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THE GROWTH AND YIELD DEVELOPMENT OF SOYBEAN (GLYCINE MAX (L) MERILL) VARIETY AS AFFECTED BY FERTILIZER APPLICATION

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ABSTRACT

The study was designed to evaluate the impact of different fertilizer on the growth and yield of soybean varieties at Babcock university farm, Ilishan-Remo in 2009 and 2010. The experimental design was a randomized complete block (RCBD) using three replications. The treatments are three varieties of soybean: (TGx 1740-2F), (TGx 1842 - IE) and (TGx 1448 -2E) and four different fertilizers application: 4ton/ha compost; 30kgN/ha, urea, combination of 2ton/ha compost and 30kgN/ha urea, and (a control). Data analysis using ANOVA at 5% level of probability showed Plant height, number of leaves, number of nodes and branches were significantly higher in fertilizer plots than in the control ($P < 0.05$). However at 8, 10 and 12 weeks after planting, plant height was significantly influenced by both application of 2t/ha compost + 30kgN/ha urea and 4t/ha compost which was superior to other fertilizer treatments and the control. Number of leaves showed the similar trend where compost rate of 4t/ha was superior at all stages of growth measured. At 12 weeks after planting, TGx 1842 – IE had significantly higher plant height compared with the other varieties study. Application of compost at the rate of 4t/ha produced significantly higher number of seeds per plant followed by combine application of 2t/ha compost + 30kgN/ha and the least from the control plots.

INTRODUCTION

Soyabean is an important tropical grain legume and oilseed, which provide cheap and balanced diet (Ogundipe *et al.,* 1989). The crop has been described as the world's chief source of edible vegetable oil and high protein feed for livestock (Deishide *et al.,* 1990). It compares favorably with animal protein source and contains all the essential amino acid required by man. (Williams, *et al.,* 1987, Buttery, *et al.,* 1992). On dry matter basis, the protein yield of soybean is about twice that of meat and of most beans and nuts and four times that of milk, and in South Western Nigeria, soybean seed residue is used in place of melon as soup ingredient (Deishide *et al.,* 1990). One of the major problems associated with soybean in tropical ecology is poor soil fertilizer. This is due to the intensive cropping system which has now become a characteristic feature of Nigerian's arable agriculture. Therefore soil fertility and productivity can be maintained through the use of fertilizer (inorganic and organic). Among other strategies soybean production is increasing in tropical African countries like Nigeria, Ghana, Zambia, and Cameroon, where the crop is grown by small holders as either mono crop or an intercrop with maize cassava using single super phosphate. (Deishiede *et al.,* 1990). The use of chemical fertilizers has drastically reduced due to scarcity and higher price (Akanbi *et al.,* 2001). Hence most developing countries are now exploring the value of organic fertilizers. (Babatola *et al*., 2002). In addition complementary use of organic manure and minerals fertilizer has also been practiced in the tropics and high and sustained crop yield can be obtained with judicious and balanced N-fertilization combined with organic matter amendment. (Makinde *et al.,* 2001). Reports are scanty on the use of different fertilizer source on the growth and development of soybean hence the objective of the study is to determine or evaluate the effect of fertilizer types on soybean growth and grain yield.

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MATERIALS AND METHODS

Field experiments were carried out at the teaching and Research farm of Babcock University, Ilishan-Remo, Ogun

State, Nigeria between 2009 and 2010. The site is located on lat 60N and Long 70w situated in humid tropical rain forest zone of south western Nigeria. It has a bimodal rainfall pattern that is characteristic of southern part of West African. The annual rainfall ranges between 2004 and 3140mm while relative humidity is generally high with the peak during the month of May and October followed by a drastic fall from the month of November. Field experiment was carried out at Babcock University farm in Ogun state, Nigeria to evaluate the influence of different fertilizers on the performance of soybean varieties. The land was ploughed and harrowed once while soil sampling and chemical analysis were carried out. The treatment consisted of three varieties of soybean: (TGx1740-2F), (TGx1842-1E) and (TGx1448-2E) and four fertilizer types: 4t/ha compost, 30kgN/ha urea, 2t/ha compost + 30kgN/ha urea and the control (0kgN/ha). The design was randomized complete block with three replications. The plot size was 3m x 2m with planting spacing of 60cm x 5m, there were1m gaps between subplots and 2m gaps left between replicates. The total land area was 30m x 15m. the compost application was applied a week before planting while minerals fertilizer was applied on week after germination weed control was achieved by the use of hoe as at when necessary while insects control was achieved with the use of insecticide; Karate at 2ml per 1 litre of water starting from 4th week after planting and at when necessary. Destructive method of sampling was done at 2, 4, 6, 8, 10, 12 and 14 weeks after planting where six plants were taken for measurement. The parameter measured were; stem height number of leaves per plant, number of nodes per plant, number of flowers, dry matter weight of roots, stem and roots and gain yield. Data collected were subjected to analysis of variance ANOVA and Duncan Multiple Range Test at 5% level of probability.

Table 1. Pre cropping soil chemical and physical analysis of experimental soil

Properties	Babcock.
pH (H20)	5.8
Organic Carbon (%)	0.55
Total N (%)	0.03
Available P (ppm)	0.68
Fe (mg / kg)	9.16
Cu (mg / kg)	1.20
Zn (mg / kg)	5.12
Exchangeable K (c mol /kg)	0.21
Exchangeable Na (c mol /kg)	-
Exchangeable Ca (c mol /kg)	0.8
Exchangeable Mg (c mol /kg)	0.05
Exchangeable Acidity (c mol /kg)	-
E C E C (c mol /kg)	1.06
Base saturation (g/kg)	926
Sand (g / kg)	950
Silt (g / kg)	120
Clay (g / kg)	12
Textural Class;	Loam sand

RESULTS

The effect of variety on plant height, number of leaves, number of nodes and branches were all significant at all sampling times in the study, except for number of leaves at 4WAP and plant height at 10WAP (table 2 and 3) .Variety TGx 1842-IE showed significantly superiority in plant height at all growing stages when compared with other varieties. The same trend was observed with number of leaves per plant and number of nodes at 8WAP where variety TGx 1842-IE was also superior to TGx 1740-2F and TGx 1448-2E (table 3 and 4). Plant height was significantly higher through the application of 2t/ha + 30kgN/ha rates at all sampling times compared to the control and when N-was applied alone (30kgN/ha) (table 2). There was no significant difference among the treatments at 4WAP, but at 6 and 12 WAP, application of 30kgN/ha and compost rate of 4t/ha significantly produced more leaves followed by the 2t/ha + 30kgN/ha) combine application refers. The number of nodes per plant was significantly higher in plants that received compost application rate of 4t/ha or the combine application of 2t/ha compost + 30kgN/ha fertilizer (table 4). There were significant difference among fertilizer treatments on the number of branches per plant at 6WAP ,where the fertilizer treatments were better than the control (table 5) but at 10WAP, combine application rates of 2t/ha compost + 30kgN/ha urea produced higher branch number followed by 30kgN/ha and compost rate at 4t/ha while control had significantly least.

Table 2. Effect of Variety and Fertilizer types on soybean stem height at different growth stages

VARIETY	2wks	4wks	6wks	8wks	10wks	12wks
TGx1448-2E	17.0a	29.0a	34.0b	57.0a	49.0a	51.0c
TGx1842-IE	14.0b	25.0b	36.0a	50.0ab	51.0a	53.0b
TGx1740-2F	13.0c	22.0c	30.0c	49.0ab	49.0a	60.0a
FERTILIZER TYPES						
30KgN/ha	15.0c	23.0c	31.0c	44.0c	49.0c	52.0bc
2t/ha Compost +30KgN/ha	15.0c	28.0a	37.0a	52.0a	56.0a	58.0a
4t/ha compost	18.0a	26.0b	35.0b	51.0ab	54.0b	54.0b
0kg/ha(control)	16.0b	26.0b	30.0c	40.0cd	43.0d	56.0ab

Values with different letters along column are significantly different using DMRT at 5% probability level

Table 3. Effect of Variety and Fertilizer types on soybean number of leaves at different growth stages

VARIETY	2wks	4wks	6wks	8wks	10wks	12wks
TGx1448-2E	6.0a	8.5a	8.9b	24.3b	26.5a	19.5a
TGx1842-IE	5.2b	7.9a	10.9a	30.8a	29.5a	16.1b
TGx1740-2F	5.3b	8.0a	9.9ab	20.8b	21.3b	11.6c
FERTILIZER TYPES						
30KgN/ha	5.2b	8.2a	9.8ab	20.8b	24.1bc	17.1a
2t/ha Compost +30KgN/ha	5.4ab	8.3a	11.2a	25.8a	29.8a	15.3ab
4t/ha compost	5.9a	8.3a	9.7ab	28.6a	28.3ab	17.6a
0kg/ha(control)	5.4ab	7.8a	8.9b	26.1a	20.8c	12.9b

Values with different letters along column are significantly different using DMRT at 5% probability level

Table 4. Effects of Variety and Fertilizer types on soybean Nodes number at different growth stage

VARIETY	2wks	4wks	6wks	8wks	10wks	12wks
TGx1448-2E	7.0a	12.1a	11.4b	24.0ab	25.7b	31.8b
TGx1842-IE	6.5b	8.0b	13.0a	27.3a	28.4a	28.9c
TGx1740-2F	6.4b	7.8b	9.5c	23.0b	25.8b	35.5a
FERTILIZER TYPES						
30KgN/ha	6.5b	9.4a	21.2b	23.8b	26.6b	34.8a
2t/ha Compost +30KgN/ha	6.4b	9.4a	25.9a	31.7a	33.9a	34.2ab
4t/ha compost	6.8a	8.9a	23.4ab	30.3a	32.2a	36.3a
0kg/ha(control)	7.0a	9.4a	20.8b	27.6a	28.8b	29.8b

Values with different letters along column are significantly different using DMRT at 5% probability level.

Table 5. Effects of Variety and Fertilizer types on soybean number of branches at different growth stages

VARIETY	6wks	8wks	10wks	12wks
TGx1448-2E	2.0c	3.3b	6.8a	7.0a
TGx1842-IE	3.1a	5.8a	6.6a	6.9a
TGx1740-2F	2.6c	3.3b	3.8b	4.1c
FERTILIZER TYPES				
30KgN/ha	2.8a	3.9b	5.0ab	5.1ab
2t/ha Compost +30KgN/ha	2.8a	4.2ab	5.2a	5.4ab
4t/ha compost	2.6a	4.7ab	5.0ab	5.7a
0kg/ha(control)	2.1b	4.9a	4.9b	4.9b

Values with different letters along column are significantly different using DMRT at 5% probability level

Dry Matter Accumulation

Varietal effect was significant on stem dry weight, leaf dry weight, root dry weight and pod dry weight during the growth and development (table 6, 7, 8 and 9).

Table 6. Effects of Variety and Fertilizer types on soybean stem dry matter yield at different growth stages

VARIETY	2wks	4wks	6wks	8wks	10wks	12wks
TGx1448-2E	0.19a	0.8a	1.7a	5.6ab	5.2a	4.1b
TGx1842-IE	0.14b	0.7ab	1.6ab	12.9a	4.6a	5.9a
TGx1740-2F	0.16ab	0.6b	1.3b	4.5b	2.5b	4.6b
FERTILIZER TYPES						
30KgN/ha	0.14c	0.6b	1.6a	4.6b	3.1bc	4.0b
2t/ha Compost +30KgN/ha	0.2ab	0.81a	1.7a	6.5ab	5.6a	5.7a
4t/ha compost	0.2a	0.8ab	1.4a	14.2a	4.8ab	6.4a
0kg/ha(control)	0.15c	0.6ab	1.5a	5.6ab	2.8c	3.5b

Values with different letters along column are significantly different using DMRT at 5% probability level

Table 7. Effects of Variety and Fertilizer types on soybean leaf dry weight at different growth stages

VARIETY	2wks	4wks	6wks	8wks	10wks	12wks
TGx1448-2E	0.4a	1.8a	2.0b	8.9a	6.6a	4.2a
TGx1842-IE	0.1b	1.4ab	2.3b	10.5a	6.9a	3.5a
TGx1740-2F	0.4a	1.1b	3.1a	5.9b	3.6b	4.4a
FERTILIZER TYPES						
30KgN/ha	0.3b	1.0b	1.9c	6.3b	3.8b	3.6bc
2t/ha Compost +30KgN/ha	0.4ab	1.6a	2.9b	8.7ab	7.1a	4.2b
4t/ha compost	0.5a	1.7a	3.1a	11.2a	7.6a	5.9a
0kg/ha(control)	0.4b	1.4ab	3.6a	7.6b	4.4b	2.5c

Values with different letters along column are significantly different using DMRT at 5% probability level

Table 8. Effects of Variety and Fertilizer types on soybean root dry matter at different growth stages

VARIETY	2wks	4wks	6wks	8wks	10wks	12wks
TGx1448-2E	0.10ab	0.5a	0.80a	1.8a	2.2a	2.13ab
TGx1842-IE	0.08b	0.5a	0.66a	2.2a	1.9a	1.87b
TGx1740-2F	0.13a	0.5a	0.75a	1.8a	1.9a	2.32a
FERTILIZER TYPES						
30KgN/ha	0.08b	0.4c	0.67b	1.6b	1.7bc	1.73b
2t/ha Compost +30KgN/ha	0.10ab	0.54a	0.87a	1.9ab	2.9a	2.40a
4t/ha compost	0.12a	0.53ab	0.76ab	2.4a	2.2ab	2.51a
0kg/ha(control)	0.12a	0.41bc	0.67b	1.8b	1.3c	1.78b

Values with different letters along column are significantly different using DMRT at 5% probability level

Table 9. Effects of Variety and Fertilizer types on soybean pod dry weight at different growth stages

VARIETY	8wks	10wks
TGx1448-2E	3.9b	13.9b
TGx1842-IE	5.9a	20.1a
TGx1740-2F	2.7b	14.4b
FERTILIZER TYPES		
30KgN/ha	2.6c	11.7b
2t/ha Compost +30KgN/ha	5.6a	18.0a
4t/ha compost	5.1ab	18.9a
0kg/ha(control)	3.4bc	15.9a

Values with different letters along column are significantly different using DMRT at 5% probability level

Through all the sampling period TGx 1448-2E accumulated higher stem dry matter except at 12 WAP when compared with other varieties. However at 8 and 12 WAP, TGx 1842-IE had higher stem dry matter accumulation than other two varieties (table 6). Leaf dry weight was significantly higher in both varieties TGX 1842-IE and TGx 1448 -2E when compared with TGx 1740-2F at 8 and 10WAP. However at 12 WAP there were no significant effects among all the varieties studied (table 7). Dry matter accumulated in the root of soybean was not significantly different among the varieties at 4, 6,8, and 10WAP except at 2 and 12WAP when TGx 1740-2F produced significantly highest values for root dry weight followed by TGx 1448-2E and least with TGx 1842-IE (table 8). Fertilizer treatments resulted in higher dry matter accumulation compared with the control. Irrespective of the period of sampling, application of 2t/ha compost + 30kgN/ha fertilizer produced higher root dry matter accumulation, although were similar most times with 4t/ha compost rate. This trend was observed in stem dry matter yield, leaf dry matter yield and pod dry matter yield (table 9).There was no significant effect of the treatments on the number of flower at 6 and 10WAP except at 8WAP where compost rate of 4t/ha produced highest number of flower followed by the combine application and the least from 30kgN/ha (table 10).

Table 10. Effects of Variety and Fertilizer types on soybean number of Flowers at different growth stages

VARIETY	6	8	10
TGx1448-2E	13.8a	65.0a	18.3a
TGx1842-IE	13.3a	47.9b	14.3a
TGx1740-2F	15.4a	71.8a	21.4a
FERTILIZER TYPES			
30KgN/ha	14.6a	46.4c	16.4a
2t/ha Compost +30KgN/ha	15.0a	63.9b	21.7a
4t/ha compost	15.6a	78.1a	17.3a
0kg/ha(control)	11.4a	38.1bc	16.4a

Values with different letters along column are significantly different using DMRT at 5% probability level

Seed Characteristics and Seed Yield

Varieties produced significant effects on the seed characteristics and seed yield of soybeans in the study. Variety TGx1842-1E had significant higher number of pod at all sampling period except at 12WAP where variety TGx 1448-2E produced the highest number of pod per plant (table 11). The Pod weight, number of seed, seed weight, husk weight and grain yield were significantly higher in TGx 1842-IE compared to other varieties (table 12). Effect of fertilizer types was significant on number of pod per plant at 8 and 10 WAP but not at 12WAP (table 11). The same trend was observed

with pod weight and seed weight but not on the number of seeds (table 12). Application of compost at the rate of 4t/ha was better when compared to other fertilizer treatments on all the seed/seed yield parameter studied. Followed by the combine application of 2t/ha compost + 30kgN/ha urea and least with 30kgN/ha urea (table 12 and fig 1).

Table 11. Effects of Variety and Fertilizer types on soybean number of pods at different growth stages

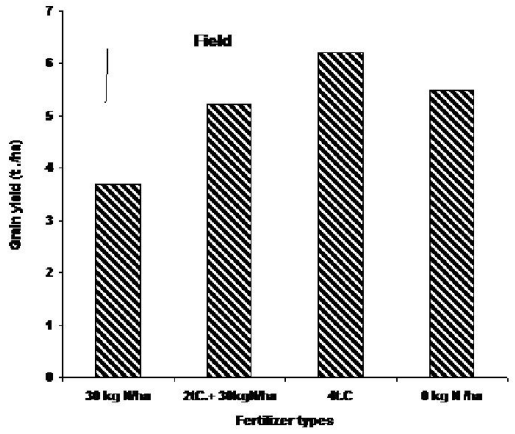
VARIETY	8wks	10wks	12wks
TGx1448-2E	9.9b	60.6a	81.8a
TGx1842-IE	35.8a	63.1a	69.9ab
TGx1740-2F	14.3b	34.7b	58.8b
FERTILIZER TYPES			
30KgN/ha	16.1b	45.1b	67.9a
2t/ha Compost +30KgN/ha	20.3ab	61.7a	68.4a
4t/ha compost	23.8a	61.2a	75.0a
0kg/ha(control)	19.9b	43.1b	66.3a

Values with different letters along column are significantly different using DMRT at 5% probability level

Table 12. Effects of Variety and Fertilizer types on soybean pod and seed characteristics

VARIETY	Pod Weight	No of Seed	Seed Weight	Husk Weight
TGx1448-2E	25.5b	159.7b	15.4b	9.9b
TGx1842-IE	36.2a	255.1a	21.3a	14.6a
TGx1740-2F	23.6b	130.1b	14.2b	9.5b
FERTILIZER TYPES				
30KgN/ha	21.4b	140.3a	12.3b	8.8b
2t/ha Compost +30KgN/ha	30.3ab	198.3a	17.6ab	12.6ab
4t/ha compost	34.6a	199.8a	20.7a	13.9a
0kg/ha(control)	27.6ab	188.1a	17.5ab	9.9ab

Values with different letters along column are significantly different using DMRT at 5% probability level



DISCUSSION

The results of the experiment showed that fertilizer types influence the growth, dry matter production and yield of soybean variety. Varietal effect was significant on all the vegetative parameter taken. Plant height was significant at all stages of growth except at 2 and 10 WAP, where variety TGx 1448-2E had the lowest height compared with the two varieties. Also the number of nodes increases with age of the plant and at 8WAP which respect the peak of vegetative growth; variety TGx 1842-IE had the highest number of nodes. This showed genetic variation in the soybean varieties used. Nitrogen and compost applications enhanced development of vegetative characteristics of soybean crop grown. Plant, height, number of leaves, node number and number of branches were significantly better in fertilized plants than in the control. The better performance of fertilizer plant over the control suggested reduction in crop productivity under a condition of limited nutrients most especially N-availability. This is in line with the observation of smith *et al.* (1992), Makinde et al, Akanbi *et al* 2007 and Daramola *et al*, 2009. They reported that availability of adequate nutrients could improve crop growth and yield parameters.

Conclusion

From the study combine application of 2t/ha compost + 30kgN/ha urea is recommended for the production of soybean in the South Western part of Nigeria. This treatment was as effective as application of 4t/ha compost and 30kgN/ha urea. This reduces the quantity of inorganic fertilizer required whenever the two are needed to be applied together.

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