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Effects of Animal Wastes from Cow, Goat and Poultry on the Growth and Yield of Selected Soybean Varieties

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Abstract

A study on the comparative effects of organic sources of manure as well as inorganic fertilizer on the performances of selected soybean varieties was undertaken. The experimental set up was a completely randomized design (a 17 x 3 factorial treatment structures) consisting of 17 treatments combination and 3 Soybean varieties, replicated twice. Significant variety effect was observed on plant height two weeks after treatment (2WAT), days to flowering, plant height 5WAT, number of stem, stem circumference, leaf length, plant spread, number of leaves, number of pods and pod length. The effect of fertilizer type on growth and yield of soybean was found to significantly influence stem circumference and number of leaves. The interaction of variety x fertilizer type was found to only produce significant effect in the number of leaves and number of pods in soybean. The mean performance of the three different soybean varieties applied with organic and inorganic fertilizers revealed that variety TGx-1448-2E produced longer plant spread (34.28 cm), followed by variety TGx-1955-4E (31.69 cm) and then variety TGx-1904-6F (31.69 cm). The average number of pods (13.38 pods) obtained for variety TGx-1955-4E was more and significantly higher than the reduced number of pods counted for varieties TGx-1904-6F and TGx-1448-2E with an average of 9.79 pods and 10.43 pods respectively. Pod length of variety TGx-1904-6F was longer (3.69 cm), significantly more than pod length of 3.30 cm and 2.73 cm measured for varieties TGx-1955-4E and TGx-1448-2E respectively. The main effect of fertilizer type on growth and yield of different soybean varieties showed that fertilizer combination of poultry litter + goat dung at 7.5g had significantly high stem circumference (2.41 cm) and number of leaves (48.00 leaves). Interaction effect of variety x fertilizer showed that the application of poultry litter +goat dung fertilizer combination at the rate of 7.5g produced the highest number of leaves in TGx-1448-2E variety (59.00 leaves). Also, application of cow dung + poultry litter + goat dung at the rate of 5g gave higher number of pods (22.00 pods) for variety TGx-1955-4E. The findings of this study shows the response of TGx-1955-4E soybean variety to increasing number of pods with the use of organic manure combinations (particularly cow dung + poultry litter + goat dung at the rate of 5g and 7.5g as well as poultry litter + goat dung manure combinations at 7.5g rate), will be advantageous in increasing yield.

Keywords

Soybean, Animal Waste, Growth, Yield

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1. Introduction

Soybean (*Glycine max* L. Merrill) is an annual legume of the pea family Fabeace. Like all other peas, beans, lentils and peanuts, which include some 500 genera and more than 12,000 species, it belongs to the subfamily Papilionideae [1]. Soybean is an important global legume crop that grows in the tropical, sub-tropical and temperate climates like peas, beans, lentils, peanuts. Soybean is a multipurpose crop which is drought tolerant and grown for oil production, human food, livestock feed, industrial purposes, and recently for bio-energy [2]. It is rich in high quality protein (40-42%), oil (18-20%) and other nutrients like calcium, iron, salts, vitamins (thiamine, riboflavin) and glycines [3, 4]. It has the highest protein content of all food crops and is second only to groundnut in terms of oil content among food legumes [5, 6]. Soybean protein is rich in the valuable amino acid lysine (5%) in which most of the cereals is deficient.

It plays a very important function in the natural ecosystem and agriculture, where its ability to fix atmospheric N2 in symbiosis with rhizobium makes it a very good colonizer of low-N environment [7]. All these makes soybean a vegetarian meat and a wonder crop.

Attention has recently focused on the possible role of soybeans in the diet for the prevention and treatment of degenerative Western diseases. Several studies documented the hypocholesterolaemic effect, anti-carcinogenic effects of soy beans, and the ability of soybeans to lower the risk of osteoporosis, cardiovascular disease as well as relieving menopausal symptoms, renal disease beneficial effect against diabetes and antioxidant activity. It is also being used as a folklore medicine in a various rural parts of India against conditions like Hyperhidrosis, night sweats, confusion, hyper cholesterolemia and joint pain. *G. max* has been proved for its liver and gallbladder complaints, anemia, cerebral, nerve conditions and general debility. Soybean also helps in preventing heart diseases, cancer, HIV etc [8].

It is an economically important leguminous crop in Africa widely cultivated in different agro-ecologies, yet its production still lags behind annual consumption [9]. Nigeria is the largest producer of soybean in sub-saharan Africa, followed by South Africa. But due to growing population and decrease in yield there is need to improve so as to meet the growing population. The low yield of soybean has been associated with poor soil fertility and in appropriate soil bacterium strains for roots nodulation. Non Inherent poor and declining soil fertility, soil acidity, poor management practices and low agricultural input use are the major causes of low soybean yields [10, 11, 12].

Fertilizers are substances used to add nutrients to the soil for promoting soil fertility and increasing plant growth and plant yield. Fertilizers can change rate of plant growth, maturity time, size of plant parts, and biochemical content of plants and seed capabilities. However, environmental degradation is a major threat confronting the world, and the rampant use of chemical fertilizers contribute largely to the deterioration of the environment. The long-term use of inorganic fertilizers without organic supplements damages the physical, chemical and biological properties of soil and causes environmental pollution. The harmful effects on the environment due to the heavy use of N fertilizers are becoming more evident [13]. Also, inorganic fertilizers are known for their high cost and their negative environmental effect if managed poorly [14],

There is a need for sustainable farming in which soil fertility is maintained by the use of inexpensive renewable resources that are readily available on the farm such as organic manures [15]. Organic manures act not only as a source of nutrients and organic matter, but also increase microbial biodiversity and activity in soil, influence structure, nutrients get turnover and many other changes related to physical, chemical and biological parameters of the soil [16]. The soil having higher organic matter concentrations have been proved to enhance the growth and yield of different crops [17]. The supply of other nutrients such as P can also be increased with the use of biofertilizers (BFs) [15].

Because soybean is an important food crop that is consumed for it rich protein content, there is need to test if single or mixed animal organic sources can be used to increase the yield for sustainable production, this study was designed to evaluate and compare the effect of organic (cow, goat, poultry) and inorganic sources on the growth and yield parameters of three soybean varieties.

2. Material and Methods

Sources of Materials

A pot experiment was carried out with three (3) varieties of soybean (TGx-1904-6F, TGx-1955-4E, TGx-1448-2E) and seventeen (17) fertilizer treatments combinations replicated two times. The experiment was 3 x 17 factorial arrangement, laid out in a completely randomized design (CRD). The three varieties of soybean seeds were sourced from the Molecular Biology Laboratory Federal University of Agriculture, Makurdi. The organic manure (cow dung, poultry litter, goat dung) were collected from various animal houses and the inorganic fertilizer (N. P. K.) was purchased from a reliable agro-chemical store.

The fertilizer treatment combinations and their respective interpretations are as follows:

CD 5g= Cow dung 5.0g

CD 7.5g= Cow dung 7.5 g

GD 5.0g= Goat dung 5.0g

GD 7.5g= Goat dung 7.5g

PL 5.0g= Poultry litter 5.0g

PL 7.5g= Poultrylitter 7.5g

CD+GD 5.0g=Cow dung +goat dung 5.0g

CD+PL 5.0g=Cow dung +poultry litter 5.0g

GD+PL 5.0g= Goat dung+ poultry litter 5.0g

CD+PL 7.5g= Cow dung+ poultry litter 5.0g

GD+PL 7.5g=Goat dung+poultry litter 7.5g

CD+GD 7.5g=Cow dung +goat dung 7.5g

CD+GD+PL 5.0g= Cow dung+ goat dung+poultry litter 5g

CD+GD+PL 7.5g= Cowdung+ goat dung+poultry litter 7.5g

NPK 5.0g= Nitrogen Phosphorus, Potassium 5g

NPK 7.5g= Nitrogen Phosphorus, Potassium 7. 5g

CTRL= Control (no treatment)

The organic manures were sun-dried and crushed to powder form. The organic treatments were calibrated and mixed with soil samples in pots (small polythene bags, perforated under) which was found to be loam soil (sieved) and suitable for growing soybeans. Each polythene bag contains 5kg of loam soil. Each pot was sown with an average of three seeds each. After 21 days (3 weeks) of planting organic and inorganic fertilizers were applied. Each pot was irrigated with 25 cl of water daily (from day 1 to 37), and 50 cl from day 38 till pods were formed, and then 25 cl at maturity. Weed control was done manually on a daily basis to avoid competition for nutrients with the plants. Data was collected on number of leaves, plant spread, plant height, seedlings vigor, number of plant stem, stem diameter, leaf length, leaf width, yield and yield related parameters, day to flowering, number of flowers, number of fruit/ pod, pod /fruit length, pod weight and number of seeds /pod. Data were analyzed for Analysis of Variance and Mean separation using GenStat Statistical Package (3rd edition). The Duncan Multiple Range Test (DMRT) was used to compare treatment means at $P<0.05$

3. Results and Discussion

The effect of animal waste from cow, goat and poultry on the growth and yield of selected soybean varieties have been successfully investigated. Soybean varieties responded differently ($p<0.05$) with respect to plant height two weeks after treatment (2WAT), number of days to flowering, plant height five weeks after treatment (5WAT), number of stem, stem circumference, leaf length, plant spread, number of leaves, number of pods and pod length. However, the effect of variety was not significant for seedling vigour, number of flowers, plant performance and leaf breath (Table 1).

Table 1. Analysis of Variance showing the effect of organic and inorganic fertilizers on growth, yield and quality of different soybean varieties.

Source of Variation	Df	S. Vigour	PH 2WAT	DTF	NOF	Plant P.	PH 5WAT	N OF STEM	S C	LL	LB	PS	NOL	NOP	POD L
REP	1	20.89	46.38	0.04	0.01	0.09	25.78	4.75	0.042	4.63	0.01	72.75	8.05	0.92	1.25
VARIETY (V)	2	1.34^{ns}	222.79**	42.70**	3.52^{ns}	0.09^{ns}	222.38**	6.25**	0.31**	10.80**	0.32^{ns}	305.26**	1269.09**	124.98**	7.90**
FERTILIZER (F)	16	13.39^{ns}	31.75^{ns}	0.039^{ns}	3.85^{ns}	0.03^{ns}	21.88^{ns}	1.37^{ns}	0.16**	0.98^{ns}	0.60^{ns}	18.31^{ns}	132.91**	16.47^{ns}	0.59^{ns}
VxF	32	6.87^{ns}	23.22^{ns}	0.039^{ns}	3.54^{ns}	0.03^{ns}	42.80^{ns}	1.90^{ns}	0.06^{ns}	0.76^{ns}	0.34^{ns}	20.92^{ns}	101.05**	23.26**	0.36^{ns}
ERROR	50	8.82	21.18	0.039	2.50	0.03	28.86	1.26	0.04	0.68	0.51	14.64	59.80	9.26	0.38

Key: S. Vigour= seedling Vigour; PH 2WAT= plant height two weeks after treatment; DTF= number of days to flowering; NOF= number of flowers 3WBT; Plant P. = Plant performance; PH 5WAT= plant height five weeks after treatment; N of Stem= number of stem; SC = stem circumference; LL= leaf length; LB= Leaf Breath; PS= plant spread; NOL= number of leaves; NOP= number of pods; POD L= pod length.

The mean performance of the three different soybean varieties applied with organic and inorganic fertilizers is presented in Table 2. The effect of variety on plant height at 2WAT showed that the TGx-1904-6F soybean variety produced taller plants (23.36 cm), followed by TGx-1955-4E (22.08cm) and TGx-1448-2E (18.43cm). However, TGx-1448-2E produced longer plant spread (34.28 cm), followed by variety TGx-1955-4E (31.69 cm) and then variety TGx-1904-6F (31.69 cm). Number of days to flowering also varied. Varieties TGx-1904-6F and TGx-1955-4E both recorded 37.00 days interval from planting to flowering, while TGx-1448-2E variety recorded (39.00 days). The average number of stems produced was highest for Variety TGx-1904-6F (2.21 stems), followed by variety TGx-1448-2E (1.38 stems), and variety TGx-1955-4E. Stem circumference of both TGx-1955-4E and TGx-1448-2E varieties (2.25 cm) were significantly greater than that of variety TGx-1904-6F which measured 2.08 cm. The longer leaf length (8.13 cm) measured for variety TGx-1448-2E was significantly greater than leaf length of 7.01 cm and 7.41 cm measured for varieties TGx-1904-6F and TGx-1955-4E respectively. Variety TGx-1448-2E produced more number of

leaves (44.00 leaves), followed by TGx-1955-4E (36.00 leaves) and then variety TGx-1904-6F (32.00 leaves). The average number of pods (13.38 pods) obtained for variety TGx-1955-4E was more and significantly higher than the reduced number of pods counted for varieties TGx-1904-6F and TGx-1448-2E with an average of 9.79 pods and 10.43 pods respectively. Pod length of variety TGx-1904-6F was longer (3.69 cm), significantly more than pod length of 3.30cm and 2.73 cm measured for varieties TGx-1955-4E and TGx-1448-2E respectively.

Table 2. Main effect of variety on growth, yield and quality of different soybean varieties applied with organic and inorganic fertilizers.

Variety	S. Vigour	PH 2WAT	DTF 5WAT	NOF	Plant P	PH 5WAT	N OF STEM	SC	LL	LB	P S	NOL	NOP	Pod L
TGx-1904-6F	5.53a	23.36a	37.00b	6.38a	2.00a	34.50a	2.21a	2.08b	7.01b	4.28a	28.30c	31.68b	9.79b	3.69a
TGx-1955-4E	5.27a	22.08a	37.00b	6.49a	2.00a	36.00a	1.59ab	2.25a	7.41b	4.14a	31.69b	36.18b	13.38a	3.30b
TGx-1448-2E	5.15a	18.43b	39.00a	5.88a	1.91a	31.01a	1.38b	2.25a	8.13a	4.33a	34.28a	43.76a	10.43b	2.73c

Means within a column with similar letter are not significantly different at $P \leq 0.05$.
Key: S. Vigour= seedling Vigour; PH 2WAT= plant height two weeks after treatment; DTF= number of days to flowering; NOF= number of flowers 3WBT; Plant P. = Plant performance; PH 5WAT= plant height five weeks after treatment; N of Stem= number of stem; SC = stem circumference; LL= leaf length; LB= Leaf Breath; PS= plant spread; NOL= number of leaves; NOP= number of pods; POD L= pod length.

This confirms the findings of several authors [18-21], who reported significant differences for soybean traits measured. For example [21], reported variation in growth parameters among old and newly released soybean varieties. Similarly, [20] reported genotypic difference in growth and yield traits among seventeen advanced soybean lines.

The consistent taller plant produced for both varieties (TGx-1904-6F and TGx-1955-4E) indicates its better performance in terms of plant height which is a desirable trait for increasing grain yield in soybean. On the other hand, TGx-1448-2E produced longer plant spread (34.28 cm), significantly better than plant spread of 28.30 cm and 31.69 cm recorded for varieties TGx-1904-6F and TGx-1955-4E respectively. The plant spreading ability of variety TGx-1448-2E may also play a significant role in yield increase. Variation in the number of leaves followed similar trend, with variety TGx-1448-2E producing more number of leaves (44.00 leaves), significantly better than the number of leaves counted for varieties TGx-1904-6F and TGx-1955-4E (32.00 and 36.00 leaves respectively). Also, the study shows that the increase in plant spread resulted to a corresponding increase in the number of leaves in soybean. This agreeing trend between plant spread and number of leaves shows the relationship between this two measured parameters.

The effect of fertilizer type on growth and yield of soybean was found to significantly influence stem circumference and number of leaves. However, seedling vigour, plant height 2WAT, number of days to flowering, number of flowers, plant performance, plant height 5WAT, number of stem, leaf length, leaf breath, plant spread, number of pods and pod length showed no significant difference (Table 1). The effect of fertilizer type on growth and yield of soybean has also been evaluated by several authors [21-24]. Significant response of soybean varieties has been reported to vary with respect to organic and inorganic fertilizer types [21].

The current study shows that fertilizer combination of poultry litter + goat dung at 7.5g had the highest stem circumference of 2.41cm, while cow dung at 5g had the least stem circumference of 1.90cm (Table 3). Fertilizer combination of poultry litter + goat dung at 7.5g had the highest number of leaves (48.00 leaves), while control plot with no fertilizer application had the least number of leaves (28.00 leaves) as shown in Table 3. This shows that the application of organic manure in soybean can play a critical role in increasing plant photosynthesis by increasing the number of leaves. This agrees with the findings of [23], who reported variation in number of leaves observing that the maximum number of leaves per plant was recorded from the application of 125% RDF + FYM @5t/ha at 30, 45 and 60 days after sowing. They also reported that growth attributes of the crop was found to be enhanced with the increase in the application of organic matter. In general, the number of leaves increased with the advancement of age in all the stages of the crop because growth processes are irreversible in nature [23]. The improvement in number of leaves might be due to the increase metabolic activity, stimulation of root growth ultimately increasing the uptake of Nitrogen. The increased applications of poultry litter + goat dung applied at the rate of 7.5g may have optimized the conditions for the growth of the crop which led to luxuriant growth of the plant with respect to stem circumference and number of leaves. Similar results showing increase in growth attribute with the increase in nutrient application have also been observed by [25].

Interaction of variety x fertilizer type had significant effect on the number of leaves and number of pods. All other parameters measured (seedling vigour, plant height 2WAT, days to flowering, plant performance, plant height 5WAT, number of stem, stem circumference, leaf length, leaf breath, plant spread and pod length) did not respond significantly to the interaction effect of variety x fertilizer types (Table 1). Similar findings [23] also shows that soybean genotypes responded differently to variety x fertilizer rate interaction with respect to the number of leaves and number of pods.

Table 3. Main effect of fertilizer type on growth, yield and quality of different soybean varieties.

FERT	SV	PH 2WAT	DF	No. F	Plant P.	PH 5WAT	NOS	SC	LL	LB	PS	NOL	NOP	PL
CD+GD 5g	4.75 a	22.85 a	37.67 a	6.61 a	2.00 a	31.45 a	1.83 a	2.19 ab	7.63 a	4.01 a	31.86 a	37.00 ab	10.22ab	2.70 a
CD+GD 7.5g	4.66 a	23.65 a	37.67 a	5.45 a	2.00 a	33.36 a	1.83 a	2.34 a	7.46 a	4.34 a	28.72 a	40.00 ab	11.50 ab	2.70 a
CD+PL+GD 5g	8.53 a	22.67 a	37.67 a	7.75 a	2.00 a	33.36 a	2.17 a	2.01 ab	7.99 a	4.77 a	30.64 a	32.00 ab	13.06 ab	3.20 a
CD+PL+GD 7.5g	8.49 a	16.08 a	37.67 a	7.33 a	2.00 a	35.45 a	1.83 a	2.40 a	8.20 a	4.48 a	30.53 a	36.00 ab	12.06 ab	3.21 a
CD+PL 5g	7.61 a	17.95 a	37.67 a	5.75 a	1.83 a	32.08 a	1.00 a	2.02 ab	7.31 a	4.08 a	29.95 a	35.00 ab	14.92 a	3.38 a
CD+PL 7.5g	5.27 a	21.00 a	37.67 a	5.78 a	2.00 a	35.78 a	1.33 a	2.25 ab	7.66 a	4.22 a	30.37 a	41.00 ab	12.00 ab	3.21 a
CD 5g	4.42 a	20.61 a	37.33 a	5.11 a	2.00 a	29.29 a	1.50 a	1.90 b	7.71 a	3.62 a	31.03 a	37.00 ab	8.45 b	3.42 a
CD 7.5g	4.24 a	22.78 a	37.67 a	4.95 a	1.83 a	32.95 a	2.00 a	2.02 ab	7.38 a	4.12 a	31.06 a	29.00 b	9.89 ab	3.71 a
CTRL	5.35 a	19.21 a	37.67 a	5.83 a	2.00 a	32.03 a	1.50 a	2.02 ab	6.54 a	3.78 a	28.75 a	28.00 b	9.08 ab	3.07 a
GD 5g	4.11 a	24.02 a	37.67 a	6.33 a	1.83 a	36.33 a	3.17 a	2.15 ab	7.51 a	4.10 a	34.25 a	38.00 ab	11.50 ab	3.08 a
GD 7.5g	4.11 a	24.07 a	37.67 a	6.03 a	2.00 a	35.56 a	1.67 a	2.20 ab	7.14 a	4.20 a	31.08 a	33.00 ab	10.78 ab	3.25 a
NPK 5g	4.48 a	19.35 a	37.67 a	5.83 a	2.00 a	33.36 a	1.67 a	2.28 ab	12.73 a	4.21 a	34.29 a	40.00 ab	10.50 ab	3.58 a
NPK 7.5g	12.86 a	22.23 a	37.67 a	6.42 a	2.00 a	35.42 a	1.50 a	2.34 a	7.15 a	4.60 a	31.92 a	40.00 ab	11.42 ab	3.28 a
PL+GD 5g	6.18 a	20.30 a	37.67 a	6.17 a	2.00 a	33.83 a	1.17 a	2.33 a	8.04 a	4.56 a	33.28 a	42.00 ab	12.50 ab	2.83 a
PL+GD 7.5 g	4.95 a	23.97 a	37.67 a	6.50 a	2.00 a	35.67 a	1.67 a	2.41 a	7.41 a	4.78 a	34.39 a	48.00 a	12.83 ab	3.33 a
PL 5g	3.89 a	20.98 a	37.67 a	6.81 a	2.00 a	35.50 a	2.00 a	2.13 ab	7.25 a	4.25 a	31.25 a	39.00 ab	8.95 ab	3.29 a
PL 7.5	4.86 a	20.13 a	37.67 a	7.58 a	2.00 a	33.83 a	1.50 a	2.31 ab	7.51 a	4.14 a	30.83 a	39.00 ab	10.75 ab	3.83 a

Means within a column with similar letter are not significantly different at $P \leq 0.05$

Key: S. Vigour= seedling Vigour; PH 2WAT= plant height two weeks after treatment; DTF= number of days to flowering; NOF= number of flowers 3WBT; Plant P. = Plant performance; PH 5WAT= plant height five weeks after treatment; N of Stem= number of stem; SC = stem circumference; LL= leaf length; LB= Leaf Breath; PS= plant spread; NOL= number of leaves; NOP= number of pods; POD L= pod length.

Variation in the number of leaves as influenced by variety x fertilizer type interaction (Table 4) showed that the application of poultry litter +goat dung fertilizer combination at the rate of 7.5g produced the highest leaves in TGx-1448-2E variety (59.00 leaves), followed by application of poultry litter + goat dung at 7.5g in TGx-1955-4E (58.00 leaves). Variety TGx-1904-6F control had the least number of leaves (22.00 leaves). The significant interaction effect of variety x fertilizer type on the number of pods in soybean (Table 4) showed that the application of cow dung + poultry litter + goat dung at the rate of 5g gave higher number of pods (22.00 pods) for variety TGx-1955-4E, followed by variety TGx-1448-2E (19.00 pods) with combination of cow dung + poultry litter at 7.5g, and variety TGx-1955-4E (19.00 pods) with combination of cow dung + poultry litter + goat dung at the rate of 7.5g. The least number of pods was observed in the following varieties with fertilizer combination: Variety TGx-1904-6F with poultry litter application at 5g (7.00 pods), variety TGx-1448-2E with N. P. K application at 7.5g (7.00 pods), variety TGx-1448-2E control (7.00 pods), variety TGx-1448-2E with application of cow dung + poultry litter + goat dung at the rate of 7.5g (7.00 pods) and variety TGx-1904-6F with application of cow dung at 5g (7.00 pods).

Singh (2012) observed that the variety JS 97-52 receiving applied with 125% RDF+FYM@ 5 t/ha produced highest number of pods per plant. The current study shows that application of organic manure combinations (particularly cow dung + poultry litter + goat dung at the rate of 5g and 7.5g as well as poultry litter + goat dung manure combinations at 7.5g rate) proved significant for variety TGx-1955-4E by increasing the number of pods per plant. The response of TGx-1955-4E soybean variety to increasing number of pods will be advantageous in increasing yield. Following the findings of [26] who identified seeds pod^{-1} as positively influencing seeds m^{-2}, it is therefore certain that increase in the number of pods in soybean will lead to yield increase.

Table 4. Effect of variety x fertilizer type interaction on growth, yield and quality of different soybean varieties.

Variety	Fertilizer Type	SV	PH 2WAT	DF	No. F	PP	PH5WAT	NOS	SC	LL	LB	PS	NOL	NOP	PL
TGx-1448-2E	CD +GD 5 g	3.350 b	19.750 a	39 a	6.000 a	2.0 a	31.000 a	1.5 b	2.450 ab	8.93 ab	3.89 a	32.50 a	54.00 a	11.00 ab	2.50 a
TGx-1904-6F	CD +GD 5 g	7.440 ab	22.800 a	37 c	5.335 a	2.0 a	25.335 a	2.5 ab	2.025 ab	6.97 b	3.78 a	28.08 a	24.00 c	8.00 b	3.00 a
TGx-1955-4E	CD +GD 5 g	3.450 b	26.000 a	37 c	8.500 a	2.0 a	38.000 a	1.5 b	2.100 ab	6.98 b	4.37 a	35.00 a	33.00 abc	11.00 ab	2.60 a
TGx-1448-2E	CD 5g	3.180 b	17.750 a	38 b	4.500 a	2.0 a	26.500 a	1.0 b	2.000 ab	8.43 b	3.94 a	31.00 a	41.00 abc	11.00 ab	2.75 a
TGx-1904-6F	CD 5g	4.975 ab	27.085 a	37 c	5.835 a	2.0 a	37.875 a	2.5 ab	1.850 b	6.20 b	3.59 a	26.09 a	32.00 abc	7.00 b	3.75 a
TGx-1955-4E	CD 5g	5.090 ab	17.000 a	37 c	5.000 a	2.0 a	23.500 a	1.0 b	1.850 b	8.51 b	3.34 a	36.00 a	39.00 abc	8.00 b	3.75 a
TGx-1448-2E	CD 7.5g	4.135 ab	23.250 a	39 a	5.000 a	1.5 a	35.750 a	2.0 b	2.075 ab	7.20 b	4.23 a	36.75 a	35.00 abc	8.00 b	2.50 a
TGx-1904-6F	CD 7.5g	5.045 ab	22.225 a	37 c	4.585 a	2.0 a	32.835 a	2.5 ab	1.940 ab	6.84 b	4.06 a	24.17 a	25.00 bc	12.00 ab	4.13 a
TGx-1955-4E	CD 7.5g	3.540 b	22.875 a	37 c	5.250 a	2.0 a	30.250 a	1.5 b	2.050 ab	8.10 b	4.07 a	32.25 a	27.00 bc	10.00 ab	4.50 a
TGx-1448-2E	CD+ GD 7.5g	4.010 ab	18.250 a	39 a	5.500 a	2.0 a	35.500 a	1.5 b	2.550 ab	8.61 b	3.95 a	33.00 a	53.00 a	10.00 ab	2.50 a
TGx-1904-6F	CD+ GD 7.5g	6.750 ab	22.960 a	37 c	6.335 a	2.0 a	28.835 a	2.5 ab	1.980 ab	6.25 b	4.75 a	23.92 a	32.00 abc	13.00 ab	2.59 a
TGx-1955-4E	CD+ GD 7.5g	3.205 b	29.750 a	37 c	4.500 a	2.0 a	35.750 a	1.5 b	2.475 ab	7.52 b	4.33 a	29.25 a	34.00 abc	13.00 ab	3.00 a
TGx-1448-2E	CD+ PL 5g	7.530 ab	16.875 a	39 a	6.000 a	1.5 a	29.000 a	1.0 b	1.850 b	7.42 b	4.45 a	29.60 a	34.00 abc	17.00 ab	3.30 a
TGx-1904-6F	CD+ PL 5g	6.075 ab	20.500 a	37 c	6.500 a	2.0 a	34.000 a	1.0 b	2.250 ab	7.17 b	4.13 a	33.50 a	41.00 abc	15.00 ab	3.10 a
TGx-1955-4E	CD+ PL 5g	9.225 ab	16.500 a	37 c	4.750 a	2.0 a	33.250 a	1.0 b	1.950 ab	7.33 b	3.66 a	26.75 a	30.00 abc	14.00 ab	3.75 a

Variety	Fertilizer Type	SV	PH 2WAT	DF	No. F	PP	PH5WAT	NOS	SC	LL	LB	PS	NOL	NOP	PL
TGx-1448-2E	CD+PL 7.5g	3.300 b	20.500 a	39 a	6.000 a	2.0 a	32.000 a	1.0 b	2.300 ab	8.11 b	3.94 a	33.10 a	45.00 ab	19.00 a	2.75 a
TGx-1904-6F	CD+PL 7.5g	4.295 ab	24.385 a	37 c	5.835 a	2.0 a	36.835 a	2.0 b	2.225 ab	6.79 b	4.28 a	31.00 a	37.00 abc	9.00 b	3.88 a
TGx-1955-4E	CD+PL 7.5g	8.205 ab	18.125 a	37 c	5.500 a	2.0 a	38.500 a	1.0 b	2.225 ab	8.08 b	4.44 a	27.00 a	40.00 abc	9.00 b	3.00 a
TGx-1448-2E	CD+PL+GD 5g	11.460 ab	15.000 a	39 a	6.000 a	2.0 a	27.000 a	2.0 b	1.900 ab	8.79 b	4.56 a	36.50 a	45.00 ab	7.00 b	2.50 a
TGx-1904-6F	CD+PL+GD 5g	5.790 ab	29.015 a	37 c	6.250 a	2.0 a	31.585 a	3.0 ab	1.950 ab	7.20 b	4.95 a	26.92 a	24.00 c	10.00 ab	4.00 a
TGx-1955-4E	CD+PL+GD 5g	8.330 ab	24.000 a	37 c	11.000 a	2.0 a	41.500 a	1.5 b	2.175 ab	7.97 b	4.81 a	28.50 a	27.00 bc	22.00 a	3.10 a
TGx-1448-2E	CD+PL+GD7.5g	6.475 ab	15.250 a	39 a	6.000 a	2.0 a	32.500 a	2.0 b	2.700 ab	9.44 ab	5.48 a	34.50 a	44.00 abc	8.00 b	2.50 a
TGx-1904-6F	CD+PL+GD7.5g	7.865 ab	20.000 a	37 c	6.500 a	2.0 a	33.335 a	2.5 ab	2.190 ab	7.70 b	3.96 a	25.59 a	31.00 abc	10.00 ab	4.13 a
TGx-1955-4E	CD+PL+GD7.5g	11.115 ab	13.000 a	37 c	9.500 a	2.0 a	40.500 a	1.0 b	2.300 ab	7.46 b	4.01 a	31.50 a	3.050 abc	19.00 a	3.00 a
TGx-1448-2E	Ctrl	4.465 ab	16.000 a	39 a	5.000 a	2.0 a	31.500 a	1.0 b	1.850 b	7.01 b	3.96 a	30.00 a	34.00 abc	7.00 b	2.50 a
TGx-1904-6F	Ctrl	7.845 ab	23.140 a	37 c	5.000 a	2.0 a	29.085 a	2.5 ab	2.200 ab	6.40 b	3.57 a	26.75 a	22.00 c	8.00 b	3.75 a
TGx-1955-4E	Ctrl	3.750 ab	18.500 a	37 c	7.500 a	2.0 a	35.500 a	1.0 b	2.000 ab	6.20 b	3.80 a	29.50 a	30.00 abc	13.00 ab	2.96 a
TGx-1448-2E	GD 5g	3.300 b	19.500 a	39 a	6.000 a	1.5 a	27.500 a	1.0 b	2.250 ab	8.61 b	3.96 a	38.00 a	42.00 abc	16.00 ab	3.00 a
TGx-1904-6F	GD 5g	3.855 ab	26.425 a	37 c	8.250 a	2.0 a	41.750 a	1.5 b	2.050 ab	7.50 b	4.28 a	34.75 a	43.00 abc	9.00 b	3.75 a
TGx-1955-4E	GD 5g	5.175 ab	26.125 a	37 c	4.750 a	2.0 a	39.750 a	7.0 a	2.150 ab	6.42 b	4.07 a	30.00 a	30.00 abc	11.00 ab	2.50 a
TGx-1448-2E	GD 7.5g	3.900 ab	19.000 a	39 a	7.000 a	2.0 a	32.000 a	1.0 b	2.300 ab	8.17 b	4.23 a	35.00 a	33.00 abc	12.00 ab	3.00 a
TGx-1904-6F	GD 7.5g	5.315 ab	24.135 a	37 c	5.585 a	2.0 a	36.165 a	2.5 ab	1.925 ab	6.40 b	4.47 a	25.50 a	31.00 abc	7.00 b	3.00 a
TGx-1955-4E	GD 7.5g	3.120 b	29.075 a	37 c	5.500 a	2.0 a	38.500 a	1.5 b	2.375 ab	6.86 b	3.89 a	32.75 a	35.00 abc	14.00 ab	3.75 a
TGx-1448-2E	npk 5g	4.600 ab	17.100 a	39 a	4.500 a	2.0 a	34.500 a	1.5 b	2.350 ab	8.76 b	4.72 a	40.00 a	54.00 a	9.00 b	3.00 a
TGx-1904-6F	npk 5g	4.130 ab	19.525 a	37 c	7.000 a	2.0 a	30.585 a	2.0 b	2.100 ab	21.69 a	3.79 a	30.13 a	35.00 abc	10.00 ab	4.50 a
TGx-1955-4E	npk 5g	4.720 ab	21.425 a	37 c	6.000 a	2.0 a	35.000 a	1.5 b	2.375 ab	7.75 b	4.13 a	32.75 a	30.00 abc	14.00 ab	3.25 a
TGx-1448-2E	Npk 7.5	29.915 a	19.900 a	39 a	6.000 a	2.0 a	34.000 a	1.0 b	2.550 ab	8.02 b	4.66 a	36.50 a	47.00 ab	7.00 b	2.60 a
TGx-1904-6F	Npk 7.5	4.350 ab	25.800 a	37 c	7.000 a	2.0 a	39.500 a	2.0 b	2.200 ab	6.95 b	4.70 a	28.25 a	33.00 abc	12.00 ab	3.75 a
TGx-1955-4E	Npk 7.5	4.305 ab	21.000 a	37 c	6.250 a	2.0 a	32.750 a	1.5 b	2.275 ab	6.47 b	4.45 a	31.00 a	39.00 abc	16.00 ab	3.50 a
TGx-1448-2E	PL 5g	3.040 b	15.500 a	39 a	5.500 a	2.0 a	26.500 a	2.5 ab	2.050 ab	7.00 b	3.73 a	28.75 a	38.00 abc	8.00 b	3.00 a
TGx-1904-6F	PL 5g	5.295 ab	22.340 a	37 c	7.165 a	2.0 a	39.750 a	2.0 b	2.075 ab	7.12 b	4.28 a	29.50 a	38.00 abc	9.00 b	3.88 a
TGx-1955-4E	PL 5g	3.340 b	25.125 a	37 c	7.750 a	2.0 a	40.250 a	1.5 b	2.275 ab	7.63 b	4.73 a	35.50 a	41.00 abc	10.00 ab	3.00 a
TGx-1448-2E	PL 7.5g	5.215 ab	15.000 a	39 a	7.500 a	2.0 a	33.000 a	1.0 b	2.250 ab	7.65 b	4.00 a	37.00 a	37.00 abc	12.00 ab	3.00 a
TGx-1904-6F	PL 7.5g	5.135 ab	24.375 a	37 c	7.750 a	2.0 a	39.000 a	2.5 ab	2.275 ab	8.00 b	4.97 a	27.00 a	36.00 abc	7.00 b	4.50 a
TGx-1955-4E	PL 7.5g	4.215 ab	21.000 a	37 c	7.500 a	2.0 a	29.500 a	1.0 b	2.400 ab	6.89 b	3.44 a	28.50 a	44.00 abc	14.00 ab	4.00 a
TGx-1448-2E	PL+GD 5g	9.985 ab	24.600 a	39 a	5.500 a	2.0 a	29.500 a	1.5 b	2.500 ab	8.57 b	4.93 a	35.00 a	53.00 a	10.00 ab	2.50 a
TGx-1904-6F	PL+GD 5g	3.545 b	16.450 a	37 c	8.000 a	2.0 a	32.500 a	1.0 b	2.000 ab	7.44 b	4.66 a	28.84 a	29.00 bc	13.00 ab	3.00 a
TGx-1955-4E	PL+GD 5g	5.000 ab	19.850 a	37 c	5.000 a	2.0 a	39.500 a	1.0 b	2.500 ab	8.12 b	4.08 a	36.00 a	44.00 abc	16.00 ab	3.00 a
TGx-1448-2E	PL+GD 7.5g	4.610 ab	20.000 a	39 a	8.000 a	2.0 a	29.500 a	1.0 b	2.300 ab	7.50 b	4.99 a	35.50 a	59.00 a	11.00 ab	2.50 a
TGx-1904-6F	PL+GD 7.5g	6.390 ab	25.915 a	37 c	5.500 a	2.0 a	37.500 a	3.0 ab	2.165 ab	7.00 b	4.54 a	31.17 a	26.00 bc	10.00 ab	4.00 a
TGx-1955-4E	PL+GD 7.5g	3.840 ab	26.000 a	37 c	6.000 a	2.0 a	40.000 a	1.0 b	2.750 a	7.74 b	4.80 a	36.50 a	58.00 a	18.00 a	3.50 a

Means within a column with similar letter are not significantly different at $P \leq 0.05$.
Key: S. Vigour= seedling Vigour; PH 2WAT= plant height two weeks after treatment; DTF= number of days to flowering; NOF= number of flowers 3WBT; Plant P. = Plant performance; PH 5WAT= plant height five weeks after treatment; N of Stem= number of stem; SC = stem circumference; LL= leaf length; LB= Leaf Breath; PS= plant spread; NOL= number of leaves; NOP= number of pods; POD L= pod length.

4. Conclusion

The findings of this study shows that various combinations of different fertilizer types is a determinant factor in accessing the variable response to growth, yield and quality in soybean varieties. The increase in the number of leaves when poultry litter + goat dung was applied at the rate of 7.5g, shows that the application of organic manure in soybean can play a critical role in increasing plant photosynthesis by increasing metabolic activity and stimulation of root growth, ultimately leading to yield increase. Also, the response of TGx-1955-4E soybean variety to increasing number of pods with the use of organic manure combinations (particularly cow dung + poultry litter + goat dung at the rate of 5g and 7.5g as well as poultry litter + goat dung manure combinations at 7.5g rate), will be advantageous in increasing yield. The interaction of variety x fertilizer type was found to only produce significant effect in the number of leaves and number of pods in soybean.

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