

Effect of Seed Size on Germination and Seedling Performance on Grafted Avocado

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Abstract

Avocado (Persea americana) producing areas in Kenya face constraints in generating sufficient propagation material. Lack of technical production skills has led to poor quality avocado seedlings. This research was carried out to determine the effect of avocado seed size on germination, growth and seedling development (using the local varieties as rootstock). A ratio of 5:2:2:1 (Topsoil: Compost: Coconut fiber: Gravel) of planting media was used under green house conditions. The effect of seed size on scion growth and development of avocado seedlings was determined. The experiment had a completely randomized design with three replications. Each replication had three plants and three seed sizes (Large, Medium and Small) were used. Germination percentage was determined. Quantitative data on plant height and stem diameter were recorded before grafting. Scions (Hass variety) that had 3 buds were used. Time to produce buds, bud length and growth vigor was measured. Data was subjected to Analysis of Variance using Genstat version 14.1 software. Mean separation was done by Duncan's multiple range test. Significant differences were observed in height, stem diameter, bud length and vigour with the following %CV 14.1, 11.8, 37.4 and 24.0 respectively. The medium seeds had the highest germination percentage of 77.78 and small seeds had the least percentage of 33.33. The large sized seeds produced bigger girth which greatly contributed to quicker graft take. Buds from large sized seeds were more vigorous than those of medium and small seeds. In conclusion mass propagation of Hass avocado seedlings can be achieved using medium to large seeds due to quicker germination, growth and graft take

Key words; *Persea americana*, propagation, seed size

INTRODUCTION

High protein, minerals (K, Mg and S), anti-oxidant (Vitamin E) and oil content (20-30%) of avocado contribute positively to the health of those that consume it (Griesbach, 2005). Constraints to production include insufficient planting material and lack of technical skills (Njuguna *et al.*, 2017). Lack of ready seedlings at onset of rains, low technical know-how of fruit tree nursery production techniques, low ranking of avocado crop by extension agents, pesticide residue standards and traceability regulations were listed as the main hindrances to avocado production in the North Rift Region in Kenya (Anjichi *et al.*, 2010).

Since 1994, the production of avocado fruit has not been stable in the avocado producing areas (Griesbach, 2005). Insufficient planting materials has led to over 60% losses (Chege, 2006). To increase avocado production, this research focused on the effect of seed size on germination; growth and development of avocado seedlings. The effect of seed size on scion (Hass variety) growth and development of avocado seedlings was determined.

MATERIALS AND METHODS

This experiment was carried out at University of Eldoret green house. Seeds were soaked in hot water at 40-52 degrees Celsius for thirty minutes as a treatment against the seed borne fungal disease (*Phytophthora cinnamoni*). Seeds were oriented with the slightly pointed end facing upwards and the flat end facing downwards.

The experimental design was completely randomized design (CRD) with three replications containing three plants per replication. A media, 5 parts topsoil: 2 coconut fibre: 2 compost: 1 gravel was used. Avocado seed size as a factor had three levels [Large (<4.5cm), Medium (3.5-4.5 cm) and small (>3.5cm)]. Seed sorting was done before planting. Grafting (wedge grafting) of the sorted avocado seedlings was done forty five days after emergence where Hass scions that had equal number of buds (3 buds) were used. A tunnel was made in order to ensure that a temperature of between 15-16 degrees Celsius and a relative humidity of 95-98% were maintained. This ensured that the roots and graft union remain warm and the scion remained cool.

Germination percentage was determined. Quantitative data on plant height and stem diameter was recorded before grafting. The bud length and growth vigour was measured after grafting. Data was subjected to Analysis of Variance using Genstat software and mean separation done by Duncan's multiple range tests.

RESULTS

The seed sizes had different germination percentage, growth and influenced Hass scion growth and development differently. The following results were obtained after evaluation.

Germination Percentage

The medium seeds had the highest germination percentage of 77.78% followed by the large with a percentage of 55.56% and the least was 33.33% for the small seed

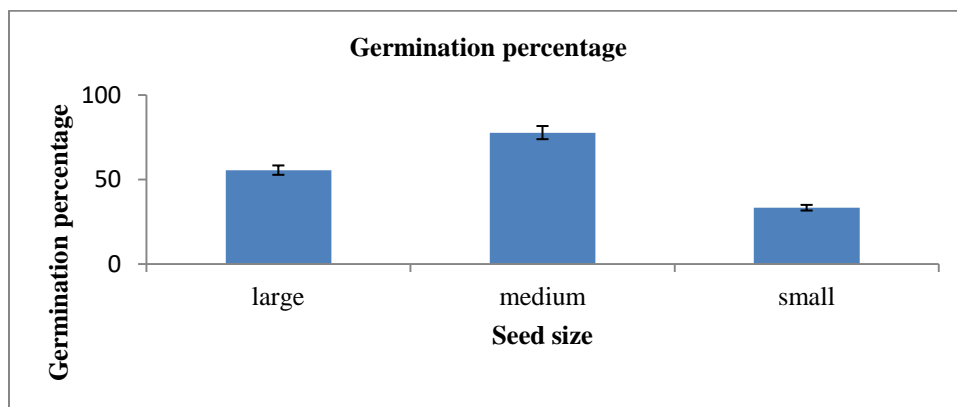


Figure 1: Germination percentage against seed size

Plant Height

All the three seed sizes showed an increment in height over the period. The height of plants propagated from the large sized seeds was the highest. Significance difference was observed on the 9th day after emergence among the large, medium and small seed sizes.

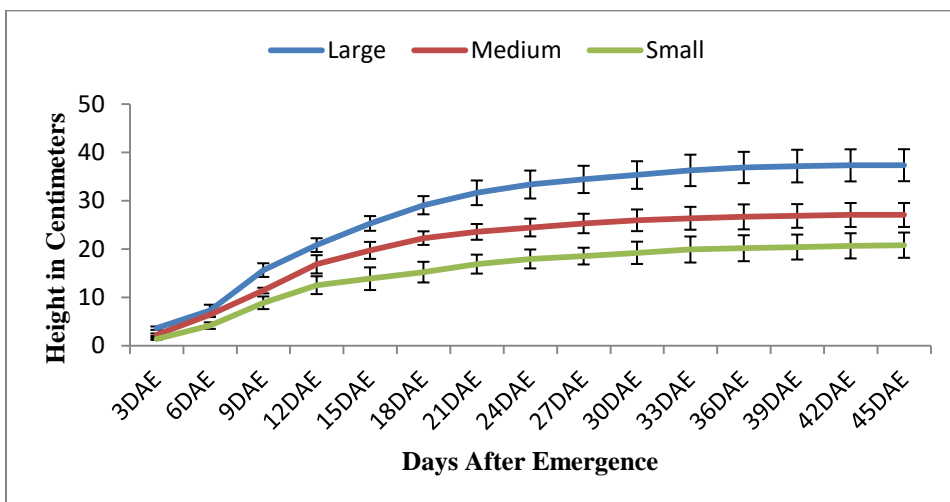


Figure 2: Effects of seeds sizes on the height against days after emergence

Stem Diameter

The largest stem girth was noted in seedlings from the large sized seeds. Significance difference was observed at the 18th day among the large, medium and small. On the 15th day there was significance difference between the large and medium but there was no significance difference between the medium and small seed sizes.

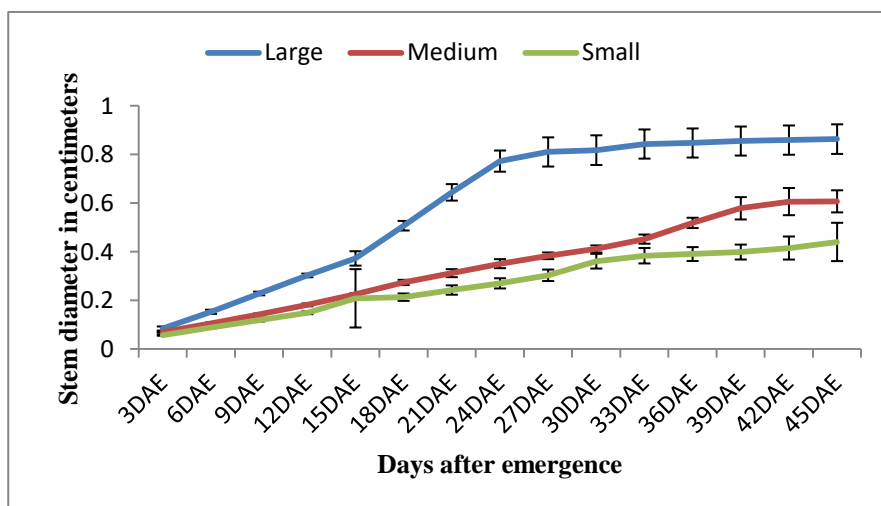


Figure 3: Effects of seeds sizes on stem diameter against days after emergence

Bud Length

Small sized seeds had the least bud length while the buds from the large seeds were the longest. The large seed size had an increased bud length compared to the medium and small seeds. Significance difference was observed at the 30th day to the 65th day after sprouting among the three seed sizes.

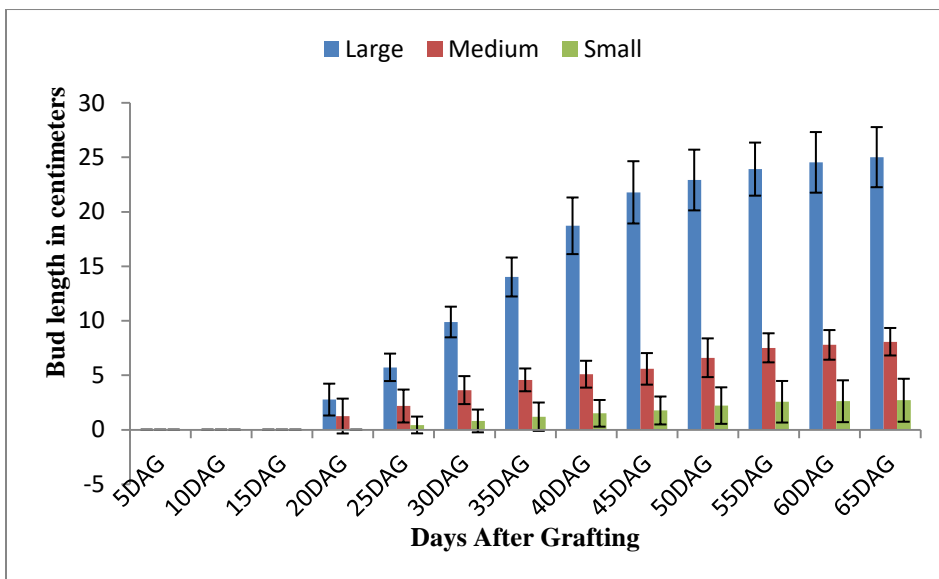


Figure 4: Effects of seeds sizes on bud length against days after grafting

Vigour

The large sized seeds produced more vigorous buds compared to the medium and small sized seeds. There was significance difference between the large and medium seed sizes from the 20th day to the 65th day after sprouting.

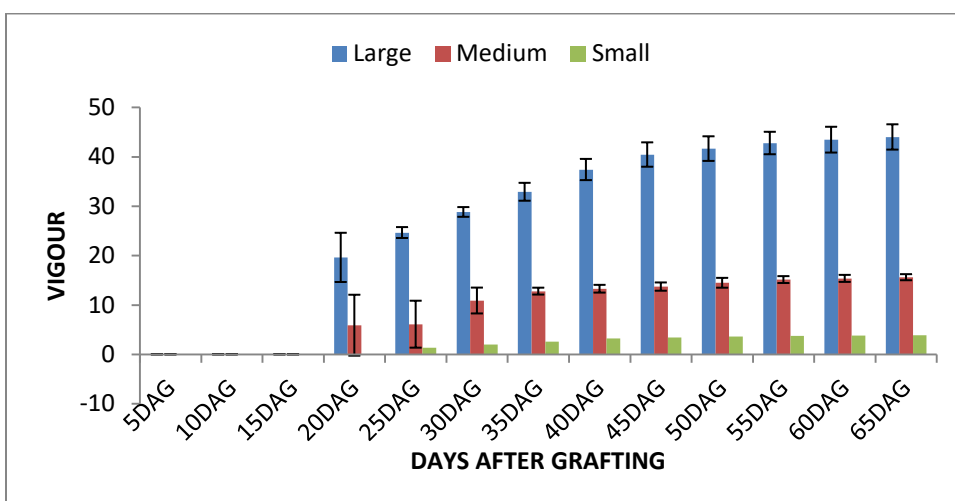


Figure 5: Effects of seeds sizes on Vigour against Days after grafting

DISCUSSION

Germination

Rate of avocado seed germination was influenced by the seed size, medium had the highest germination percentage followed by the large and small had the least. This is clearly attributed to their proportional food reserves. The medium seeds emerged faster than the large seeds which can be explained by the varying sowing depths. According to (Abdellatif & Sidding, 2015) the deeper the seed is sown the more strength it needs to push its shoots above the soil surface. This is also in agreement with (Bustamante *et al.*, 1998) who carried out a research on the effect of seed size on germination and seedling growth of *Cryptocarya alba* (Lauraceae) and found large seeds germinated in greater numbers than small seeds and seedlings from large seeds had larger shoots and a greater probability of producing leaves.

Effect of Seed Size on Seedling Growth Rate before Grafting

This analysis supports earlier publication by (Karnataka, 2011). According to (Karnataka, 2011) seedling growth characteristics such as seedling height, collar diameter, number of leaves and root length had significant variation in large, medium and small seeds of *Mammea suriga*. Bigger sized avocado seeds showed significantly higher seedling height and collar diameter than those of medium and smaller seeds. This was attributed to higher amount of carbohydrates and other nutrients present in the large seed than in medium and small sized seeds. This trend has also been reported in *Quercus macrocarpa* and *Quercus alba* by (Hall *et al.*, 2007) which are also recalcitrant seeds.

Effect of Seed Size on Scion Growth and Development

After cutting, tissues adhere and cell expansion and division occurs thus formation of undifferentiated stem cell- like tissue (callus). Callus and tissues surrounding the cut thus differentiate to phloem and xylem before the vascular strands are connected between scion and rootstock. This research supports that greater girth produced by the large avocado seed improved proper alignment of parenchymatous tissues. This initiated quick cell-to- cell communication and eventually vascular continuity between the scion and rootstock which were compatible partners. This study has shown that the days to graft take decreased as the rootstock diameter increases. A higher survival (86.6667 %) and reduced time to graft take (20 days) were achieved with thicker rootstocks (2.751 cm) than thinner rootstocks (0.272cm). The present findings agreed with the findings of (Ajayi *et al.*, 2010) .

Vigour

The large sized seeds had highest vigour of buds produced after grafting followed by the medium and small had the least. This is clearly due to mobility of food reserves to the growing scion by the different proportional seed carbohydrates and other nutrients. This research is similar to the findings of (Ambika, Manonmani, & Somasundar, 2014).

CONCLUSION

In conclusion medium seed size gave the best germination. Both large and medium sized seedlings performed better than the small sized seedlings.

RECOMMENDATION

Medium to large seed sizes that have a diameter of 3.5cm and above should be used to raise quality avocado seedlings.

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