

Effect of Seed Size on Germination and Some Growth and Yield Components of Cowpea (*Vigna unguiculata* L.) Grown on Sandy Loam Soils in Maiduguri, Northeast Nigeria

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ABSTRACT

The effect of seed size on germination and early growth of cowpea (Vigna unguiculata L.) on some sandy loam soils of Maiduguri, Borno state was assessed during the 2014 rainy season. Cowpea seeds were sourced and tested using floatation method for viability. The seeds were later sorted into large, medium, and small sizes that weighed between 0.26-0.30g, 0.20-0.25g, and 0.15-0.19 g, respectively. Three seeds from each grade were sown into 5 pots filled with sterilized sandy loam soils and replicated 5 times in a completely randomized design. The seedlings were later thinned down to 2 seedlings per pot at 2 weeks after sowing (WAS). Data on germination and seedling establishment were respectively taken at 1 and 2-WAS, while plant height, stem diameter, number of leaves and branches per plant per pot and root-biomass were studied at 3 and 4-WAS. The results showed that large sized seeds germinated better (95%). The medium sized cowpea seeds trailed with 86.75% germination, while the small sized cowpea seeds followed with 83.50% germination. All the plant parameters studied differed significantly ($P < 0.05$) among the treatments, except for stem diameter at 2-WAS. However, the large and medium seeds recorded a generally comparable effect on the early growth characteristics of cowpea in the study area. Farmers are recommended to consider using large sized cowpea seeds during propagation.

Keywords: Cowpea, Seed-size, Germination, Growth, Sandy-loam

INTRODUCTION

The high demand for protein in human diets has repositioned both crop and soil scientists on the provision of good quality seeds and soil conditions for higher crop yields. The use of such qualitative seeds was found to increase crop yields by 15-20% (Ambika *et al.*, 2014). Cowpea seeds are rich in protein and are highly nutritious when eaten fresh or dried. Cowpea plays a vital role in both human diets and animal feeds, thereby the need for its sustainable production. Several studies have confirmed the effect of seed size on cowpea propagation, seedling vigor and

yielding quality (Roozrokhi *et al.*, 2005); Hojjat, 2011). According to Morrison and Xue (2007), size is one of the most important characteristics of seeds that affect germination, seedling establishment and seed yield quality. Other studies on seed size in various plant species such as carrots, clover, wheat, barley, chickpea, soyabean and cowpea higher germination, seedling dry weights, food storages, and other yield components around the world (Roozrokhi *et al.*, 2005).

In a similar work by Kaydan and Yagmur (2008), there were highly significant ($P < 0.05$) differences among mean germination of larger and medium cowpea seeds, where larger seeds performed better. However, despite the wide spread report on the relative advantages of larger seeds on seed vigor and yield components, yet few scholars like Munir and Abdel-Rahman (2002) still argue that seed size could not influence plant performances in faba beans as reported by Ambika *et al.* (2014). This conflicting position further gave room for confirmatory research works of this kind. Therefore, the current work is aimed at testing the effects of different seed sizes on cowpea seed germination, seedling establishment and early growth characteristics, considering the lack of such information in the study area.

MATERIALS AND METHODS

The Study Area

The study was carried out at the Teaching and Research farm of University of Maiduguri, Borno State. Maiduguri city is located at latitude 11° 50' 42" N and 13° 9' 36" E, and finally within the Sahel Savanah vegetation of Nigeria. Maiduguri has both rainy (June - October) and dry seasons (November - May) of a tropical climate. The climate of the state is hot and dry for the greater part of the year (Nwagboso and Uyanga, 1999). The annual rainfall amounts vary between 499 and 951 mm received in the area with a predominantly sandy loam soils (Appendix 1).

Seed Sources and Sorting

A local variety cowpea seeds (*Vigna unguiculata*) were sourced from the Monday Market, Maiduguri. The seeds are brown in color and weighed between 0.15 g and 0.30 g. Viability test was performed using floatation method. The viable seeds sunk beneath and the non-viable seeds floated on water. The viable seeds were later dried, while the non-viable seeds were discarded. The seeds were then sorted into 3 groups based on their sizes as large, medium and small, which respectively weighed between 0.15 - 0.19 g; 0.20 - 0.25 g; and 0.26 - 0.30 g. Each of the 3 seed grades consisted of 15 seeds, giving a total of 45 seeds used for this study. Ambika *et al.* (2014) similarly sorted seeds into large, medium, small and very small when studying seed size effects on some arable crop seeds.

Soil Sterilization, Experimental Design and Nursery Operation

Sandy loam soils were collected from the Teaching and Research Farm of

University of Maiduguri and placed in a sterilizing tank, then steamed for 40 minutes. The sterilized soil was allowed to cool at room temperature and later transferred into well labeled polythene bags and watered. The experiment was laid out in completely randomized design (CRD) and replicated 5 times. The large, medium and small sized seeds were respectively sown to 5 polythene bags for each seed grade at a rate of 3 seeds per bag and separated by an alley of 1 m apart. The seeds were later thinned down to 2 seeds per polythene bag.

Experimental Design

Fifteen seeds each from large, medium and small sized grades were respectively sown to each of the replications at 1 cm depths in the polythene bags, where the cowpea seed germination, growth and yield components were timely observed.

Data Collection

Seed Germination and Seedling Establishment

The seed germination was determined at 1 week after sowing (WAS) by physically counting the germinated cowpea seeds and their percentages computed for each seed size. Also, the seedling establishment was done by still counting the number of surviving seedlings at 2-WAS, and their percentage survival in terms of each seed size was as well computed.

Data Analysis

The data collected on seed germination, seedling establishment, growth characteristics, and the shoot and root biomass were subjected to the generalized linear model of Statistix 9.1 for the analysis of variance (ANOVA). The sample means were also separated using LSD at 0.5 level of significance.

RESULTS AND DISCUSSION

Germination and Seedling Establishment

The results on seed germination count and seedling establishment are presented in Table 1. The results showed that all the large sized seeds had better germination (95%) in comparison to other grades of seeds evaluated. The medium sized cowpea seeds trailed with 86.75% germination, while the small sized cowpea seeds followed with 83.50% germination. Conversely, the seedling establishment was patterned after seed germination in this study. However, there was a significant ($P < 0.05$) difference among the treatment effects on the percentage seedling establishment compared to percentage germination which did not differ significantly ($P < 0.05$). A similar work by Nagaraju (2001) reported higher germination of 93.95% and field emergence of 83% in large seeds compared to smaller seeds of sunflower. In addition, Ahirwar (2012) also reported that larger seeds had higher germination of 76%, followed by medium and small sized seeds with 74% and 59% respective germinations in *Alangium Lamarckii Thwaites*. The

higher germination and vigour of larger seeds could be due to the presence of higher amounts of carbohydrates and other nutrients than in the medium and small sized seeds (Ambika *et al.*, 2014)

Table 1: Treatment effects on seed germination and seedling establishment

Seed size	Germination Count	Seedling Establishment	Percent Seed Germination (%)	Percent Seedling Establishment (%)
Large	14.25 ^a	13.50 ^a	95.00	94.50 ^a
Medium	13.00 ^{ab}	11.75 ^{ab}	86.75	92.50 ^{ab}
Small	12.50 ^{ab}	11.50 ^{ab}	83.50	90.00 ^{ab}
SE (±)	1.13	1.17	NS	3.85

Key: Means in the same column having the same letter(s) are not significantly different at 5% level

Effect of Seed Size on Cowpea Growth Parameters

The effects of seed size on the heights of cowpea are presented in Table 2. The results showed that the plant heights, number of leaves, stem diameter and number of branches were significantly ($P < 0.05$) affected by the seed size grades. The larger cowpea seed sizes recorded the highest plant heights, number of leaves, number of branches and stem diameters followed by the medium sized cowpea seeds. The small sized cowpea seeds had the least plant growth in this study. The results of effect of seed size on cowpea growth parameters at 4-WAS are still presented in Table 2. The results showed that all the growth parameters studied were more influenced by larger seed sizes than both the medium and small sized seeds. Nagaraju (2001) also reported higher increases in plant heights, number of leaves and stem diameters by 97.83%, 7.58 and 6.98 mm respectively, with larger seed sizes. As it was the case for studies at 2-WAS, the observations made during 4-WAS on the same growth characteristics revealed a repeated pattern of treatment effects.

Table 2: Effect of seed size on Cowpea growth parameters at 2, 4 and 6-WAS

Seed Size	Plant height (cm)	Number of leaves	Number of branches	Stem diameter (mm)
<u>2 – WAS</u>				
Large	16.04 ^a	61.61 ^a	23.33 ^a	1.23 ^a
Medium	15.28 ^b	46.33 ^b	11.67 ^b	1.16 ^b
Small	12.26 ^c	37.67 ^c	11.33 ^c	0.99 ^c
Mean	14.54	48.54	16.22	1.13
SE (±)	0.008	0.008	0.008	0.008
<u>4 – WAS</u>				
Large	18.35 ^a	79.20 ^a	25.67 ^a	1.46 ^a
Medium	17.42 ^a	70.25 ^b	21.33 ^b	1.34 ^b
Small	13.00 ^b	67.20 ^b	18.33 ^c	1.25 ^c
Mean	16.25	72.18	21.78	1.35
SE (±)	0.472	0.067	0.008	0.009
<u>6 – WAS</u>				
Large	21.33 ^a	114.33 ^a	38.67 ^a	1.62 ^a
Medium	21.09 ^b	107.33 ^b	37.20 ^b	1.54 ^b
Small	16.73 ^c	83.33 ^c	31.15 ^c	1.44 ^c
Mean	19.70	101.55	35.67	1.72
SE (±)	0.048	0.048	0.048	0.025

Key: Means in the same column having the same letter(s) are not significantly different at 5% level

It was only plant height that didn't differ significantly ($P < 0.05$) between plots sown with large and medium seeds in this study. The results of the effects of seed size on cowpea growth parameters at 6-WAS showed that all the plant growth parameters still increased proportionally to the seed sizes. The large seeds recorded significantly ($P < 0.05$) higher growth influences on the cowpea plants, followed by

the medium sized seeds, than the small sized seeds. Kaydan and Yagmur (2008) also reported higher seed germination, emergence and related agronomical aspects in many crop species. According to Cookson *et al.* (2001), larger seed sizes positively correlated with vigorous seedling growth in wheat.

Effect of Seed Size on Cowpea Shoot and Root Biomass Yields at 4-WAS

The results of the effect of seed size on cowpea shoot and root biomass yields are presented in Table 4. The results generally depicted a similar pattern of seed size effects on both the shoot and root biomass in this study. The larger sized seeds recorded significantly ($P < 0.05$) higher shoot biomass, than the medium sized seeds and the smaller sized seeds with the least shoot biomass. The root biomass yield followed suit with that of shoot biomass, which also had a directly proportional yields to the cowpea seed sizes. Stougaard and Xue (2005) opined that 18% of increased yields could be attributed to larger seed sizes in wheat. In addition, Morrison and Xue (2007) reported that smaller seeds produced lower dry matter yields than medium, large and unscreened seeds. Similarly, Mehmet *et al.* (2011) and Nik *et al.* (2011) also reported that plants grown from larger seeds were more vigorous and produced greater dry matter yield than those of both medium and small sized seeds of wheat.

Table 3: Effects of seed size on cowpea shoot and root biomass yield at 6-WAS

Seed Size	Shoot Biomass (g)	Root Biomass (g)
Large	20.08 ^a	2.87 ^a
Medium	19.67 ^b	2.07 ^b
Small	11.20 ^c	2.18 ^c
Mean	16.98	2.37
SE (±)	0.048	0.018

Key: Means in the same column having the same letter(s) are not significantly different at 5% level.

Conclusion and Recommendation

From the results of this work, it suffices to conclude that cowpea seed sizes strongly correlates with plant growth parameters, proportionally. It also implies that the larger the cowpea seed size, then the more the cowpea seed germination, seedling vigor growth and yield components.

It is therefore recommended that cowpea farmers in the study area should use larger sized cowpea seeds during propagations for profitable production of cowpea yields.

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