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## The effect of packaged organic and inorganic fertilizers on the growth and yield of soyabean (*glycine max* l)

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**ABSTRACT:** The effect of packaged organic and inorganic fertilizers on the growth and yield of soyabean *Glycine max* (L) merr was carried out in the rainforest zone of Nigeria. The treatments used were inorganic fertilizer NPK 15: 15: 15 and packaged organic fertilizer. The experiment was laid out in a randomized complete block designed (RCBD) in three replicates with six treatments viz, 0, 100, 200 and 300kg/ha NPK 15:15:15 fertilizer, and 100 and 300 Kg/ha organic fertilizer.

Results showed that plant height, number of branches, leaf area and number of leaves per plant were enhanced by organic and inorganic fertilizers at different weeks after planting (WAP). Similarly, application of inorganic fertilizer increased the pod weight/plant compared to the control and organic fertilizers. However, 200kg/ha of NPK fertilizer gave the highest soya bean yield followed by 300 and 100kg/ha NPK fertilizer, then 300kg/ha and 100kg/ha packaged organic fertilizer. There were significant differences among treatments. The triad suggests that moderate rate of inorganic fertilizer (200kg/ha NPK) is appropriate for soya bean yield.

**Keywords:** Inorganic fertilizer, soyabean, growth, yields.

### Introduction

Soyabean (*Glycine max* L) has occupied third place in oil seed crop of the world, which is a rich source of protein (40 - 42%). It also enriches the soil through symbiotic fixation and leaves about 30 - 40KgN per hectare for succeeding crops [1]. Soyabean production in Nigeria was for many years centered on the savanna ecological zone where soils are characteristically low in Nitrogen and Phosphorous [2]. It is now widely grown in the middle belt states of Benue, Kogi, Niger, Kwara and Kaduna [3] and in the rain forest zone of Ondo, Oyo and Northern parts of Delta State [4-5]. By 1980, Nigeria had over 197000 hectares of land devoted to soyabean production, the largest in Africa with yield of 300 - 400kg/ha (Apeji, 1988) [6-7].

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In spite of the integrated use of various soil fertility amendment input aimed at alleviating the limiting nutrient, problems and improving their availability in soil reserves, crop yield still fall short of their potential because of inadequate nutrient inputs, in appropriate quality of the organic materials and insufficient combination [8]. It was also reported that farmers have devised ways of restoring and maintain soil fertility; these include application of organic or inorganic fertilizer to offset the nutrients removed by the crops, recycling part of the nutrients through the use of manures or leave the crop residue in the field to decompose and offset organic matter losses [9]. To provide Nitrogen in soils through organic matters, high quality organic materials that are free from pathogens need to be used [10].

The overall goal of this study was to examine some of the agronomic practices that could lead to the improvement in yield of soya bean by determining the effect of inorganic fertilizer (NPK 15:15:15) and packaged organic fertilizer on the growth of the crop.

## Materials and Methods

The experiments were conducted on a parcel of land located at kilometer 11 along Benin Lagos road, Benin City temperatures during the growing period range between 20.5 -34.2°C with an average of 27.3°C. The rainy season starts in May and ends 15 October (Table 1). The soils are sandy, loam and slightly acidic (Table 2). The chemical composition of POF is shown on (Table 3). The portion of land for the experiment had been left fallow for one year and was over grown with spear grass (*Imperata cylindrical*) and siam weed (*Chromoleana odorata*). Variety of soyabean used is Tax 1440.

**Table 1.** Meteorological conditions at NIFOR Benin City during the period of the trial, May 2004 – January 2005.

|                        | May   | June  | Jul   | Aug   | Sept  | Oct   | Nov   | Dec   | Jan   |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Total Rainfall (mm)    | 323.4 | 355.7 | 214.3 | 398.6 | 293.7 | 280.7 | 32.3  | 5.0   | 32.2  |
| Min. Temp.(°C)         | 23.0  | 22.8  | 21.8  | 21.8  | 23.3  | 22.9  | 23.4  | 20.5  | 22.5  |
| Max.(°C)               | 31.5  | 30.7  | 30.7  | 29.8  | 31.2  | 32.5  | 33.2  | 34.2  | 33.4  |
| Rel. Humidity          | 84.8  | 87.8  | 81.5  | 90.0  | 85.2  | 82.4  | 83.2  | 75.5  | 74.4  |
| Solar Rad.             | 384.9 | 359.6 | 2943  | 294.8 | 320.1 | 385.2 | 358.2 | 389.2 | 364.1 |
| Mean Sunshine (hr/day) | 4.5   | 4.2   | 2.7   | 1.4   | 3.8   | 4.2   | 41    | 6.3   | 7.1   |

## Treatments

Six treatments were arranged in a complete randomized block designed and replicated three times. Each replicate was separated from each other by 1m pathway for easy agronomic operations. The trial was planted on a fiat leveled land, each experiments plot measured 3 3.6m soyabean were planted in may and per stand at a depth of 5cm at a spacing of 60cm between rows and 10cm within rows and later thinned to 1 seedling per stand a week after planting .the trial received 0, 100,200 and300 kg ha NPK and 100 and 300 kg /ha packaged organic fertilizer two weeks before planting. Weeds were controlled manually at 3 and 7 wks after planting .The second experiment was under sprinkle irrigation because it was planted in the dry season.

**Table 2.** Physical and chemical properties of soils from experimental site.

| Soil Variable       | Exp 1      | Exp 2      |
|---------------------|------------|------------|
| Clay (%)            | 3.00       | 4.50       |
| Silt (%)            | 1.80       | 3.50       |
| Sand (%)            | 95.20      | 92.20      |
| Textural group      | Sandy loam | Sandy loam |
| pH (1.1)            | 4.80       | 4.80       |
| Organic Carbon (%)  | 1.12       | 1.66       |
| C/N                 | 43.60      | 60.00      |
| Nitrogen (%)        | 0.10       | 0.21       |
| Phosphorous (Mg/kg) | 3.78       | 9.80       |
| Sodium (Cmol/kg)    | 0.18       | 0.63       |
| Potassium (Cmol/kg) | 0.10       | 0.83       |
| Calcium (Cmol/kg)   | 2.10       | 2.10       |
| Magnesium (Cmol/kg) | 0.80       | 0.32       |

Table 3. Chemical analysis of packaged organic fertilizer.

| Nutrients           | Composition |
|---------------------|-------------|
| pH (1.1) in water   | 6.31        |
| Organic C (%)       | 2.10        |
| Organic matter (%)  | 3.59        |
| Sodium (Cmol/kg)    | 70.54       |
| Potassium (Cmol/kg) | 446.95      |
| Calcium (Cmol/kg)   | 481.10      |
| Magnesium (Cmol/kg) | 160.51      |
| Phosphate (ppm)     | 59.36       |
| Nitrate (ppm)       | 5.47        |
| Sulphate %          | 14.75       |

## Data Collection

The parameter on five randomly selected plants measured were plant height (cm), number of leaves per plant, leaf area (cm<sup>2</sup>) and number of branches per plant. At harvest, number of pods/net plot, weight of pods/net plot, weight of grains/net plot and shelling percentage were computed.

The data collected were subjected to analysis of variance (ANOVA) as described by Gomeze and Gomez [11] and significant differences among treatment means were separated using the least significant difference (LSD) test [12].

## Results and Discussion

### Vegetative trait

In general, there was increase in vegetative traits of soyabean plant at various stages of growth, when compared with the control in both experiments (Tables 4 and 5). However, application of inorganic fertilizers tends to enhance more vegetative growth when compared with the packaged organic fertilizer in both experiments. Though there were no significant differences among treatment, application of 200 kg/ha NPK fertilizer tends to be more favourable for soya bean production in this experiments as plants under this application had higher plant height, number of branches, number of leaves and leaf area.

The increase in vegetative traits of plants treated with moderate application of NPK 200 Kg/ha may be attributed to internode elongation and other nutrients received by the plant from inorganic sources. This result is comparable to the findings of Leo Espinoza [13] who reported that nutrients in inorganic fertilizer are readily available for plant uptake upon application while the organic forms of nutrients are slowly available. Orellana et al [14] also reported that moderate application of fertilizer gave greater number of leaves and branches in soyabean. The lower trend in vegetative traits as seen with those in which packaged organic fertilizer is applied could be due to the slow release of nutrients in the organic form to plants.

Another reason could be non availability of some nutrients which may have been fixed in the soil. This confirms the findings of Tisdale et al, (1985) [15] who reported that the availability of Mg decreased as the pH approaches neutrality. The lowest plant height, number of leaves, number of branches, leaf area as seen with the control may be due to the fact that plants had to depend mainly on the intrinsic soil fertility.

Table 4: Effects of Fertilizer application on Vegetative Traits Experiment 1

| Treatment      | Plant height | No. of leaves | Leaf area | Number of branches |
|----------------|--------------|---------------|-----------|--------------------|
| Control        | 161.00       | 132.30        | 31937.22  | 20.60              |
| NPK 100(kg/ha) | 220.00       | 181.60        | 61593.06  | 29.60              |
| NPK 200(kg/ha) | 227.60       | 221.30        | 80176.99  | 34.00              |
| NPK 300(kg/ha) | 196.60       | 190.00        | 73245.00  | 33.00              |
| POF 100(kg/ha) | 177.00       | 184.30        | 59510.32  | 26.60              |
| POF 300(kg/ha) | 176.00       | 156.60        | 48264.12  | 23.30              |
| Mean           | 193.03       | 177.68        | 59121.11  | 27.85              |
| LSD (0.05)     | NS           | NS            | NS        | NS                 |
| CV (%)         | 4.85         | 8.3           | 7.42      | 10.18              |

Table 5: Effects of Fertilizer application on Vegetative Traits Experiment 2

| Treatment      | Plant height | No. of leaves | Leaf area | Number of branches |
|----------------|--------------|---------------|-----------|--------------------|
| Control        | 161.30       | 128.30        | 30971.62  | 20.60              |
| NPK 100(kg/ha) | 219.30       | 246.60        | 80687.50  | 28.60              |
| NPK 200(kg/ha) | 228.30       | 188.60        | 68386.3   | 33.60              |
| NPK 300(kg/ha) | 197.00       | 190.00        | 75202.00  | 32.60              |
| POF 100(kg/ha) | 177.00       | 181.60        | 60727.0   | 36.00              |
| POF 300(kg/ha) | 176.00       | 153.00        | 47139.3   | 23.60              |
| Mean           | 193.25       | 181.35        | 60518.95  | 27.50              |
| LSD (0.05)     | NS           | NS            | NS        | NS                 |
| CV (%)         | 4.90         | 7.37          | 7.7       | 10.06              |

Table 6: Effects of Fertilizer application on reproductive Traits Experiment 1

| Treatment      | No. pods/<br>plant | Wt pods<br>(g)/plant | Wt grains(g)/<br>plant | Shelling (%) | Grain<br>yield/kg/ha |
|----------------|--------------------|----------------------|------------------------|--------------|----------------------|
| Control        | 225.00             | 62.84                | 42.50                  | 67.13        | 1416.60              |
| NPK 100(kg/ha) | 367.01             | 102.00               | 82.40                  | 80.70        | 2733.30              |
| NPK 200(kg/ha) | 511.31             | 146.80               | 96.40                  | 65.60        | 3213.33              |
| NPK 300(kg/ha) | 455.32             | 120.60               | 80.60                  | 66.70        | 2686.66              |
| POF 100(kg/ha) | 265.31             | 120.70               | 80.60                  | 66.70        | 2686.60              |
| POF 300(kg/ha) | 225.01             | 75.70                | 50.90                  | 67.10        | 1696.60              |
| Mean           | 341.49             | 104.77               | 72.23                  | 68.98        | 2255.36              |
| LSD (0.05)     | 165.41             | 48.9                 | 31.10                  | 31.42        | 149.03               |

### Reproductive trait

There was a significant difference amongst treatment ( $P \leq 0.05$ ) in the performance of the soya bean plant (Tables 6 and 7). Number of pods, weights of pods, weights of grains and grain yield (Kg/ha) increased with the application of inorganic fertilizer up to the highest yield (200 kg/ha NPK). Increase rate of application of package organic fertilizer decreased the reproductive traits. This observation corresponds with the reports of Jayapaul and Ganesaraja (1970) [16], as well as Kumar and Rao (1971) [17] that moderate application of nitrogen and phosphorous increase the number of pods per plant, seeds per pod,

seed weight and seed yield of soya bean.

Grain yield of soya bean treated with inorganic fertilizer were significantly higher than yields treated with packaged organic fertilizer and the control. The highest grain yield 3213.33 kg/ha was recorded with crops treated with 200 kg/ha inorganic fertilizer.

Result of this study suggests that moderate application of inorganic fertilizer has a comparative yield advantage over application of organic fertilizer. However, additional studies are needed to confirm the present results.

Table 7: Effects of Fertilizer application on reproductive Traits Experiment 2

| Treatment      | No. pods/plant | Wt pods (g)/plant | Wt grains(g)/plant | Shelling (%) | Grain yield/kg/ha |
|----------------|----------------|-------------------|--------------------|--------------|-------------------|
| Control        | 166.30         | 63.11             | 42.87              | 67.92        | 1429.00           |
| NPK 100(kg/ha) | 315.31         | 101.75            | 83.05              | 81.62        | 2768.33           |
| NPK 200(kg/ha) | 468.01         | 146.97            | 96.07              | 65.36        | 3202.33           |
| NPK 300(kg/ha) | 418.62         | 120.59            | 80.59              | 66.83        | 2686.33           |
| POF 100(kg/ha) | 229.61         | 120.43            | 80.45              | 66.80        | 2681.66           |
| POF 300(kg/ha) | 228.61         | 76.14             | 50.98              | 66.95        | 1696.33           |
| Mean           | 304.41         | 104.83            | 72.34              | 69.25        | 2411.16           |
| LSD (0.05)     | 164.27         | 48.96             | 31.10              | 31.45        | 149.04            |

### *Conclusion*

The study showed that moderate rates of NPK 15: 15: 15 fertilizer (100 or 200 kg/ha can be applied to boost soyabean production. Similarly, low levels of packaged organic fertilizer can also be applied as plants responded very well to these levels in the two experiments reported. This work is reported for the first time.

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