Crop Seed Sizes and Their Role in The Productivity of Field Crops: A Review Article

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Abstract. The world has begun to be interested in developing new variations that fulfill the needs of the people which necessitates research into some things that are still uninteresting, such as many qualities of the varieties. The first cycle of increasing agricultural production begins with the seed, as seeds are one of the important factors affecting crop growth and productivity. High-quality seeds are characterized by a set of specifications, including their good fullness and homogeneity of sizes in the agricultural sample, which is intended to be comparable to plant growth and then to balanced exploitation of light energy and growth sources by all plants equally with its reflection on yield and quality. From most of the studies been reviewed, the current study concludes that the technique of grading seed sizes led to stimulating and accelerating germination and thus increasing growth and raising the productivity and quality of crops. Therefore, the seeding rate must be determined according to the number of seeds per unit area, not the weight of the seeds per unit area, and the reason is due to the large variation in the weights of the seeds of one variety per crop planted in different environmental conditions. The majority of studies likewise found an inverse association between the number of seeds and their size within one weight. Given the rise and rapid population growth, seed size grading may be the most important factor in enhancing output.

Keywords: Crops, Grading, Seeds, Technology, Yield.

Introduction

Most seeds prepared for culture are heterogeneous in size and to variable degrees depending on the variety utilized and prior growing circumstances (Khalaf and Abdel-Sattar, 2006), resulting in growth disparities between those plants. As a result, sorting the seeds intended for cultivation into homogeneous sizes before planting may reduce differences among plants caused by a specific size of these seeds and provide an equal opportunity for all plants to obtain sources of growth, whether from soil or lighting, which are positively reflected on the yield of these plants (Al-Khafaji, 2009). According to Moshatat and Gharineh (2012), seed size is a measure of the energy generated and stored in the seed embryo, and this energy comprises activation and germination of the seed embryo. It is evident that utilizing large-sized seeds that are high in nutrients is preferable to using small-sized or weak seeds which usually result in weak plants. Several studies have shown that the influence of large-sized seeds outperforms field emergence and the creation of active seedlings to increase the performance of the ensuing plants in the field, as evidenced by the maximum grain yield compared with other medium and small seed sizes (Jiad and Al-Sahoki 2011; EnayatGholizadeh et al., 2012). Thus, the aim of this study is studying the crop seed sizes and their role in the productivity of field crops.

Why to Use Gradation of Field Crop Seeds?

The enormous disparity between local production and worldwide production rates is attributable to a variety of factors, including the usage of seeds of various sizes. Choosing the size of seeds is one of the most critical needs for effective field establishment since the capacity of the seeds to germinate and produce vigorous seedlings in a variety of environmental circumstances is required for reaching a high yield. Low-quality seeds significantly contribute to plant germination failure or a heterogeneous appearance in the field because they are extremely susceptible to the unfavorable circumstances and stress induced by the environmental conditions around these seeds (ISTA, 1987). The seed size is proportional to the size and strength of the seed embryo, as well as the volume of carbohydrates stored in the endosperm. The larger the amount of this
The cultivation of seeds of homogeneous size is one of the important factors in achieving the best utilization of the resources available for plant growth. On the contrary, heterogeneity of seeds results in the production of plants of a varying growth and competition among these plants for the elements of growth. This leads to an increase in the disparity in growth with the progression of time and thus negatively affects grain yield. According to Al-Khafaji (2009), larger seeds are more likely to produce seedlings that are larger and more capable of growing. According to Al-Nouri and Antar (2007), large wheat seeds outperform small wheat seeds in traits of germination percentage, germination speed, the average length of seedling, speed of elongation and decreased number of days for the appearance of the second leaf in 50% of tillers. The apparent growth disparity is noticed in wheat fields particularly when planting mixed seeds of varying sizes. This is occasionally translated in a rise in the number of vegetative branch at the expense of fruiting branch (Al-Nouri, 2006).

**Literature Review Concerned with the Grading of Field Crop Seeds**

Choosing the optimum seed size influences the rise in agricultural production since it has a direct effect on the rate and speed of germination and the rate of establishment which is eventually reflected on the increase of yield. One of the primary aims of the seed size grading procedure is to ensure that there is a true scale for pricing field agricultural goods that protects the interests of both producers and consumers (Fowler, 2003). There are several characteristics that can influence crop seed consumption and usage. One of which is seed size with few seeds often used for fodder and large seeds for human use. Large in size is intended for human consumption (Wang et al., 2013, Lichti et al., 2017).

**The Effect of Seed Size on the Characteristics of Wheat**

According to some research, wheat seeds must be graded into multiple sizes, with small seeds 1000-grain weight equaling 22.5 g and large seeds with 1000-grains weight equaling 44.4 g. (Haider et al., 2016). When employing small seed sizes in wheat crops, Mian and Nafziger (1994) reported a drop in germination % and dry weight of seedlings and roots. A significant difference was observed between the two sizes and the superiority of the large size for the trait of plant height, the number of grains per spike, the spike length, the weight of one thousand grains and the grain yield in the study conducted by Khan et al., (2000) to determine the effect of the two sizes of seeds (viz. large and small) on the components of the wheat yield.

According to the findings of a study conducted by Chaudhry and Hussain (2001) to determine the effect of a seed size (large and small) and its average on wheat yield, there were significant variances among the seed sizes on the plant height, the number of spikes, the spike length and the weight of 1000 grains and the percentage of protein at a large size. A significant difference in the wheat yield was observed depending on the seed size based in Royo et al. (2006)'s study which aimed at determining the effect of the seed sizes (viz. large, medium and small) on the wheat yield. The medium and the small sizes gave the highest significant superiority in the number tillers, while the large size gave the highest significant superiority in the number of spikes and 1000-grains weight, while the large and the medium sizes provided the largest substantial superiority to the harvest index.

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size, while the results showed a significant increase for all studied traits (viz. plant height, number of tillers, number of spikes, spike length, weight of 1000 grains, biological yield, grain yield, harvest index, and protein percentage). Significant differences were observed among the sizes in an experiment conducted by Al-Nouri and Nayef (2013) to study the effect of bread wheat seed sizes (small, medium, large, and a mixture without sorting) for the grains of three varieties of wheat, with the large size outperforming the others in the following characteristics, viz. the number of spikes, the grain yield, and the biological yield, the grain weight by spike and the harvest index. McDonald and Hussein (2017) discovered a substantial difference in the seed sizes while studying the effect of seed size on grain production with the large size (2.8) outperforming the grain yield characteristic. Shahwani et al., (2014) discovered a substantial difference between the two seed sizes in the influence of seed size on the vegetative characteristics of bread wheat production, with the large size outperforming the plant height, the number of tillers, the number of grains per spike, the spike length and the grain yield.

Haider et al. (2016) described an experiment in which they investigated the influence of seed preparation and seed sizes on wheat growth and yield. The results revealed substantial differences between the two seed sizes, as well as among the superiority of the large size in characteristics of the number of grains in the spike, the length of the spike, the weight of a thousand grains, the grain yield and the biological yield. Mohamed et al., (2016) discovered this in research evaluating the influence of three seed sizes (large, medium, and small) on the development of bread wheat seedlings. The results revealed considerable variations between seed sizes, with the large size outperforming the other sizes in characteristics of flag leaf area.

According to Mustafa et al., (2018) a significant difference was observed among the seed sizes when studying the effect of the seed size on the production of wheat yield, and the large size gave a significant superiority for the plant height, the number of tillers, the number of grains / spike, the weight of thousand grains, the grain yield, the biological yield and the protein percentage. Muzaffar et al. (2019) investigated the impact of different seed sizes on the development and productivity of several wheat cultivars. The results revealed that there were significant differences among seed sizes, with the small size outperforming the large and medium sizes in characteristics of the number of tillers and the yield, while the large and medium sizes outperformed in characteristics of the spike length, the grain weight and the harvest index.

The Effect of Seed Size on Traits Corn and Sorghum

Standard sieves with rounded holes (8.50 and 9.32) mm were used to divide the corn seeds into two sizes; viz. large and small sizes. The seeds that fall through the sieve with holes (8.50) mm were small, but the seeds that fall through the sieve with holes 9.32 mm were large. Table #1 displays the weights of various seed sizes based on plant density and variety (Al-Obady, 2012).

<table>
<thead>
<tr>
<th>Plant density plant /h</th>
<th>Seed size</th>
<th>Grain weight (g)</th>
<th>Seed rate kg/h</th>
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<td>44.444</td>
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<td>0.3255</td>
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<td>Small</td>
<td>0.2876</td>
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<td>53.333</td>
<td>Large</td>
<td>0.3255</td>
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<td>66.667</td>
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<td>88.889</td>
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Graven and Carter (1990) found no significant differences in the germination percentage of maize seedlings or the number of days until 50% of female inflorescences emerged from large seed (circular shape) or large-sized (wrinkled shape), or small seeds (circular shape) seeds during either research season. According to Zaidan (1994), the percentage of germination of corn seeds after seven days of planting significantly varied depending on the size of the seeds prepared for culture. The medium and small-sized seeds germinated at 89 and 88 %, respectively, greatly outperforming the large-sized seeds which germinated at 80 %.
According to Swamy et al. (1998), the largest percentage of field emergence was achieved in large-sized maize seeds which amounted to 67.19%, and significantly outperformed (medium, small, very small and unincorporated seeds) which gave a field emergence rate of 60.66, 55.06, 46.39, and 63.93%, respectively and found significant differences in the number of days until 50% of male and female inflorescences appeared in maize plant. Kurdiikeri et al. (1999) also found a considerable increase in the percentage of field emergence of maize plants produced from large seeds with a rate of 87.90% compared with plants grown from medium and small seeds which had rates of 84.60 and 78.80% respectively. Plants grown from large-sized seeds were significantly faster in the trait of the emergence of 50% of female inflorescences progressing with a difference of 0.56 and 1.40 days respectively than plants grown from medium-sized and small-sized seeds with no significant differences in the height of maize plant found.

However, Martinelli and Carvalho (1999) observed a significant increase in the height of maize seedlings as well as significant differences in the average weight of corn seeds for maize plants grown from different sizes of seeds as large seeds outperformed medium and small seeds. So the average weight of the ears of corn plants for plants were grown from seeds. Large seeds weighed 151.2 g, medium seeds weighed 133.3 g and small seeds weighed 141.9 g respectively. They also discovered that plants grown from large seeds produced the most maize kernels, outperforming plants derived from medium and small seeds in characteristics of ear pod production. Mande (1999), on the other hand, found no significant differences in the percentage of field emergence and cob weight of maize cultivated from large or small seeds. Furthermore, Chaudhry and Ikram Ullah (2001) found no significant influence of seed size (i.e. large, small and none graded) on the parameters of field germination in maize. Maize plants developed from large seeds, small seeds or unincorporated seeds had a percentage of field emergence of 70.89, 68.27 and 69.67% respectively as the heights of the plants generated from these seeds were 205.50, 208.70 and 213.82 cm respectively. In plants generated from large, small and small seeds, the average number of corn cob grains was 464.56, 458.21 and 463.45 grains/cob respectively.

According to Tabakovic et al. (2020), the highest height of maize plants was obtained through the cultivation of large seeds reaching 198 cm which was significantly greater than the height of plants obtained through the cultivation of medium, small and unlisted seeds; and the number of corn grains reached 587.42 grains/corn. They discovered that plants grown from large-sized seeds had the maximum biological yield thus reaching 21.14 tons/ha. 1000 weight grains of plant generated from these seeds weigh 238.33, 232.68 and 236.07 g respectively.

Khan et al. (2005) also discovered a considerable increase in the height of maize plants developed from large and medium seeds when compared with plants grown from mixed seeds and small seeds with the height of plants reaching 158.87, 151.61, 147.74 and 144.00 cm respectively. The superiority of plants grown from large-sized seeds in height was explained by the researcher as a result of their production of strong and early seedlings which were improved their vegetative growth and development, and then gave them higher plants and more grain yield per unit area as they gave a grain yield of 2.40 tons / ha with an increase of 8.60, 10.97 and 22.28% respectively. Hamza (2006) discovered significant differences in leaf area and an evidence in sorghum plants. Thus, plants grown from large and small seeds were significantly superior to plants grown from medium-sized seeds in the two characteristics of leaf area and evidence in the spring season. However, the researcher observed the superiority of plants grown from medium-sized seeds in the autumn season. Plants developed from small seeds of these two features had a major impact on large and medium-sized seeds. According to Jadoua et al. (2008), there were significant differences in the height of sorghum plants based on the size of the sown seeds, as the plants produced from large-sized seeds outperformed the plants produced from medium-sized and small-sized seeds for both seasons (spring and autumn). The researcher, therefore, explained this superiority due to the large size of the sown seeds. At the start of growth, seedlings formed from large seeds had a better efficiency in the production and accumulation of dry matter which was reflected in the rise in the plant height.

Molatudi and Mariga (2009) found no significant differences in the percentage of field emergence of large and small seeds in maize after eight, twelve, fourteen and eighteen days of sowing. The number of leaves produced by maize plants were developed from large or small seeds did not significantly differ. The average number of leaves per plant after five weeks was 4.2, 4.5 leaves/plant. It also found a substantial rise in the lengths of maize seedlings developed from large-sized seeds compared with seedlings grown from small-sized seeds after (2,3,4,5) weeks of planting which was when the researcher measured the seedling lengths.
The Effect of Seed Size on Traits Beans

Because of the wide range of seed sizes in the bean crop, they were categorized into three primary types based on average seed weight; namely, small (700-1000 mg), medium (1001-1500 mg) and large (more than 1500 mg) (Al-Rifae and others (2004); Mekkei (2014)). Idris (2008), on the other hand, found no significant variation in the characteristics of four sizes of bean seeds (i.e. number of pods/plant, number of seeds/pod, weight of 100 seeds and seed yield).

According to Al-Anbari et al. (2010), a depth of (10 cm) was superior to depths of both (5 and 15 cm) in the characteristic of seed yield, whereas depths of (10 and 15 cm) were superior to depth of (5 cm) in the trait of weight of 100 seeds. Singh et al. (2010) discovered that very large seeds planted at a depth of 12 cm outperformed small, medium and large seeds planted at depths of 4 and 8 cm in characteristics of days to germination. Besides, medium-sized seeds planted at depth of 4 cm outperformed small, medium and large seeds planted at depths of 4 cm in characteristics of yield. Seeds against seeds (small, large and extremely large) placed at various depths of (4, 8 and 12 cm). Small seeds sown at a depth of 4 cm produced the longest pods, the most pods per plant and the most seeds per pod.

Hussein et al. (2013) discovered that large planted seeds outperformed small planted seeds in characteristics of bean germination rate. Hussein et al. (2013) discovered that large seeds planted at depths of 4 and 8 cm outperformed small seeds in characteristics of seed germination rate. Mekkei (2014) discovered that plants grew from large seeds outperformed plants grown from medium and small seeds in characteristics of seed weight (100) and seed yield.

According to Siddig and Idris (2015), the percentage of germination rose with medium and large seeds planted at a depth of (5 cm), and there was no significant variation in the features of the percentage of germination among the planting depths. Ali et al. (2020) discovered influence of three sizes of bean seeds (small, medium and large) on the growth and qualitative attributes of the indigenous bean, small and medium-sized seeds.

The Effect of Seed Size on Traits Chickpeas

Chickpea seeds are classified into two types based on their size and smooth: Kabuli and Desi. The first is Kabuli which is large, soft to touch and yellowish-white seeds with an average seed weight of 270-550 mg. The second is Desi which is small, coarse-grained seeds with a hue ranging from yellowish-brown to black with an average seed weight of 170-250 mg (Crop et al. (2004)).

According to Anbari et al. (2010) discovered that plants grew from large chickpea seeds (more than 1500 mg) (Al-Rifae and others (2004); Mekkei (2014)). Idris (2008), on the other hand, found no significant variation in the characteristics of four sizes of bean seeds (i.e. number of pods/plant, number of seeds/pod, weight of 100 seeds and seed yield). According to Al-Anbari et al. (2010), a depth of (10 cm) was superior to depths of both (5 and 15 cm) in the characteristic of seed yield, whereas depths of (10 and 15 cm) were superior to depth of (5 cm) in the trait of weight of 100 seeds. Singh et al. (2010) discovered that very large seeds planted at a depth of 12 cm outperformed small, medium and large seeds planted at depths of 4 and 8 cm in characteristics of days to germination. Besides, medium-sized seeds planted at depth of 4 cm outperformed small, medium and large seeds planted at depths of 4 cm in characteristics of yield. Seeds against seeds (small, large and extremely large) placed at various depths of (4, 8 and 12 cm). Small seeds sown at a depth of 4 cm produced the longest pods, the most pods per plant and the most seeds per pod.

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Alnori (2019) performed their research on two separate places (viz. Mosul and Erbil). The study sought to determine the impact of three chickpea varieties: viz. Marrakech, American (with large seeds) and Mexican (having small seeds). Mexican cultivar plants outperformed the other cultivars in characteristics of germination % and plant height, but American and Marrakesh cultivars outperformed the test weight feature.

In a study conducted by Omer et al. (2021) during the agricultural season (2018-2019) in Shariya (Dohuk), two cultivars of chickpea Shami (small seeds) and Marrakchi (large seeds) were used where the researcher noted the superiority of the Shami variety in the number of pods, the number of seeds and the yield Seeds/plant, while Marrakchi cultivar significantly outperformed in the weight of 100 seeds obtaining (25.19) gm for Marrakchi versus (22.11) for Shami cultivar.

Conclusion

After dispaying the previous studies, the present study concludes the following results:

1. The technique of grading seeds into different sizes is regarded a low-cost procedure with the result of decreasing seed rates and the amount of time necessary for this while enhancing the productivity of most crops, particularly crops with a considerable variation among the seeds of their varieties.

2. The influence of seed size was mostly noticeable in the early phases of the plant life; namely, the germination and emergence stages where the development of seedling growth from the beginning of the germination stage to the emergence stage was influenced by the nutrients stored in the endosperm. It would almost completely die out in the seed, and the plant would become autotrophic or self-sufficient in the production of nutrition by photosynthesis.

3. Sorting seeds by size aided in exploiting each size for an agricultural or industrial purpose was based on the demand and the verified economic revenue beside the fact that the sorting process aided in achieving a balanced plant growth in the field as opposing the unbalanced growth of mixed seeds of varying sizes.

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