

RESEARCH ARTICLE

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Seed Size Influence On Germination And Seedling Development Of Cowpea (*Vigna unguiculata* (L) walp)

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Abstract

The effect of seed size on the germination and seedling development was carried out on four local varieties of cowpea (*Vigna unguiculata* (L) walp), *oloyin, drum, ifebrown* and *local white*. Each of the varieties were sorted into big and small seeds, 100 seeds each of both big and small seeds of the four Varieties were weighed and the average weights were calculated and recorded. Six seeds of each sort were planted in a plastic pot filled with sandy-loamy soil in three replicates. Results of the various parameters studied revealed that germination efficiency was similar in both big and small seeds of *drum, oloyin* and *ifebrown* but not in small seeds of *local white*, weights of 100 seeds from big seeds were much heavier than those of small seeds. Number of leaves, leaf length, leaf breadth, leaf area, stem height and dry weight, were consistently higher in cowpea plants from big seeds than the small seeds of all the varieties. Number of seeds per pod was higher in cowpea from big seeds in all the varieties except in *drum* where number of seeds was higher in plants from small seeds. In general, seedlings emerging from big seeds of all the cowpea varieties performed better in all the parameters studied than those emerging from smaller seeds.

Keywords: cowpea, germination, seedling, size, *vigna unguiculata*,

1. Introduction

Cowpea is an erect to sub-erect, or prostrate, climbing, glabrous, annual herb. The stems are somewhat square and ripped, often with violent nodes [11]. It belongs to the family Fabaceae, it is one of the most ancient crop known to man. Cowpea is botanically known as *Vigna unguiculata* (L) walp which in older references may be identified as *Vigna sinensis* (L). [5]. It is widely grown in Africa (with Nigeria and Niger Republic predominating), Brazil, West Indies, India, United States, Burma, Srilanka, Yugoslavia and Australia. The history of cowpea dates to ancient West African cereal farming, five to six thousand years ago, where it was closely associated with the cultivation of sorghum and pearl millet [11]. Cowpea is a heat-loving, drought tolerant crop with high protein content and lower soil fertility requirements than many other crops [2].

The seed coat can be smooth or wrinkled and of various colours including white, cream, green, buff, red, brown and black. Seed may also be speckled, mottled or blotchy. Many are also referred to as "eyed" (black-eye, pink-eye, purple hull, etc) where the white coloured hilum is surrounded by another colour [4].

Cowpea can be used at all stages of growth as a vegetable crop. The tender green leaves are an important food source in Africa and are prepared as

herb, like spinach. Immature snapped pods are used in the same way as snap beans, often being mixed with other foods. Green cowpea seeds are boiled as a fresh vegetable, or may be canned or frozen. Dry mature seeds are also suitable for boiling and canning [4]. Cowpea has been identified as an ideal summer cover crop for many areas which can both produce abundant biomass and fix substantial quantities of atmospheric nitrogen [3].

It was observed by [10] that less time was required for germination initiation of medium seeds and small seeds than big seeds of cowpea. However, germination percentage has a distinct advantage of larger over smaller seeds. Larger seeds showed early vigorous seedling growth as compared to smaller seeds [10]). Small seeds were reported to germinate earlier as well as higher germination index than large seeds in Turkish cultivars of chickpea (*Cicer arietinum* L.) under interactive study of seed size and NaCl [7].

In many cases one observes small or tiny seeds of cowpea which were sorted and thrown away germinated and produced fruits. It is therefore, the objective of this study to investigate the effect of seed size and seed weight on the germination and seedling development of some local cowpea varieties in Ilorin, Nigeria.

2. Materials and Methods

Seeds of four varieties of cowpea (*Vigna unguiculata*) were purchased in Ilorin, Kwara State, Nigeria and were sorted into big and small sizes. The dry weights of 100 seeds of both big and small seeds of each variety were taken using mettler balance and the average recorded.

The varieties used include; 'Drum', 'local white', 'oloyin' and 'Ifebrown'. Twenty-four plastic pots used for planting were previously perforated to prevent water logging. The pots were filled with sandy-loam soil and arranged in four rows according to the number of varieties of cowpea and were labelled accordingly. Six seeds were sown in each pot for the big and small size seeds, and replicated thrice on 3rd, February 2012. Watering was done daily. Speed of germination was calculated using the formula: $\frac{A_1+A_2...}{A_1T_1+A_2+T_2...} \times 100/1$

Where A= number of seeds germinating, T= time (day) corresponding to germination

Germination efficiency was observed in order to determine the rate of germination for both the big and small seeds of each variety of cowpea. Germination percentage was based on the total number of germinated seeds/total number planted seeds x100. The efficiency of seeds was expressed as the activation value (the reciprocal of a half time value) multiplied by the germination percentage i.e. $1/T_{50} \times$ germination %.

Average stem heights of three (3) seedlings of each treatment of the four varieties were recorded. The distance between ground level and the top of the main stem was taken as the stem height, using a metre rule on weekly basis. Leaf area was determined by multiplying the average leaf length, average leaf breadth and 0.75 (i.e. $L \times B \times 0.75$). This was done bi-weekly. Number of leaves was determined by direct counting of the leaves on weekly basis

Fresh and dry weights of seedlings from each of the varieties were also determined.

The seedlings were dried in Gallenkemp oven, then the dry weight of the seedlings was taken for each variety and treatment (big and small seeds) on an electronic mettler balance, and the average was recorded. The day to flowering of the cowpea plants of both the big and small seeds of each variety was recorded.

The seeds produced by cowpea plants from big and small seeds of each variety were dried after harvesting, and the average weight of 40 seeds was taken and recorded.

The data collected were subjected to analysis of variance (ANOVA) using SPSS 15 statistical package with their means separated by Duncan's multiple range test (DMRT).

3. Results

Seed size did not negatively affect germination speed in cowpea as both big and small seeds germinated readily with small seeds of both oloyin and Ifebrown faster than the big seeds 66.67, 66.67, 57.89 and 57.89% respectively (Figure 2). Germination efficiency was also better in both big and small seeds in all the varieties (Figure 3).

3.1. Number of Leaves:

Number of leaves increased with age irrespective of the varieties and planting seed size. However, seedlings from big seeds produced more leaves than seedlings from small seeds (Table 2) The seedlings of small seeds of Ifebrown variety had the lowest number of leaves at 2WAP to 6WAP, but later had more leaves such that there was no significant difference in its number of leaves, when compared with seedlings of big and small seeds of drum and white varieties at 8WAP.

3.2. Stem height:

Stem height also increased with age irrespective of the varieties, at 2WAP. But significant difference occurred by 3WAP, with seedlings of big seeds of the white variety having the tallest height from 3WAP to 8WAP (Table 3). Seedlings of small seeds of oloyin variety had the shortest height (Table 3.)

3.3. Leaf length:

leaf length increased with age irrespective of the variety of cowpea. Significant difference in the leaf length occurred only at 2WAP. The seedlings had no significant difference in leaf length as from 4WAP to 8WAP. Probably, they have limits to rate of increase in leaf length. At 2WAP, there was significant difference in leaf length with seedlings of big seeds of drum variety had the longest leaf, while seedlings of small seeds of Ifebrown had the shortest leaf (Table 4.)

3.4. Leaf breadth:

leaf breadth also increased with age irrespective of the varieties. Significant difference occurred in the leaf breadth at 2WAP and 8WAP, while there were no significant differences at 4WAP and 6WAP (Table 5).

Seedlings of big seeds from white cowpea variety had the widest leaf breath. Interestingly seedlings from big seeds of Ifebrown variety had leaf breadth that were not significantly different from those of the big seeds of the drum variety (Table 5).

3.5. Leaf area:

leaf area increased with age irrespective of the varieties. No significant differences occurred at 4WAP and 6WAP, but there were significant differences at 2WAP and 8WAP (Table 6). Table 6 also shows that, at 2WAP, the seedlings of big seeds from Drum had the highest value for leaf area while at 8WAP cowpea plants from big seeds of white variety had the highest value for leaf area. The seedlings with the lowest value for leaf area at 8WAP were those of oloyin variety. Though, no significant difference occurred in the leaf area of seedlings of its big and small seeds.

3.6. Dry weight:

Dry weight also increased with age irrespective of the varieties. Table 8 reveals that the dry weights of the seedlings of small seeds of Ifebrown had the least dry weights at 2, 4, and 6WAP while the seedlings of the big seeds of the local white varieties had the highest dry weights at 6WAP. However, at 2 and 4 WAP, the seedlings of the big seeds of the white variety had the highest dry weights.

3.7. Flowering:

As shown on Table 9, the day to flowering of cowpea plants were shorter in cowpea plants from big

seeds of drum (38days) variety and the longest those from the small seeds of Ifebrown variety (52days). The table also reveals that, the flowering day of the cowpea plants of the big and small seeds of each variety differed.

4. Discussion

Results obtained from this study clearly showed that both seed size and seed weight played important role in seed germination, seedling vigour, vegetative growth and reproductive behaviour of cowpea. These observations agreed with the earlier reports of [8, 9] who observed significant effects of big and heavy seeds on the seedling dry weights and leaf area of *Daniellia oliveri* and production of more number of seedlings per seed, longer stem heights, higher seedling dry weights and more number of leaves from heavy seeds of *Mangifera indica*. Better performance of seedlings from big cowpea seeds may be as a result of greater vigour of seedlings after germination due to large amount of food reserves in those seeds that were readily made available to them. Similar observation was reported by [6] who reported better survival and greater dry matter yield in seedlings from heavy seeds than those from small seeds in *Quercus semiserrata* Roxb. Reduction in the germination percentage in small seeds of oloyin and drum cowpea in this study was in concord with the observation of [1] and [12] who variously reported that the germination percentage significantly declined with reduction in size and weight of the seeds of *Alangium lamarckii* and *Prunus jenkinsii* respectively.

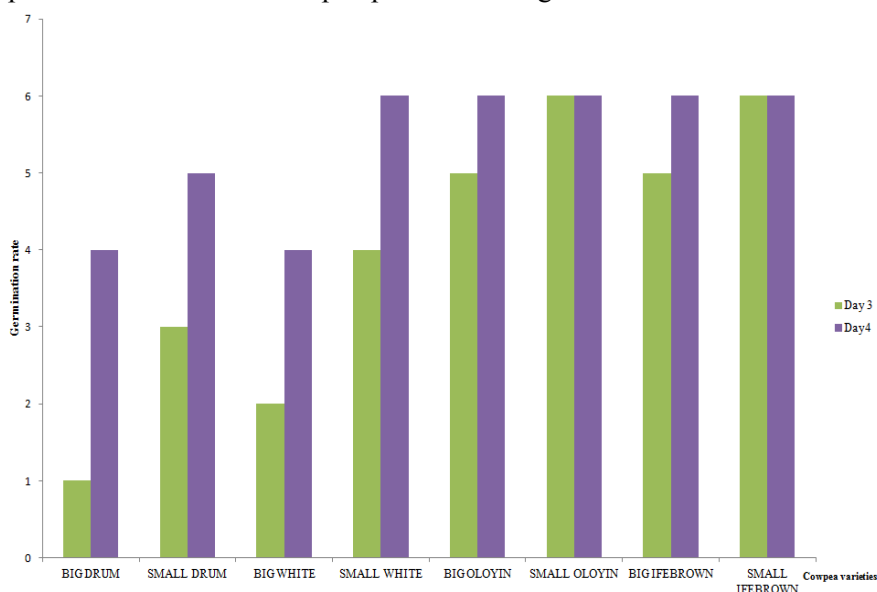


Figure1: Effect of seed size on germination rate of cowpea varieties

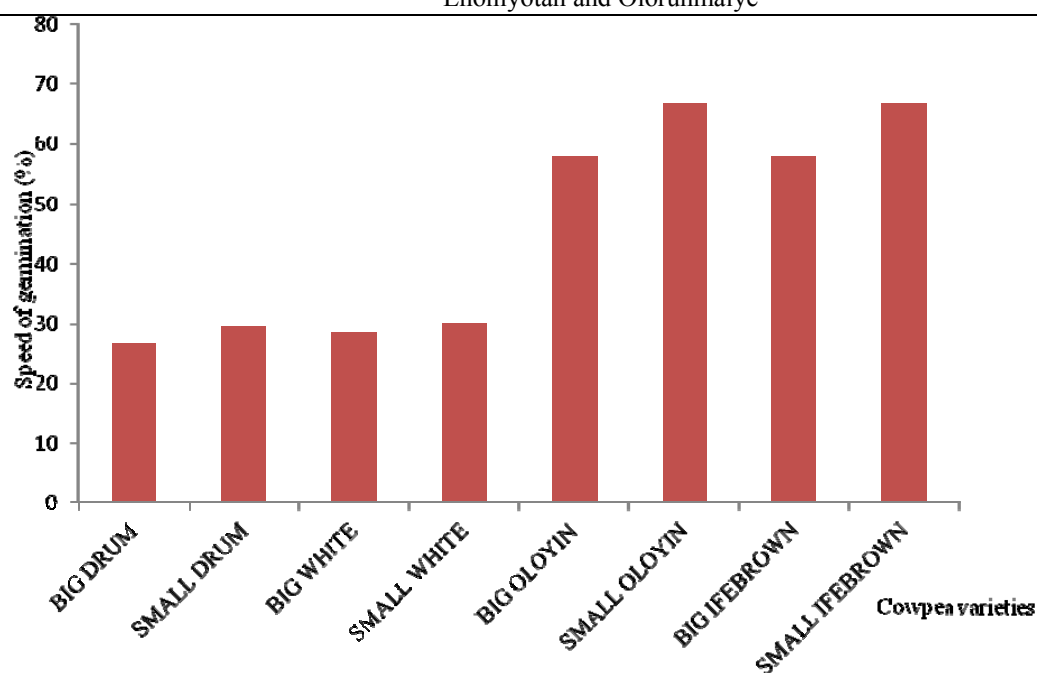


Figure 2: Effect of seed size on speed of germination of cowpea varieties

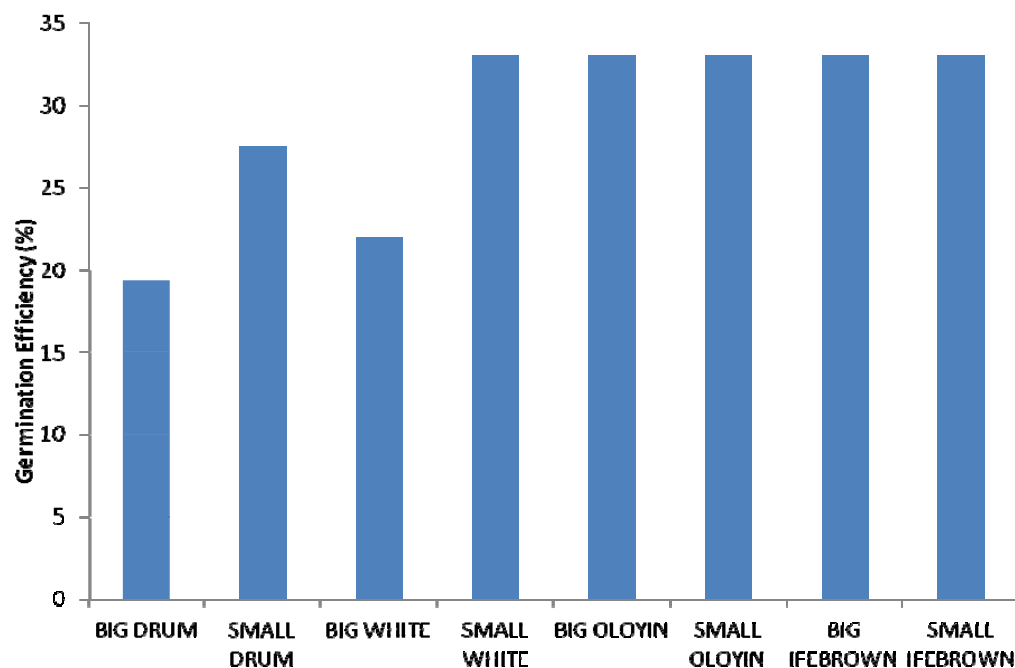


Figure 3: Effect of seed size on germination efficiency of cowpea varieties

Table 1: Weight of 100 seeds of cowpea varieties planted (g)

Cowpea Seeds	Size	Weight of 100Seeds (g)	Weight of a seed (g)
Drum	Big	28.09	1.40
	Small	15.02	0.75
White	Big	26.30	1.32
	Small	14.72	0.74
Oloyin	Big	20.28	1.02
	Small	13.05	0.65
Ifebrown	Big	13.66	0.68
	Small	7.50	0.38

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Table 2: Effect of seed size on number of leaf of cowpea varieties

Seed variety	Size	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
Ifebrown	Big	5.00 ^b	11.00 ^{abc}	16.00 ^{cd}	20.00 ^{cd}	23.33 ^{cd}	31.67 ^a	50.67 ^{ab}
	Small	5.00 ^b	9.00 ^c	14.00 ^d	17.00 ^d	19.00 ^d	27.00 ^a	40.33 ^b
Oloyin	Big	6.00 ^{ab}	11.00 ^{abc}	19.00 ^{bc}	25.00 ^b	27.00 ^{ab}	32.00 ^a	33.33 ^b
	Small	5.00 ^b	11.00 ^{abc}	19.00 ^{bc}	24.00 ^c	26.00 ^{bc}	29.67 ^a	29.67 ^c
Drum	Big	8.00 ^a	13.00 ^a	23.00 ^a	26.00 ^b	26.00 ^{bc}	36.67 ^a	40.33 ^b
	Small	6.00 ^{ab}	10.00 ^{bc}	19.00 ^{bc}	23.33 ^c	25.00 ^{bc}	36.00 ^a	41.67 ^a
White	Big	7.33 ^{ab}	11.67 ^{ab}	21.33 ^{ab}	27.33 ^a	30.67 ^a	40.33 ^a	69.33 ^a
	Small	7.00 ^{ab}	12.00 ^{ab}	18.67 ^{bc}	23.00 ^c	27.00 ^{ab}	39.00 ^a	47.37 ^b

Values having the same letter(s) along the same column are not significantly different at (p < 0.05).
WAP= week(s) after planting

Table 3: Effect fo seed size on stem height of cowpea varteties

Seed Variety	Size	2WAP	3WAP	4WAP	5WAP	6WAP	7WAP	8WAP
Ifebrown	Big	9.57 ^a	12.40 ^{ab}	16.00 ^{abc}	18.87 ^{bc}	21.40 ^{bc}	22.90 ^a	23.50 ^{ab}
	Small	9.43 ^a	11.60 ^b	13.40 ^{cd}	15.60 ^{de}	17.87 ^{cd}	19.00 ^b	19.83 ^{bcd}
Oloyin	Big	8.73 ^a	10.57 ^b	14.87 ^{abc}	16.37 ^{cd}	17.63 ^{de}	17.93 ^b	17.97 ^{de}
	Small	7.80 ^a	9.53 ^c	11.17 ^d	12.53 ^e	14.13 ^e	14.57 ^c	15.67 ^e
Drum	Big	9.70 ^a	12.10 ^b	17.07 ^{ab}	20.90 ^b	22.90 ^b	22.90 ^a	22.90 ^{abc}
	Small	9.67 ^a	11.90 ^b	14.07 ^{bc}	15.40 ^{de}	18.17 ^{cd}	18.97 ^b	19.30 ^{cde}
White	Big	8.27 ^a	15.20 ^a	19.57 ^a	22.97 ^a	25.20 ^a	25.60 ^a	26.33 ^a
	Small	8.07 ^a	11.07 ^b	14.80 ^{abc}	17.40 ^{cd}	20.70 ^{bcd}	22.63 ^a	23.63 ^{ab}

Values having the same letter(s) along the same column are not significantly different at (p < 0.05).
WAP= week(s) after planting

Table 4: Effect of seed size on leaf length of cowpea varieties

Seed Variety	Size	2WAP	4WAP	6WAP	8WAP
Ifebrown	Big	5.77 ^{ab}	8.43 ^a	8.50 ^a	11.63 ^a
	Small	4.70 ^b	6.03 ^a	8.00 ^a	10.83 ^a
Oloyin	Big	6.60 ^{ab}	9.43 ^a	10.17 ^a	10.17 ^a
	Small	5.70 ^{ab}	8.93 ^a	9.00 ^a	9.90 ^a
White	Big	6.40 ^{ab}	9.73 ^a	11.47 ^a	12.27 ^a
	Small	5.80 ^{ab}	9.27 ^a	9.53 ^a	10.90 ^a
Drum	Big	7.30 ^a	9.27 ^a	11.37 ^a	12.47 ^a
	Small	6.87 ^{ab}	10.43 ^a	10.93 ^a	12.13 ^a

Values having the same letter(s) along the same column are not significantly different at (p < 0.05). WAP= week(s) after planting

Table 5: Effect of seed size on leaf breadth of cowpea varieties

Seed variety	Size	2WAP	4WAP	6WAP	8WAP
Ifebrown	Big	3.17 ^{ab}	4.90 ^a	5.27 ^a	7.63 ^{ab}
	Small	2.30 ^b	3.10 ^a	4.57 ^a	6.33 ^{bc}
Oloin	Big	3.27 ^{ab}	4.67 ^a	5.57 ^a	5.57 ^c
	Small	3.10 ^{ab}	4.40 ^a	4.83 ^a	5.90 ^{bc}
White	Big	4.17 ^a	5.57 ^a	7.83 ^a	8.47 ^a
	Small	2.40 ^{ab}	4.37 ^a	5.63 ^a	6.00 ^{bc}
Drum	Big	4.07 ^{ab}	5.57 ^a	6.57 ^a	7.73 ^{ab}
	Small	3.13 ^{ab}	5.23 ^a	6.67 ^a	7.23 ^{abc}

Values having the same letter(s) along the same column are not significantly different at (p < 0.05).
WAP= week(s) after planting

Table 6: Effect of seed size on leaf area (cm²) of cowpea varieties

Seed variety	Size	2WAP	4WAP	6WAP	8WAP
Ifebrown	Big	14.24 ^{ab}	31.67 ^a	37.81 ^a	68.26 ^{ab}
	Small	8.26 ^b	14.95 ^a	29.63 ^a	52.56 ^{ab}
Oloyin	Big	16.49 ^{ab}	33.82 ^a	43.06 ^a	43.06 ^b
	Small	13.65 ^{ab}	31.79 ^a	32.85 ^a	44.09 ^b
White	Big	20.70 ^{ab}	42.39 ^a	71.39 ^a	78.65 ^a
	Small	10.58 ^{ab}	32.15 ^a	43.86 ^a	49.59 ^{ab}
Drum	Big	23.30 ^a	43.45 ^a	60.14 ^a	72.97 ^{ab}
	Small	16.87 ^{ab}	42.51 ^a	55.77 ^a	66.11 ^{ab}

Values having the same letter(s) along the same column are not significantly different at ($p < 0.05$). WAP= week(s) after planting

Table 7: Effect of seed size on cowpea dry weight (g)

Seed variety	Size	2WAP	4WAP	6WAP
Ife brown	Big	0.27 ^g	0.73 ^g	3.23 ^f
	Small	0.18 ^h	0.42 ^h	1.40 ^h
Oloyin	Big	0.38 ^f	1.20 ^c	3.33 ^c
	Small	0.29 ^e	0.97 ^e	2.33 ^g
Local white	Big	0.60 ^b	1.55 ^b	6.67 ^a
	Small	0.40 ^d	0.98 ^d	3.67 ^d
Drum	Big	0.76 ^a	1.63 ^a	5.67 ^b
	Small	0.47 ^c	0.88 ^f	4.33 ^c

Values having the same letter(s) along the same column are not significantly different at ($p < 0.05$). WAP= week(s) after planting

Table 8: Effect of seed size on the dry weight of cowpea seedlings (g)

Seed Variety	Size	2WAP	4WAP	6WAP
Ifebrown	Big	0.27 ^g	0.73 ^g	3.23 ^f
	Small	0.18 ^b	0.42 ^b	1.40 ^h
Oloyin	Big	0.38 ^f	1.20 ^c	3.33 ^c
	Small	0.29 ^e	0.97 ^e	2.33 ^g
White	Big	0.60 ^b	1.55 ^b	6.67 ^a
	Small	0.40 ^d	0.98 ^d	3.67 ^d
Drum	Big	0.76 ^a	1.63 ^a	5.67 ^b
	Small	0.47 ^c	0.88 ^f	4.33 ^c

Values having the same letter(s) along the same column are not significantly different at ($p < 0.05$). WAP= week(s) after planting

Table 9: Effect of seed size on the reproductive performance of cowpea varieties

Seed variety	Size	Day to flowering	Number of seed per pod
Ifebrown	Big	49	11.8
	Small	57	10
Oloyin	Big	41	10
	Small	43	9.8
White	Big	49	11
	Small	52	10.7
Drum	Big	38	8.7
	Small	44	12

5. Conclusion

Results and observations from this study revealed that big seeds of cowpea had advantage of higher

germination percentage and seedling vigour over small seeds. In some cases however, small seeds showed faster germination speed due to faster and

higher water absorption in the early stage of germination.

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