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# Review on Effect of Seed Size on Seedling Vigour and Seed Yield

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## ABSTRACT

Seed size is an important physical indicator of seed quality that affects vegetative growth and is frequently related to yield, market grade factors and harvest efficiency. Genetic variation is the cause for variation in size of seed between varieties. Based on size, the seeds are classified as very large, large, medium, small and very small. This variation is due to flow of nutrients into the seed at the mother plant. Since seed coat and embryonic axis are the first to develop in a seed within a pod and accumulation of food reserve is occur later one. This variation is exerted in size, later on, on mobilization of food reserve to growing seedling. It has been reflected in many crop species and many varieties. A wide array of different effects of seed size has been reported for seed germination, emergence and related agronomic aspects in many crop species. Generally, large seed has better field performance than small seed.

**Key words:** Seed size, seedling vigour, seed yield, large seed, small seed

## INTRODUCTION

For a successful crop production, the use of good quality seed is very essential which increase the yield by 15-20%. The extent of this increase is directly proportional to the quality of seed that is being sown. The seeds of a seed lot may differ by size, weight and density due to production environment and cultivation practices. Seed size is one of the components of seed quality which affects the performance of crop (Ojo, 2000; Adebisi, 2004; Adebisi *et al.*, 2011). Size is a widely accepted measure of seed quality and large seeds have high seeding survival growth and establishment (Jerlin and Vadivelu, 2004). A wide array of different effects of seed size has been reported for seed germination, emergence and related agronomical aspects in many crop species (Kaydan and Yagmur, 2008). However, these results varied widely between species. Generally, large seed has better field performance than small seed.

## EFFECT OF LARGE SEED ON SEEDLING VIGOUR

In wheat, seed size is positively correlated with seed vigor, larger seeds tend to produce more vigorous seedlings (Ries and Everson, 1973). Germination rate and seedling vigour index values increased with the increase of seed size suggesting the selection of larger seeds for good stand establishment in rice (Roy *et al.*, 1996). In wheat, seed size is positively correlated with seed vigour: larger seeds tend to produce more vigorous seedlings (Cookson *et al.*, 2001). Nagaraju (2001) observed higher plant height (97.83 g), number of leaves (7.58) and stem girth (6.98 cm) in plants raised by large size (3.0 mm oblong hole screen) followed by medium (seeds passed through 3.00 mm screen) compared to small seeds (passed through 2.8 mm) (90.50, 6.53 and 6.30 cm, respectively), in sunflower. Nagaraju (2001) noticed higher germination percentage (93.95%), seedling length (25.26 cm), seedling vigour index (2379), dry weight (0.23 mg) and field emergence (83.00%) in large size seeds compared to small seeds (87.16%, 22.33 cm, 1941,0.22 mg and 77.83%), respectively, in sunflower. Nerson (2002) showed that small muskmelon seeds had the lowest percentage germination, emergence and the lowest seedling growth demonstrating that there is an association between seed physical parameters and seed quality. The K1 safflower seeds retained in 11/64" round perforated metal sieve recorded higher germination (94%), vigour index (1362) and productivity (800 kg $ha^{-1}$) compared to other 13/64", 12/64" and 10/64" sieves (Balamurugan *et al.*, 2004). Willenborg *et al.* (2005) that have been studied about germination specification of six oat cultivars with three seed size (less than 1.95, 1.95-2.35 and more than 2.35 mm) at water stress condition (0, -0.4, -0.2 MPa) resulted that oat cultivars genotypes with large seed size under different osmotic potential produced high germination rate. Large seeds expressed high seedling vigour index than the small size seeds in all the varieties, however, minimun differences among seed grades were noticed in UPAS 120 and Pant AI04 of red gram (Verma *et al.*, 2005). Vishvanath *et al.* (2006) noticed significantly higher seed quality parameters viz. 100 seed weight, field emergence, seedling length, vigour index with the increase in sieve size in french bean. Suresha *et al.* (2007) reported that in soap nut, the larger size seeds possessed higher percentage (98%) of germination. Sulochanamma and Reddy (2007) observed that in groundnut, seedling vigour in shrivelled and small seeds was less than bold seeds. Whereas, abnormal seedlings observed in bold seeds were more (34.9%) than small and shrivelled seed (10.6%). Some researchers showed that large soybean seeds are preferable in stress condition (Hanley *et al.*, 2007). Generally, bigger seeds germinate quicker and would take lesser duration when compare to that of smaller ones (Gunaga *et al.*, 2007). Manonmani *et al.* (1996) and Gunaga *et al.* (2007) have recorded higher seed germination and seedling vigour by using bigger sized seeds in *Pongamia pinnata* and *Vateria indica*. Menaka and Balamurugan (2008) proved that larger seeds of amaranthus possess higher physiological quality. With increased seed size higher germination and emergence was determined in triticale (Kaydan and Yagmur, 2008). Mandal *et al.* (2008) noted that in *Hypatis suaveolous*, variation in seed size and mass influenced emergence; large seeds showed a higher emergence potential than smaller seeds. Larger seeds were capable of emerging from greater planting depths and showed an enhanced ability to penetrate ground cover and survive burial by litter (Mandal *et al.*, 2008). Increased germination percentage as well as greater speed of germination in large seed compared with small seed in pinto bean (Gholami *et al.*, 2009). In bengal gram larger size seeds retained on 19/64" round perforated metal sieves recorded the maximum germination, seedling vigour, protein content, dehydrogense and alpha-amylase activity (Anuradha *et al.*, 2009). In safflower, was showed that water uptake of small seeds (72%) was lower than large seeds (83%) (Farhoudi and Motamedi, 2010). Jute cv. JRO 524 and JRO 8432 seeds size graded using BSS 16×16 sieves recorded higher seed quality standards (Jerlin *et al.*, 2010). Large seeds produced the highest germination percent, coleoptiles fresh weight, coleoptiles dry weight, radicle fresh weight and 1000 seed weights compared other seed size in safflower (Sadeghi *et al.*, 2011). Safflower seedlings from small seeds had the highest $Na^+$ and $Cl^-$ content of all measured NaCl levels. Large seeds produced vigorous seedling growth due to a lower ion accumulation under NaCl stress (Mehmet *et al.*, 2011). Plant grown from large seeds compared to those grown from small seeds was more vigorous and produces greater dry matter in wheat (Nik *et al.*, 2011). 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. In *Mammea suriga* bigger sized seeds recorded quick and highest seed germination (79.2), followed by medium (59.0) and small (22.0%). Higher and quicker germination in bigger sized seeds could be due to the presence of higher amount of carbohydrates and other nutrients than in medium and small sized seeds (Gunaga *et al.*, 2011). Bigger seed of fluted pumpkin statistically produced seedling of very high vigour index of 320.35 compare to the small seeds which produce seedling that have low vigour index of 301.38 (Ndor *et al.*, 2012). Ahirwar (2012) reported that *Alangium lamarckii Thwaites* of large size seeds gave maximum (76.00%) germination followed by medium size (74.00%) and small size seeds characterized by low germination percentage (59.00%).

## EFFECT OF LARGE SEED ON SEED YIELD

Larger seeds of spring wheat produced higher yields than smaller seeds under late-sown conditions (Singh and Kailasanathan, 1976) but not under optimum management conditions (Kalita and Choudhury, 1984). Baalbaki and Copeland (1997) reported that in wheat, seed size not only influence emergence and establishment but also affected yield components and ultimately grain yield. Simmone *et al.* (2000) reported that size of seed has a strong influence on germination as well as growth and biomass increment of a plant. With increasing seed size spike production and density, number of tillers, main stem length, thousand kernel mass, test mass, seed vigor and yield increased, maturity was advanced and seed moisture content at harvest decreased in Croatian spring malting barleys (Rukavina *et al.*, 2002). Similar results were obtained from Roozrokh *et al.* (2005) on chickpea, Taleghani *et al.* (2002) on sugar beet. Nagaraju (2001) recorded significantly higher yield and yield traits in sunflower with large seeds (retained over 3.00 mm sieve) the higher head diameter (15.08 cm), number of filled seeds per head, total number of seeds per head (619.41), percent seed filling (84.17), seed yield per plant (22.31 g) and per hectare (10.99 g) recorded in bold seeds followed by medium sized seeds (passed through 3.00 mm sieve) and significantly lower in small sized seeds (passed through 2.8 mm sieve).

Munir and Abdel-Rahman (2002) noticed that plant height and primary branches per plant and seed yield were not significantly affected by seed size in faba bean. Use of large seed size and increased seeding rates can improve wheat competitiveness and provide an effective means to reduce wild oat biomass and seed production (Xue and Stougaard, 2002). Verma and Bajpai (2002) reported in pigeonpea that, the ungraded and large seed grade showed higher performance for yield and primary branches per plant in all eight genotypes than small seed grade. Verma and Bajpai (2002) reported in pigeonpea that, the ungraded and large seed grade showed higher performance for yield and primary branches per plant in all eight genotypes than small seed grade. Kumar and Seth (2004) observed that seed size affected the seed yield significantly. Medium, bold and ungraded seed were on par with seed yield but significantly greater over small seeds. Significantly lower number of pods per meter square and decreased 1000 seed weight resulted in small seeds in fodder cowpea. Plants derived from large seed appear to have greater vigour and are able to acquire a larger share of plant growth factors relative to plants derived from small seed (Stougaard and Xue, 2004). Tawaha and Turk (2004) in field pea noted that plants produced from heavier seeds had 100 seed weight that is 12% greated than those produced from lighter seeds. In canola and wheat, large seeds showed early germination and vigorous plants that are more likely to produce higher yields (CSIRO, 2005). More than 1 g size seedling tubers can be successfully used for potato production as from the seed tubers of any standard variety (Adhikari, 2005). In similar study was reported that use of larger seed sizes improved grain yields by 18% and the use of small seeds reduced yield by 16% in wheat (Stougaard and Xue, 2005). Santosh *et al.* (2005)

studied the effects of soybean seed size on physiological quality during storage. Some research has shown that for cereal crops, large seeds tend to produce more yield than small seeds (Anonymous, 2005). Stougaard and Xue (2005) opined that 18% of increased yield could be obtained by larger seeds in wheat. Large seeds have more food storage for embryo growth and development which lead to vigorous growth of the seedling before weeds can emerge and create competition. Lima *et al.* (2005) noted that crop growth rate at the beginning of the growth cycle was higher in plants originating from large seeds. Yogeesha *et al.* (2005) reported that in french bean cv. Arka Komal, the seed size of >4.35 mm can be used for better field performance instead of seeds with >4.75 size as presently practicing. In mustard pronounced effect of seed size was observed, in large seed size category by having higher values of yield attributing parameters. In soybean small seeds resulted in lower yield than medium, large and unscreened seeds (Morrison and Xue, 2007). Khurana and Singh (2000), who noted that seed size variations affected leaf area, large seeds producing greater leaf area. Large seeds increased leaf area production of *Abizia* plants, particularly at the beginning of the growth cycle (Khurana and Singh, 2000). Upadhya and Cabello (2000) observed that seed size had some significant effects on emergence and total marketable yields; they also noted that seedlings grown from large seeds had higher survival and total tuber in Irish potato (*Solanum tuberosum*).

Elliott *et al.* (2008) noted that small seeds produced seedlings with much less vigour. Stobbe *et al.* (2008) reported that crops grown from large kernels consistently yielded higher than crops grown from small kernels of the same cultivar, for both wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare*). In chickpea and lentil, were observed that plants from large seeds yielded 6% more than medium seeds and 10% more than mixed seeds (Bicer, 2009). Bicer (2009) stated that in chickpea effect of seed size on yield and 100 seed weight was positive. Chiamai *et al.* (2010) who noted that large seeds of mung beans (*Vigna radiate*) produced larger sprouts including sprout mass and head diameter characters. Adejare (2010) reported that large seed size of elite maize had higher seed quality and higher seed yield compared to other medium and small sizes. High grain yield was obtained with the 7 mm seed size seed size of 6 and 6.5 mm in corn (EnayatGholizadeh *et al.*, 2012). Smallest seed size had lowest emergence therefore, it is assumed that plants grown from small seed had less fertile tillers than those grown from large seed. Whereby, grain yield and biological yield decreased in smallest seed size. It is obvious that increase in biological yield by increasing seed size was related to higher seedling weight and weight of 100 plants were produced by larger seed sizes (Zareian *et al.*, 2013) in wheat. Adebisi *et al.* (2013) reported that in tropical soybean lots with small seed size had maximum seed germination (97%) and emergence (90%) while those with large seed size produced the highest seed (88) per plant, pods (54) per plant and seed yield (9.72 g) per plant.

## EFFECT OF SMALL SEEDS ON SEEDLING VIGOUR

Dar *et al.* (2002) have mentioned that small seeds to medium sized ones produced better germination and seedling vigor than those of bigger ones. Peksen *et al.* (2004) showed that cultivars with low 100 seed weight had higher germination percentage than larger seed ones in pea (*Pisum sativum* L.). Even the ungraded seed category was observed to be better for sowing purpose than small size of seed in mustard (Kumar *et al.*, 2005). Farhoudi and Motamedi (2010) proposed that small seeds germinated faster and grew higher under saline conditions and that they could be preferred for use in saline soils to achieve better stands. Small seeds had better germination uniformity and getting reserves more and faster than larger ones to seedlings in soybean cv. KATUL (Rastegar and Kandi, 2011).

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