

## Influence of Seedbed Preparation on the Growth and Development of Medium Maturing Varieties of Soybean (*Glycine max* (L) Merrill)

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### Abstract

In the University of Nigeria research farm, two different seedbeds preparation/types were experimented upon with five medium - maturing soybeans between July 29 and December 3, 1996 and development of the cultivars were evaluated. There were no significant effect of the land preparation methods on all the parameters studied except on the height of lowest pod which recorded highest values among the plants on flats. Significant differences were observed among the cultivars in a number of parameters measured. On the basis of number of seed per pod, number of seeds per plant, number of nodules per plant and number of pod per plant, Samsoy-2 came top of the other five cultivars, but in terms of grain yield (ton/ha) and 100 seed weight, TGX 1440-E had highest of 0.213 ton/ha and 10.510 gm respectively. From the results cultivars TGX 1440-1E, TGX 1479-1E and SamSoy-2 were found to be more promising than TGX 1807-19E, and TGX 1805-33F. TGX 1805-33f was the least on number of seed per plant, number of pods per plant, weight of 100 seeds and in grain yield (ton/ha.).

**Keywords:** Soybean, Cultivars, Seedbed preparation, Ridges, Flat

### Introduction

Growth and alterations in plant development occur when soybean is grown in different seed bed preparations (Pedersen and Lauer, 2004). Different seed bed preparations have been shown to affect soil physical properties, soil organic matter content, aggregate stability, and macroporosity (Lal *et al.*, 1990). Collectively and individually, changes in these soil attributes influence plant growth and development (Dao, 1993). The changes can be detrimental, neutral, or beneficial for crop growth and yield, depending on soil texture and structure (Dick and VanDoren, 1985), climatic factors such as rainfall (Boyer, 1970), and weed control (Miguel and Matt, 1987).

Ridging is widely used in Africa to ensure good root development and good drainage in temporary wetlands, and to collect fertile soil around plants grown on the most degraded soils. Ridging also facilitates weed control by giving the crop an advantage of 10 – 20cm in height over the weeds (Roose, E. 1996). Ridging is widely practised in Northern Nigeria as a soil and water conservation measure. Significant increases in yields of crops have been reported in the sub-humid and semi-arid zones of West Africa, especially when ridges were tied to conserve water and soil (Lawes, 1960). It has been shown that reduced cultivation affects absorption of water and nutrients and that growth and yield suffer when these stresses in the soil interfere with root development (Scott *et al.* 1975). The objective of the present investigation was to evaluate the influence of seedbed on the growth and development of medium maturing soybean cultivars in Nsukka agro-ecological zone.

### Materials and Methods

The research was carried out at the Teaching and Research farm of the University of Nigeria, Nsukka

(UNN) between July 29 and December 3, 1996. Nsukka is situated in a derived savannah ecological zone at latitude 06 52<sup>o</sup>N, longitude 07 24<sup>o</sup>E and with an altitude of 447.26 meters above sea level. The land used for the experiment measured 62m x 4m. The division into ridges and flats was in random pattern and each of the blocks was tilled with a hoe and mixed fertilizer of single superphosphate and NPK 15:15:15 compound fertilizer at the rate of 200kg/ha and 150kg/ha, respectively was worked into the soil. The experimental design was split plot in randomized complete block design (RCBD) with three (3) replications. The factors in the main plot are the ridge and flat seedbeds while the factor in the subplots are the five varieties of soybean. The soybean varieties were; TGX 1479-1E 1807-19E, TGX 1805-33F, TGX 1440-1E and Samsoy-2. All the varieties used are medium-maturing varieties.

### Results

Rainfall during the year peaked in the months of August and September; 219.6 and 226.4 mm respectively and sharply declined to 96.9mm in October; 17mm and zero in November and December respectively (Table 1). The relative humidity ranged from 72-80.5%. The temperature was lowest (17<sup>o</sup>c) in November and December and highest (32.5<sup>o</sup>c) in February.

The cultivars attained 50 percent flowering at different times as shown in table 2 except TGX 1805-33F and TGX 1440-E that have the same number of days (56.2days) TGX 1807-19E took the highest number of days (57.8days) to attain 50 percent flowering and this was statistically different. TGX 1479-1E attained 50 percent flowering earlier (55days). There was a significant difference among the varieties in their number of flowers per plant. TGX 1807-19E had the highest number of flowers per plant followed by TGX 1479-1E, TGX1805-33E,

while the least number of flowers per plant came from Samsoy-2.

Samsoy-2 produce the highest number of nodules in comparison to the other five cultivars studied (table 2). This was followed by TGX 1807-19E while TGX 1440-1E and TGX 1479-1E produce the least number of nodules per plant, each had 1.63 nodules per plant. There was no significant difference in the cultivars ability to nodulate. TGX 1479-1E and Samsoy-2 had the highest number of days from flowering to harvest the last number of days from flowering to harvest come from TGX 1805-33F. There is a significant difference between TGX 1479-E, TGX 1805-33F and cultivars TGX 1479-E TGX1807-19E, TGX 1440-01E and Samsoy-2 at 0.05 probability level.

The varieties under investigation showed no significant differences in respect of the mean height of the lowest pod (Table 2). The highest mean height of 10.667cm was not statistically significant. The mean height of lowest pod for cultivars TGX1479-1E, TGX 1807-19E, TGX 1440-1E and Samsoy-2 were 10.167cm, 10.000cm, 8.833cm and 9.333cm respectively. The lowest mean height of 8.833cm was recorded in TGX 1440-1E. As shown in Table 2, TGX 1479-1E had the highest number of branches per plant. The least number of branches per plant was recorded in TGX 1805-33F. Statistically, there was significant differences between TGX 1479-1E and cultivars TGX 1440-1E and TGX 1805-33F. There were also significant differences between Samsoy-2 with the cultivars TGX 1479-1E and TGX 1805-33F.

The tallest of the cultivars is TGX 1805-33F (Table 2). The cultivars had a mean height of 27.00cm. This was followed by TGX 1807-19E, TGX1440-1E, TGX 1479-1E and Samsoy-2 with mean heights of 26.500cm, 24.000cm, 22.000cm and 21.500cm respectively. So the shortest variety was Samsoy-2. which had a mean height of 21.5cm. Statistically, there were significant difference between TGX 1805-33F and the cultivars TGX 1479-1E and Samsoy-2. There were significant differences between TGX 1440-1E and the Cultivars TGX 1805-33F and TGX 1805-33F and the cultivars TGX 1479-1E and Samsoy-2. There were also significant differences between TGX 1807-19E and Cultivars TGX 1479-1E and Samsoy-2.

The cultivars attained 50 percent maturity at different times.(Table 2) TGX 1807-19E took the highest number of days (113.50 days) to attain 50 percent maturity. This was followed by TGX 1440-1E Samsoy-2, TGX1479-1E and TGX 1805-33F with number of days to 50 percent maturity of 112.50 days, 110.17,109.33, and 108-17 days respectively. Statistically, there were significant differences between TGX 1807-19E and cultivars TGX 1805-33F, TGX1479-1E and Samsoy-2. There were significant differences between TGX 1440-1E and the cultivars TGX 1805-33F and TGX 1479-1E.

As shown in table 2, there was no significant difference in the number of seeds per plant among the varieties. However, Samsoy-2 had the highest number of seeds per plant which was 29.80 seeds. The cultivars TGX1479-1E, TGX 1807-19E, and TGX1440-1E had 19.633, 15.867, and 19.567 mean

number of seeds per plant respectively. The lowest number of seeds per plant of 14.700 seeds was recorded in TGX 1805-33E

Results, as shown in table 2 indicated that the cultivars showed a significant difference in respect of the weight of seeds per plant. The highest weight of 1.632g per plant was obtained from Samsoy-2. The least weight of 0.682g per plant was obtained from TGX 1807-19E. TGX 1479-1E, TGX 1805-33F and TGX 1440-1E and the weights of 1.247,0.787, and 0.757g respectively. There were significant differences in weight of seeds per plant between Samsoy-2 and the cultivars TGX 1807-19E, TGX 1805-33F and TGX 1440-1E. There was a significant difference in the cultivars in respect of the number of seeds per pod (Table 2). Statistically, there were significant difference between Samsoy-2 and the cultivars TGX 1440-1E, TGX 1479-1E and TGX1805-33F. The highest number of seeds per pod of 1.788 seeds was recorded in Samsoy-2. And the lowest number of seeds per pod of 1.522 seeds was obtained from TGX 1440-21E. The cultivars TGX 1479-19E, and TGX 1805.33F had 1.600 seeds, 1.647 and 1.618 seeds per pod respectively.

There was no significant difference in the cultivars in respect of the number of pods per plant (Table 2). However, the highest mean number of pods per plant of 24.33 pods was obtained from Samsoy-2. The least number of pods per plant of 11.50 pods was obtained from TGX 1805-33F. The cultivars TGX 1479-1EM TGX 1807-19E, and 15.17, 13.00, and 23.67 pods plant respectively.

The cultivars showed no significant differences in their 100 seed weights (Table 2). The highest seed weight of 10. 510g was obtained from TGX 1807-1E. The cultivars TGX 1479-1E, TGX 1807-19E, and Samsoy-2 had the weights of 10.432, 10.388, and 10.368g respectively. The least weight of 10.297g was obtained from TGX 1805-33F which was statistically non significant.

As shown in table 2, the grain yields of the five cultivars under investigation was statistically non-significant at 0.05 probability level. However, of all the cultivars, TGX 1440-1E recorded the highest grain yield of 0.213 ton/ha. This was followed by TGTX 1807-19E with a grain yield of 0.183 ton/ha. Cultivars TGX 1479-1E and Samsoy-2 yielded 0.181 and 0.167 ton/ha respectively. TGX 1805- 33F had the least grain yield.'

There were no significant effects of type of seed bed on number of days to 50 percent flowering, number of flowers per plant, number of nodules per plant, days to 50 percent maturity, number of seeds per plant, 100 seed weight, and grain yield (ton/ha), however, the higher values occurred among plants on ridges (Table 3). The seedbeds showed significant difference in respect to mean heights of lowest pod which was higher among plants on ridges than those on flat.

Seedbed methods did not significantly affect the number of pods per plant, weight of seeds per plant, height at maturity, number of branches per plant, number of seeds per pod, and number of days from flowering to maturity (Table 3) Except for number of seeds per pod, plants grown on the ridges had higher values than those on flat.

Table 1: Summary of the monthly total rainfall (mm), Rain days and relative humidity (%) morning (0600 HR) and evening (1800 HR) for the year 1996

|                       | % Monthly totals |      |      |       |      |      |       |       |       |      |      |      |
|-----------------------|------------------|------|------|-------|------|------|-------|-------|-------|------|------|------|
|                       | Jan              | Feb. | Mar. | April | May  | June | July  | Aug.  | Sept. | Oct  | Nov  | Dec. |
| Rain days             | 1                | 5    | 4    | 8     | 14   | 13   | 15    | 22    | 22    | 16   | 1    | 0    |
| Rainfall (mm)         | 34.5             | 14.2 | 26.7 | 04.3  | 35.1 | 40.5 | 137.8 | 219.6 | 26.4  | 96.9 | 17   | 0.00 |
| Relative humidity (%) |                  |      |      |       |      |      |       |       |       |      |      |      |
| 0600 HR               | 78.0             | 74.5 | 74.5 | 74.5  | 74   | 74.5 | 75.0  | 77.5  | 80.5  | 80.5 | 77.5 | 80.5 |
| 1800 HR               | 57.0             | 61.5 | 66.5 | 67.0  | 70.0 | 72.0 | 72    | 75.0  | 70.0  | 70.0 | 65.0 | 55.5 |

Table 2: Main effect of variety on days to 50 percent flowering, number of flowers per plant, number of nodules per plant, number of days from flowering to harvest, number of seeds per plant, weight of seeds per plant (g), number of pods per plant, 100 seeds weight (g), grain yield (ton/ha).

| Cultivars    | Days to 50% Flowering | No. of flowers per plant | No. of nodules per plant | Days to flowering | Height of lowest pod (cm) | No. of branches per plant | Height at maturity (cm) | Days to 50% maturity | No. of seeds per plant | Weight of seeds per plant (g) | No. of pods per plant | No. of seeds per pod | 100 seeds weight (g) | Grain yield (ton/ha.) |
|--------------|-----------------------|--------------------------|--------------------------|-------------------|---------------------------|---------------------------|-------------------------|----------------------|------------------------|-------------------------------|-----------------------|----------------------|----------------------|-----------------------|
| TGX 1479-1E  | 54.5                  | 7.7                      | 1.63                     | 77.0              | 10.17                     | 10.250                    | 22.000                  | 109.333              | 19.633                 | 1.247                         | 15.17                 | 1.600                | 10.432               | 0.181                 |
| TGX 1807-19E | 57.8                  | 8.8                      | 1.88                     | 75.5              | 10.00                     | 9.333                     | 26.500                  | 113.500              | 15.867                 | 0.682                         | 13.00                 | 1.647                | 10.388               | 0.163                 |
| TGX 1805-33F | 56.2                  | 4.3                      | 1.75                     | 76.3              | 10.67                     | 8.625                     | 27.000                  | 108.167              | 14.700                 | 0.787                         | 11.50                 | 1.618                | 10.297               | 0.192                 |
| TGX 1440-1E  | 56.2                  | 7.1                      | 1.63                     | 76.7              | 8.83                      | 8.875                     | 24.000                  | 112.500              | 19.567                 | 0.757                         | 23.67                 | 1.522                | 10.510               | 0.213                 |
| SAMSOY-2     | 55.0                  | 2.7                      | 2.04                     | 77.0              | 9.33                      | 10.208                    | 21.500                  | 110.167              | 1.632                  | 1.632                         | 24.33                 | 1.788                | 10.368               | 0.167                 |
| F-LSD 0.05   | 1.5                   | 2.7                      | N.S                      | 0.4               | N.S.                      | 1.2389                    | 3.4384                  | 2.6250               | N.S.                   | 0.640                         | N.S.                  | 0.1524               | N.S.                 | N.S.                  |

Table 3: Main effect of seedbed on days to 50% flowering, number of flowers per plant, number of nodules per plant, days to 50% maturity, height of lowest pod (cm), number of seeds per plant, 100 seed weight (gm), grain yield (ton/ha), number of pods per plant, weight of seeds per plant (g), height at maturity (cm), number of branches per plant, number of seeds per pod and days from flowering to maturity.

| Tillage System | Days to 50% Flowering | No. of flowers per plant | No. of nodules per plant | Days to 50% maturity | Height of lowest pod (cm) | No. of branches per plant | Height at maturity (cm) | No. of days from flowering to maturity | No. of seeds per plant | Weight of seeds per plant (g) | No. of pods per plant | No. of seeds per pod | 100 seeds weight (g) | Grain yield (ton/ha.) |
|----------------|-----------------------|--------------------------|--------------------------|----------------------|---------------------------|---------------------------|-------------------------|--|------------------------|-------------------------------|-----------------------|----------------------|----------------------|-----------------------|
| FLAT           | 5.00                  | 4.78                     | 1.57                     | 109.07               | 11.0                      | 8.25                      | 22.0                    | 76.47                                  | 10.07                  | 0.50                          | 8.0                   | 1.67                 | 10.30                | 0.11                  |
| RIDGE          | 55.87                 | 7.47                     | 2.00                     | 112.40               | 8.0                       | 10.67                     | 26.0                    | 76.53                                  | 29.76                  | 1.54                          | 27.0                  | 1.60                 | 10.50                | 0.24                  |
| F-LSD 0.05     | N.S.                  | N.S.                     | N.S                      | N.S.                 | 2.17                      | N.S.                      | N.S.                    | N.S.                                   | N.S.                   | N.S.                          | N.S.                  | N.S                  | N.S.                 | N.S.                  |

Table 4: Seed bed x variety interaction table for height of lowest pod (cm)

| Variety        | Seed bed ridge |    | Flat |       | Variety mean |
|----------------|----------------|----|------|-------|--------------|
|                | 7              | 10 | 13   | 10.17 |              |
| TGX 149-1E     |                |    |      |       |              |
| TGX 1807 - 19E |                | 10 |      |       | 10.00        |
| TGX 1805-33F   |                | 9  |      |       | 10.67        |
| TGX 1440-1E    |                | 8  |      |       | 8.83         |
| SAMSOY-2       |                | 8  |      |       | 9.33         |
| SEEDBED MEANS  |                | 8  |      |       |              |

F-LSD between 2 seed bed means = 2.17; F-LSD between 2 seed bed x variety = 2.76

The seedbed x variety interaction showed significant difference in respect to mean heights of lowest pod. There were significant mean heights of lowest pod among plants on flats (Table 4).

### Discussion

At the early stage of this experiment (July), precipitation and relative humidity were not limiting factors. The investigation however, extended into the dry season (end of November) when soil moisture, relative humidity and high arid velocity posed a serious problem to the soybean plants. These later factors led to high evapotranspiration experienced by the plants during this later part of the investigation. Grain yields of soybean have been reported to decline with delay in sowing in the northern Guinea Savanna (Pal *et al.*, 1985). Favourable effects of early sowing, had been attributed to factors such as rainfall distribution, soil moisture reserve at time of rains and availability of mineralized nitrogen (Lal, 1973). Thus, the early sown crop had the opportunity of fully utilizing the nitrogen thereby experiencing its full growth and yield potentials.

The results obtained from the field investigation showed that the response of the five soybean cultivars did not differ between the two types of seedbeds. This could have accounted for the no significant differences obtained in all the growth and yield parameters. The only exception was height of lowest pod in which the effect of flat seedbed significantly differed from the ridge seedbed. The non-significant yield difference between the seedbed types could be attributed to seasonal changes in crop growth rates observed in plants grown on ridges and flats (Yusuf *et al.* 1999). Yusuf *et al.* (1999) observed that with soybean (*Glycine max*) grown in the Agricultural Engineering Research farm of the University of Illinois at Urbana – Champaign soybean growing on conventional tillage plots had an initial higher crop growth rate than those on no-tillage plots. The difference in crop growth rate was present from the start of sampling and continued until late season, after which the soybean growing in the no-tillage plots possessed a greater crop growth rate. They also observed that the crop growth rate for plants with conventional tillage peaked earlier than the crop growth rate for plants with no-tillage. This demonstrates that plants growing with no-tillage conditions were delayed relative to the conventional tillage treatment, but compensated for the early delay by rapid growth prior to and during grain fill. They reported that this later increase in crop growth rate was responsible for the similar total plant dry biomass at the end of the season and conventional tillage soybean producing similar yields.

Yusuf *et al.* (1999) noted that while both conventional tillage and no-tillage soybean had periods in which their crop growth rate was significantly greater, the bases for the advantage differed. In the case of conventional soybean, the crop growth rate advantage was due to a greater leaf area index; for the no-tillage soybean, the crop growth rate advantage was due to a greater net assimilation rate. In general, an increase in crop growth rates is more commonly due to an increase in

leaf area index than an increase in net assimilation rate (Clawson *et al.* 1986).

Although seedbed showed no significant effect on the mean number of flowers per plant, nodulation count, height at maturity, number of branches per plant, weight of seeds per plant, 100 seeds weight (gm) and grain yield (ton/ha), the general trend however, was for plants found among the ridges to record the higher means as shown in (Table 3). The higher yields obtained from plants that were grown on ridges could have been due to the ability of ridge plots to conserve moisture for plant uptake more than the flat plots. This agrees with the work of Munro (1960) who reported that the advantage of ridge over flat in groundnut production is the ability of the former to conserve moisture and control weeds. Scott *et al.* (1975) observed that reduced cultivation affects absorption of water and nutrients and that growth and yield suffer when these stresses in the soil interfere with root development.

The poor yield of the cultivars could be attributed on poor nodulation. When properly nodulated, soybean roots may derive a considerable portion of the nitrogen needs of the plant from the nodules through the fixation of atmospheric nitrogen (Norman 1963).

The moisture stress experienced during the flowering and pod filling phases of this investigation adversely affected the plant performance. This agreed with the work of Campbell and Grime, (1993) who reported that moisture stress during the dry periods of the year seriously depressed yield and such moisture stress could lead to flower and ovule abortion.

The better performance of plants on ridges is suggestive that there is need for elaborate soil preparation in the production of soybean in Nsukka Agro-ecological zone, which is within the derived Savanna belt of south eastern Nigeria. The yields of cultivars; TGX 1440-1E, TGX 1479-1E and most especially Samsoy-2 were comparatively impressive. Samsoy-2 appears to be the most outstanding of the five cultivars studied as it had the highest weight of seeds per plant, highest number of nodules, highest number of seeds per pod and highest number of pod plant, number of pods per plant, weight of 100 seeds and in grain yield (ton/ha).

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