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

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Abstract. The globe has been increasingly interested in generating new varieties that fulfill people's needs, necessitating studies on certain formerly uninteresting topics, such as varieties' seed size for the crops. The initial step in improving output from agriculture starts with seeds, some of the most important variables determining the growth of crops and yield. Excellent seeds of quality can be identified by specifications, which include good fullness size a uniformity in the agricultural samples, and this is supposed to be similar to crop development followed by ensuring equal of light and other energy sources by all plants similarly, with having an impact positively on the quality and yield of the seed. The present research concludes that, according to the overwhelming majority of the investigated studies, the practice of categorizing seed sizes helped in promoting and speeding germination, and this in turn improved plant development, output, and quality. As a result, the seeding rate needs to be calculated based on the number of seeds first, and weight of the grain second, which is owing to the big variations in the weight of seeds from varieties of each crop sown under environmental conditions. A lot of experiments showed an inverse relationship both The number and size of seeds in a given weight. Considering the surge and quick rise in populations, the size of seed grade may be the most critical component in increasing 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 can decrease variances between plants due to seed size and give equal chances for every crop plants to find nutrients for development, whether from soil or climate, which has a positive impact on plant yield (Al-Khafaji, 2009).

Moshatati and Gharineh (2012) define seed size as the amount of power generated and stored in a seed embryo, which includes activating and germination. Using big seeds that have plenty of nutrients is superior to using smaller or weak seeds, that typically produce weaker 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's seed size and its impact on field crop productivity.

Why to Use Gradation of Field Crop Seeds?

The enormous disparity between local production and worldwide production rates is attributable to 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 or produce vigorous seedlings in a variety to 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 reservoir is, the faster and stronger the seedlings develop and appear above the soil's surface than those with less supply (Jallow *et al*., 2009).

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 Anta r (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 best seed size impacts agricultural output since this has a direct impact on the speed and rate of germination, as well as the rate at which establishment, which outcomes in increased production. One of the key goals of the seed size classification technique is to provide a proper scale for selling field agricultural production that protects consumers as well as farmers (Fowler, 2003). Some may influence crop seed production and utilization. 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 Impact of Seed Sizes on Wheat Properties

Research suggests that wheat seeds should be graded based on their size, with larger grains weighing 44.4 g compared to smaller grains weighing 22.5 g. for 1000 grains (Haider and Associates, 2016). Mian and Nafziger (1994) discovered a decrease in the dry weight of seedlings and roots, as well as a decrease in germination % while employing small seed sizes in wheat crops. A significant difference was observed between the two sizes and The positive effects of the big-size for the trait to plant height, number of seeds per spike, spike length, weight of one thousand grains and the kernel yield in the study conducted by Khan *et al*., (2000) to determine the effect of the two sizes of seeds (viz. big and small) in the yield and its components to wheat crops.

The effects of both small and large seed sizes, as well as their average, on wheat yield, were studied by Chaudhry and Hussain (2001). The results proved that there were considerable disparities in the seed sizes in terms of plant height, spike count, spike length, weight of 1000 grains, and protein percentage at large sizes. According to Royo et al. (2006) study, which sought to ascertain the impact of the seed sizes (big, medium, and small) on the wheat yield, there was a notable variation in the wheat yield dependent on the size of the seeds. The medium and the small sizes gave there was a statistical difference in the number of tillers while the large size recorded variation in number of spikes and 1000- grains weight, while the large and the medium sizes provided the largest substantial superiority to the harvest index. Hossein et al. (2011) discovered that adopting large size seeds for wheat crops increased the germination percentage and the root dry weight. Al-Jubouri (2011) conducted an experiment to study the impact of the seed size on traits yield of some bread wheat varieties. The results revealed significant differences between seed sizes with large and medium seed sizes outperforming the number of spikes, the number of grains.spike^{-1}, and the biological yield.

The big seed size outperformed the grain weight / spike, the grain yield, the harvest index and the test weight, whereas the small seed size outperformed the protein percentage. When using small seeds of the wheat crop as opposed to large seeds, Dohuki et al. (2011) found that the number of leaves, chlorophyll percentage, plant height, biological yield, and seed production decreased. Zareian et al. (2012) evaluated 3 varieties of wheat (Mahdavi, Pishtaz, and Bahar) and 5 grain sizes (2-2.2, 2.2-2.5, 2.5-2.8, 2.8-3, and more than 3 mm). Excluding the number of seeds/spikes, which decreased significantly with increasing seed size, the data showed significant increases for all measured parameters (viz number of tillers, plant height, number of spikes, spike length, weight of 1000 grains, kernel yield, harvest index, biological yield 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, big size record upper 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) found a substantial variation 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) noticed a significant distinction between the 2 seed sizes in the impact of seed size on the development traits associated with flour production, with the big size superior to plant height, tiller number, number of grains each spike, spike length, and yield of grains. Haider et al. (2016) reported a study that looked into the effects of seed pretreatment and seed size on the growth of wheat and yield. The results indicate significant variance between the two seed sizes as the superiority of bigger seeds in a number of kernels per spike, the length of the spike, the weight of the thousand grains, the grain yield, and biological yield. This was found by Mohamed et al. (2016) in their investigation of the effects of three different seed sizes big, medium, and small on the growth of bread wheat seedlings. The large size outperformed the other sizes in characteristics of flag leaf area, according to the results, which showed substantial variation across seed sizes. According to Mustafa *et al.*, (2018) a significant difference was observed among the seed sizes when studying the effect of the grain sizes 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 kernel, the weight of 100 kernel, kernel yield, the biological yield and the protein percentage.

Muzaffar et al. (2019) looked into how various seed sizes affected the growth and yield of several wheat cultivars. Research results showed that there were variations in the characteristics of the grain sizes; the small size performed better in terms of yield while the big and medium sizes performed better in terms of spike length, grain weight, and harvest index.

The Impact of Seed Sizes on Corn and Sorghum Properties

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 1. Weights of different sizes of seeds based on plant density and variety.

plant density plant /h	Seed size	Grain weight (g)		Seed rate kg/h	
		Buhouth106	Sarah	Buhouth106	Sarah
44.444	Large	0.3255	0.3334	14.47	14.82
	Small	0.2876	0.2926	12.78	13.00
53.333	Large	0.3255	0.3334	17.36	17.78
	Small	0.2876	0.2926	15.34	15.61
66.667	Large	0.3255	0.3334	21.70	22.23
	Small	0.2876	0.2926	19.17	19.51
88.889	Large	0.3255	0.3334	28.93	29.64
	Small	0.2876	0.2926	25،56	26.01

Graven and Carter (1990) see that no differences in the germination % 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. Kurdikeri *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 seedling development from small and medium grain 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 small and medium kernel in traits 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 seedling grown from big-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% respectivey.

Hamza (2006) discovered significant differences in leaf area and an evidence in sorghum plants. Thus, seedling grown from big and small seeds were significantly effected to seedling produce from medium-sized seeds in the two traits 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 big-sized grain 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 outset of development, seedlings grown from big seeds were more efficient in producing plant height and dry matter.

Molatudi and Mariga (2009) discovered no significant variations in the rate of field emergence of big and small grains in maize after 8, 12, 14 and 18- days of seeding. The total amount of leaves produced from crops of maize that grew from big or tiny seeds did not vary considerably.

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 Impact of Seed Sizes on Beans Properties

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-Rifaee 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, weight of 100 grains, number of grain and grain 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 big seeds sown at a depth of 12 cm outperformed small, medium and big seeds sown 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 big seeds sown 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 plants and the most grain 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) found that seedlings developed from big seeds best from seedlings produced from seeds mid and small in the weight and yield of seeds.

a study by Siddig and Idris (2015), middle and big seeds sown at a 5 cm depth resulted in higher germination, and there was not a significant difference in the traits of the germination % across depth of seeding. Ali et al. (2020) investigated the effect of 3 bean seed volume (minor, medium, and big) on the development and qualitative traits of the local bean, minor and medium seeds.

The Impact of Seed Sizes on Chickpeas Properties

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 some refrences, there is a third type of chickpea known as Gulabi Intermediaire which is medium-sized, smooth-textured and light-colored seeds with an average seed weight of 200-400 mg (Bouyeldieu, 1991). See that (Chopra and Singha, 1987) Chickpea production spreads across the northern part of the world in general around latitudes 20 and 40 north, with the bulk of daisy-type farming appearing around latitudes 20 and 30 north and Kabuli type appearing below 30 north.

Khalil et al. (2007) reported major variations across cultivars in rates of germination for two different kinds of chick pea seeds (Kabuli and Desi). Through the Kabuli cultivar surpassing the Desi cultivar, Emenky and Khalaf (2008) discovered that big chickpea cultivars outperform smaller cultivars in terms of germination rate, plant height, lowest pod height, and 1000-seed weight.

Kaydan and Ya-mur (2008) discovered that seed size impacts the rate of germination and seedling growth, as big seeds provided a higher percentage of germination than small-sized seeds. Gnyandev (2009) found that big chickpea cultivars generated significantly more pods versus small cultivars.

Anuradha (2009) found that large (Kabuli) chickpea seeds had the greatest values in laboratory experiment features, such as; percentage of germination, root length, feather and dry weight of the root and feather when compared with small chickpea seeds (i.e. desi). When Alnori and Al-Obady (2014) studied the characteristics of two chickpea cultivars (Al-Rafidain and Ghab4), they found that the cultivar (Al-Rafidain) was significantly superior in the trait of seed yield, while the cultivar (Gab4) was significantly superior in the trait of total pods weight (g). In addition, the adjective quantity of seeds did not differ between varieties.

Kanouni *et al*. (2015) conducted a research (14) on the genetic structure of chickpea in which the genotype of large seeds (FLIP 00-39C and SEL 99 TH150454) outperformed a seed yield. For the 2017-2018 agricultural season, AL-Amrei and 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 (havng small seeds). Mexican cultivar plants outperformed the other cultivars in traits 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 usem where the researcher noted the superiority of the Shami variety in the yield Seeds and number of pods and seeds, while Marrakchi cultivar 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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