea/Potato intercrop plots.Generelly, Sweet potato lines established by 95% in mixture with legumes and by 75% under sole crops. AYT/08/055 in groundnut mixture produced 33%, under soybean,22%, cowpea, 6% and in Pigeon pea mixture,34% more root yield than its sole crop root yield while NRSP/11/097 groundnut mixture produced 28%, in soybean mixture, 16% and in Pigeon pea mixture 34% more root yield than its sole crop yield but under cowpea/legume mixture, its root yield was 8% less than its sole crop yield an indication of strong inter specific competition between the two crops. AE/11/003 line produced under groundnut mixture 28%, in soybean 24%, cowpea 6% and under pigeon pea mixture, 28% more root yield than its sole crop yield. For UM/SP/03, its intercrop yield was more than its sole crop yield by 28% in groundnut mixture, 24% in soybean mixture and 34% in pigeon pea mixture but was 42% less than the sole crop in cowpea

mixture. Kwara variety produced 5% more root yield in groundnut mixture, 8% in soybean mixture and 24% in pigeon pea mixture than its sole crop yield but its sole crop root yield was 10% higher than its intercrop yield in cowpea mixture. Pigeon pea+NRSP/11/097 gave the highest L.E.C. while UMU/SP/O3+ soybean mixture gave the lowest L.E.C.(0.45) and the highest GM (4.85) was obtained from Pigeon pea+NRSP/11/097 mixture while the least (0.644) came from Cow pea+ UM/SP/03 crop mixture. For intercropping purposes, it is therefore suggested that potato/groundnut and potato/pigeon pea intercrops are more suitable for high yield.
Keywords: Comparative, Contribution, soil conservation, Intercropping, Sole cropping, Land Equivalent Ratio, Land Equivalent Coefficient, Benefit Cost Ratio.

INTRODUCTION

The economy of Nigeria historically was based on agriculture, and about 70% of the workforce is still engaged in farming (largely of a subsistence type). The chief crops are cocoa, peanuts, palm oil, corn, rice, sorghum, millet, soybeans, cassava, yams, and rubber. In addition, cattle, sheep, goats, and pigs are raised.

With the advent of crude oil, petroleum became the leading mineral produced in Nigeria and provides about 95% of foreign exchange earnings and the majority of government revenues. The growing oil industry attracted many to urban centers, to the detriment of the agricultural sector, and the huge government revenues from oil led to widespread corruption that has continued to be a problem. In the 1980s a decline in world oil prices prompted the government to bolster the agricultural sector. One of such many measures was the project "Sweet potato Action for Security and Health in Africa,(SASHA)", a 5 year project with the goal of how Nigeria which ranks third in global output of sweet potato can exploit the untapped potential of sweet potato for profit and Health Initiative expected to improve the health of over 20 million people in Sub Sahara Africa in 10 years, (Tewe et al 2003).

With the current economic crises and subsequently the recession in the country, SASHA project needs to be given serious attention by the Federal Government. Thanks to National Root Crop Research

Institute, Umudike, (NRCRI) of which mandate crops also include Sweet potato. With the Institute several varieties of highly improved sweet potato had been produced. Three improved varieties had been officially released by NRCRI and planted by farmers, (Gruver 2015). These are TIS87/0087 (White fleshed), TIS 8164, (Cream fleshed and TIS 2532-OP-1-13 (White fleshed). In addition to the three varieties above, over 30 pre-released advanced lines of Orange fleshed sweet potato had been produced by the Institute, some of which can produce up to 40 t $ha^{-1.}$ of storage roots. Some of them include; AYT/08/055, NRSP/11/097, TIS/87/0087, NRSP/12/060, EA/11/003, NRSP/12/095, AE/M/022, CIP/42/0068, CIP/99/004-2, UM/11/001, UM/SP/03, KWARA/ UM/11/015 and EA/11/025.

In addition to their high yielding, most of these advanced lines effectively cover the ground within two or three weeks. This "canopy closure" puts tiny, emerging weeds in the shade and hinders their growth, (Gruver et al 2015). With weeds relatively controlled by this process, the only major problem confronting farmers will be soil fertility for effective performance of the crops in the field. This is so because apart from the health hazards associated with the use of chemical fertilizers that had led to the quest to substitute with organic fertilizers, its market price is beyond the reach of 80% of farmers in Nigeria. Unfortunately, the highly recommended organic fertilizer is also not readily available in the market despite its high price. Hence there is need to look for suitable cheap alternative for the farmers to keep their farms fertile for sustained crop yield. This trial is therefore designed to assess the efficiency of selected leguminous crops in soil fertility maintenance in the production of selected pre release advanced sweet potato lines, to assess the mixture productivity of inter cropping the advanced sweet potato lines with selected legumes and to make recommendation to the farmers as to the best leguminous crop for the production of sweet potato.

MATERIALS AND METHODS

Two experiments, one in 2015 and the other in 2016 were carried out at the Teaching and Research Farm of the Faculty of Agriculture, University of Abuja, Nigeria, located on Latitude 8°98' in the East and Longitude 7°19' North. Average temperature in this area was 33°C with 14% humidity during planting season and an annual rainfall of 1,100 to 1,600 mm in 2015 while in 2016 the data were; temperature 32°C with 14.6% humidity and rainfall of 1000 to 1300mm.

The Experimental treatments of which effects were evaluated include; the Legume crops (Factor A); Groundnut (*Arachis hypogeae*), Soy bean (*Glycine max*) and Cowpea (*Zigna unquiculata*), Pigion pea(*Cajanus cajan*) and Advanced Potato variety (Factor B); AYT/08/055 (Advanced New Trial, 2008, line 97), NRSP/11/097 (National Root Sweet Potato, 2011, No. 97), EA/11/003 (variety obtained from East Africa, in 2011, no. 3 in line of foreign introduction), UM/SP/O3 (Umudike Sweet Potato, no. 3),Kwara (Local variety obtained from kwara state,

The factorial arrangement of the two treatments gave a total of 20 treatment combinations; Groundnut+ AYT/08/055, Groundnut+NRSP/11/097, Groundnut+EA/11/003, Groundnut+UM/SP/03, Groundnut+ Kwara, Soybean+AYT/08/055, Soybean+NRSP/11/097, Soybean+EA/11/003, Soybean+UM/SP/03, Soybean+AYT/08 Soybean+ Kwara, Cow pea+ AYT/08/055, Cow pea+NRSP/11/097, Cow pea+ EA/11/003, Cow pea+ UM/SP/03, Cow pea+ Kwara, Pigion pea+ AYT/08/055, Pigion pea+NRSP/11/097, Pigeon pea+ EA/11/003, Pigion pea+ UM/SP/03, Pigion pea+Kwara. For the purpose of mixture productivity assessment, sole crop plots of both the individual legumes and the advanced sweet potato lines were established.

The experimental design used was Randomized Complete Block Design (RCBD) with 3 replicates. Each replicate contained 29 plots, and each plot measuring 3m x 3m, contained 3 ridges. Each ridge was one meter away from the other. Thus, a total of 87 plots and 261 ridges were established for the experiment. Each plot was separated from the other by 1m pathway.

Planting was done uniformly with sweet potato planted at the spacing of 1m x 30cm giving a population of 33333.33 stands/ ha^{-1} and the legumes at 50cm x 50cm(1 seed per hole)giving a population of 40,000 stands/ ha^{-1} . During planting, 2/3 of the length of each potato vine (20cm long) was inserted into the soil, at an angle of 60°. The soil around the vine was firmly pressed to ensure proper contact of the vine with the soil for easy establishment. While the sweet potato vines were planted at the top of the ridges, the legume seeds were planted by the side of the ridges. First weeding was done three weeks after planting using hoes.

Data collected include; Stand count at harvest, Mean number of marketable root/plot, Mean number of unmarketable root/plot and Root yield tones/hectare, legume seed yield t ha^{-1}, Land Equivalent Ratio (LER), and Land Equivalent Coefficient (LEC). An Economic analysis was carried out to determine the monetary benefit from the various cropping systems. Total cost (TC) was recorded for individual cropping systems. Total Cost is defined as total expenses incurred during the production period which is obtained by multiplying the inputs used by unit prices. Total Revenue (TR) for individual cropping systems was obtained by multiplying units of out puts with current farm gate price levels in the study area. The difference between Total Revenue and total Cost makes up the Net Farm Income (NFI) or Gross Margin (GM) per cropping system. Benefit Cost Ratio (BCR), is obtained by dividing the NFI of individual cropping systems by their corresponding TVC. The model is as follows;

$GM = TR - TVC$ …….. (1)

Where

GM = Gross Margin

TR = Total Revenue

TVC = Total Variable Cost

BCR = GM/TVC ..... (2)

Where

BCR = Benefit Cost Ratio

A **BCR ≥ 1 is economically viable**

All data collected were subjected to Analysis of Variance (ANOVA). Treatment means were separated using Duncan's Multiple Range Test as described by Anyaegbu, (1995) .Tables were used to present the analyzed results. The results presented are the mean results from the data collected in the two cropping seasons, (2015 and 2016).

RESULTS AND DISCUSSION

Pre planting soil analysis as shown in Table 1, indicates that the soil fertility status of the experimental site was relatively poor. Nwaka, (2012) and Esu, (2010) classified the soil in the area as Alfisols, well drained and strongly acidic. In the West Africa savanna, the intensification of agricultural systems has resulted in declining nutrient availability, soil acidification, compaction and build-up of pest problems seriously affecting soil productivity and affecting soil fertility and the overall yield of crops (Webber et al, 1996). Cropping history of the site revealed that it was under one year fallow following a two year maize based experiment.. Thus continuous cropping without any soil amelioration might have caused the reduction in soil fertility of the experimental area. Linn and Lagemann,(1980) observed that increasing intensity of cultivation and shorter fallows caused decline in soil pH, cation exchange capacity and available phosphorous. After the second year of the trial, post harvest soil analysis, (Table 2). showed that the status of some basic elements was enhanced significantly ($P>0.05$) especially in the Potato//Legumes intercrop plots. This may be as a result of the organic matter contribution of sweet potato leaves and the

positive effects of legumes on soil properties. The influence of organic matter on soil properties has been reviewed by Brady, (1974) and Janick et al (1974) to include effects on colour from brown to black, soil physical properties; granulation, reduction in plasticity and cohesion, increase in water holding capacity and soil structure. The status of the basic elements was improved in Groundnut/potato and Cowpea/potato inter crop plots respectively followed by potato/ pigeon pea intercrops. The observation was confirmed by the various post harvest soil pH levels obtained from the plots of the inter crops and those of the sole crops. While the soil pH in the Groundnut/potato and cowpea/potato inter crop plots was improved by 10%, other plots including the sole crop plots except that of sole UM/SP/03 was enhanced by 2%. Perhaps the volume of organic matter added to the soil was higher in groundnut/potato and cowpea/potato plots than in those of the soybean/potato and pigeon pea/potato plots including the sole crop plots. Mayin (1990) reported that organic matter significantly ($P>0.05$) increased the soil pH, leaf chemical composition of nitrogen, phosphorous, potassium, magnesium and growth parameters of tuber crops.

The low pH levels recorded from UM/SP/O3 sole crop plots was as a result of its poor vegetative growth and poor establishment hence it has the lowest stand count at harvest in the cropping systems, (Table 2).
The yield and yield components of the advanced sweet potato lines as influenced by the selected legumes is shown in Table 3. Results of the stand count per plot at harvest showed that the potato lines significantly ($P>0.05$) established more under mixture with legume crops than in their individual sole crops. Irrespective of the varieties, the sweet potato lines established by 95% in mixture with legumes and by 75% under sole crops. However the parameter did not differ significantly with differences in the types of legumes used in the experiment. Thus the contribution of the different legumes to the companion crop was fairly the same. Stand count per plot of the potato line, UM/SP/03 was

relatively low and that may be due to its inability to adapt to the environment and perhaps has poor competitive ability.

Anyaegbu et al (2016), in their maize based cropping system trials, reported that UMU/SP/03 could not perform under the prevailing environmental condition with only 20% survival rate under sole cropping and 33% under maize inter crop. The results of the experiment also showed that inter cropping the selected advanced potato lines with legumes had significant ($P>0.05$) effect on their root yields when compared to their individual sole crop yields, (Table 3). The yield advantages of legume- cereal intercropping system over sole have been reported (Pal et 'al, 1993). AYT/08/055 in groundnut mixture produced 33%, under soybean,22%, cowpea, 6% and in Pigeon pea mixture,34% more root yield than its sole crop root yield while NRSP/11/097/ groundnut mixture produced 28%, in soybean mixture, 16% and in Pigeon pea mixture 34% more root yield than its sole crop yield but under cowpea mixture its root yield was 8% less than its sole crop yield an indication of strong inter specific competition between the two crops. AE/11/003 line produced under groundnut mixture 28%, in soybean 24%, cowpea 6% and under pigeon pea mixture, 28% more root yields than its sole crop yield.

For UM/SP/03, its intercrop yield was more than its sole crop yield by 28% in groundnut mixture, 24% in soybean mixture and 34% in pigeon pea mixture but was 42% less than the sole crop in cowpea mixture. Kwara variety produced 5% more root yield in groundnut mixture, 8% in soybean mixture and 24% in pigeon pea mixture than the its sole crop yield but its sole crop root yield was 10% higher than its intercrop yield in cowpea mixture. The result indicates that competition for space and natural resources was perhaps more aggressive between potato and cowpea than it occurred in other legume crops. However, Elemo and Olufajo (1991) observed that maize grain yield was not affected by the intercropped cowpea, but cowpea grain yield was reduced by 19% in the

sole crop and the situation was also observed in this trial. The result on potato/ pigeon in mixture and sole in this trial collaborates with that of Ofori and Stern (1982) who reported an increased dry matter production, yield and leaf area index in maize-pigeon pea intercropping system as compared to sole crops.

Wanki et al(1982,while intercropping maize with either beans or cowpeas decreased total yield of grain (cereal and legume) per hectare, intercropping sorghum with pigeon peas increased total grain yield per hectare. Component crops when intercropped usually compete with each other for growth resources such as light, nutrients and water. To minimize this competition and increase production, appropriate cultural practices such as choice of genotypes, plant populations and spatial arrangements and relative planting time should be adopted.

The combination of sweet potato and the selected legumes in the two year study gave a comparison of inter cropping system with sole cropping. The land equivalent ratio (L.E.R.) showed a yield advantage of intercrops over the sole crops. The values of Land Equivalent Ratio except in UMSP/03/soybean inter crop(0.70) and in UMSP/03/cowpea (0.86),recorded in this trial were greater than 1.00 , which implies an advantage of intercropping over sole cropping; This agrees with the findings of Burton et al (1983) and further corroborates the findings of Pal et al (1993).

Averaged over the two years of study, the highest L.E.R of 1.86 was recorded from Groundnut+NRSP/11/097. This implied that more effective use of the land occurred in Groundnut+NRSP/11/097inter crop. Hence intercropping was 86% more advantageous than the sole cropping systems. When crops are grown in mixtures, the yields of individual components might be reduced but the overall total yields are known to be higher than for sole crops, (Olukosi and Erhabor 1986). The lowest L.E.R. of 0.70 was obtained from the breeding line of

UMU/SP/03+soybean mixture. Perhaps, the prevailing environmental condition did not favour its proper development and growth as indicated earlier. Unfortunately the variety is the one that is being cherished by farmers as they normally eat its roots raw in the field. Its popular name is "sweet potato carrot".

The neighbourhood effect of association of sweet potato and the selected legumes was assessed using Land Equivalent Coefficient,(L.E.C). An L.E.C.< 0.25 shows that neighbourhood effect of the crops to each other is not beneficial and the intercrop interaction is inhibitive,(Adetiloye et al (1982). In this trial the values of the L.E.C were above 0.25, although not up to unity (1.0) an indication that the inter crop interaction or neighbourhood effect involved competitive complimentarily. Pigeon pea+NRSP/11/097 gave the highest L.E.C. while UMU/SP/O3+ soybean mixture gave the lowest L.E.C.(0.45).

Economic analysis using the current gate price per kg of potato and that of the legumes seeds showed that farmers who engage in this venture are bound to make significant profit. In all the mixtures, the Gross Margin (GM) was positive, an indication that farmers would maximize the use of the available land and at the same time have a variety of crops available for sale and for the family. Thus, highest GM (4.85) was obtained from Pigeon pea+NRSP/11/097 mixture while the least (0.644) came from Cow pea+ UM/SP/03 crop. Hence, the high Gross Margin recorded in this trial showed that intercropping potato and legume crops as those used in this work is economically viable. Ebeniro et al (2015) reported positive compatibility and economic viability in sweet potato/ Garden egg based cropping systems. The profitability of the system is confirmed by the high values of the Benefit Cost Ratio recorded in this study. The highest BCR (20.0) was obtained from Pigeon pea/ potato inter crop indicating that a farmer makes ₦20.00 profit for every one kobo invested in his farming business

CONCLUSION AND RECOMMENDATION

The result of the trial showed that the status of some basic elements and soil pH which were very poor before experiment commenced was enhanced significantly (P>0.05) especially in Groundnut/potato and cowpea/potato intercrop plots. Sweet potato lines established by 95% in mixture with legumes and by 75% under sole crops. AYT/08/055 in groundnut mixture produced 33%, under soybean,22%, cowpea, 6% and in Pigeon pea mixture,34% more root yield than its sole crop root yield while NRSP/11/097 groundnut mixture produced 28%, in soybean mixture, 16% and in Pigeon pea mixture 34% more root yield than its sole crop yield but under cowpea mixture its root yield was 8% less than its sole crop yield. AE/11/003 line produced under groundnut mixture 28%, in soybean 24%, cowpea 6% and under pigeon pea mixture, 28% more root yields than its sole crop yield. For UM/SP/03, its intercrop yield was more than its sole crop yield by 28% in groundnut mixture, 24% in soybean mixture and 34% in pigeon pea mixture but was 42% less than the sole crop in cowpea mixture. Kwara produced 5% more root yield in groundnut mixture, 8% in soybean mixture and 24% in pigeon pea mixture than the its sole crop yield but its sole crop root yield was 10% higher than its intercrop yield in cowpea mixture Pigeon pea+NRSP/11/097 gave the highest L.E.C. while UMU/SP/O3+ soybean mixture gave the lowest L.E.C.(0.45) and highest GM (4.85) was obtained from Pigion pea+NRSP/11/097 mixture while the least (0.644) came from Cow pea+ UM/SP/03 crop

However research is needed on nitrogen fixation and factors influencing N-transfer between the crops.

Table 1: Pre-planting physicochemical properties of the soil in the Experimental site

S/No	Elements	Values
1	Clay	40%
2	Silt	17%
3	Sand	43%
4	Textural class	Clay loam
5	pH (ratio 1:2:5)	5.5
6	Organic carbon	2.4%
7	Total nitrogen	0.05%
8	Available phosphorus	15.3ppm
Exchangeable cations ($cmolkg^{-1}$)		
9	Ca	2.60
10	Mg	2.22
11	K	0.63
12	Na	0.79
13	H^+AL	0.87

Table 2: Chemical Properties of the Soil as influenced by Potato/Legumes Cropping Systems after harvest in 2016

Treatments				Elements				
Soybean /Maize Clay		Organic		Available				
Plants ha^{-1}Plts ha^{-1}	pH	M%	N	Mg P	K ←	Na ($cmolkg^{-1}$)	Ca	--->
Gnut+AYT/08/055	6.8	2.5	0.08	10.7	2.00	0.55	0.42	1.31
Gnut+NRSP/11/097	6.7	2.8	0.08	14.3	3.50	0.62	0.42	1.23
Groundnut+EA/11/003,	6.8	2.8	0.07	15.0	3.50	0.50	0.45	1.30
Groundnut+UM/SP/03,	6.6	2.7	0.06	11.6	2.00	0.50	0.35	2.40
Groundnut+ Kwara,	6.8	2.7	0.07	14.8	2.00	0.40	0.42	1.34
Mean	**6.7**	**2.7**	**0.07**	**13.3**	**3.00**	**0.51**	**0.41**	**1.51**
Soybean+AYT/08/055,	5.8	2.3	0.06	16.1	3.60	0.55	0.55	2.47
Soybean+NRSP/11/097	5.6	2.5	0.06	15.3	2.21	0.42	0.50	2.68
Soybean+EA/11/003,	5.6	2.2	0.07	15.8	3.12	0.65	0.57	2.33

Soybean+UM/SP/03	5.7	2.4	0.05	15.8	2.33	0.63	0.42	2.65
Soybean+ Kwara	5.8	2.4	0.06	14.2	2.13	0.62	0.45	2.31
Mean	**5.7**	**2.36**	**0.06**	**15.44**	**2.68**	**0.48**	**0.50**	**2.49**
Cow pea+ AYT/08/055	6.8	2.5	0.07	13.2	2.40	0.20	0.42	1.32
Cow pea+NRSP/11/097,	6.7	2.7	0.07	14.6	2.11	0.21	0.43	1.22
Cow pea+ EA/11/003	6.5	2.6	0.07	15.7	2.34	0.31	0.44	1.18
Cow pea+ UM/SP/03,	6.5	1.8	0.04	14.2	2.22	0.32	0.43	2.63
Cowpea+Kwara	6.6	2.7	0.06	14.6	2.12	0.32	0.34	1.41
Mean	**6.6**	**2.46**	**0.06**	**14.46**	**2.24**	**0.27**	**0.41**	**1.55**
Pig. pea+ AYT/08/055	5.7	2.4	0.06	13.4	2.18	0.52	0.45	2.53
Pig. pea+NRSP/11/097	5.8	2.4	0.06	15.3	2.35	0.55	0.50	2.38
Pig. Pea+EA/11/003	6.0	2.2	0.06	14.8	2.23	0.52	0.53	2.13
Pig. Pea+UM/SP/03	5.5	1.6	0.04	13,5	2.49	0.55	0.48	2.61
Pig. Pea+Kwara	6.2	2.3	0.06	14.7	2.23	0.55	0.55	2.11
Mean	**5.8**	**2.18**	**0.06**	**14.34**	**2.32**	**0.54**	**0.50**	**2.35**
Sole AYT/08/055	5.6	2.2	0.04	15.8	2.43	0.41	0.63	2.22
Sole NRSP/11/097	5.8	2.2	0.05	15.9	2.17	0.47	0.63	2.43
Sole EA/11/003	5.7	1.9	0.04	14.3	2.33	0.52	0.58	2.38
Sole UM/SP/03	5.2	1.4	0.03	15,6	2.07	0.46	0.67	2.66
Sole Kwara	5.8	2.0	0.04	16.8	2.41	0.56	0.58	2.23

Table 3 Contributions of Legumes on the Yield and Yield Components of selected Pre Released Advanced lines of sweet potato

Treatments Combinations	Stand count per plot Sweet Potato	Number of marketable Roots/plot	Number of unmark able Roots/plot	Root yield t ha^{-1}	Legume Seed yield tha^{-1}
Groundnut+ AYT/08/055,	27a	30a	10b	13.0a	1.2
Groundnut+NRSP/11/097,	26ab	26bc	8c	13.2a	1.3
Groundnut+EA/11/003,	26ab	30a	6cd	10.2bc	1.2
Groundnut+UM/SP/03,	20d	16f	10b	5.8e	1.4
Groundnut+ Kwara,	26c	20e	12a	6.4de	1.3
Mean ± S	**25 ±1.02**	**24 ±4.21**	**9 ±1.33**	**9.7 ±1.1**	**1.3**
Soybean+AYT/08/055,	28a	28b	7ab	10.6bc	2.3
Soybean+NRSP/11/097	27a	21de	10b	10.2bc	2.3
Soybean+EA/11/003,	28a	30a	10b	11.8b	1.7
Soybean+UM/SP/03,	18d	16f	7ab	3.8f	1.5
Soybean+ Kwara,	27a	25bc	10b	6.8de	2.1
Mean ±S	**26 ±2.55**	**24 ±1.06**	**8.8 ±1.11**	**8.3 ±2.15**	**1.98**
Cow pea+ AYT/08/055,	28a	21de	10b	7.6d	1.8
Cow pea+NRSP/11/097,	28a	23d	7c	6.2de	2.3
Cow pea+ EA/11/003,	28a	20e	10b	6.5de	2.7
Cow pea+ UM/SP/03,	19d	16f	8c	1.3g	2.4
Cow pea+ Kwara,	26ab	21de	10b	4.7ef	2.1
Mean ± S	**26 ±1.98**	**20.2 ±2.76**	**8.6 ±1.22**	**5.3 ±1.22**	**2.26**
Pigion pea+ AYT/08/055,	28a	28b	8c	13.6ab	1.8
Pigion pea+NRSP/11/097,	27a	21de	6cd	14.8a	1.8
Pigeon pea+ EA/11/003,	26ab	32a	5d	10.3bc	1.9
Pigion pea+ UM/SP/03,	24c	20e	7c	6.5	2.2
Pigion pea+Kwara	28a	25c	12a	9.6b	2.0
Mean ±S	**27 ±0.87**	**26 ±3.01**	**7.6 ±1.54**	**8.9 ±1.05**	**1.94**
Sole AYT/08/055	24b	24c	12a	6.8de	----
Sole NRSP/11/097	24c	22d	13a	7.4d	----
Sole EA/11/003	24c	20e	12a	5.7e	----
Sole Um/SP/03	15e	16f	6d	3.2f	-----
Sole Kwara	24c	22d	12a	5.8e	----
Mean ± S	**22 ±4.33**	**20.8 ±1.68**	**11 ± 3.42**	**5.8 ±1.16**	
Sole Groundnut	----	----	----	----	1.6
Sole soybean	---	----	----	----	2.4
Sole cowpea	----	----	----	----	2.6
Pigeon pea	----	----	----	----	2.0
Mean					
DMRT (P>0.05)					

Means in a column with similar letter(s) are not significantly different at 5% level according to Duncan Multiple Range Test.

Table 4 Mixture Productivity of Intercropped Pre release Advanced sweet potato lines and Selected Legumes

Treatments Combinations	Root yield t ha^{-1}	Legume Seed yield tha^{-1}	LER	LEC ₦	TR ₦	TVC ₦	GM ₦	BCR
Groundnut+ AYT/08/055,	8.1	1.2	1.45	0.73	3.2	.255	2.95	11.57
Groundnut+NRSP/11/097,	13.2	1.6	1.86	0.78	4.6	.255	4.35	17.06
Groundnut+EA/11/003,	10.2	1.8	1.63	0.62	3.6	.255	3.35	16
Groundnut+UM/SP/03,	5.8	1.4	1.26	0.51	2.1	.265	1.85	7.90
Groundnut+ Kwara,	6.4	1.3	1.21	0.54	2.3	.255	2.05	9.02
Soybean+AYT/08/055,	10.6	2.3	1.43	0.67	3.8	.255	3.55	14.90
Soybean+NRSP/11/097	10.2	2.3	1.43	0.67	3.7	.255	3.45	14.51
Soybean+EA/11/003,	11.8	1.7	1.56	0.70	4.1	.255	3.85	16.08
Soybean+UM/SP/03,	3.8	1.5	0.78	0.45	1.5	.265	1.24	5.66
Soybean+ Kwara,	6.8	2.1	1.54	0.53	2.5	.255	2.25	9.80
Cow pea+ AYT/08/055,	7.6	1.8	1.67	0.65	2.6	.255	2.35	19.19
Cow pea+NRSP/11/097,	6.2	2.3	1.52	0.63	2.3	.255	2.05	9.02
Cow pea+ EA/11/003,	6.5	2.7	1.44	0.68	2.5	.255	2.25	9.80
Cow pea+ UM/SP/03,	1.3	2.4	0.86	0.38	.72	.265	.455	1.58
Cow pea+ Kwara,	4.7	2.1	1.14	0.51	1.8	.255	1.55	7.06
Pigion pea+ AYT/08/055,	12.	1.8	1.43	0.76	4.2	.255	3.95	16.47
Pigion pea+NRSP/11/097,	14.6	1.8	1.61	0.80	5.1	.255	4.85	20.00
Pigeon pea+ EA/11/003,	10.3	1.9	1.53	0.71	3.6	.255	3.35	14.12
Pigion pea+ UM/SP/03,	4.4	2.2	1.24	0.46	1.7	.275	1.43	6.67
Pigion pea+Kwara	4.6	2.0	1.20	0.50	1.8	.255	1.55	7.06
Sole AYT/08/055	6.8	----	1	----	2.3	.270	2.03	8.52
Sole NRSP/11/097	7.4	----	1	-----	2.5	.270	2.23	9.25
Sole EA/11/003	5.7	----	1	-----	1.9	.270	1.63	7.03
Sole Um/SP/03	3.2	-----	1	-----	1.1	.300	.800	3.67
Sole Kwara	5.8	----	1	-----	1.9	.270	1.63	7.04

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