Growth and Yield Performances of Maize/Egusi Melon Intercrop under Different Planting Period on the Ultisols of Port Harcourt, Nigeria.

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Abstract
Studies were carried out in the early cropping season of 2017 to determine the interaction between maize and egusi melon in an intercrop on an Ultisols of Port Harcourt. In the experiment, maize and egusi melon were sown simultaneously and at varying intervals in mixtures as: egusi melon into maize at 2, 4 and 6 weeks after planting (WAP) of maize; and maize into egusi melon at 2, 4 and 6 WAP of egusi melon. Results showed that sowing of egusi melon into maize plots did not significantly ($p<0.05$) reduce the growth and yields of maize irrespective of the sowing date, rather, egusi melon growth and yield were significantly reduced when sowing was made from 4 weeks upward after maize planting; while sowing of maize into planted egusi melon plots from 4 weeks upward significantly reduced ear height, plant height, yield and yield components of maize. On the contrally, egusi melon yield and yield components were not affected when maize sowing was delayed to 4 weeks and beyond.

Key words: *maize, egusi-melon, intercropping cropping, time of planting*

Introduction

Mixed cropping, which is the growing of two or more crops simultaneously on the same piece of land, is a common practice in the farming system of southern Nigeria. Farmers in the zone cultivate crops in mixtures for various advantages which include effective use of labour, diverse food items from the same farm within a cropping season (Rahman *et al.*, 2006), higher land equivalent ratio (LER) and efficient land usage (Jalilian *et al.*, 2017). Farmers practice involves no definite composition of crops per season and with no definite entry time of each crop. In most cases the practice is with no regards to any specific plant spacing arrangement (Ekwu and Nwokwu, 2012) or the competitive effects thereof (Orluchukwu and Udensi, 2013). Most recent works on intercropping systems research have shown a great benefit accrued from the practice as larger land equivalent ratio (LER) (Konlan *et al.*, 2013; Atabo and Umaru, 2015). The system if not properly managed result in depleting soil nutrients status (Ibeawuchi, 2007), crops failure and changes in the number and composition of soil organisms (Owusu and Sadick. 2016). Maize legume intercropping increased the quantity of residues produced sand retained as surface mulch (Ngwira *et al.*, 2012)

Maize (*Zea mays* L) and egusi melon (*Colosynthis citrullus* L) are among the important food crops that play important roles in terms of food security, income generation and general rural employment of the people of the humid forest zone of Nigeria.

Maize is a tall plant with fast initial growth but of a short life span. It is an annual cereal plant of the gramineae family. It is believed to be a native of Mexico (Kirkl and Patterson 2006). It

is an important food crop in Nigeria ranking the third cereal crop following sorghum and millet (Uzozie, 2001). The crop is grown mainly for its grains used mainly for human food and livestock feed (Clark *et al.,* 2009). Other industrial products of maize include starch, oil and alcohol (Pauline *et al.,* 2017). Maize when in full vegetative growth it forms a palatable fodder for livestock.

Melon is a member of the family Cucurbitaceae and a native of Africa. It is a creeping plant with an initial aggressive vegetative growth with short growth duration. Unlike maize, the crop is grown mainly for its edible seed (Ogbona and Obi, 2010). The oil from the seed is extracted and used for cooking and other industrial purposes. The residue after extraction is used as soup thickener. Egusi melon is grown and produced mainly under intercropping system in southeastern Nigeria (Ijoyah *et al*., 2012)

Mixed cropping deposits heavy weight on soils in terms of nutrients depletion (Ibeawuchi, 2007). The system is not only widely practiced with little or no input of fertilizers in most cases whereas crop combinations are introduced with no definite regard for timing and specific plant spacing (Sener *et al.,* 2004). Any practice that likely gives the newly introduced crop a competitive disadvantage must be addressed promptly. In recent years cropping systems research has generated lot of interest and there are many reports in the literature of various crop combinations For instance, studies have been carried out on maize/cowpea mixture (Dahmardeh *et al.,* 2009; Eskandari, and Ghanbari, 2009), maize/cassava mixture (Ezumah.and Lawson, 1990), Cassava/maize/egusi melon (Gbaraneh *et al.,* 2010). The management and organization of the respective crops in the system has become a necessity in other to sustain their individual potential. Intercropping research has shown that the practice of introducing one crop into another that is already established is likely to give the newly introduced crop a competitive disadvantage (Gbaraneh *et al.,* 2004; Kermah *et al.,* 2017; Giller, 2001), hence this study which examined

Maize and egusi melon are among the important food crops that play important roles in terms of food security, income generation and general rural employment of the people of the humid forest of Nigeria. These characteristics of the system if properly harnessed would enable the crops evolve higher level of compatibility in intercropping hence this studies aimed at investigating the entry time of maize and egusi melon in a maize/egusi melon intercropping system on the degraded Ultisol of Port Harcourt.

Materials and Methods

Site

For the purpose of studying the interaction between maize and egusi melon an infertile site was chosen at the Rivers State Institute of Agricultural Research and Training (RIART) experimental farm, Rivers State University, Port Harcourt. Port Harcourt situates in the rain forest zone of South-south Nigeria. The station is 15m above sea level with mean annual rainfall of 2400 mm coming in a bimodal distribution over nine months (March to November). The temperatures and relative humidity vary from 25^{o} - 32^{o} C and 78 - 89%, respectively.

The soil of the land used for the study was very acidic with low nitrogen and organic matter content (Table 1). The land had been cropped to cassava and maize in the previous year. Maize cultivar: Oba 98 and egusi-melon were the test crops used for the study. ‘Oba 98’ is an improved open pollinated cultivar released to farmers by the National Cereals Research

Institute. It is white, floury and of medium maturity. Egusi melon is a major vegetable and one of the best cover crops widely grown in the intercropping system of the zone.

Table 1. Physio-chemical composition of soil at the commencement of the study.

Properties	items	Soil depth (0-30 cm)
Physical	Sand (%)	69.5
	Silt (%)	10.5
	Clay (%)	18.5
chemical	pH (1:2.5H_2O)	4.47
	Organic carbon (%)	0.43
	Organic matter (%)	0.75
	Nitrogen (%)	0.06
	Available P (g/kg)	47.3
	Exchangeable K (Cmol/kg)	0.21

Table 2: Meteorological data of experimental site (January – July) 2017

Month	**Rainfall (mm)**	**Relative Humidity (%)**		**Sunshine (hr)**
		0900	**1600**	
January	15.3	80.8	74.4	5.6
February	56.6	82.5	58.0	5.4
March	135.1	82.2	61.2	4.4
April	88.4	80.4	63.8	4.2
May	162.8	91.3	69.4	5.2
June	341.4	85.3	80.1	3.3
July				

Experimental design

The treatments comprised the planting of maize and egusi-melon in mixtures simultaneously, and melon introduced into maize (in between rows of maize stands) at 2, 4 and 6 weeks after planting (WAP) and maize introduced into egusi melon (in between rows of melon stands) at 2, 4 and 6 WAP. Others were sole crops of maize and egusi melon, making a total of nine (9) treatments. The experiments were laid out in a randomized complete block design with three replicates. Each plot measured 4m x 4m.

Cultural operations

The land was ploughed and harrowed. Sowing of crops for the experiments was on 24 March, 2015 and 5th August, 2016. Planting was done on the flat. Maize was planted two grains per stand at a spacing of 0.75m x 0.25m while melon was planted two seeds per stand at a spacing of 0.75m x 1m. For the intercrop, a row of maize alternated with each row of melon. Seedlings were thinned to one per stand at two weeks after planting (WAP). Fertilizer (NPK 20:10:10), at the rate of 300kg/ha was applied in split doses of ½ rate at planting and the rest at 6 WAP. Weeding was done at 3 and 7 weeks after planting (WAP). All agronomic practices except those under study were kept uniform for all treatments. At maturity (15 WAP), dried maize cops were harvested, de-husked and air-dried under a shade to 12% moisture content before shelling and weighing. Melon was harvested next when all vegetative parts dried up leaving the green pods which were collected and processed to obtain dry seed.

The data obtained for the crops include:

Maize

Number of days to 50% tasseling (number of days from date of simultaneous sowing until half of the plants were shedding pollen); number of days to 50% silking (number of days from date of simultaneous sowing until the stigmas has emerged from the ear shoot on half of the plants); ear height (the height of plant from the base to the node bearing the upper ear); plant height (the height of the plant from the base to the point where the tassel branching begins). Others were number of cobs per net plot, weight of cobs per net plot, weight per cob, number of grains per cob, shelling percentage and grain yield.

$$\text{Weight per cob was estimated as: } \frac{\text{Weight of ears harvested per net plot}}{\text{Number of ears harvested per net plot}}$$

$$\text{Maize shelling percentage as: } \frac{\text{Dry weight of shelled grains}}{\text{Dry weight of ears}} \times 100$$

Egusi melon

Days to 50% flowering (the number of days from sowing until 50% of plants had open flowers); number and weight of pods/plot, number and weight of seeds/pod, shelling percentage and seed yield. Others were:

$$\text{Number of pods/plant (estimated thus): } \frac{\text{Number of harvested pods,}}{\text{Number of plants harvested}}$$

$$\text{Weight /pod (estimated thus): } \frac{\text{Weight of harvested pods,}}{\text{Number of pods harvested}}$$

$$\text{Shelling percentage was: } \frac{\text{Weight of dry seeds}}{\text{Weight of dry pods}} \times 100$$

Data analysis

All data collected were analyzed for variance using the procedure GLM of SAS (SAS, 2010). Means were compared using the Least Significant Difference (LSD) at 5% probability level (Wahua, 2000)

Results

Maize

The different dates of sowing of maize and egusi melon in the intercrop had significant ($p<0.05$) effects on the growth and yield of maize and egusi melon.

Effect of sowing date of egusi melon into maize plots on maize performance:

Sowing of egusi melon into maize plots at the various planting dates delayed tasseling and silking of maize in relation to the sole maize plot (Table 3). The different dates of sowing did not influence tasseling and silking of maize significantly. Ear height, plant height and Leaf area were not significantly influenced by time of egusi melon entry into maize. Similarly, cob

weight, weight of grains per cob and grain yield per hectare, though differed slightly, were not significantly influenced by time of egusi melon entry into maize plots. In any case, the simultaneous planting reduced grain yield than other intercrops.

Effect of sowing date of maize into egusi melon plots on maize performance:
Entry time of maize into egusi melon plots significantly affected tasseling and silking dates, yield and yield characteristics of maize (Table 3). Maize tasseling and silking date, were significantly delayed in relation to the sole maize. Similarly, plant height, ear height and leaf area were significantly reduced especially when maize sowing was delayed to 4 WAP and beyond. In the same vein, cob weight, weight of grains per cob, grains yield per hectare and shelling percentage were significantly reduced.

Table 3. Flowering, height and yield components of maize grown with egusi melon at varying intervals

Treatment	Days to	Days to	Ear	Plant	Leaf	Weight/	Weight	Grain	Shelling
	50%	50%	height	height	area	cob	of grains/	yield	%
	Tasseling	Silking	(cm)	(cm)	(cm^2)	(g)	cob (g)	(t/ha)	
	**	**	**	**		**	**	**	
Maize alone	60.7	64.3	90.1	186.0	384.06	52.2	17.0	3.27	70.7
Maize/melon same day	61.3	65.0	90.1	196.0	372.83	61.0	18.5	2.14	61.9
Melon intro maize at 2 wap	61.9	66.0	91.2	191.2	388.11	61.2	20.6	2.31	63.4
Melon intro maize at 4 wap	62.0	66.2	93.1	186.0	392.42	63.7	20.5	2.51	67.0
Melon intro maize at 6 wap	62.3	65.3	93.8	189.1	397.61	65.2	27.3	2.54	69.6
Maize into melon at 2 wap	63.0	66.3	79.0	161.0	363.17	50.3	15.7	1.76	57.5
Maize into melon at 4 wap	65.9	69.8	71.0	153.1	318.26	42.7	4.7	1.58	41.3
Maize into melon at 6 wap	69.1	72.3	53.7	146.7	284.55	37.6	4.2	1.02	24.2
LSD $_{(0.05)}$	2.22	2.35	4.11	12.13	21.331	7.22	4.81	0.73	8.42

Egusi melon
Effect of sowing date of egusi melon into maize plots on egusi melon performance:
Flowering date of egusi melon was significantly delayed in the intercrops as compared to the monocrop (Table 4). Planting of egusi melon into maize plots at 4 and 6 weeks after planting significantly delayed flowering in egusi melon by 8 and 17 extral days, respectively, in relation to the simultaneous planting. Number of pods and weight of pods per plant, weight per pod and seed yield per hectare were equally reduced. Generally, seed yield and yield components of egusi melon were significantly reduced when egusi melon was introduced into maize beyond 2 WAP.

Effect of sowing date of maize into egusi melon plots on egusi melon performance:
The sowing dates of maize into established egusi melon crop had significant effects on the performance of egusi melon (Table 4). Flowering date in egusi melon decreased with delayed sowing of maize as compared with the simultaneous planting. Whereas yield and yield components increased with delayed sowing of maize into the established egusi melon. Shelling percentage of egusi melon increased progressively with delayed introduction of

maize into egusi melon. The highest performance of the crop was obtained when maize was sown into egusi melon at 6 WAP. The intercropping significantly increased the seed yield of egusi melon by 2%, 9% and 20% when maize was sown into egusi melon at 2, 4 and 6 WAP, respectively

Table 4. Flowering and yield components of egusi melon grown with maize at varying intervals

Treatment	Days to 50% flowering	Number of pods/ plant	Weight of pods/ plant (kg)	Weight per pod (g)	Number of seeds /pod	Weight of seeds/ pod (g)	Seed yield (kg/ha)	Relative Yield (RY)	Shelling %
Melon alone	46.7	4.8	2.52	586.0	379.1	22.0	341.63		76.7
Maize/melon same day	52.0	4.3	2.59	489.1	310.3	22.3	217.8	0.64	27.6
Melon intro maize at 2 wap	52.8	4.3	1.97	346.0	297.6	20.5	189.2	0.55	69.0
Melon intro maize at 4 wap	60.6	3.2	0.95	227.0	120.3	16.7	166.6	0.49	57.5
Melon intro maize at 6 wap	69.3	2.3	0.38	164.6	88.5	17.9	125.2	0.37	-
Maize into melon at 2 wap	52.3	4.0	1.45	363.1	202.7	22.9	221.8	0.58	41.3
Maize into melon at 4 wap	51.3	4.9	2.42	494.8	242.3	24.6	236.6	0.66	78.4
Maize into melon at 6 wap	49.3	6.6	4.56	591.0	320.7	27.5	260.5	0.67	63.9
LSD $_{(0.05)}$	0.48	1.1	1.67	21.36	0.59	3.78	10.88		4.14

Discussion

Mixed cropping is a common practice in the farming systems of south-south Nigeria. Maize and egusi melon are important crops in the cropping system of the zone. In this study, the intercrops gave lower yields than the monocultures. This was however expected since the population of the monoculture was higher than the respective component of the intercrop. This agrees with the works of Ekwu and Nwokwu (2012) and Agba *at el.,* (2011) who observed high total yield with high population due to closer spacing.

When maize was sown into egusi melon at 6 WAP the maize in the mixture with egusi melon produced very few harvestable ears hence, yields were very poor. Similarly, when egusi melon was introduced into maize at 4 - 6 WAP the egusi melon in the mixture with maize produced very few flowers and small size pods hence, seed yield were very low. Each crop was more competitive when planted before the other and there was all indication that the species sown first may have exploited nutrients in successive horizons in advance of the later introduced species. Akpa *et al.,* (2013), the low efficiency of the latter introduced crop component as in the case of egusi melon planted 6 weeks after the maize component was established, lead to reduced shoot growth and development probably by the shading of the leaves by the established maize component. Sunlight is one of the important resources of crop growth and development. Panhwar *et al.,* (2004) and Gbaraneh *et al.,* (2004) observed that when soil nutrients are not limiting factors, competition in maize/egusi melon mixture is for light due to their different canopy levels. In extremely poor and acid soils like Port Harcourt soil, it is likely that the maize planted 4 to 6 weeks before egusi melon utilized most of the available soil nutrients at the detriment of the later introduced egusi melon (Orluchukwu and Udensi, (2013); Olasantan *et al.,* 1996). Although egusi melon is a cover crop capable of smothering the weeds on the soil surface, it needs soil or applied N for early establishment, growth and yield. Hence egusi melon introduced at 4 or 6 weeks of planting maize were feeble and did not flower effectively. This result agrees with Gbaraneh *et al*., (2010) who in a cassava/maize/egusi melon intercrop observed that delaying sowing of egusi melon to 4 weeks after cassava and maize was the most depressed in growth and seed yield.

The soil of Port Harcourt is very acidic (pH 4.47) with low nitrogen (0.06%) and organic matter (0.75%) content (Table 1). Successful cropping on these soils therefore demands a proper organization of the component crops to avoid the full suppressive effect of each component over the other to enhance growth and development of the crops.

Conclusion

This study demonstrates that crops in mixture suffer some degree of suppression from each other especially with their diverse growth rate and canopy formation. Time of entry of each component crop should be given proper attention since the species sown first tends to exploit the nutrients in successive horizons in advance of the later introduced species. From results of this study it becomes very clear and necessary that the growth and yield of each component crop should be optimized, purpose of the intercrop. When maize is the base crop, sowing of egusi melon into the intercrop should not more than 2 weeks after maize sowing to reduce the over dominant effect of the base crop. On the other hand, when egusi melon is the base crop, entry of maize should be delayed to 4 weeks after egusi planting to allow the full expression of the base crop, egusi melon.

Refernces

Abera, R., Worku, W. and Beyene, S. 2017. Performance variation among improved common bean (Phaseolus vulgaris L.) genotypes under sole and intercropping with maize (Zea mays L.). African Journal of Agricultural Research. 12(6):397-405.

Agba, O. A, B. N. Mbah, J.E. Asiegbu and I. B. Adinya .2011. Effects of spacing on the growth and yield of okra (*Abelmochus esculentus*) l. Moench in Obubra, Cross River state. Global Journal of Agricultural Sciences Vol 10(1): 57-61

Akpan, I.I., Muoneke, C.O. and Okpara, D.A. 2013. Effect of Egusi Planting Density on productivity of egusi/Turmeric Intercrops in Southeadthern Nigeria. *Assian Journal of Crop Scienca*. 5:41 –47.

Anil, L., J. Park and R. H. Phipps (2000). The potential of forage-maize intercrops in ruminant nutrition. Animal Feed Science and Technology. 85: 157-164.

Asif, M.I., 1977. Estimation of leaf area in okra (*Abelmosclus esculentus* (L.) Moench). *Tropical Agriculture (Trinidad)* 54:192.

Atabo, J. A. and Umaru,T. M.. 2015. Assessing the land equivalent ratio (LER) and stability of yield of two cultivars of sorghum (Sorghum bicolorL. Moench)-Soyabean (Glycine max L. Merr) to Row intercropping system. Journal of Biology, Agriculture and Healthcare. 5(18) :144-149

Aune, J.B., and Mkwinda, S. 2012. On-farm evaluation of yield and economic benefit of short term maize legume intercropping systems under conservation agriculture in Malawi. Field Crops Research. 132: 149-157

Clark, P. M., Behnke, K. C. and Fahrenholz, A. C.. 2009. Effects of feeding cracked corn and concentrate protein pellets on broiler growth performance. *The Journal of Applied Poultry Research*, Volume 18, Issue 2, 1 July 2009, Pages 259–268

Dahmardeh, M., A, Ghanbari, B. Syasar and M. Ramroudi (2009). Effect of intercropping maize with cowpea on green forage yield and quality evaluation. Asian Journal of Plant Science. 8(3):235-239.

Eskandari, H. and Ghanbari, H. 2009. Intercropping of Maize (Zea mays) and Cowpea (Vigna sinensis) as Whole-Crop Forage: Effect of Different Planting Pattern on Total Dry Matter Production and Maize Forage Quality. Notulae Botanicae Horti Agrobotanici Cluj-Napoca 37 (2), 152-155

Ekwu, L.G. and Nwokwu, G.N. 2012. Effect of plant spacing and planting date on the growth and yield of okra. International Journal of Agriculture and Rural Development 15(2): 1041-1048.

Ezumah, H. C.and. Lawson, T. L. 1990 Cassava and Maize Intercropping Systems — The Effects of Varieties and Plant Populations. Journal of Agronomy and Crop Science

Gbaraneh, L.D., F.N. Ikpe, B.A. Onueghu and T.A.T. Wahua. 2010. Productivity of Cassava/Maize/Melon Intercropping systems as influenced by time of undersowing melon in the rain forest of Nigeria. *Acta Agronimica Nigeria.* 10(2): 85-94.

Gbaraneh, L.D., Ikpe, F.N., Larbi, A. Wahua, T.A.T. and Torunana, J.M.A. (2004). The influence of Lablab (Lablab purpureus) on Grain and Fodder Yield of Maize (Zea mays) in a humid forest zone of Nigeria. *Journal of Applied Science and Environment Management.* 8(2): 45-50.

Ibeawuchi, I. I. 2007. Landrace legumes: synopsis of the culture, importance, potentials and roles in agricultural production systems. Journal of Biological Sciences, 7(3): 464-474

Ijoyah, M.O, Adagba, E.O. and Iorlamen, T, (2012). Productivity of okra-maize intercropping system as influenced by varying maize plant densities in Makurdi, Nigeria. International journal of Current Research, 4(4): 59-63

Jalilian, J., Najafabadi, A. & Zardashti, M.R. (2017) Intercropping patterns and different farming systems affect the yield and yield components of safflower and bitter vetch. Journal of Plant Interactions, 12 (1): 92-99

Kermah, M., Franke, M.A.C., Adjei-Nsiah, S., Ahiabor, B.D.K., Abaidoo, R.C., and Giller, K.E. 2017. Maize-grain legume intercropping for enhanced resource use efficiency and crop productivity in the Guinea savanna of northern Ghana. Field Crops Research. 213: 38-50

Konlan S., Sarkodie-Addo, J. Kombiok . M. J. Asare, E. and Bawah, I. 2013. Yield response of three groundnut (Arachis hypogaea L.) varieties intercropped with maize (Zea mays) in the guinea savanna zone of Ghana. 6(32): 76-84,

Kirkl, R.M. and Patterson, D.C. 2006. The effect of quality of grass and maize silage on the intake and performance of beef cattle. Livestock Science. 100(2–3):179-188

Ngwira, A.R.,influence of Lablab (*Lablab purpureus*) on Grain and Fodder Yield of Maize (*Zea mays*) in a humid forest zone of Nigeria. *Journal of Applied Science and Environmental Management.* 8(2): 45-50.

Ogbonna, P.E. and Obi, I.U. (2010), Aspects of reproductive character of egusi melon. Proceedings of the 34th Annual Conference of Genetics Society of Nigeria, pp. 22-27.

Olasantan, F.O,.Ezumah, H.C.and Lucas, E.O. 1996. Effects of intercropping with maize on the micro-environment, growth and yield of cassava. Agriculture, Ecosystems & Environment 57 (2–3): 149-158

Orluchukwu, J. A. and Udensi, U.E. 2013. The effect of intercropping pattern of okra, maize, pepper on weeds infestations and okra yield. African Journal of Agricultural Research. Vol. 8(10), pp. 896-902

Owusu, A. and Sadick, A. 2016. Assessment of Soil Nutrients under Maize Intercropping System Involving Soybean. International Research Journal of Agricultural and Food Sciences. 1(3):33-43

Panhwar, M.A., Memon, F.H., Kalhoro, M.A., and Soomro, M.I. 2004. Performance of Maize in Intercropping System with Soybean under Different Planting Patterns and Nitrogen Levels. *Journal of Applied Sciences,* 4: 201-204.

Rahman, M.Z., Rahman, M.H., Haque, M.E., Kabir, M.H., Naher, S.L., Ferdaus, K.M.K.B., Nazmul Huda, A.K.M., Imran, M.S. and Khalekuzzaman, M. 2006. Banana Based Intercropping System in North-west Part of Bangladesh. *Journal of Agronomy*, 5: 228-231

Sener,O., Gozubenli, H., Konuskan, O., and Kilinc, M. 2004. The Effects of Intra-row Spacings on the Grain Yield and Some Agronomic Characteristics of Maize (*Zea mays* L.) Hybrids. *Asian Journal of Plant Sciences, 3: 429-432.*

Uzozie, P. R. 2001. "Effect of time of interplanting maize on the performance of cassava-maize intercrop," Journal of Agricultural Science, vol. 12, pp. 18–21,.

Wahua T.A.T. 2000. Applied statistics for scientific studies. African Link Books. lbadan. Nigeria.