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# The Effect of Seed Size and Burial Depth on the Germination, Growth and Yield of Sunflower (*Helianthus annus* L.)

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**Abstract**

A pot experiment was conducted in the year 2016 to evaluate the effect of seed size and burial depth of sunflower on the germination, growth and some yield components. The experiment was laid in a split plot design with seed size as main plot and burial depth as sub-plot with three replicates. The results indicated that seed size had significant effect on germination, plant height, number of leaves, leaf area, number of seeds per plant. The analysis indicated that there was no significant effect for seed size on head diameter, head weight and seed weight. A significant difference was observed between the burial depth, and the interaction between seed size and burial depth showed significant effect.

***Keywords:*** Seed size; sunflower; germination; yield.

## 1. Introduction

For a successful crop production, the use of good quality seed is essential which increases the yield by 15-20%. Seed size is one of the components of seed quality which affects the performance of crop [1, 2]. Size is widely accepted measure of seed quality and large seeds have high seedling survival growth and establishment [3]. A wide array of different effects of seed size has been reported for seed germination, emergence and related agronomical aspects in many crop species [4]. Generally large seed has better field performance than small seed. Seedling emergence, seedling mass and height were usually reduced by deep burial particularly for small nuts [5]. Also [6] found that seedling emergence was negatively related to burial depth for all species, sunflower is a multi-purpose crop, being used mainly for oil extraction and its seed is used as bird feed and human food.

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The commercial production of sunflower in the Sudan was started in the mid-eighties by private sector in Damazine and Gadarif [7]. Sunflower production faced many difficulties; one of these is the low yield, so the study was conducted to evaluate the use of large size seed and different burial depth on the germination, growth and yield of sunflower.

## 2. Materials and Methods

### a) Laboratory experiment:

The seeds of the sunflower (local cultivar) were used in all experiments. The seeds were obtained from the Agricultural Research Center in Shambat. The seeds were graded into two categories; large and small, by means of a copper screen. The large size group constituted seeds that were retained by the screen. The small size group comprised seed that passed through the screen. The seeds of sunflower without seen defect or insect damage were set for germination. Germination tests were performed according to guidelines issued by the International Seed Testing Association [8]. Seeds of sunflower were germinated in sterilized Petri dishes, 100m in diameter, on Whatman filter paper moistened with 10ml of double distilled water. Petri dishes were kept in dark, at 25C for a span of 7 days. During the experiment germinated seeds were counted daily and then the percentages were calculated at the end of the experiment.

### b) Glasshouse experiment:

A pot experiment was conducted at the glasshouse of the Faculty of Education, Alzaeim Alazhari University, Omdurman, Sudan in season 2016. A split-plot experimental design was used. Large and small seed of sunflower served as the main plot effect and the three burial depths of sunflower, [(2) cm, (3) cm, and (4) cm] represented the sub-plots. All treatments were replicated three times. The soil type used in the experiments were river silt moderately acid (pH 6.75), highly permeable, plastic pots (35cm in diameter and 56cm in depth) filled with 5kg of soil. Five seeds of sunflower were sown at different burial depth (2, 3, 4cm) and later thinned to 2 seedlings per pot. Plants were irrigated daily using tap water. In all experiments sunflower plant height, number of leaves, leaf area, stem diameter, head diameter, head weight, seed weight and number of seeds per plant were recorded and the data were subjected to analysis of variance (ANOV) According to [9].

## 3. Results and discussion

### a) Germination:

The germination percentage for sunflower was 96.60% for large size seed and 86.60% for small size seed at the burial depth (2cm) (Table 1). However, the germination for large size seed was 94.00% and 90.60% at the burial depths (3cm) and (4cm) respectively. On the other hand the germination percentage for small size seed was 73.30% and 70.00% at the burial depths (3cm) and (4cm) respectively. The statistical analysis revealed a significant difference (P=0.05) between large size seed and small size seed at the three burial depths (2cm, 3cm and 4cm). A significant effect (P=0.05) was observed between the different burial depths. The interaction between the seed size and burial depths was also significant. The high germination rate of the large size seed

may be attributed to greater food reserves available to the growing seedling. These results are in agreement with the findings reported by [4, 10, 11, 12]. The negative effect of deep sowing was reported by [13] who found that seedling emergence was decreased with increased sowing depth in cotton. This could be explained by the fact that the deeper the seed is sown the more strength it needs to push its shoots above the soil surface.

**b) Growth parameters:**

The plant height of sunflower showed significant effect (P=0.05) between large size seed and small size seed at the three readings (Table 2). The difference between the burial depths was also significant at the three readings. The interaction between the seed size and burial depths was significant at the three readings except at third reading. These results concur with the findings of [14] who found higher plant length in Croatian spring malting larges and the results of [15] who observed higher plant height in plants raised by large size followed by medium compared to small seed in sunflower. The results of the study agree with the results of [16] and the results of [17]. The number of leaves per plant as shown in Table (3) revealed a significant difference (P=0.05) between large size seed and small size seed at the three readings. However, a n on-significant difference was observed between the different burial depths at the first reading the second and third reading showed significant effect between the burial depths. The interaction between seed size and burial depth was only significant at the third reading. These results were supported by the results of [15] who observed higher plant height, number of leaves and stem girth in plants raised by large size seed followed by medium compared to small size seed in sunflower.

**Table 1:** Germination percentage of sunflower as influenced by seed size and burial depth

| Burial depth (cm) | Germination percentage | |
|---|---|---|
| | Large seed | Small seed |
| 2 | 96.60 | 86.60 |
| 3 | 94.0 | 73.30 |
| 4 | 90.60 | 70.00 |

**Table 2:** Plant height of sunflower as influenced by seed size and burial depth

| | Burial depth (cm) | Plant large | Height small (cm) |
|---|---|---|---|
| Two weeks after sowing | 2 | 14.26 | 9.73 |
| | 3 | 11.63 | 8.80 |
| | 4 | 9.56 | 7.30 |
| Six weeks after sowing | 2 | 40.70 | 36.53 |
| | 3 | 33.00 | 31.07 |
| | 4 | 26.60 | 24.87 |
| Twelve weeks after sowing | 2 | 54.48 | 5176 |
| | 3 | 51.312 | 48.93 |
| | 4 | 48.10 | 44.95 |

The leaf area showed significant difference (P=0.05) between large size seed and small size seed at the three readings (Table 4). A significant effect (P=0.05) was also observed between the burial depths at the three readings. The interaction between seed size and burial depth was significant at the three readings. These results are consistent with [18] who found that large seed has positive effect on the leaf area of *Gmelina arborea* plant. Similar results were obtained from [19] on common bean [20] on *Albizza procera*.

The stem diameter exhibited significant difference (P=0.05) between large size seed and small size seed at the three readings (Table 5). A significant difference (P=0.05) was observed between the burial depths (2cm) and (3cm) and between the burial depths (2cm) and (4cm), however, a n on-significant difference was observed between (3cm) and (4cm) at the three readings. The interaction between seed size and burial depth was not significant.

The head diameter showed a non significant effect between seed sizes (Table 6). However, a significant effect (P=0.05) was observed between the burial depth (2cm) and (4cm), and between (3cm) and (4cm), however a non-significant difference was detected between the burial depth (2cm) and (3cm). The interaction between seed size and burial depth was not significant.

**Table 3:** Number of leaves of sunflower as influenced by seed size and burial depth

| | Burial depth (cm) | Number of leaves | |
|---|---|---|---|
| | | Large | Small |
| Two weeks after sowing | 2 | 8.07 | 7.07 |
| | 3 | 8.00 | 6.80 |
| | 4 | 7.30 | 6.40 |
| Six weeks after sowing | 2 | 18.53 | 16.13 |
| | 3 | 17.27 | 14.27 |
| | 4 | 15.87 | 14.20 |
| Twelve weeks after sowing | 2 | 19.78 | 16.40 |
| | 3 | 18.29 | 16.20 |
| | 4 | 16.01 | 15.12 |

**Table 4:** Leaf area of sunflower as influenced by seed size and burial depth

| | Burial depth (cm) | Leaf area ($cm^2$) | |
|---|---|---|---|
| | | Large | Small |
| Two weeks after sowing | 2 | 23.36 | 16.53 |
| | 3 | 21.97 | 15.35 |
| | 4 | 20.28 | 15.00 |
| Six weeks after sowing | 2 | 48.08 | 46.77 |
| | 3 | 33.37 | 28.89 |
| | 4 | 25.35 | 18.58 |
| Twelve weeks after sowing | 2 | 54.80 | 50.64 |
| | 3 | 37.89 | 31.62 |
| | 4 | 28.18 | 20.90 |

**Table 5:** Stem diameter of sunflower as influenced by seed size and burial depth

| | Burial depth (cm) | Stem diameter (cm) | |
|---|---|---|---|
| | | Large | Small |
| Two weeks after sowing | 2 | 0.38 | 0.30 |
| | 3 | 0.32 | 0.9 |
| | 4 | 0.30 | 0.27 |
| Six weeks after sowing | 2 | 0.58 | 0.52 |
| | 3 | 0.39 | 0.32 |
| | 4 | 0.38 | 0.30 |
| Twelve weeks after sowing | 2 | 0.87 | 0.57 |
| | 3 | 0.53 | 0.52 |
| | 4 | 0.50 | 0.49 |

**Table 6:** Head diameter (cm) of sunflower as influenced by seed size and burial depth

| Burial depth (cm) | Head diameter (cm) | |
|---|---|---|
| | Large | Small |
| 2 | 3.39 | 3.33 |
| 3 | 3.29 | 3.20 |
| 4 | 2.67 | 2.55 |

**Table 7:** Head weight per plant of sunflower as influenced by seed size and burial depth

| Burial depth (cm) | Head weight (g) | |
|---|---|---|
| | Large | Small |
| 2 | 2.18 | 2.00 |
| 3 | 2.04 | 1.93 |
| 4 | 1.48 | 1.90 |

The number of seeds per plant exhibited a significant effect (P=0.05) between the large size seed and the small size seed (Table 8). The differences between the burial depths were significant and the interaction between seed

size and burial depth was also significant. Similar results were reported by [21] who reported that large size produced the highest seeds per plant, pods per plant and seed yield per plant.

The seed weight showed a non-significant difference between the large size seed and the small size seed (Table 9). A significant difference (P=0.05) was detected between the burial depth (2cm) and (3cm), and between (2cm) and (4cm), however the difference between the burial depth (3cm) and (4cm) was not significant. The interaction between seed size and burial depth was not significant. The result of this study is supported y the findings of [21] who found that large seed size had highest values of 100-seed weight within seed grades and was significantly reduced in the medium and small, and the work of [22] who stated that chick pea effect of seed size on yield and 100-seed weight was positive. Also [23] in field pea noted that plants produced from heavier seeds had 100-seed weight that is greater than those produced from lighter seeds.

**Table 8:** Number of seeds per plant of sunflower as influenced by seed size and burial depth

| Burial depth (cm) | Number of seed per plant | |
|---|---|---|
| | Large | Small |
| 2 | 41.23 | 34.12 |
| 3 | 36.36 | 31.11 |
| 4 | 25.43 | 30.13 |

**Table 9:** Seed weight of sunflower as influenced by seed size and burial depth

| Burial depth (cm) | Seed weight (g) | |
|---|---|---|
| | Large | Small |
| 2 | 0.80 | 0.0 |
| 3 | 0.80 | 0.35 |
| 4 | 0.76 | 0.30 |

## 4. Conclusion

From the results of this study, it can be concluded that seed germination, plant height, number of leaves, leaf area, stem diameter and number of seeds, increased as seeds increased and decreased as burial depth increased. Seed size had no significant effect on head diameter, head weight and seed weight.

## 5. Recommendation

The study recommends to grade the sunflower seeds to different sizes, and this may be useful to improve seed germination. It is advisable not to plants sunflower in deeper depths

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