COMPATIBILITY AND ECONOMIC ASSESSMENT OF SWEETPOTATO AND GARDEN EGG INTERCROP IN A HUMID ULTISOL OF SOUTHEASTERN NIGERIA

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ABSTRACT
This study was conducted at Umudike in the tropical ultisol of rainforest agro-ecological zone of Nigeria, to determine the compatibility and economic viability of sweetpotato (*Ipomoea batatas)* and garden egg (*Solanum gelio*) intercrop during 2011 and 2012 cropping seasons. Two sweetpotato varieties; NR05/022 and TIS/87/0087 were planted at a spacing of 1m x 0.30m between and within rows. Each variety was intercropped with garden egg at three different plant spacing; 1mx 0.5m, 1m x 1m and 1m x1.5m.The experiment was laid out in a randomized complete block design. Yield and economic data were collected on sweetpotato root yield at harvest (16WAP) while garden egg fruits were harvested in piece meal from 8-14 WAP and the yield summed up. The yield data were subjected to analysis of variance to compare the means while Land Equivalent ratio was used to estimate productivity. Also Gross margin analysis and Benefit Cost Ratio were employed to determine the economic viability of the cropping systems. The result showed that the Sweetpotato variety NR05/022 out yielded TIS 87/0087 both in sole and intercrop. Intercropping Sweetpotato with garden egg did not affect garden fruit yield. The land equivalent ratio (LER) was greater when Sweetpotato/garden egg were intercropped than the sole crop which shows that Sweetpotato and garden egg were compatible. The economic evaluation showed that in the intercropping system, NR05/022 variety of sweet potato intercropped with garden egg at a plant population of 33,333 and 10,000 plants/ha respectively, gave the best gross margin value of ₦240,825. However, sole cropping of NR05/022 variety of Sweetpotato had the best Naira return on investment with a BCR of 3.25. It is therefore recommended that Sweetpotato and garden egg are compatible and intercropping them in a humid ultisol is economically viable. So farmers in the study area are encouraged to intercrop Sweetpotato and Garden egg.

Keywords: Sweetpotato, Garden egg, Intercropping, Compatibility, Growth and Yield

INTRODUCTION
Intercropping is a common agricultural practice among small scale West African farmers. It is an agricultural practice of growing two or more crops simultaneously on the same field during a growing season, in definite pattern or arrangements (Filho, 2000). It is one of the most widespread traditional agricultural practices among small scale farmers where it provides food and income at different periods of the year for the family (Emede and Adegoke, 2011). Intercropping is an efficient production system which ensures food security. In Nigeria, between 60- 70% of cropped land is devoted to growing crop mixtures with 2-3 even up to 8 crops (Elemo *et al*., 1990). Intercropping crops with different growth habit have shown to give high productivity and yield advantages over mono-cropping. Yield advantage of intercropping studies (Okoli *et al*., 1996, Muoneke and Asiegbu, 1997) is attributed to better use of environmental resources such as light, nutrients and water (Trenbath, 1776).

Sweetpotato (*Ipomoea batatas (L.)Lam)* from the *Convolvulaceae* family is one of the world's most widely grown crops. It is a prostrate crop which is used to alleviate poverty and ensure food security in

sub Saharan Africa due to its productivity per unit area and time (NRCRI, 2005). Farmers in more than 100 countries rely on environmental resilience of sweetpotato to produce high yields in marginal soils with minimum investment (Horton *et al, 1989*). Sweetpotato is becoming a staple food in Nigeria and over 3.5 million metric tons sweetpotato is produced annually on 1.03 million hectares (FAO, 2008). Sweetpotato can be made into various confectionaries like cakes, pancakes, rolls, buns and puff-puff (Martin, 1986). It can be made into sweetpotato gari (Odebode, 2004), and as a stabilizer in ice cream industry (FAO, 1990). The roots and tops could be made into a dried meal and fermented silage to feed livestock like pigs, cattle and poultry (Woolfe, 1992).

Garden egg (*Solanum gelio*) (L.) belongs to the family *Solanaceae*. It is fruit vegetable that is widely eaten as a desert fruit type or as part of a main meal or as a popular salad item. Its economic importance equals that of tomatoes (Schippers, 2000). Garden egg is rich in vitamins (vitamin A, B and C) and minerals (Udo *et al*., 2005). In most traditional societies especially in southeast Nigeria, garden egg plays a supplementary role to kola nut used to welcome visitors. Ngwa community in south eastern Nigeria produces a lot of garden egg which has impacted positively on the economy of the community.

Intercropping sweetpotato with different crops for example legumes, cereals, root and tuber crops have been reported (Onwueme and Charles 1994, Njoku *et al*., 2010), Udealor and Ezulike (2011). Few reports exist on intercropping sweetpotato with garden egg. These crops are planted as sole crops in southeastern Nigeria. Based on crop architecture, sweetpotato is planophile while garden egg is an erectophile and can be intercropped. Intercropping sweetpotato with garden egg could increase income and productivity of farming systems if the crops are compatible. There is the need to study intercropping compatibility of sweetpotato and garden egg. This study therefore is set out to achieve the following objectives: To determine the compatibility of sweetpotato and garden egg in the study area and to estimate the cost and returns of intercropping sweetpotato and garden egg.

MATERIALS AND METHODS

The study was conducted in 2011 and 2012 cropping seasons at National Root Crops Research Institute (NRCRI) experimental farm at Umudike, situated at latitude 05˚ 29' N and longitude 07˚ 33' E and at an elevation of 122 m above sea level. The annual rainfall is 2162.7 mm while the relative humidity ranges from 54% – 87%. The minimum and maximum temperature ranges 20-23˚C and 28-33˚C, respectively. The soil is acidic and well drained sandy loam. The experiment was laid out in randomized complete block design and replicated three times with plot size of 6m x 5m ($30m^2$). The treatments consist of two sweetpotato varieties (NR05/022 light orange flesh and TIS 87/0087 white flesh) and three garden egg plant spacing of 1m x 0.5m (20,000 plants/ha), 1m x1m (10,000 plants/ha) and 1m x 1.5m (6,666 plants/ha). Sole crops of sweetpotato and garden egg for all spacing were included for computation of the productivity parameter of intercropping systems. Sweetpotato was planted at 1m x 0.30m to give a population of 33,333 plants/ha. Garden egg seeds were raised in nursery beds and transplanted into the field at 6 weeks after planting (WAP). Sweetpotato was planted on the crest of the ridge while garden egg seedlings (var. Ngwa large) were planted mid way on the right side of ridges. Weeding was done at 4 WAP, NPK 15:15:15 fertilizer poultry manure were applied to the plots at the rate of 200kg/ha and 3t/ha respectively at 4 WAP. Insecticide (Karate) was also applied at 4 WAP before flowering of garden egg. Sweetpotato roots were harvested at 16 weeks after planting and measured in (t/ha) while garden egg fruit (t/ha) were harvested in piece meal at 8 – 14 WAP. The data collected were subjected to analysis of variance using Genstat discovery edition 1 (2003). Means were compared using LSD at 5% level of probability. LER (land equivalent ratio) was calculated as defined by Mead and Willy (1980) is a measure of productivity of any systems. The model is specified as follows;

$$LER = \left[\frac{\text{Intercrop yield of Sweetpotato}}{\text{Sole crop yield of Sweetpotato}}\right] + \left[\frac{\text{Intercrop yield of Garden egg}}{\text{Sole crop yield of Garden egg}}\right] \quad \text{---Eq 1.}$$

Gross Margin analysis as used by Obifuna *et al.*, (2012) was employed to determine the cost and returns of the cropping systems. The model is specified as follows;

GM = TVP – TVC

Where;

GM = Gross Margin

TVP = Total Value of production

TVC = Total Variable Cost

RESULTS AND DISCUSSION

Compatibility of Sweetpotato and Garden Egg

The yield results of the different cropping systems for sweetpotato and garden egg are presented in tables 1 and 2. The result in table 1 shows that there was a significant variation in root yield of the sweetpotato varieties with NR 05/022 yielding higher than TIS 87/0087 in both sole and intercropping systems. The highest average yield of 16tons/ha was recorded with NR05/022 planted sole. In the intercropping system, NR05/022 and Garden egg at plant population of 33,333 plants/ha (sweetpotato) and 10,000 plants/ha (Garden Egg) gave the highest mean yield of 11.09tons/ha. This variation could be attributed to differences in potentials of two varieties. Varietal differences in yield have been reported by many authors including Udealor and Asiegbu(2005). Higher yield obtained in sole crops than intercrop in this result is similar to results reported by Muoneke and Mbah (2007) and Njoku *et al*., (2010).

Table 1: Effect of cropping systems on productivity of Sweetpotato

	2011		2012		Mean
Sole	**Yield (t/ha)**	**Ler**	**Yield (t/ha)**	**Ler**	**Yield (t/ha)**
Sole NR 05/022	15.23	1	16.73	1	16.00
Sole TIS 87/0087	9.79	1	10.58	1	10.19
Mean	12.51		13.66		13.09
LSD	1.83		2.46		2.15
Intercrop					
NR 05/022 + GE @ 1m × 0.5m	4.75	1.12	9.30	0.99	7.03
NR 05/022 + GE @ 1m × 1m	6.42	1.58	15.75	1.47	11.09
NR 05/022 + GE @ 1m × 1.5m	8.69	1.34	10.76	1.54	9.73
Mean	6.62		11.94		9.28
TIS 87/0087 + GE @ 1m × 0.5m	3.19	0.89	5.36	0.67	4.28
TIS 87/0087 + GE @ 1m × 1m	3.39	1.36	7.38	1.014	5.39
TIS 87/0087 + GE @ 1m × 1.5m	4.59	1.01	6.38	1.435	5.49
Mean	3.72		6.38		5.05
LSD	2.58		3.50		3.04

Intercropping sweetpotato with garden egg did not affect garden egg fruit yield (Table 2). The land equivalent ratio (LER) as given in Equation 1, is greater when sweetpotato/garden egg was intercropped than the sole crops. This is an indication that the two crops are compatible. The higher

LER obtained with the intercropping system over the sole buttresses the fact that sweetpotato and garden egg are compatible. Again the sole cropping system showed superiority over intercropping in terms of fruit yield but the variation was not as large as observed in sweetpotato.

Table 2I Effect of cropping systems on productivity of Garden egg

	2011		2012		Mean
Sole	**Yield (t/ha)**	**LER**	**Yield (t/ha)**	**LER**	**Yield (t/ha)**
GE @ 1m × 0.5m	8.00	1	2.45	1	5.23
GE @ 1m × 1m	5.27	1	2.678	1	3.98
GE @ 1m × 1.5m	6.81	1	1.560	1	4.19
Mean	6.70		2.23		4.17
LSD	NS		.051		
Intercrop					
NR 05/022 + GE @ 1m × 0.5m	6.45	1.12	1.05	0.99	3.75
NR 05/022 + GE @ 1m × 1m	6.61	1.58	1.42	1.47	4.02
NR 05/022 + GE @ 1m × 1.5m	5.29	1.34	1.42	1.54	3.36
Mean	6.12		1.30		3.71
TIS 87/0087 + GE @ 1m × 0.5m	6.98	0.89	0.86	0.67	3.92
TIS 87/0087 + GE @ 1m × 1m	6.94	1.36	1.54	1.014	4.24
TIS 87/0087 + GE @ 1m × 1.5m	5.29	1.07	1.62	1.435	3.46
Mean	6.47		1.11		3.79
LSD	0.99		NS		

Economic Evaluation of intercropping Sweetpotato and Garden Egg

The result of the economic evaluation of intercropping sweetpotato with garden egg showed that all the cropping systems had positive gross margin and BCR greater than unity (1). This indicates economic compatibility among the crops (table 3).

Table 3: Economic Evaluation of intercropping Sweetpotato and Garden Egg in the study area (Value in the table are Mean values for 2011 and 2012 cropping seasons)

Cropping systems	**TVP (₦)**	**TVC**	**GM**	**BCR**
Sole Cropping				
a. Sweetpotato				
NR/05/022	324,600	99,785	224,815	3.25
TIS/87/0087	203,700	99,785	103,915	2.04
b. Garden Egg				
1m x 0.5m	216,250	200,670	15,580	1.08
1m x 1m	198,750	136.670	62,080	1.45
1m x 1.5m	193,500	108,300	85,200	1.79
Intercropping				
a. NR05/022 and Garden Egg				
1m x 0.5m	328,000	245,625	82,375	1.34
1m x 1m	422,450	181,625	240,825	**2.33**
1m x 1m	362,250	157,255	204,995	2.30
b. TIS87/0087 and Garden Egg				
1m x 0.5m	276,450	245,625	30,825	1.13
1m x 1m	306,550	181,625	124,925	1.69
1m x 1.5m	294,050	157,255	136,795	1.89

However, in the intercropping systems, NR05/022 variety of sweet potato intercropped with garden egg at a plant population of 33,333 and 10,000 plants/ha (1m x 1m) respectively, gave the best gross margin value of ₦240,825. This was followed by sole cropping of NR05/022 variety of sweetpototo, with a gross margin of ₦224,815 at the recommended plant population of 33,333 plants/ha. On the other hand, a further economic evaluation of the intercropping system revealed that sole cropping of NR05/022 variety of sweetpotato had the best BCR of 3.25. This implies that it has the highest Naira return on investment because for every ₦1 invested in the enterprise, ₦3.25k is received in return. However, intercropping sweetpotato (NR05/022) and garden egg had a BCR of 2.33. Although this is slightly lower that the sole, there is the advantage of having different crops in the farmers field for separate uses. Based on this result, it is evident that sweetpotato and garden egg are compatible and economically viable in the intercropping systems of the study area.

CONCLUSION

Intercropping is a common farming system in the southeast Nigeria because the vegetation of the area is that of typical rainforest agro ecology. Land availability for farming is scarce. So in order to make efficient use of the available land, farmers commonly adopt the intercropping system. Both sweetpotato and garden egg are short period crops. The results obtained from this study have shown that the crops are compatible and economically viable. However, NR05/022 is superior either as a sole crop or intercropped with garden egg in the study area. It is therefore recommended that farmers in the study area should be encouraged to intercrop sweetpotato with garden egg.

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