Agricultural and Biological Sciences Journal
Vol. 1, No. 1, 2015, pp. 1-5
http://www.publicscienceframework.org/journal/absj

Effect of Seed Size and Sowing Depth on Germination and Some Growth Parameters of Faba Bean (*Viciafaba* L.)

Siddig A. M. Ali, Abdellatif Y. Idris*

Department of Agronomy, Faculty of Agriculture, University of Zalingei, Zalingei, Sudan

Abstract

The present study was undertaken in the Faculty of Forestry Sciences nursery, University of Zalingei in November 2014. The objectives of the study were to investigate the effect of seed size and sowing depth on germination and some growth parameters of faba bean. The treatments consisted of three seed size categories (small, medium and large) and two sowing depths of 5 cm and 10 cm. The treatments were arranged as factorial experiment laid in Randomized Complete Design (RCD) with three replications. The data revealed that very little difference occurred between large and medium seeds. Seed germination and other parameters studied increased as the depth of sowing decreased. The medium seed class and 5 cm sowing depth gave the highest germination percentage (86.7, 80.0%) and seed vigor index (20.7, 18.1) respectively. Large seed size and 5 cm sowing depth produced the highest seedling and root length, seedling and root fresh and dry weight. The statistical analysis indicated that there was no significant effect for the interaction between seed size and sowing depth on all tested parameters.

Keywords

Seed Size, Sowing Depth, Faba Bean

Received: December 17, 2014 / Accepted: January 2, 2015 / Published online: January 27, 2015

1. Introduction

Faba beans (*Vicia faba* L.) ranks among the world's most important grain legume crop considering the area under cultivation and the number of people depending on it. In Sudan, the crop attains the first place in importance in both area and production (Solh, 1995). It is the principal food for millions of people, and perhaps the main source of protein for middle and low income groups. The crop provides a major part of the daily diet for the population.

In Sudan, the crop is grown mainly under irrigation in the Northern parts of the country where the environmental conditions suit its production better than in other parts of Sudan. Small amounts of seeds are also produced in Khartoum, Central Sudan and Darfur Area (Zalingei and Kabkabia). Constraints that contribute to low productivity of faba bean in its traditional areas include: lack of good seed qualities and improper cultural practices. Thus, it is more frequent to obtain unsatisfactory stands in spite of prevalence of congenital climates and hence replanting adds additional costs. In order to extend and improve the production of the crop in Darfur (Zalingei), a research works have to be done on various agronomic traits such as seed grading in term of seed size and sowing depth as major factors determining seed germination.

The depth of sowing seeds is important as it contributes to achieving a good crop stand and establishment and higher yields. Too shallow sowing results in poor germination due to

* Corresponding author
E-mail address: siddig998@yahoo.com (S. A. M. Ali), abdalf@yahoo.com (A. Y. Idris)

inadequate soil moisture at the top soil layer (Desbiolles, 2002). On the other hand, deep sowing can also significantly reduce crop emergence and yield (Aikins*et al*., 2006).

Seed size is one of the most important characteristics of seeds that can affect seed development and has a special role in crop production. Grading of seed based upon their size and weights is a common practice in a majority of crops as it has been found to regulate the germination and subsequent seedling growth in many plants. There have been immense studies on seed size in various plant species (Idris, 2008; Salih and Salih, 1981). The effect of seed size on germination, ground cover, and performance of faba bean has been confirmed. Studies of this nature are virtually lacking in faba bean cultivar Kabkabia (a newly introduced cultivar to the area of Zalingei in Central Sudan). The present study therefore, seeks to find the optimum seed and sowing depth that could be recommended for successful seedling production and growth in faba bean.

2. Materials and Methods

Pot experiment was conducted in the Faculty of Forestry Sciences nursery, University of Zalingei in November 2014. The experiments consisted of three seed size classes and two sowing depth. The seeds of faba bean were sorted visually by hands into three size classes namely large, medium and small thereafter, being designated as L, M and S with mean weights in g/100-seed of 148, 92.5 and 50.2 respectively. Sowing depth treatments were denoted as D1 and D2 for 5 cm and 10 cm respectively.

Sowing was conducted on the first week of November 2014. Seeds were sown in plastic pots 20 cm diameter containing 5kg loamy soil, with ten seeds per pot. Accurate depth of seeding was accomplished by use of wooden boards 20 cm in length with thickness corresponding to the planting depth. These were pressed into the soil to their respective depths. The three seed size classes and the two sowing depth treatments were combined together consisting six treatment combinations which were organized in a factorial experiment in a Randomized Complete Design (RCD) with three replications.

A seed was considered germinated when the plumule was sprouted of the soil. Germination count was made through the experimental period until all the seeds were either germinated otherwise considered died. Data were collected on number of daily germinated seeds, germination percentage (GP), seedling vigor index (SVI), seedling root length, shoot length, weight of dry roots per plant, shoot fresh and shoot dry weights and number of leaves per plant. Shoot dry weights were obtained by drying the plant materials in an oven for 24 hours at 70 °C. Germination Percentage (GP) was calculated according to the following equation:

$$GP = \text{Number of germinated seeds} / \text{Number of total seeds} \times 100$$

(Keshavariz*et al*., 2011)

Seedling vigor index (SVI) was calculated by the following formula:

$$SVI = \text{Seedling length cm} \times \text{Germination percentage} / 100$$

(Abdul-Baki and Anderson, 1970)

The analysis of variance was carried out for the results and the treatment means were separated using the least significant difference (LSD) at 0.05 and 0.01 probability levels according to procedure described by Gomez and Gomez (1984).

3. Results and Discussion

3.1. Number of Germinated Seeds

First seed germination emerged 8 days after sowing and continued 8-14 days, days taken to initiate and complete the germination of seeds varied in different seed sizes. The effects of seed size and sowing depth on number of germinated seeds were not significant (Fig. 1 and 2). However as a general trend, the medium seed size and less sowing depth (5 cm) gave the highest number of germinated seeds. On the 7th count after sowing in this study, very little difference occurred between large and medium seed as indicated by 7.8 seedlings recorded from large seed, 8.7 from the medium seed and 7.3 from the small seed. Girish*et al*., (2001); Indira *et al*., (2000) reported that seed size is a considerable and significant factor in the germination and early stage of plant growth. Different size of seeds having different levels of starch and other food storage may be one factor that influences the expression of number of germinated seeds in faba bean. An interaction between seed size and depth of planting indicated that the number of germinated seeds was greatly reduced with the increased depth of planting, too shallow sowing results in poor germination due to inadequate soil moisture at the top soil layer, deep sowing can also significantly reduce crop emergence and yield (Aikins*et al*., 2006).

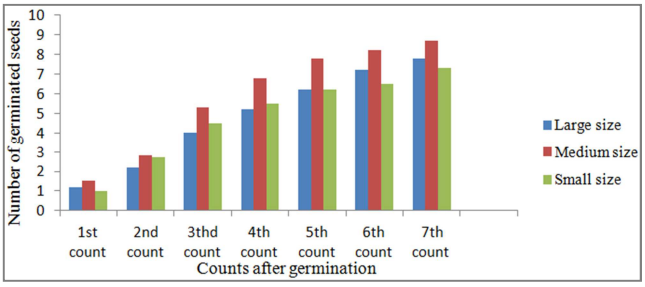

Figure 1. Effect of seed size on the number of germinated seeds

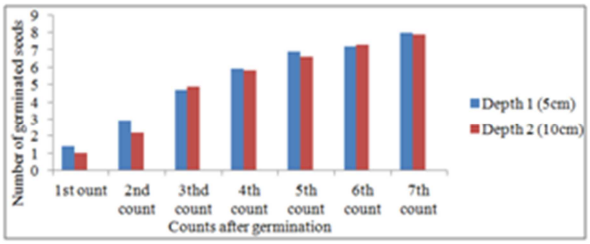

Figure 2. Effect of sowing depth on the number of germinated seeds

3.2. Germination Percentage (GP) and Seed Vigor Index (SVI)

There was a significant difference (P>0.05) between seeds with different sizes in terms of germination percentage and seed vigor index. Medium seed size and 5 cm sowing depth led to a significantly higher germination percentage, germination rate and seed vigor index (Table 1 & 2). The lowest amount of seed germinated was detected by small seeds. Germination percentage was reduced from 80.0 percent at the 5 cm planting depth to 78.9 percent at the 10 cm. Hojjat (2011) reported that the germination parameters were significantly related by seed weight and large seeds germinated early and showed better germination than small seeds of lentil genotypes. The observed results with regard to germination percentage and seed vigor are in concurrence with findings of Roozrokh *et al*., (2005) on chick pea, Salih and Salih (1981) on Faba Bean and Roshanak (2013) on soybean. The negative effect of deep sowing depth was reported by Nabi *et al*., (2011) who found that seedling emergence was decreased with increased sowing depth in cotton. The deeper the seed is sown the more strength it needs to push its shoots above the soil surface. It is suggested that with similar seeds, shallow sowing depth are best. Supporting evidences were also reported by Singh *et al*., (1972) in Soybean.

Table 1. Effect of seed size on seed germination parameters

Seed size	Germination percentage (GP)	Seed vigor index (SVI)
L	78.3	19.55a
M	86.7	20.72a
S	73.3	13.01b
C.V%	22.4	25.3
LSD	17.12^{ns}	4.61*

Numbers within the column having the same letter are not significantly different. *Significant at 5% level, ** highly significant at 1% level, ns not significant.

Table 2. Effect of sowing depth on seed germination parameters

Sowing depth	Germination percentage (GP)	Seed vigor index (SVI)
D 1	80.0	18.12
D 2	78.9	17.39
C.V%	22.4	25.3
LSD	17.12 ^{ns}	4.16 ^{ns}

Legends as in Table (1)

3.3. Root and Seedling Length

Root length was significantly (P>0.05) affected by seed size. The main effect of seed size was that root length was significantly greater from the large than the small seed (Table 4). Medium seed produced plants with radicals ranging in size between those from the large and small seed. This is similar to the findings of Singh *et al*. (1972) who found that large seeds had greater supply of stored energy to support early seedling growth and subsequently affected plant growth and development. Mut and Akay (2010) reported that decreasing the seed size can cause to decrease the root length of oat (Avena *sativa* L.). The main effect of sowing depth was a linear reduction in radical length as the sowing depth increased. Plants sown in 5 cm depth were 18.31 cm as tall as at 10 cm (17.31 cm). There was no interaction between seed sizes and sowing depth on radical length. This study showed no significant interaction between seed size and sowing depth on root length.

It is evident from Table (3) that the Seedling length significantly (P>0.01) declined with reduction in size and weight of the seeds. The largest amount of seedling length was detected by large seeds and the lowest amount by small seeds. There was a linear reduction in seedling height and weight with the increased depth of sowing (Table 5). This result corresponds to Alam and Locasscio (1965).

3.4. Seedling Dry and Fresh Weight

The effect of seed size of Faba Bean on seedling dry and fresh weight is shown in Table 3 & 4. Dry and fresh weight of seedlings obtained from large seeds increased faster than those of the medium and small seeds (1.03, 5.2g - 0.55, 4.5g - 0.30, 3.0g respectively). Contrasting findings were reported by (Roshanak *et al*., 2013) who detected that the highest and the lowest amounts of seedling dry weight of soybean seeds were detected by medium and small seeds. The depth of sowing had no significant effect on seedling dry and fresh

weight. Studies of Roozrokh *et al*., (2005) showed that large seeds of chick pea had more seedlings dry and fresh weight in compare with small seeds. This is related by more food storages of large seeds which are clearly affected by genetic structure and environmental conditions during grain filling stage.

Table 3. Effect of seed size on vegetative growth parameters

Seed size	Seedling length (cm)	No. of leafs/plant	Seedling fresh weight (g)	Seedling dry weight (g)
L	24.8[a]	11.7[a]	5.2[a]	1.03[a]
M	23.8[a]	11.1[a]	4.5[b]	0.55[b]
S	18.0[b]	9.5[b]	3.0[c]	0.30[c]
C.V%	10.3	8.9	8.9	3.3
LSD	2.35**	0.98**	0.39**	0.15**

Legend as in Table (1)

Table 4. Effect of seed size on root growth parameters

Seed size	Root length (cm)	Root fresh weight (g)	Root dry weight (g)
L	22.3[a]	2.46[a]	0.37[a]
M	16.9[b]	1.79[b]	0.31[a]
S	14.3[b]	1.11[c]	0.24[b]
C.V%	21.4	20.1	14.1
LSD	3.92*	0.37**	0.04**

Legend as in Table (1)

3.5. Root dry and Fresh Weight

The results show that seed size classes significantly (P>0.01) affected both root dry and fresh weight as demonstrated in Table 4 & 5. Dry and fresh weight of root obtained from large seeds increased faster than those of the medium and small seeds (0.37, 2.46 - 0.31, 1.72g - 0.24, 1.11g respectively). The depth of sowing had no significant effect on seedling dry and fresh weight. Faba Bean seedlings performed well when sown at shallow depths in terms of root dry and fresh weight.

3.6. Number of Leaves per Plant

The negative effect of seed size and sowing depth in number of leaves per plant is shown in (Table 3 & 5). The superior performance is by large seed size followed by the medium while the small seed was least. Results also indicated no significant effect of sowing depth on number of leaves per plant. Number of leaves per plant declined as sowing depth increased. The reason behind this is that, Seedlings from deep sown depth produced fewer amounts of leaves and this might have been expected as deep sowing has been shown to have a number of consequences on seedling growth.

Table 5. Effect of sowing depth on seedling growth parameters

Sowing depth	Seedling length(cm)	No .of leaves/ plant	Seedling fresh weight(g)	Seedling dry weight(g)	Root length (cm)	Root fresh weight(g)	Root dry weight(g)
D 1	22.4	11.2	4.1	0.61	18.31	1.85	0.31
D 2	21.8	10.4	4.4	0.64	17.31	1.72	0.31
C.V%	13.0	8.9	8.9	3.3	21.4	20.14	14.1
LSD	2.96ns	0.98[ns]	0.39[ns]	0.15[ns]	3.92[ns]	0.37[ns]	0.04[ns]

Legend as in Table (1)

4. Conclusion

From the results of this study, it can be concluded that seed size and sowing depth had varying effects on faba bean. Seed germination, seedling vigor and seedling fresh and dry weight increased as seed size increased and decreased as sowing depth increased. Accordingly, it is useful to grade the seeds to different seed sizes and that may be helpful to improve seed germination. For best seedling growth, faba bean shouldn't be planted in deeper depths.

Acknowledgement

The Authors would like to acknowledge with deepest sense of gratitude and profound respect the assistance for this study provided by the staff of Department of Forestry, University of Zalingei.

References

[1] Abdul-Baki AA and Anderson JD (1970).Viability and leaching of sugar from germinated barley. *Crop Science*, 10:31-34.cited by :Saroj , M. and D. Soumana (2014). Salt stress induced changes in growth of germinating seeds of *Vignamungo* L.Hepper and *Vigna aconite folia* Jacq. Marechal. *JOSR Journal of Agriculture and Veterinary science*, 7(4): 44-48. www.iosrjournals.orgwww.iosrjournals.org

[2] Aikins SHM, Afuakwa JJ and Baidoo D (2006). Effect of planting depth on maize stand establishment. Ghana Institute of Engineers 4(2): 20-25.

[3] Alam Z and Locascio SJ (1965). Effect of seed size and depth of planting on Broccoli and Beans. *Florida Agric. Exp. St.*, *Journal* Series No. 2234. Gainesville, Florida.

[4] Desbiolles J (2002). Optimizing Seedling Depth in the Paddock. Internet: http://www.unisa.edu.au/amrdc/Areas/Proj/SeedTrials/Seedingdepthartice.pdf.

[5] Girish B, Shahapurmath GR, Kumar AK and Ganiger BS (2001). Effect of seed size and depth of sowing on seed germination in Sapin dustrifoliatus. *My Forest*, 37:483-489.

[6] Gomez KA and Gomez AA (1984). Statistical procedures in agricultural research. Wiley, 2nd Ed. New York.

[7] Hojjat SS (2011). Effect of seed size on germination and seedling growth of some lentil genotypes. *International journal of Agriculture and Crop Sciences*, 3:1-5.

[8] Idris AY (2008).Effect of seed size and plant spacing on yield and yield components of Faba Bean (*Vicia faba* L.). *Research J. of Agric. and Biological Sci*., INSInet Publication.

[9] Indira EP, Chand BS and Chacko KC (2000). Effect of seed size grading on germination and growth of teak (*Tectona grandis*) seedlings. *J. Trop. For. Sci*., 12(1): 21-27.

[10] Keshavarzi BHM, Rafsanjani OSM, Moussavinik MS and Lak PA (2011). Effect of salt (NaCl) stress on germination and early seedling growth of Spinach (*Spinaciao leracea*). *Annals of Biological Research*, 2(4):490-497. www.scholarsresearchlibrary.com

[11] Mut Z and Akay H (2010). Effect of seed size and drought stress on germination and seedling growth of naked oat (*Avena sativa* L.). *Bulgarian J. of Agric. Sci*., 16: 459-467.

[12] Nabi G, Mullins CE, Montemayor MB and Akhtar MS (2001). Germination and Emergence of irrigated Cotton in Pakistan in relation to Sowing Depth and Physical proprieties of the Seedbed. *Soil Tillage Research*, 59: 33-44.

[13] Roozrokh M, Shams K and Vghar M (2005). Effect of seed size and seedling depth on seed vigorof chick pea. First National Legume Congress. Mashhad Ferdowsi University, Mashhad, Iran.

[14] Roshanak R, Hamdollah K, Mehrdad Y and Parisa Z (2013). Effect of seed size on germination and seed vigor of two soybean (*Glycin max* L.) cultivars. *International Research Journal of Applied and Basic Sciences*, 4(11): 3396-3401.

[15] Salih FS and SH Salih (1981). Influence of seed size on yield and yield components of broad beans (Vicia faba L.). *Seed Sci. and Tech.*, 8:175-181.

[16] Singh JN, Tripathi SK and Negi PS (1972). Note on the effect of seed size and on germination, growth and yield of soybean (*Glycin max* L. Merr.). *Indian Journal* of *Agric. Sci*, 42: 83-86.

[17] Solh MB (1995). Faba Bean improvement. In: *Production and Improvement of Cool-Season Legumes in Sudan*.