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Germination Studies in Some Varieties of *Vigna unguiculata* L. Walp. (Cowpea) from Northern Nigeria

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Abstract: Unpredictable climate change is already having a profound effect on our agricultural crops thus, the need to have periodic data base on their physiology. The consequences of the change is becoming more wide spread affecting all component of our ecosystem including the vegetable species. The present studies was carried out to study cowpea seed germination and seedling establishment of seven varieties (Sampea-5, Sampea-6, Sampea-7, Sampea-8, Sampea-9, Sampea-10 and Sampea-12) in the laboratory and botanical garden of the Department of Biological Sciences, Ahmadu Bello University Zaria-Nigeria. Cowpea is used to substitute the insufficient expensive animal protein in the diet of many people in Nigeria either directly or in other preparation. Water absorption rate of cowpea seeds during imbibitions were determined after 30 min of soaking in water. Significant difference were found among Sampea-5, Sampea-7, Sampea-8, Sampea-10 and Sampea-12 while there was no significant difference between Sampea-6 and Sampea-7 in terms of water absorption rate. Mean comparison showed that the highest germination percentage (100%), seedling weight change (1.52 g), shoot length (25.81 cm), root length (23.12 cm) was observed. Based on this result, the analysis of variance (ANOVA) showed significant difference in the rate of imbibitions as well as shoots and root length exist in the seven cowpea varieties.

Key words: Cow pea, seed, germination, imbibition, climate change, Nigeria

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp.) is an annual herbaceous important leguminous plant cultivated as a food source to human and livestock as well a cash crop to both subsistence and large scale farmers of most African countries. Presently, Nigeria is the largest producer of cowpea in the world. In Nigeria in particular and most sub-Saharan Africa, cowpea complements the protein source of common carbohydrate staples like sorghum, corn and millet thereby improving dietary provisions of households. Recently, Mohammed *et al.* (2008) are of the view that cowpea plays a key role in food security, income generation and maintenance of the environment for smallholder farmers in the Sudan and Sahelian zones. Semiarid tropics are prone to drought and nowadays to excessive flooding accounting as some of the major constraints in production. Singh and Matsui (2002) confirm that due to the erratic rainfall in the beginning and towards the end of the rainy season, crops are often subjected to drought stress in both seedling and terminal growth stages.

Crop performance is judged right from the time of the physiological process of germination which relies heavily on moisture provisions. This process is so important between world human population and food production. Nowadays and with the climate change experiences, water availability for both cultivated and wild plant species is a major concern since it is a major indicator in this global phenomenon. The threat of climate change on natural resource like water is already eminent in most parts of the world. The fluctuations in water provisions is readily conspicuous in both extremes of less or excessive supply with profound effect on crop yield. Already the effect of higher temperatures on crop yield is harder to predict, but there are some indications with Maize and Rice that higher temperatures reduce yields (Fisher and Cook, 2010). Cowpea production in Nigeria is faced by a lot of constraints which result in low yield. The main constraints associated with cowpea production in Nigeria leading to low yield are unreliable distribution of rainfall in the northern guinea savannah which is major area of production, lack of suitable and highly adaptable varieties, pest and disease attack are also major problems associated with cowpea production.

Adequate water supply is one of the external requirements for seed germination. During imbibition water molecules enter seed and cause the colloidal particles in the seed to swell. The swelling of the colloid particles create a considerable pressure, the imbibitions

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pressure which may be up to hundreds of atmospheres. This pressure is of great important in the process of germination as it leads to the breaking of the testa and also makes room in the soil for the development. Based on the foregoing and the recognition of the important role played by cowpea in providing human plant protein and nutritious animal fodder, the aim of this study is to provide a data base of seed initial activities of germination leading to the crop development in our present time of climate change.

MATERIALS AND METHODS

Study area and seed source: The study was conducted at the laboratory and botanical garden of Biological Science Department, Ahmadu Bello University Zaria (11°09'N 7°39'E). The varieties required for the experimental work were collected from Institute for Agriculture Research (IAR) while other materials were collected from the department of Biological Sciences, Ahmadu Bello University Zaria.

Imbibition study: Ten seeds from each variety were collected, each variety having five replicates. Initial weight of each sample was taken using weighing balance. The seeds were soaked in water for 30 min. The change in weight following imbibition was recorded.

Germination studies: Ten seeds of the varieties namely: Sampea-5, Sampea-6, Sampea-7, Sampea-8, Sampea-9 and Sampea-11 with 3 replicates were sown on moist filter paper in 9 cm labeled petri dishes. The petri dishes were covered and left by the window side of the laboratory. The seeds were inspected and observed at intervals of 4 days and moistened regularly with water and any seed(s) that germinated was recorded. After the germination test, ten seeds were then sown in plastic bags in 3 replicates also and later transplanted on to the field. These were maintained for a period of 3 weeks after which the growth of seedlings (shoot and root lengths) were measured using meter rule and thread (Darra *et al*., 1973).

Data analysis: Average values of the parameters of seed germinated, root and shoot length, change in weight after soaking was determined. The analysis of variances (ANOVA) was used to test for the significant difference in germination rate among varieties.

RESULTS AND DISCUSSION

The parameters of germination and seedling morphology in the seven cowpea varieties shows an increase with increasing number of days after sowing (Table 1). As early as first day after sowing, the result showed significant increase in the germination percentage among the varieties of cowpea. On the second, third and fourth day, percentage germination of the seven varieties did not differ significantly in that it is only the rate not total germination which differs. The observed varietal differences in the rate of germination may be related to differences in seed size and viability.

Table 1: Mean percentage germination, imbibition rate and seedling morphology in Cowpea varieties

Variety	Germination (%)	Imbibition rate	SL (cm)	RL (cm)
Sampea-5	97.50±2.50	1.52±0.01^{f}	22.71±0.20^{a}	20.81±0.19^{a}
Sampea-6	92.00±4.79	0.87±0.01^{e}	22.71±0.20^{a}	20.81±0.19^{a}
Sampea-7	95.00±2.89	0.19±0.02^{a}	22.44±0.32^{a}	21.96±0.42^{ab}
Sampea-8	100.00±0.00	0.25±0.01^{b}	22.46±0.37^{a}	21.22±0.41^{a}
Sampea-9	100.00±0.00	0.84±0.02^{e}	25.81±0.25^{b}	23.12±0.34^{c}
Sampea-10	95.00±2.89	0.30±0.01^{c}	22.48±0.26^{a}	21.25±0.19^{a}
Sampea-12	85.00±2.89	0.45±0.01^{d}	23.93±0.25^{c}	22.50±0.32^{bc}

Means with the same superscript are not significantly different (p>0.05), SL: Shoot length, RL: Root length

The rates of imbibitions in the cowpea varieties shows progressive increase in weight as the time of soaking increases up to 30 minutes. The rate of imbibitions varied significantly in the seven cowpea varieties (p>0.01) which may be as a result of difference in the permeability of testa, seed composition and availability of water in liquid or gaseous form in the environment. Maximum mean weight change was however observed in Sampea-5, Sampea-6 and Sampea-9 (0.152±0.01, 0.87±0.01, 0.84±0.02, respectively). Least weight change was observed in Sampea-7, Sampea-8, Sampea-10 and Sampea-12 (0.19±0.02, 0.25±0.01, 0.30±0.01, 0.45±0.01, respectively).

The Measurement of shoot length shows significant differences (p>0.01) among Sampea-5, Sampea-9 and Sampea-12, with a mean shoot length of 22.71±0.20, 25.81±0.25, 23.93±0.25 cm, respectively. Whereas, there was no significant difference observed among Sampea-6, Sampea-7, Sampea-8 and Sampea-10 with a mean shoot length of 22.81±0.34, 22.44±0.32, 22.46±0.37, 22.48±0.26, respectively. The variation in height is an indication of the differences in the growth habit of the plant. Significant difference in the root length was also found among Sampea-5, Sampea-7, Sampea-9 and Sampea-12 with mean shoot length of 20.81±0.81, 21.96±0.42, 23.12±0.34, 22.50±0.32, respectively. Whereas there is no significant difference observed in Sampea-6, Sampea-8 and Sampea-10 with a mean value of 21.50±0.35, 21.22±0.41, 21.25±0.91, respectively. The mean values of the root and shoot length of the various cowpea varieties are shown in Table 1.

Seeds showed variable response with respect to germination. Rate of germination in terms of radical emergence was faster in Sampea-8, Sampea-10, Sampea-5, Sampea-7 and Sampea-9 compared with Sampea-6 and

Sampea-12 (Table 1). The delayed radical emergence observed in some seed of Sampea-6 and Sampea-12 could be attributed to differences in the composition of seed cotyledon and hardness of seed testa (Mukhtar and Alhassan, 2006). The observed varietal difference in emergence may be related to different in seed size. Also Borji *et al.* (2007) observed that imbibition rate may also be related to seed coat thickness, numbers of seed coat pores, size of micropyle and hilum.

Rate of imbibitions in terms of change in fresh weight was also presented in Table 1. Evident differences were found between the varieties of cowpea seeds in terms of water absorption, rate rapid water absorption occurred in Sampea-5, Sampea-6 and Sampea-9. Borji *et al.* (2007) pointed out that in germination, water uptake consist of distinct stages, one is imbibition during which water absorption by the seed is largely passive and it is at this stage where the osmotic potential of the media is most critical. Low osmotic potential may extend the time needed for the imbibitions thus delaying the onset of germination and influencing its uniformity. This could also be attributed to presence of more permeable testa adhered loosely to the cotyledon. These factors could be attributed to slow imbibitions in Sampea-7, Sampea-9, Sampea-10 and Sampea-12, although water uptake is also restricted by the micropyle (Legese and Powell, 1992).

Generally growth response of the seven cowpea varieties under the same environmental condition show variable growth pattern at different stages of their development (imbibition, germination, shoot and root lengths). Root and shoot lengths vary among the seven varieties, with Sampea-9 having the highest mean values (25.81±0.25 and 23.12±0.34) in comparison to other varieties. The difference observed in shoot length of the sample may be an inherent trait peculiar to each of the varieties.

CONCLUSION

In conclusion, it was observed that regular experimentation becomes pertinent as to the cowpea moisture requirement in the physiological activities of imbibition and germination amidst the prevailing climate change. Documenting such data base would certainly provide complimentary information in designing breeding and adaptation strategies of our cultivated crops for improved food production.

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