Octa Journal of Environmental Research
International Peer-Reviewed Journal
Oct. Jour. Env. Res. Vol. 6(1): 001-005
Available online http://www.sciencebeingjournal.com

Jan. – Mar., 2018
ISSN 2321 3655

Research Article

Octa Journal of Environmental Research
(Oct. Jour. Env. Res.) ISSN: 2321-3655
Journal Homepage: http://www.sciencebeingjournal.com

PRODUCTIVITY OF GROUNDNUT VARIETIES INTERCROPPED WITH MILLET IN MAKURDI ENVIRONMENT

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Received: 6th Jan. 2018 **Revised**: 14th Feb. 2018 **Accepted**: 16th Feb. 2018

Abstract: Two field experiments were carried out during the cropping seasons of 2012 and 2013 at the Teaching and Research Farm of the University of Agriculture, Makurdi, Benue State, Nigeria. The main objective of the study was to evaluate the suitability of some improved groundnut varieties for intercropping with millet to improve the productivity of groundnut/millet intercropping systems in the area.The treatments consisted of two cropping systems (sole cropping and intercropping) as the main plot, combined with 3 groundnut varieties (Ijunda, Tisha-1 and Samnut 21) as the sub-plot, laid out as a split-plot in randomized complete block design with three replications. The result obtained from the experiment showed that intercropping decreased seed yield of the groundnut component and also decreased the plant height, seed yield and total plant biomass of the millet component. Productivity indices measured by land equivalent ratio and land equivalent coefficient indicated benefits of intercropping the tested groundnut varieties with millet in Makurdi environment. Millet proved more competitive than groundnut under intercropping. These results suggested that intercropping the improved groundnut varieties with millet was suitable and more productive than the sole crop of either of the intercrop components.
Keywords: Groundnut; Intercropping; Millet; Variety; Sole cropping
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INTRODUCTION

Due to high population pressure and other human activities competing with agriculture for the limited available land, the need to maximize land productivity in the humid tropics has become more evident (Steiner, 1991). This has not been achievable with monoculture with single harvests per season, as gains in production per unit area under this system have not been impressive in the tropical environment (IITA, 1990; Ayoola and Makinde, 2008). Intercropping of two or more crops especially the family Poaceae with Fabaceae is popular in many countries because yields are often higher than pure cropping systems (Lithourgidis *et al.,* 2006). Groundnut/millet intercropping is a common practice in Makurdi, Benue State. However, the yield of groundnut in Benue State is low (0.5-1.0 t/ha) (BNARDA, 2003). Among other factors like poor agronomic practices, adverse weather conditions etc. unavailability of improved varieties for intercropping are also responsible for the low yield of groundnut. With the release of several high yielding improved groundnut varieties by the Institute of Agricultural Research (IAR) Ahmadu Bello University, Zaria and other research institutions, there is need to evaluate some of these varieties for adaptation with millet which is an important crop in Makurdi. Presently, documented information on the use of some of these improved varieties of groundnut for intercropping with millet in Makurdi is scanty if not completely lacking. To fill this knowledge gap, this study was carried out and the main objective was to evaluate the suitability of three groundnut varieties for intercropping with millet in Makurdi with a view to improving the productivity of these intercropping systems.

EXPERIMENTAL

A field experiment was carried out during the cropping seasons of 2012 and 2013 at the Teaching and Research Farm of the University of Agriculture, Makurdi [Latitude 07º45′ - 07º 50′ N, Longtitude 08º 45′- 08º 50′ E, elevation 98 m above sea level] in Benue State, located in Southern Guinea Savanna of Nigeria (Kowal and Knabe, 1972). The main objective of the study was to evaluate the suitability of some improved groundnut varieties for intercropping with millet in Makurdi.Total precipitation during the cropping seasons was 1129mm and 1203mm in 2012 and 2013, respectively. Eight core samples collected from 0-30cm depth before land preparation were bulked into a composite sample, air-dried and ground. The samples were sieved through 2mm and 0.05mm screens for the determination of the physical and chemical properties of the soil (Table 1) before planting. The experiment was laid out as split-plot in randomized complete block design (RCBD) with three replications. The main plot treatment comprised of two cropping systems [sole cropping (groundnut, millet) and row intercropping (groundnut+ millet)] while the sub-plot treatment was 3 groundnut varieties [Ijunda (local check), Tisha-1 and Samnut21]. Each sub-plot consisted of four (4) ridges spaced 1m apart and 3m long (4m x 3m=12m^2). The net plot was made up of the two inner ridges and measured 6m^2. Hoes and cutlasses were used to prepare the land manually. Tisha-1 and Samnut21 were obtained from Institute of Agricultural Research (IAR) Ahmadu Bello University, Zaria while Ijunda was obtained from a local market in Makurdi. The local millet variety used was obtained from farmers in Makurdi.Groundnut and millet was sown either as sole crop or intercrop on ridges on the same day in both experimental years. Groundnut was dibbled at a spacing of 20cm apart using two seeds per stand on top of the flat ridges while millet was dibbled 50cm apart by the sides of the ridges.

Millet was thinned to two plants per stand ten days after planting. In both cropping systems, groundnut population density was maintained at 100,000 plants per hectare (ha) and millet at 40,000 plants per hectare (ha). Intercropping had a 1:1 (groundnut: millet) row proportion. All plots received a basal application of 100kg of NPK 15:15:15 and 100kgSSP (15kg N, 30kg P_2O_5 and 15kg K_2O) per hectare by broadcasting. Sole and intercropped millet were top-dressed with62.5kg Urea per hectare at 6 weeks after planting (WAP). Two hoe-weeding were done at 3 and 7 WAP for all plots. Harvesting of both crops was done from the inner 2m x 3m at physical maturity and this represented the yield per plot. Parameters measured for groundnut component included plant height, number of leaves, pod length, number of pods per plants, number of seeds per pod, dry seed yield and 100-seed weight but only dry seed weight was reported in this work. The characters measured for the millet component were plant height at harvest, panicle length, grain yield, and total plant biomass. Productivity of the various groundnut varieties intercropped with millet in this work was determined by using land equivalent ratio (LER) as described by Ofori and Stern (1987) and land equivalent coefficient (LEC) as illustrated by Adetiloye *et al.,* (1983). Competitive ratio (CR) which indicates the number of times by which one component crop is more competitive than the other was calculated using the formula proposed by Willey *et al*. (1980). Year effect was not significant, so data for both years were pooled together and analyzed. Standard procedures were followed in collecting all data and analysis was done using GENSTAT statistical software. Whenever differences between treatment means were significant, means were separated by Fishers Least Significant Difference at 5% level of probability.

RESULTS AND DISCUSSION

Groundnut Component

The main effects of cropping systems and variety as well as the interaction effects of cropping system x variety on the dry seed yield of groundnut intercropped with millet in Makurdi was significant ($P \leq 0.05$). Data presented in Table 2 showed that intercropping with millet consistently lowered the seed weight of all the varieties of groundnut tested. The percentage reduction in weight varied between 37.1% (Samnut 21) and 43.8% (Tisha-1). In both cropping systems, Ijunda gave higher seed yield than the other varieties.

Millet Component

Significant differences were observed among treatment means only in height and grain yield produced by millet intercropped with groundnut varieties in Makurdi. This was not so with other parameters evaluated for the millet component. Height of millet at harvest varied from 2.39m (in Tisha-1) to 2.41m (in Samnut 21).The height of millet produced varied with groundnut variety used. However, height was depressed by intercropping with groundnut varieties. Millet planted under sole cropping gave higher height than intercropped millet. Intercropping millet with Samnut 21 gave higher plant height (2.41m) than intercropping millet with Ijunda (2.40m) and Tisha-1 (2.39m) (Table 3). Although no significant difference was observed, the panicle length of millet varied with groundnut variety used. Intercropping groundnut varieties with Ijunda and Tisha-1 reduced the panicle length of millet. Millet intercropped with Samnut21 gave higher panicle length (41.10cm) than millet intercropped with Ijunda (39.70cm) and Tisha-1 (39.00cm). The grain yield of millet varied from 0.09t/ha (in Tisha-1) to 1.05t/ha (in Ijunda) with a mean of 0.99t/ha. Grain yield was reduced by intercropping with groundnut varieties. Sole millet produced higher grain yield than intercropped millet. Intercropping millet with Ijunda produced higher grain yield for intercropping (1.05t/ha) than millet intercropped with Samnut21 (1.02t/ha) and Tisha-1 (0.90t/ha) (Table 3). Biomass weight showed no significant difference among the treatments but the total biomass weight of millet was reduced by intercropping with groundnut varieties. Millet planted as sole produced higher total biomass weight than intercropped millet. Intercropping with Ijunda gave higher biomass weight than intercropping with Samnut21 and Tisha-1 respectively but the difference was not significant (Table 3).

Productivity of Groundnut / Millet Intercropping

Land equivalent ratio values of groundnut grown in association with millet were greater than unity in all intercrop combinations. All intercrop combinations gave land equivalent coefficient values greater than 0.25.The combinations of millet with Samnut 21 had higher values of LER and LEC than the combinations of the millet varieties with the Ijunda and Tisha-1.Competitive ratio values of millet were consistently higher than those of groundnut in all intercrop combinations.

Table 1. Physical and Chemical Properties of Surface Soil at Experimental Site in 2012 and 2013

Parameters	Value	
	2012	2013
Sand (%)	72.20	71.40
Silt (%)	12.20	12.00
Clay (%)	15.60	16.60
Textural class	Sandy loam	Sandy loam
pH (H_2O)	5.98	5.91
Organic Carbon (%)	0.85	0.88
Organic Matter (%)	1.45	1.51
Total Nitrogen (%)	0.77	0.79
Available P (ppm)	2.81	2.93
Cal^{2+} Cmol/kg soil)	3.95	3.99
Mg^{2+} (Cmol/kg soil)	1.97	2.01
K^+Cmol/kg soil)	0.40	0.59
Na^+Cmol/kg soil)	0.67	0.68
CEC Cmol/kg soil)	7.00	7.15
Base Saturation (%)	98.50	95.40

Table 2. Dry Seed Weight (t/ha) of Intercropped groundnut Varieties with Millet in Makurdi

Cropping Systems/ Groundnut Varieties	Dry Seed Weight			
	Ijunda	Tisha-1	Samnut 21	Mean
Sole Cropping	1.22	0.96	1.05	1.08
Row Intercropping	0.70	0.54	0.66	0.64
Grand Mean	**0.96**	**0.54**	**0.86**	**0.86**
Percentage Decrease of Intercropped Treatments Compared to Sole	**42.62**	**43.80**	**37.10**	**41.20**
F-LSD (0.05)				
CRS			0.02	
G-VAR			0.02	
CRS x G-VAR			0.03	

CRS: Cropping systems; G-VAR: Groundnut variety

Table 3. Height at Harvest, Grain Yield, Panicle Length and Total Plant Biomass of Millet as Influenced by Intercropping with Groundnut Varieties in Makurdi

Cropping System	Plant Height (m)	Panicle Length (cm)	Grain Yield (t/ha)	Total Biomass Weight (t/ha)
Millet + Ijunda	2.40	39.70	1.05	8.47
Millet +	2.39	39.00	0.90	4.00

Tisha-1				
Millet + Samnut21	2.41	41.10	1.02	5.63
Mean for Intercropping	**2.40**	**39.90**	**0.99**	**6.68**
Sole Millet	2.62	39.90	1.34	8.63
Grand Mean	**2.46**	**39.93**	**1.44**	**6.68**
F-LSD (0.05)	0.09	NS	0.25	NS

NS: Not significant at 5% level of probability

Table 4. Land Equivalent Ratio (LER), Land Equivalent Coefficient (LEC) and Competitive Ratio (CR) of Intercropped Pigeonpea with Cocoyam in Makurdi

Treatment	LER	LEC	CR (Groundnut)	CR (Millet)
Millet + Ijunda	1.37	0.45	0.75	1.38
Millet + Tisha-1	1.23	0.37	0.85	1.21
Millet + Samnut21	1.39	0.48	0.84	1.19
Mean	1.33	0.44	0.81	1.26
F-LSD (0.05)	0.19	0.11	0.30	0.44

Intercropping decreased the dry seed weight of groundnut. This reduction might be due to the effect of shading exerted by the taller millet component. As with other crops, biomass accumulation in groundnut is essentially a function of the amount of photo-synthetically active solar radiation intercepted by the canopy. Therefore shading by the taller millet component of the groundnut/millet intercropping might be due to the amount of solar energy available to the groundnut at lower storey. Thus, photosynthetic activities could not effectively take place to produce sufficient energy required to drive growth and developmental processes in the intercropped groundnut. The result of this study agreed with the earlier observations in groundnut/sorghum intercropping in Cameroun (Omoko and Hammond, 2010) and in groundnut/pearl millet intercropping in India (Reddy *et al.,* 1980). Intercropping caused reduction in plant height, grain yield and total plant biomass of the millet component when compared to sole systems. Such a response may be attributed to complete absence of interspecies competition in sole systems and the presence of both inter- and intra- specific competition in intercropping. Egbe (2005) had reported similar findings in his work on evaluating agronomic potentials of 15 pigeonpea genotypes for intercropping with maize and sorghum in Southern Guinea Savanna of Nigeria. It is worthy to note that the percentage reduction of the seed yield of groundnut under intercropping as compared to sole was more obvious than the reduction observed for millet component. Sakala (1994) and Waddington (1997) had demonstrated that intercropping resulted in minimal yield reduction of the cereal component of legume/cereal intercropping. Fujita and Ofosu-Budu (1996) indicated that the dry matter contribution of component cereal is important to ensure greater efficiency of the legume/cereal intercropping system.

The superior performance of Ijunda over the other varieties in dry seed yield may have been derived from its superior height, number of pods per plant, dry pod weight and number of seeds per pod (data not shown). Ijunda (local check) performed better than the improved varieties (Tisha-1 and Samnut 21) under intercropping with millet. This indicates that Ijunda was better adapted to this intercropping system. Ali (1996) had stated that identification of suitable genotypes of the component crops is necessary for complementarity. He further stressed that duration, growth rhythm, canopy structure and rooting pattern were the major considerations in selection of genotypes for intercropping. Land equivalent ratio and land equivalent coefficient showed that intercropping the three groundnut varieties with millet in Makurdi was productive. These results indicated complementarities in resource use by intercrop components, resulting in yield advantages. Even though the yield of groundnut component was depressed, the millet component provided a buffer and the system as a whole proved more productive than either sole groundnut or sole millet. Millet was the more competitive component of these intercropping arrangements. Similar results were reported by Reddy *et al.* (1980) in India and Omoko and Hammond (2010) in Cameroun.

CONCLUSION

The present study concludes that intercropping these varieties (Ijunda, Tisha-1 and Samnut 21) with millet resulted in depressed dry seed weight but the level of depression varied with variety.

Intercropping also reduced the plant height, dry grain yield and total plant biomass of the millet component. The LER and LEC values exhibited by groundnut varieties intercropped with millet have clearly proved the suitability of these varieties for intercropping with millet in Makurdi.

REFERENCES

Adetiloye P.O., Ezedinma, F.O.C. and Okigbo, B.N. (1983). A land coefficient concept for evaluation of competitive and productive interactions on simple complex mixtures. *Ecological Modelling*, 19: 27-39.

Ali M. (1996). Pigeon pea based cropping systems in semi-arid tropics, *In:* Roots and Nitrogen in cropping systems of the semi-arid tropics (Editors) Ito, O., Katayama, K., Johansen, C., Kumar Rao., J.V.D.K., Adu-Gyamf, J.J. and Rego, T.J. JIRCAS International Agricultural Series No. 3, Ohwashi, Tsukuba, Ibaraki, Japan, 41-58.

Ayoola O.T. and Makinde E.A. (2008). Influence of cassava population density on the growth and yield performance of cassava-maize intercrop with a relayed cowpea**.** *Tropical and Subtropical Agro-ecosystems,* 8:235-241

BNARDA. (2003). Annual Report of Benue State Agricultural and Rural Development Authority. Makurdi, Nigeria, pp.1-21.

Egbe O.M. (2005). Evaluation of Some Agronomic Potentials of pigeonpea genotypes for intercropping with maize and sorghum in Southern Guinea Savanna. Ph.D. thesis, University of Agriculture, Makurdi, Nigeria.

Fujita K, Ofosu-Budu, K.G. (1996). Significance of legumes in intercropping systems. *In:* Roots and nitrogen in cropping systems of the semi-arid tropics (Editors) Ito, O., Katayama, K., Johansen C., Kumar Rao., J.V.D.K., Adu-Gyamf, J.J. and Rego, T.J. JIRCAS. International Agricultural Series No. 3, Ohwashi, Tsukuba, Ibaraki, Japan, 19-40.

International Institute of Tropical Agriculture (IITA). (1990). Cassava in Tropical Africa. A Reference Manual. 176pp.

Kowal, J.M. and Knabe, D.T. (1972). An agro-climatological atlas of the northern states of Nigeria with explanatory notes. Ahmadu Bello University Press, Zaria.

Lithourgidis, A.S., Vasilakoglou, I.B., Dhima, K.V., Dordas, C.A. and Yiakoulaki, M.D. (2006). Forage yield and quality of common vetch mixtures with oat and triticale in two seeding ratios. *Field Crop Res.* 99: 106-113

Ofori, F. and Stern, W.R. (1987). Cereal–legume intercropping systems. *Advances in Agronomy*, 41:41-90.

Omoko, M. and Hammond L. C. (2010). Biological and water use efficiencies of sorghum-groundnut intercrop. *Cameroon J. Exp. Biol.,* 6(1): 1-10.

Reddy M.S., Floyd, C.N. and Willey, R. W. (1980). Groundnut in Intercropping Systems. *In:* Proceedings of theInternational Workshop on Groundnuts, 13-17 October 1980, ICRISAT Center Patancheru, India.

Sakala, W.D.M. (1994). Crop management interventions in traditional maize pigeon pea intercropping systems in Malawi. M.Sc. thesis. Bunda College of Agriculture, University of Malawi, Lilongwe.

Steiner, K.G. (1991). Overcoming soil fertility constraints to crop production in West Africa: Impact of traditional and improved cropping systems on soil fertility. *In:* Alleviating soil fertility constraints to increased crop production in West Africa (Editor) Mokwunye, A.U. 69-91.

Waddington, S.R. (1997). Risk management for maize farmers in drought-prone areas of Southern Africa. Proceedings of a workshop held at Kadoma Ranch, Zimbabwe, pp 1-3

Willey R. W., Rao, M.R. and Natarajan, M. (1980). Traditional cropping systems with pigeonpea and their improvement. *In:* Proceedings of the International Workshop on Pigeonpeas, 15-19 December 1980, ICRISAT Center, Patancheru, India. 1: 11-25.

Sources of Support: None.
Conflict of interest: None. Declared.