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# Influence of Planting Date on Physiological Seed Quality of Soybean (*Glycine max* L. Merril) in Makurdi, Nigeria

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## Abstract

A field and laboratory experiments were conducted in the Teaching and Research Farm and Plant Breeding and Seed Science laboratory both of Joseph Sarwuan Tarka University, Makurdi during the 2019 farming season to investigate the influence of planting date on physiological seed quality of soybean. The experiments consisted of three soybean varieties (TGX-1448-2E, TGX-1904-6F and TGX-1835-10E) obtained from the Seed Centre of Joseph Sarwuan Tarka University, Makurdi and five planting dates used were (22nd June, 29th June, 6th July, 13th July and 20th July, 2019). The treatments of the field experiment were arranged in a Randomized Complete Block Design (RCBD) replicated three times and the laboratory experiment was laid out in a Completely Randomized Design (CRD) also with three replications. Physiological seed quality attributes evaluated included; germination percentage (G%), germination index (GI), germination rate index (GRI) and vigor index (I). The result from the Analysis of variance (ANOVA) revealed that early planting (22nd June) significantly ($p \leq 0.05$) recorded the least germination percentage, germination index, germination rate index and vigor index. Whereas planting done 13th July (mid-July) produced seeds with the highest germination percentage, germination index, germination rate index and vigor index. TGX-1448-10E and TGX-1904-6F produced seedlings with vigor index not significantly different from each other but were significantly inferior to seedlings of TGX-1835-10E. There was an increase in the germination percentage, germination index, germination rate index and vigor index from 22nd June to 20th July planting dates in all the three varieties studied. TGX-1835-10E when planted 20th July recorded the highest germination percentage and germination index though not significantly different from TGX-1448-10E and TGX-1904-6F. TGX-1904-6F on the other hand recorded the highest germination rate index although not significantly different from TGX-1448-10E and TGX-1835-10E. Generally, physiological seed quality increased as planting was delayed with the highest quality recorded at 13th July.

## Keywords

Physiological, Seed, Emergence, Quality, Vigor

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## 1. Introduction

Soybean (*Glycine max.* (L) Merrill) belongs to the large plant family *Fabaceae* in the sub family *Papillionidae* [14]. It is a specie of legumes native of East Asia, widely grown for its edible seed which has numerous uses [13]. Soybean in global rating is among the top ten of the most widely grown crops with a total grain production of over 348,712,311 metric tonnes [4]. The largest world producer is Brazil accounting for 36% of world production [4] and [16]. In Africa, about 1.3 million hectares of arable land is put to soybean cultivation with the three major soybean producers as South

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Africa with 1.6 million tons followed by Nigeria, Zambia, Zimbabwe, Uganda and Egypt [15].

The importance of soybean cannot be over emphasized. The crop thrives well in most of the agro-ecological zones of Nigeria and is gaining fast acceptability among famers because of its nutritive value as weaning food for infants and cheap source of protein for the privileged and the less privileged people [6]. It is also the only complete plant protein; that is, it contains all of the amino acids essential for human health [10]. Soy vegetable oil is another product obtained from processing soybean. Soybean also serves as a raw material for industries for the production of edible 'vegetable oil' which is used in a wide variety of processed foods and the remaining soybean meal is used mainly as animal feeds [8]. Despite the numerous uses of Soybean, its productivity has been hampered by inadequate physiologically qualitative seeds which are mostly occasioned by inadequate knowledge of the appropriate time of planting by farmers to obtain seeds of maximum physiological quality. Agronomic practices such as appropriate sowing date using high yielding varieties of Soybean is capable of increasing both qualitative and quantitative soybean yield [5] and [9]. Higher level of quality seed production of Soybean can be possible in Nigeria by the use of improved seeds and best sowing date. Thus, it is expedient to find the most suitable planting date for optimum seed quality of soybean.

## 2. Materials and Methods

The study was conducted at the Teaching and Research Farm and Plant Breeding and Seed Science laboratory both of the Joseph Sarwuan Tarka University, Makurdi during the 2019 cropping season. The Soybean varieties used for the experiments were; TGX-1448-2E, TGX-1904-6F, and TGX-1835-10E and were obtained from the seed center of Joseph Sarwuan Tarka University, Makurdi. While the different sowing dates used for the experiments were; 22$^{nd}$ June, 29$^{th}$ June, 6$^{th}$ July, 13$^{th}$ July and 20$^{th}$ July, 2019. The experiments were 3x5 factorial combination of treatments arranged in a Randomized Complete Block Design (RCBD) and Completely Randomized Design (CRD) for field and laboratory experiment respectively, both replicated three times. The experimental area was ploughed and harrowed. Each plot consisted of 4 rows measuring 4m long and arranged 75cm apart. Seeds were planted 5cm apart on each row and this was done 22$^{nd}$ June, 29$^{th}$ June, 6$^{th}$ July, 13$^{th}$ July and 20$^{th}$ July, 2019.

Harvesting of soybean varieties planted at different dates was done as soon as the pods matured and turned brown. The harvested soybean plants were sundried and threshed. Further drying of the seeds was done to attain seed's safe storage moisture limit. Two hundred and fifty seeds were put into five 9cm petri-dishes lined with germination paper. 50 seeds were put in the five Petri-dishes each for variety and planting date. Petri-dishes with content were moistened everyday with distilled water and incubation done at room temperature. The experiment was arranged in a Completely Randomized Design (CRD) with three replications. Germination count was conducted for seven days after which the following seed quality indices were determined: germination percentage (G%), germination index (GI), germination rate index (GRI) and seedling vigor index (I) as follows:

$$G\% = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \text{ x } 100 \text{ [3]}$$

$$GI = \frac{number\ of\ germinated\ seeds}{days\ of first\ count} + \cdots + \frac{\text{number of germinated seeds}}{days\ of\ final\ count} \text{ [2]}$$

$$GRI = \frac{\text{GI}}{\text{G\% (in decimal)}} \text{ [3]}$$

I = germination percentage × seedling shoot length (cm) + seedling root length (cm) [1]. Data collected on all the measured parameters were subjected to Analysis of Variance (ANOVA) using Minitab 17 and significant means at 5% level of probability were separated using Turkey pairwise comparison.

## 3. Result and Discussion

Means for the effect of planting date on seed quality of soybean is presented in Table 1. The result showed that 13$^{th}$ July (mid-July) recorded significantly highest emergence percentage (84.26) and the lowest emergence percentage (33.99) was observed for 22$^{nd}$ June. A similar trend was observed for germination index, germination rate index and seedling vigor index. Means for the effect of variety on seed quality of soybean is presented in Table 2. The result indicated that TGX-1835-10E produced vigor index significantly higher (1196.79) than TGX-1904-6F and TGX-1448-2E. And the lowest vigor index (1113.54) was recorded in TGX-1448-2E. Mean effect of Variety x planting date is shown in Table 3. The result showed that germination percentage, germination index, germination rate index and seedling vigor index in all the varieties tend to increase from 22$^{nd}$ June down to 20$^{th}$ July planting dates. Whereas the lowest interaction effect on seed quality indices for all the

varieties was observed for the first planting date (22nd June). Seed quality attributes of soybean varieties evaluated at different planting dates consistently increased from 22nd June to 13th July where the highest seed quality values for all the varieties were recorded. This portrayed that planting done earlier than 13th July (mid-July) significantly reduced physiological seed quality. This observation was similar to what was reported by [12] and [7] that seed quality of soybean was generally better with later sowing dates than earlier ones. This could be because the harvest of early planted soybean coincided with when the humidity and temperature are still high, thus leading to seed deterioration as a result of poor drying. This increased the proportion of rain damaged seeds. More so, [9] reported an increased seed quality of soybean when planting was delayed. Soybeans planted late June (29th June) to mid-July (13th July) produced seeds with increasing quality.

The different varieties also varied in their performance. This variation indicated that varieties were different although not significantly different for some of the seed quality indices studied except in seedling vigor index where TGX-1835-10E was most superior. This agrees with the report by [13] that plants exhibits differences in their growth and quality of yield when grown in an environment. He further concluded that these variations are as a result of the differences in their genotype.

## 4. Conclusion

Results from the experiment conducted revealed that seed quality attributes (germination percentage, germination index, germination rate index and seedling vigor index) of soybean varieties (TGX-1448-2E, TGX-1904-6F, and TGX-1835-10E) were highest when planting was done mid-July. Earlier planting (22nd June) significantly reduced physiological seed quality.

**Table 1.** Mean effect of planting date on seed quality of soybean in Makurdi, 2019.

| Planting Date | Germination Percentage | Germination Index | Germination Rate Index | Vigor Index |
|---|---|---|---|---|
| 22nd June | 33.99$^{c}$ | 4.73$^{d}$ | 338.58$^{c}$ | 763.20$^{e}$ |
| 29th June | 59.47$^{b}$ | 6.13$^{c}$ | 402.60$^{b}$ | 877.95$^{d}$ |
| 6th July | 74.82$^{ab}$ | 7.62$^{b}$ | 473.54$^{a}$ | 1202.32$^{c}$ |
| 13th July | 84.26$^{a}$ | 8.52$^{a}$ | 511.17$^{a}$ | 1499.26$^{a}$ |
| 20th July | 79.21$^{a}$ | 8.11$^{ab}$ | 477.10$^{a}$ | 1358.30$^{b}$ |

*Means that share the same letter(s) in a column are not significantly different

**Table 2.** Mean Effect of Variety on Physiological Seed Quality of Soybean in Makurdi, 2019.

| Variety | Germination Percentage | Germination Index | Germination Rate Index | Vigor Index |
|---|---|---|---|---|
| TGX-1448-2E | 69.57$^{a}$ | 6.99$^{a}$ | 427.79$^{a}$ | 1113.54$^{b}$ |
| TGX-1904-6F | 61.44$^{a}$ | 7.10$^{a}$ | 451.93$^{a}$ | 1110.29$^{b}$ |
| TGX-1835-10E | 67.45$^{a}$ | 7.01$^{a}$ | 442.08$^{a}$ | 1196.79$^{a}$ |

*Means that share the same letter(s) in a column are not significantly different

**Table 3.** Mean Effect of Variety x Planting Date on Physiological Seed Quality of Soybean in Makurdi, 2019.

| Variety | Planting Date | Germination Percentage | Germination Index | Germination Rate Index | Vigor Index |
|---|---|---|---|---|---|
| | 22nd June | 39.04$^{c}$ | 4.81$^{c}$ | 313.24$^{c}$ | 771.14$^{c}$ |
| | 29th June | 56.83$^{b}$ | 6.10$^{b}$ | 411.13$^{ab}$ | 884.96$^{d}$ |
| TGX-1448-2E | 6th July | 72.51$^{a}$ | 7.07$^{a}$ | 482.07$^{a}$ | 1151.17$^{c}$ |
| | 13th July | 85.88$^{a}$ | 8.78$^{a}$ | 508.87$^{a}$ | 1507.36$^{a}$ |
| | 20th July | 83.56$^{a}$ | 7.59$^{a}$ | 423.62$^{ab}$ | 1253.04$^{b}$ |
| | 22nd June | 29.52$^{c}$ | 4.73$^{c}$ | 364.73$^{c}$ | 754.00$^{e}$ |
| | 29th June | 55.75$^{b}$ | 6.44$^{b}$ | 412.51$^{ab}$ | 782.43$^{ab}$ |
| TGX-1904-6F | 6th July | 75.81$^{a}$ | 8.21$^{a}$ | 474.68$^{ab}$ | 1221.08$^{b}$ |
| | 13th July | 83.90$^{a}$ | 8.54$^{a}$ | 559.97$^{a}$ | 1507.36$^{a}$ |
| | 20th July | 82.23$^{a}$ | 7.91$^{a}$ | 447.77$^{ab}$ | 1243.68$^{b}$ |
| | 22nd June | 33.41$^{c}$ | 4.58$^{c}$ | 337.78$^{c}$ | 764.45$^{e}$ |
| | 29th June | 55.83$^{b}$ | 5.86$^{b}$ | 384.16$^{c}$ | 966.46$^{d}$ |
| TGX-1835-10E | 6th July | 76.13$^{a}$ | 8.37$^{a}$ | 463.89$^{ab}$ | 1234.72$^{b}$ |
| | 13th July | 83.02$^{a}$ | 8.42$^{a}$ | 464.67$^{ab}$ | 1578.17$^{a}$ |
| | 20th July | 88.85$^{a}$ | 8.84$^{a}$ | 559.91$^{a}$ | 1440.16$^{ab}$ |

*Means that share the same letter(s) in a column are not significantly different

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