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Impact of Seed Size on Germination, Seedling Vigor, and Quality Traits in Fodder Cowpea (*Vigna unguiculata* (L.) Walp) Varieties

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A study was conducted to investigate how seed size affects germination and vigor of cowpea seeds. The differences due to vigour parameters of graded seeds were significant due to varieties cv. Bundel Lobia-1 showed better vigour than cv. UPC-607. Variety Bundel Lobia-1 recorded significantly higher seed weight (102.6 g) than variety UPC-607 (92.1 g). There was a significant difference between seed grades, large seeds having significantly more than 1000 seed weight (118.3 g) followed by ungraded seeds (107.2 g), medium seeds (97.1 g) and small seeds (66.8 g), respectively. Interaction Cv- Bundel Lobia-1 (93.0%) recorded a significantly superior germination percentage over cv. UPC-607 (86.48 %). However, the differences were non- significant due to seed sizes, large seeds (91.03%) recorded more germination percentage followed by medium seeds (90.34%), ungraded seeds (89.44%) and small seeds (88.16%) respectively.

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Keywords: Seed size; germination; vigor; seed grades.

1. INTRODUCTION

Cowpea (*Vigna anguiculata* (L.) Walp) is a well - known multipurpose leguminous crop. It is classified under other pulse crop. It is a quick growing bulky leguminous crop and has a high protein content. There is a difference of opinion regarding valid name of species. It is synonymously named as *Vigna sinensis* (L). Savi and Vigna catjana (Burn) Walp. Rerecord and Royal botanical gardens prefers *Vigna anguiculata* (L.) Walp with several cowpea throughout world as cultivars. Its common name is 'cowpea'. Occasionally 'Southern pea' and new English name is 'Covalence'. In vernaculars it is called as 'Chavali'. Cowpea for fodder is often grown during Kharif and summer seasons, either as a sole crop or mixed crop in maize or sorghum. Most fields after harvest of the rabi crop, remain fallow during summer season and are sown only when typhoon sets in. This period from February to May is characterized by bright sunshine, high temperature, low relative humidity and thus keeps down the infestation of insects and diseases at the lowest and thus is very much favourable for cowpea crop.

The forage crops are generally shy seed producers and forage cowpea varieties are not exception for this. However, their seed requirement is high. It is therefore, necessary to find out different ways and means to maximize the seed production of this crop.The quality seed is the cheapest input in modern agriculture. Availability of viable and vigorous seed at planting time is very important for achieving target of forage production as it acts as a catalyst for realizing the potential of other inputs. Seed size is observed to contribute increased seed production. In cowpea, seeds are 4 to 8 mm long, 3-4 mm broad and variable in size and colour. The seed indicates the amount of reserve food supply for seedling. Small and shrivelled seeds do not contain as much food to give the plant a vigorous start as the bold and plump seed [1].

2. MATERIALS AND METHODS

The laboratory experiment was conducted in a factorial completely randomized design with three replications in laboratory of Seed Science and Technology Research Unit, Institute of Agricultural Sciences, Bundelkhand University, Jhansi. The data obtained were subjected to statistical analysis of respective designs.

2.1 Thousands Seed Weight (g)

The weight of three replications of 1000 seeds of each grade from both the varieties was recorded on top pan balance with 0.1 g accuracy.

2.2 Germination Percentage, Root Shoot Length and Vigour Index

Four replications of 100 seeds of different grades were germinated at 30^0C temperature for eight days using between paper method [2]. The seedlings were sorted into normal and abnormal seedlings and germination percentage was expressed on the basis of normal seedling only.

Ten normal seedlings from each of treatments in each replication were randomly selected and the shoot and root lengths were measured in centimeters. The average of ten seedlings was calculated and recorded. Vigour index was calculated by using following formula [3].

Vigour Index = (Root length + Shoot length) X germination percentage

Treatments

List 1. The treatment details are as follows

Varieties	**a) Bundel Lobia -1**	**: V_1**
	b) UPC 607	**: V_2**
Seed sizes		
V_1	a) Ungraded	: A
	b) Large	: B
	c)Medium	: C
	d)Small	: D
V_2	a) Ungraded	: A
	b) Large	: B
	c)Medium	: C
	d)Small	: D

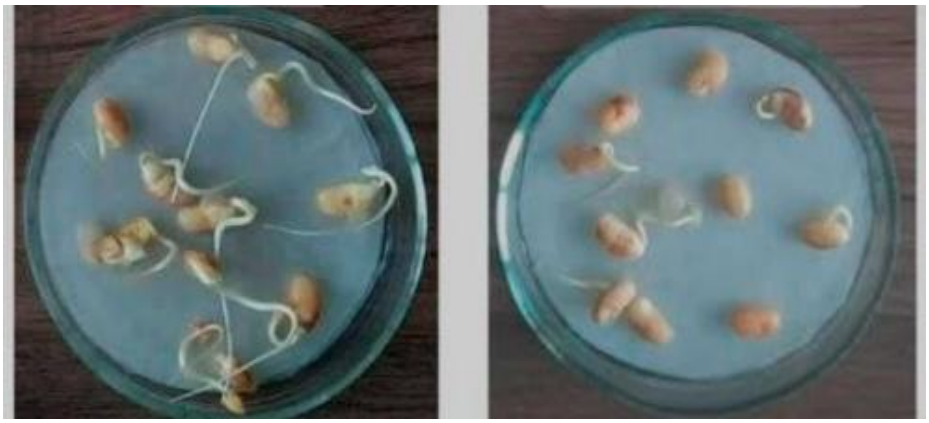

Fig. 1. Germination stage of cowpea plants

Fig. 2. Root and shoot length of cowpea plants

2.3 Fresh and Dry Weight of Seedling (g)

The fresh as well as oven dry weight of ten randomly selected eight days old normal seedlings were recorded. The average of ten seedlings was calculated for both, fresh and dry weight.

2.4 Moisture Content of Seeds

Moisture percentage was determined by griding seeds in a grinding mill and drying the 5 g ground sample at a constant temperature of 130^0C for one hour [2]. The percent moisture content was calculated on net weight basis.

3. RESULTS AND DISCUSSION

3.1 Effect of Seed Size on Thousand Seed Weight

The variation in 1000- seed weight due to seed sizes was significant. Large seeds had significantly more thousands seed weight (118.3 g) over other grades (107.2 g to 66.8 g). These results were in agreement with those reported by salih [4] in Fababean, Vadivelu and Ramkrishnan [5] in bengal gram and Jha et al*.* [6] in wheat.

3.2 Effect of Seed Size on Germination Percentage

Varieties had significant effect on this trait and cv. Bundel Lobia-1 (93.0%) had more germination percentage than cv. UPC-607 (86.48%).

On contradictory to the report of Abdullahi and Vanderlip [7] in sorghum, Randhawa et al. [8] in Kalyansona wheat, Bhor et al*.* [9] in gram. Randhawa et al*.* [8] in maize reported that seed size did not improve field emergence and germination percentage.

3.3 Effect of Seed Size on Vigour Index

In present investigation vigour index significantly differ due to varieties. But no influence of

seed size observed on seedling vigour index. These findings are in conformity with those reported by Marcos et al. [10]. However, China and Phul [11] in pearl millert and Kalakannawar et al. [12] in wheat reported that large sized seeds produce more vigorous seedlings. On contrary, Mugnisjah and Nakamura [13] in soybean reported that plants from small seed produce more vigorous growth.

In present investigation, medium sized seeds produced more vigour index (3044.33) than all other grades.

Table 1. Effect of seed size on thousand seed weight (g) and germination percentage

Treatments	Thousand seed weight (g)	Germination percentage
Variety		
V_1	102.6	93.0
V_2	92.1	86.48
SE±	1.165	0.573
C.D. at 5%	3.494	1.718
Seed size		
A (Ungraded)	107.2	89.44
B (Large)	118.3	91.03
C (Medium)	97.1	90.34
D (Small)	66.8	88.16
SE±	1.648	0.810
C.D. at 5%		
Interaction		
(Variety X Seed size)		
SE±	2.331	0.115
C.D. at 5%	6.988	N.S.

Interaction effect due to varieties and seed sizes for thousand seed weight (g)

	A	B	C	D	Mean	SE±	C.D. at 5%
V_1	111.8	119.0	106.0	73.6	102.6		6.988
V_2	102.6	117.6	88.2	60.0	92.1	2.331	
Mean	107.2	118.3	97.1	66.8			
SE±				2.331			
C.D. at 5%				6.988			

Table 2. Effect of seed size on root shoot length and vigour index

Treatments	Root length (cm)	Shoot length (cm)	Vigour index
Variety			
V_1	13.10	19.95	3156.75
V_2	12.01	19.77	2690.17
S.E. at 5%	0.560	0.454	90.275
C.D. at 5%	1.676	N.S.	270.66
Seed size			
A (Ungraded)	12.08	19.33	2696.5
B (Large)	14.12	19.20	3030.17
C (Medium)	12.29	21.35	3044.33
D (Small)	13.52	19.58	2922.83
S.E±	0.791	0.642	127.67
C.D. at 5%	N.S.	N.S.	N.S.
Interaction			
(Variety X Seed size)			
S.E.±	1.119	0.908	180.55
C.D. at 5%	N.S.	N.S.	N.S.

Table 3. Effect of seed size on moisture content of seed

Treatments	Moisture content (%)
Variety	
V_1	13.37
V_2	12.23
S.E.±	0.433
C.D. at 5%	N.S.
Seed size	
A (Ungraded)	12.90
B (Large)	13.07
C (Medium)	12.95
D (Small)	12.29
S.E.±	0.613
C.D. at 5%	N.S.
Interaction (Variety X Seed size)	
S.E. ±	0.866
C.D. at 5%	N.S.

3.4 Effect of Seed Size on Fresh and Dry Weight of Seedlings

The fresh and dry weight of seedlings due to varieties was non- significant. Fresh weight of seedlings due to seed sizes showed significant differences as dry weight of seedling showed non- significant differences (Table 3).

Singh et al. [14] in soybean, Bishnoi [15] in triticale, Evans and Bhatt [16] in wheat, Vadivelu and Ramakrishanan [5] in gram reported that larger seeds produced seedlings with higher fresh and dry weight.

3.5 Effect of Seed Size on Moisture Content of Seed

Non- significant differences were obtained due to varieties, seed sizes and their interactions for moisture content of seed. The moisture content of cv. Bundel Lobia-1 was more than that of cv. UPC-607. Large seeds showed highest moisture content (13.07%) followed by medium seeds (12.95%), ungraded seeds (12.90%) and small seeds (12.29%) respectively.

The difference due to variety x seed size interaction were non- significant for all traits except thousands seed weight.

4. CONCLUSION

The result indicated that large seeds do not have advantages over small seeds in terms of germination. Therefore, sorting it out will be of no economic return but time consuming. Large seeds size showed better vigour in seedling dry weight.

However, the difference due to variety x seed size interaction were non- significant for all traits except thousands seed weight. Seed size is not therefore important in germination of cowpea seed, sorting it out will be of no economic return but time consuming.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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