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Economic analysis of the performance of twelve cultivars of soybean *(Glycine max* (L) Merrill) in the Ife agro-climatic zone

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Abstract

Twelve cultivars of soybean (Glycine max (L) Merrill) TG_m 119, TG_m 479, TG_m 297, TG_m 7, Doko, Jac 8, Jac 2, Sterosa, AGS 2, SJ = 1 and SJ = 2 were studied with respect to some agronomic traits related to grain yield.

There was a significant genotype effect in all agronomic traits considered except in stand count. Soybean has the ability to compensate for smaller number of stands through higher number of pods per plant and its susceptibility to lodging varies inversely with plant height.

Economic analysis indicated that any of the twelve cultivars of soybean studied could be cultivated at a positive return to management in the Ife agro-climatic zone. However, the best cultivar was TG_m 7 (it had the highest physical and economic efficiency). An investment of ₦1.00 in the cultivation of TG_m 7, *ceteris paribus,* would earn the farmer a gross return of ₦3.80. The break-even yield and price are 65k/kg and 1592kg/ha. respectively of TG_m 7 below which negative returns to management (losses) will set in.

Introduction

Soybean *(Glycine max* (L) Merrill) originated from China where it had been grown and used for over two thousand years.

Soybean is an excellent source of major nutrients. About 40% of it is protein which is of high quality with the amino acid distribution very closely approximating that of animal protein. It contains about 18% oil. The grain can be used for livestock feeds and for various dishes for human consumption. It is a source of soymeal for preparing animal feeds, most especially meals for the expansion of the poultry industry (Knipscheer and Ay, 1982). Unlike other beans, soybean contains little or no starch from which the body makes sugar and it is recommended for use in diabetic diets (Akinbanji, 1988). It may be processed into different human food recipes such as milk, moin-moin, cakes, flour, snacks, paste etc. (ONADEP).

Ochse et al (1961) observed that the remarkable progress made in the culture of soybean in the United States could be duplicated in many other countries provided due attention was paid to the selection of varieties adapted to the particular conditions of soil, climate and length of day under which the crop is to be grown. Bearing in mind that agricultural production of this crop is relatively new in Nigeria, most especially in the Southwestern part, it becomes very important to select the right variety to achieve high grain yields. Thus, this study was set out to determine the physical and economic efficiency of twelve different cultivars of soybean.

Materials and Methods

Twelve cultivars of soybean were used for this experiment. These are TG_m 119, TG_m 479, TG_m 297, TG_m 7, Doko, Jac 8, Jac 5, Jac 2, Starosa, AGS 2, SJ = 1 and SJ = 2. The experiment was a randomized complete block design (RCBD) replicated four times. Plot size was 6m x 1.8m with 0.6m spacing between row and 0.05m within row. Plot separation at the sides was by a 2m border and by 1m

alleyways at the ends. Glyphosate, an herbicide, (Round up ®) was sprayed on the weeds at the rate of 3.6kg a.i/ha before ploughing and harrowing the soil. Patches of weeds appearing on the farm land were sprayed with paraquat before planting. Supplemental weeding was carried out once before canopy closure. Propoxur an insectide, (Unden 20 ®) was sprayed at the rate of 31.2 g a.i/10 litres of water on the crop to prevent seedling cutting and leaf perforations after which Benomyl, a fungicide, (Benlate 50 wp ®) was applied at the rate of 35g per 10 litres of water to control brown blotch (Collectotrichum truncatum) disease. Harvesting was done mannually, pods were sundried and threshing was by hand.

Data were collected on seed yield (kg/ha), number of days to 50% flowering, number of days to 50% pod maturity, number of days to 95% pod maturity, maturity height, number of branches per plant, number of pods per plant and 100 seed weight. The data were subjected to analysis of variance and pertinent means were separated using Duncan multiple Range Test (DMRT) (Steel and Torrie, 1960). Susceptibility to lodging was scored: 1- all plants erect, 2- all plants leaning slightly or 10% of the plants lodging, 3- ten to 50% of the plants lodging, 4- fifty to 80% of the plants lodging and 5- almost all the plants lodging.

The weather condition of the Ife agro-climatic zone during the period of cultivation (August to November, 1985) was 7.33mm, 29.98°C, 21.08°C and 74.83cm daily average for rainfall, maximum temperature, minimum temperature and relative humidity, respectively.

The various operations performed in the agricultural production of soybean were costed and the naira value of output calculated using current inputs and output prices. The physical and economic efficiency (Kay 1981) were calculated and used to select the best cultivars for the Ife agro-climatic zone. Break even analysis (Horngren, 1980) was carried out to know the output and price levels at which return to management became zero for each cultivar.

Results and Discussions

Analysis of variance for the agronomic traits considered is shown in Table 1. There was a significant genotype effect in all the agronomic traits except in stand count. This finding is important to the soybean breeders because it indicates that enough genetic variation exists among the twelve cultivars to suggest a good start for selecting for grain yield and yield components in soybean breeding programme, especially if the traits are highly heritable.

Comparison among mean values of the agronomic traits examined using Duncan Multiple Range Test (DMRT) is shown in Table 2. Considering yield per hectare (physical efficiency) TG_m7, an IITA variety gave the highest yield of 6050 kg/ha. which is significantly greater than the grain yield of all other cultivars. This was followed by other cultivars as indicated in Table 2 with Doko having the lowest yield. TG_m 7 which gave the highest mean grain yield per hectare, had the lowest mean number of stands per plot harvested (45.75) and mean number of pods per plant of 112.95 which ranked second best. This suggests that soybean has the ability to compensate for few number of stands through higher number of pods per plant. Earlier, Pandey and Torrie (1973) showed that soybean had the ability to compensate for stand differences by appropriate adjustment in number of pods per plant.

Mean score and classification based on susceptibility to lodging of the twelve soy-

TABLE 1: MEAN SQUARES OF ANALYSIS OF VARIANCE FOR YIELD AND YIELD COMPONENTS

Source of Variation	*df*	*50% flowering period*	*50% pod maturity*	*95% pod*	*Maturity height*	*Number of branches per plant*	*Number of pods per plants*	*Number of stands*	*100-seed weight*	*Yield per plant (g)*
Total	47	21.31	21.70	29.32	318.34	2.44	1632.00	9734.18	11.75	18.93
Replicate	3	1.06	8.60	5.00	300.71	1.42	116.81	6145.81	6.03	8.93
Variety	11	89.93*	69.20*	77.73*	1099.20*	7.46*	5487.08*	10806.27	44.63	52.57*
Error	33	7.05	7.05	15.39	59.65	0.86	481.38	9703.24	1.31	8.62

*Denotes significance at 0.05 level.

TABLE 2: COMPARISON AMONG MEAN VALUES OF AGRONOMIC TRAITS CONSIDERED

Days to 50% flowering	*Days to 50% pod maturity*	*Days to 95% pod maturity*	*Maturity height (cm)*	*Number of branches per plant*	*Number of pods per plant*	*Number of stands*	*100 seed weight (g)*	*Yield per plant*	*Yield in kg/ha*
$j_{35.25}$	$b_{89.00}$	$b_{94.75}$	$k_{49.25}$	$j_{2.85}$	$a_{32.65}$	$i_{46.75}$	$b_{6.75}$	$a_{4.61}$	a_{1537}
$d_{38.25}$	$d_{92.50}$	$k_{102.25}$	$a_{50.95}$	$k_{4.05}$	$j_{36.00}$	$g_{104.25}$	$c_{8.25}$	$j_{5.67}$	j_{1890}
$i_{38.50}$	$d_{94.00}$	$f_{104.50}$	$j_{59.65}$	$g_{4.40}$	$g_{52.20}$	$f_{114.50}$	$a_{13.50}$	$c_{5.89}$	c_{1963}
$g_{39.75}$	$k_{94.00}$	$l_{105.00}$	$g_{62.65}$	$l_{4.55}$	$d_{56.20}$	$h_{115.00}$	$i_{14.00}$	$b_{7.70}$	b_{2567}
$k_{40.00}$	$f_{94.75}$	$h_{105.25}$	$h_{66.10}$	$e_{4.80}$	$k_{59.75}$	$d_{117.50}$	$j_{14.38}$	$l_{8.26}$	l_{2753}
$h_{40.50}$	$e_{95.75}$	$j_{105.25}$	$l_{69.70}$	$d_{5.10}$	$f_{60.55}$	$c_{119.25}$	$l_{14.88}$	$g_{9.97}$	g_{3323}
$e_{41.75}$	$h_{97.00}$	$d_{106.75}$	$e_{76.70}$	$a_{5.20}$	$h_{68.20}$	$l_{128.50}$	$k_{15.13}$	$f_{10.18}$	f_{3393}
$f_{42.50}$	$i_{97.00}$	$e_{107.00}$	$i_{77.55}$	$b_{5.70}$	$e_{69.40}$	$k_{129.25}$	$d_{15.50}$	$d_{10.49}$	d_{3497}
$l_{43.25}$	$j_{97.00}$	$i_{107.25}$	$d_{77.75}$	$h_{5.70}$	$l_{75.35}$	$b_{130.00}$	$f_{16.25}$	$h_{11.12}$	h_{3707}
$a_{43.75}$	$g_{99.50}$	$g_{108.75}$	$f_{81.25}$	$f_{5.80}$	$b_{109.40}$	$j_{143.50}$	$h_{16.38}$	$e_{11.36}$	e_{3787}
$b_{49.00}$	$a_{102.50}$	$a_{110.75}$	$b_{99.95}$	$i_{5.80}$	$i_{112.95}$	$a_{146.00}$	$e_{17.25}$	$k_{11.89}$	k_{3963}
$c_{52.50}$	$c_{104.00}$	$c_{112.00}$	$c_{100.90}$	$c_{8.55}$	$c_{163.25}$	$e_{274.75}$	$g_{17.38}$	$i_{18.15}$	i_{6050}
lsd (0.05) 3.19)	3.19	4.71	9.22	1.11	26.33	118.20	1.37	3.52	1173.25

Comparison is by Duncan Multiple Range Test

Means not underscored by the same line are significantly different

Key: a = Doko, g = Jac 8, b = AGS_2, h = Jac 5
c = TG_m 119, i = TG_m 7, d = SJ / 1, j = Jac 2
e = TG_m 479, k = Starosa, f = TG_m 29, l = SJ / 2

bean cultivars are presented in Table 3. Doko, Jac 8, Jac 5, Jac 2, Starosa, TG_m 294 and TG_m 7 are highly resistant to lodging; SJ = 1 and TG_m 479 are moderately resistant while SJ = 2, AGS 2 and TG_m 119 are susceptible to lodging. It was observed that cultivars that were relatively very tall lodged severely while those with low to medium height were either completely not affected or only slightly susceptible to lodging (Tables 2 & 3). This result agrees with the findings of Shibbles (1975) that susceptibility to lodging increases with height of plant.

Days to 50% and 95% pod maturity were the traits used in classifying the cultivars into maturity group (Tables 2 & 4). AGS 2 was the only early maturing cultivar Doko and TG_m 119 were late maturing cultivars while the remaining cultivars were medium maturing. Jac 2 had the shortest mean number of day to 50% flowering (35.25 days) which was not significantly different from that of SJ = 1 (38.25 days) while TG_m 119 (52.50 days) and AGS 2 (49 days) had the longest mean number of days to 50% flowering which are significantly different from others (Table 2).

TABLE 3: MEAN SCORE AND CLASSIFICATION BASED ON SUSCEPTIBILITY TO LODGING

Variety	Doko	Jac 8	Jac 5	Jac 2	Starosa	TG_m 294	TG_m 7	SJ #	TG_m 479	SJ # 2	AGS_2	TG_m 119
Mean score	1	1	1	1	1	1.5	1.75_1	2.	2	2.75_1	5	5
Susceptibility lodging	Resistant							moderately resistant		susceptible		

TABLE 4: CLASSIFICATION OF CULTIVARS INTO MATURITY GROUP

Early maturity	Medium maturing	Late maturing
85 — 95 days	96 — 110 days	Doko
AGS 2	TG_m 29	TG_m 119
	SJ # 2	
	Jac 5	
	SJ # 1	
	TG_m 479	
	TG_m 7	
	Jac 8	

Source: Federal Republic of Nigeria — Department of Agricultural Research, Ibadan. Memorandum 116: Soybean in Nigeria (A review article) by Edem U. Edem.

TABLE 5: PRODUCTION COST, RETURN TO MANAGEMENT, BREAKEVEN ANALYSIS, PHYSICAL AND ECONOMIC EFFICIENCY OF EACH VARIETY

Items	*₦*											
Ploughing & Harrowing	240.00											
Herbicide (round-up) — chemical	360.00											
application — labour	40.00											
— equipment (rent)	20.00											
Planting — material (seeds)	120.00											
— labour	30.00											
Weeding — manual	150.00											
Insectide — Lindane	250.00											
application — labour	40.00											
— equipment (rent)	20.00											
Furgicidide — chemical (Henlate)	150.00											
application — labour	40.00											
— equipment (rent)	20.00											
Land rent — isakole	75.00											
Depreciation (land clearing etc.)	100.00											
Preharvest production cost/cultivator	1895.00											
Cultivar		*Doko*	*Jac 2*	*TG_m119*	*AGS_2*	*SJ # 2*	*Jac 8*	*TG_m294*	*SJ # 1*	*Jac 5*	*TG_m479*	*Starosa*	*TG_m 7*
Yield (kg/ha) physical efficiency		1,537	1,890	1,963	2,567	2,753	3323	3,393	3,497	3,707	3,787	3,963	6,050
Sales Revenue (₦2.50/kg)		3842.50	4725.00	4907.50	6417.50	688.5	8307.50	8482.50	8,742.50	9,267.50	9,467.50	9,907.50	15,125.00
Harvesting (labour)		200.00	200.00	200.00	300.00	300.00	350.00	350.00	350.00	400.00	400.00	400.00	600.00
Drying		40.00	40.00	40.00	50.00	50.00	60.00	60.00	60.00	60.00	60.00	60.00	70.00
Threshing (labour)		50.00	50.00	50.00	60.00	60.00	70.00	70.00	70.00	75.00	75.00	75.00	150.00
Bags		96.00	114.00	120.00	156.00	168.00	204.00	204.00	210.00	228.00	228.00	240.00	366.00
Bagging		40.00	45.00	45.00	50.00	50.00	60.00	60.00	65.00	70.00	70.00	75.00	140
Depreciation (Baskets, knives etc.)		110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	140.00
Miscellaneous		200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
Interest rate (17%)		225.00	225.00	225.00	225.00	250.00	300.00	300.00	300.00	320.00	320.00	330.00	450.00
Total cost		2850.00	2879.00	2885.00	3071.00	3083.00	3199.00	3249.00	3260.00	3358.00	3358.00	3385.00	3981.00
Return to management		992.50	1846.00	2022.50	3346.50	3[illegible]9.50	5308.50	5233.50	5482.50	5909.50	6109.50	6522.50	11144.00
Breakeven yield (kg.)/ha		1140.00	1151.60	1154	1228	1233.	1280	1299	1304	1343	1343	1354	1592
Breakeven price (₦/kg)		1.86	1.52	1.47	1.20	1.12	0.96	0.96	0.93	0.91	0.89	0.85	0.65
Economic Efficiency		1.35	1.64	1.70	2.09	2.35	2.60	2.61	2.68	2.76	2.82	2.93	3.80

Table 5 indicates that the pre-harvest production costs are essentially labour (manual), chemical and equipment costs (about 87% of the total pre-harvest production costs). Chemical cost accounted for about 46% of pre-harvest production cost when herbicide was used for weeding which decreased to 21% (insecticides and fungicides costs only) when manual weeding only was adopted. Weed control cost was about 45% of pre-harvest production cost. In the absence of herbicides and tractor services or their relative high cost, soybean production could be labour intensive. Harvesting cost for the best cultivar of soybean TG_m 7 was about 52% of the total production cost. The manual labour cost was about 56% of the total harvesting costs. Other harvesting costs were expenses on consumable inputs and interest on capital. Harvesting of soybean is yet to be mechanised.

The price of the least yielding cultivar (Doko) has to fall to as low as ₦1.86/kg. and the best cultivar (TG_m 7) to as low as ₦0.65/kg before the soybean farmer would not be able to cover all costs in the short run. In the case of adverse weather condition affecting yield, analysis shows that Doko's yield would have to drop by 26% and the TG_m 7's yield by 73% for farmers to sustain economic losses.

The chemical and labour inputs are to some extent substitutes for each other in weeding (herbicides serve as substitutes for manual labour and vice-versa) and their costs accounting for a significant proportion of the production cost should be watched critically as rise in the prices of these two inputs in the absence of a compensating rise in product (soybean) price could throw the profit margin of the soybean enterprise off-balance.

Return to management was about 35% for Doko, a percentage that is higher than the present interest rate on fixed deposit account (20%). Barring terrible production disaster, farmer could take to soybean production to earn return higher than the return on riskless investment and enough to compensate for risk taking. This high rate of return makes soybean production to compare favourably well or better than some other farming enterprises.

With the investment cost of about ₦4,000.00 on TG_m 7 cultivar in a growing season, the enterprise cannot run into any cash liquidity problem.

In conclusion all the economic analyses (Table 5) indicated that any of the soybean cultivars could be cultivated in Ife agro-climatic zone at a positive return to management and that the best cultivar is TG_m 7, TG_m 7 has the highest technical and economic efficiency and the highest return to management.

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