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# Effect of seed source on physiological attributes of *Celosia argentia* on germination and early seedling growth

**Olufelo, J. O.**

Department of Crop production, University of Agriculture and Environmental Sciences, Umuagwo, Owerri, Imo- State, Nigeria.

Corresponding Author's e-mail address: jolufelo@yahoo.com

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## ABSTRACT

Seed germination and early growth rates of *Celosia argentia* from five sources in Nigeria were evaluated. Seeds of *Celosia argentia* were collected from Aba, Enugu, Owerri, Onitsha and Abakaliki and examined for variation in germination performance and early seedling growth attributes both in nursery and on the field. A total of 400 seeds (four replicate of 100 seeds) per location were sown and germination was monitored for 30 days. Growth parameter like germination %, seedlings shoot length, mean germination time, seedling vigour and germination index rate were evaluated during germination period. At 30 days after planting, 50 seedlings at uniform height from each location were selected and transplanted on the field with addition of no fertilizer. The growth parameters such as root length and shoot length, leaf area and leaf production were assessed at two months after planting. Analysis of variance revealed that significant difference ($p < 0.05$) existed in germination of seeds from the different sources both in the nursery and on the field. Onitsha sourced seeds, gave the highest germination% (92%), followed by seeds from Abakaliki (90%) while Enugu sourced seeds had the least (53%). Commencement of germination was earliest (5.6 DAS) in Onitsha seeds and Enugu seed had the longest (9.9DAS). Seedlings from Onitsha sourced seeds had the highest mean values for all the seedling growth attributes investigated on the field. It had an average leaf number (12.25), closely followed by seed sourced from Aba (12.10), while Enugu sourced seeds had the least (10.10). The study has shown that the choice of an appropriate seed source is an important process in restoration and domestication of the plant species.

**Key words**: *Celosia argentia*, germination percentage, Seed quality, seedling vigour

## INTRODUCTION

Seed is a propagating organ formed in the sexual reproductive cycle of gymnosperms and angiosperms consisting of a protective coat enclosing an embryo and food reserves (Wu *et al.,* 2015). Seed could also be defined as the protector as well as the propagator of its kind. Thousands of kinds of plants have evolved in such ways that cannot survive, even in the regions where they are best adapted, if they produce no seeds (Singh *et al* 2012). They carry the parent germplasm; protect it against heat, cold, drought and water from growing season that is suitable for growth of the species to the next. The primary biological purpose of seed is to propagate the species by successfully completing germination and resuming plant growth (Masood and Muhammed, 2018,). Seeds serve several functions for the plant that produce them.

Keys among these functions are nourishment of the embryo, dispersal to a new location, provide the most natural resources of plant reproduction, preservation of genetic variability, transportation, propagation of floral and dormancy during unfavourable condition (Butler *et al*.,2014).

Fundamentally, seeds are means of reproduction, and most seeds are the product of sexual reproduction which produces a remixing of genetic material and phenotype variability on which natural selection acts. It is considered as one of the important basic agricultural inputs for obtaining higher yield. It is generally assumed that populations within the same regions of provenance are derived from the same random mating or base population (Han *et al*., 2018). The genetic component of this variation among populations from different regions can, therefore, be identified by testing different seed sources and exploited through selection of superior populations for seed collection. Quality seed has been recognized as an important input in crop production and is considered essential for increasing seed production (Baxter *et al*., 2019). Good quality seed acts as a guarantee for realizing the potential of all other inputs in agriculture. Without good seeds, the investment on fertilizer, water, pesticides and other agricultural inputs will not yield the desired dividends. One of the key factor to be considered before going into vegetable production is knowing the source of seeds as this help to determine the quantity, quality of seed, yield potential and pest resistance potential (Bukvic *et al.,* 2010). Gosh and Singh (2011) reported effect of poor quality seed source in germinability and yield of *Jatropha curcas.* They reported that the *Jatropha* seeds performed below optimum despite applying farmyard manure. Similar effects were reported by Aigbe *et al*. (2016). Abdusalaam and Shenge, (2011) in some selected Sorghum and yioukatso *et al*., (2021) in carrot. The effect of seed source was also, reported by Aigbe *et al*. (2016) and in yield and germinability of carrot. They established that OPN variety of carrot seeds sourced from a research institute performed highest than any other seed sourced somewhere else. Other researchers that have reported similar low yield in various crop production as a result of diverse seed sources were Ginwal *et al*. (2005) in *Jatropha curcaslin* and Niamjit *et al*. (2014) on three brands of *Acacia* species. However, the effect has not only been reported in legumes, tubers and fruits alone but also in vegetables. Aigbe *et al*., (2016) reported that effect of seed source affected the growth and leafy production of Heinsia crinite which ultimately affected the fresh weight and the dry weight of the vegetable.

Some 200 indigenous plant species are used as leafy vegetables in the country. Only a few have been fully domesticated, a good number are semi-domesticated, while most are wild (Onwordi, *et al*., 2009). The challenge is to protect biodiversity and natural resources while producing enough food (Shiyam, and Binang (2011). The literature is full of evidence of benefits associated with the production and marketing of indigenous African vegetables by smallholder farmers. *Celosia argentia* is also, a leafy vegetable with a wealth of information on its dietary importance. This leafy vegetable which is extensively grown in West Africa has scanty information about its nutritional requirements generally. This is because in West Africa's farming system, leafy vegetables are regarded as backyard crops. It is a common vegetable in south and eastern Nigeria.

The leaves and tender stems are cooked into soups, sauces and stews with various ingredients including the other ingredients like onions, hot pepper, tomatoes and meat. The crop is cultivated on small and scattered plots in home gardens, farmlands and urban areas. It is a dark green leafy vegetable with a high content of micronutrients, comparable with amaranth (*Amaranthus cruentus*). The young leaves, if harvested within five- seven weeks after sowing have the best nutritional value and are especially rich in Fe, vitamins A and vitamin C. Unfortunately, these leafy vegetables have been widely utilized by only rural dwellers and few Nigerians that know the nutritional benefits thus, there is need for realization worldwide that these plants can make an essential contribution to food and nutrition security. Seed source testing of native species is necessary to screen the available variation for higher productivity and future breeding work. Selection of the best seed source of a desired species for a given site or region is necessary to achieve maximum productivity in vegetable production (Aigbe *et al*., 2016). However, such studies on *Celosia argentia* are lacking in Nigeria. Sequel to the above, effect of seed source on germination and early seedling growth of *Celosia argentia* was investigated.

## MATERIALS AND METHODS

### Experimental site

Experimental site used for the study was the Department of Crop Science laboratory of Faculty of Agriculture, University of Agriculture and Environmental sciences, Umuagwo, Imo- State.

### Seed collection

Seeds of *Celosia argentia* were collected from five sources in five different states in south-east Nigeria (Aba, Enugu, Owerri, Onitsha and Abakaliki). The geographic locations and climatic conditions of the different provenances are given in Table 1. Matured *Celosia argentia* seeds were collected from farmer's agro-allied shops in various zones in Aba, Enugu, Owerii, Onitsha and Abakaliki. The survey showed that farmers were using farmer saved seeds in these agro-ecological zones. The seeds from each source were bulked together, dried and the moisture content of the seed lots were determined following the procedure outlined by (ISTA, 2005) using the oven drying method and stored in a moisture proved polyethylene bags until usage.

**Table 1: Geographic locations and climatic conditions of different sources of *Celosia argentia* seeds**

| Collection site | (Lat. and Long.) | Rainfall (mm) | Temperatue$^{o}$C |
|---|---|---|---|
| Aba | 5.525$^{o}$N –7.4922$^{o}$E | 2200-2653 | 25.6 |
| Enugu | 6.448$^{o}$N – 7.213$^{o}$E | 1719-1800 | 26.4 |
| Owerri | 5.509$^{o}$N- 7.039$^{o}$E | 2100-2400 | 25.9 |
| Onitsha | 6.132$^{o}$N – 8.112$^{o}$E | 1700-2020 | 26.6 |
| Abakaliki | 6.323$^{o}$N- 8.112$^{o}$E | 1977- 2012 | 29.69 |

### Experimental design and data analysis

The experiment was laid in a Completely Randomized Design (CRD) in four replicates with seed sources as treatment and only source of variation. Four hundred (400) seeds per location were sown (i.e. 100 seeds in one replication). Observation for seed germination was done daily, starting from the first day of sowing until there was no further germination for a few days. Each seed was directly sown in a germination tray measuring 45 cm x 30 cm x 10 cm, filled with sterilized sharp sand and were kept moist by watering daily and they were monitored in the laboratory for one month. However, one month after seeds were sown, 50 seedlings at uniform height from each location were selected and transplanted into the prepared vegetable beds for the Lagos spinach (*Celosia argentia*). The beds were marked for each collection location and measuring 1 × 10 m, with 0.3 m between adjacent beds were randomly laid out. No fertilizer was added to the soil and the seedlings were monitored for two months after transplant.

## Data Collection

(a) **Laboratory assessment**

i. Standard germination (%); Three replicates of 100-seeds of each genotype were germinated in 9cm diameter Petri dishes laid with moisture paper towels with 10ml of distilled water. The Petri dishes was arranged in an incubator set at 25°C.

$$GP = \frac{\text{Total seed germinated after 7 days}}{\text{Total seed sown}} \times 100$$

Germination percentage was calculated based on the equation according to ISTA, (2005).

Germination counts were taken after three, five and seven days after planting (ISTA, 2005).

ii. Germination index =

$E(N_x)(DAP)$ /Total number of seedlings that germinated on the 7th day

Where $N_x$ is the number of seedlings that emerged on day x after sowing, DAP is the days after planting.

iii. Seedling Vigour Index**:** Seedling vigour level (%) of each seed source was calculated by multiplying percentage normal germination by the average of plumule length of each genotype after 7 days of germination and divided by 100. The plumule length was done through the use of ruler, measuring from the base of the plant to its highest point.

iv**.** Seedling shoot length (cm); Ten normal seedlings were selected randomly and their hypocotyls length measured from the shoot hypocotyls zone to the top of cotyledon in centimeters with a meter rule.

v. Mean Germination Time (MGT): This measured the rate and time-spread of germination. Speeds of germination were determined using = $n1/d1 + n^2/d^2 + \ldots\ldots\ldots$ where n = number of germinated seeds,

d= number of days.

**Field assessment**

1. Shoot lengths – Ten normal seedlings were selected randomly and their hypocotyls length measured from the shoot hypocotyls zone to the top of cotyledon in centimeters with a meter rule.

2. Leaf area – Ten normal seedlings were selected randomly and they were measured using a plant planimeter.

3. Leaf production- Ten normal seedlings were selected randomly and their numbers of leaves were directly counted.

4. Collar diameter- This was measured through the use of slide caliper by measuring the diameter of the root collar.

## Statistical analyses

Data analyses were performed using SPSS for window statistical (version 21) software package. Means were analyzed using analysis of variance (ANOVA) and treatment means were detected using Tukey's HSD test at 5% level of probability.

## RESULTS AND DISCUSSION

The results at 30 days after planting show that the germination of *Celosia argentia* seeds from different sources was significantly different (Table 2). The highest seed germination percentage (92%) was obtained from Onitsha sourced seed, which was followed by seed from Abakaliki (86%), while the lowest germination (53%) was obtained in seeds from Enugu (Table 2). The difference in germination percentage can be attributed to the effect of seed source. Also, highest seedling shoot length was recorded in seeds sourced from Onitsha (13cm), and this was closely followed by seed sourced from Aba (12cm) while Enugu and Abakaliki sourced seeds were least (9cm). Seeds sourced from Onitsha still maintained the lead with the lowest mean germination time (5.6 days), while seeds sourced from Enugu had the longest germination time (9.9 days). There was no significant difference recorded in seedling vigour index and germination Index rate.

**Table 2: Laboratory Physiological performance of *Celosia argentia* seeds at 30 days after planting**

| Location | Germination Percentage (%) | Seedling shoot length (cm) | Mean germination time (days). | Seedling vigour index(cm) | Germination index rate |
|---|---|---|---|---|---|
| Aba | 66d | 12a | 8.7d | 20.71b | 1.28a |
| Enugu | 53e | 9a | 9.9d | 20.10b | 1.29a |
| Owerri | 86c | 10a | 7.8c | 22.20a | 1.04a |
| Onitsha | 92a | 13a | 5.6a | 24.03a | 1.02a |
| Abakaliki | 90b | 9a | 6.2b | 22.90a | 1.03a |

Means followed by the same alphabets along the columns within a character are not significantly different from one another at 5 % probability level according toTukey test.

**Table 3: Seedling growth performance of *Celosia argentia* 60 days after planting on the field**

| Field seedling assessment | Aba | Enugu | Onitsha | Onitsha | Abakaliki |
|---|---|---|---|---|---|
| Shoot length (cm) | 28.82±3.68b | 15.10±2.10c | 38.48±2.36a | 20.10±2.10c | 17.10±2.10c |
| Root length(cm) | 8.28±1.43b | 5.77±1.32c | 14.45±1.56a | 7.37±1.32c | 6.37±1.32c |
| Cd (mm) | 2.62±0.42b | 1.14±0.16c | 3.12±0.57a | 2.17±0.16c | 1.19±0.16c |
| Leaf number | 12.10±0.50a | 10.10±0.08b | 12.25±0.64a | 11.80±0.09b | 11.90±0.08b |

CD: Collar diameter

The seedlings of *Celosia argentia* from the different seed sources revealed significant difference ($p \leq 0.05$) in the mean shoot length (Table 3). The mean shoot length ranged from 15.10 cm to 38.48 cm with the highest recorded in seedlings sourced from Onitsha (38.48cm) which significantly higher than other sources. Root length per plant was significantly different among the seedlings sources. Seedlings from Onitsha was outstanding in terms root length (14.45cm), collar diameter (3.12mm) and number of leaves (12.25).

Significant differences existed among the collar diameter, seedling from Onitsha produced the highest value (3.12mm) while, it was followed by seedling from Aba (2.62mm) while the least was recorded in seed sourced from Enugu (1.14mm). There was no significant difference between the numbers of leaves recorded in the seedlings produced from Aba (12.40) and Onitsha (12.25) while seedlings sourced from Enugu recorded the least values.

## DISCUSSION

This study showed that significant difference existed among the various sources of *Celosia argentia* seeds in south eastern, Nigeria. Seeds and seedlings from various sources can drastically affect the seed germinability and other physiological component of seeds. This is in agreement with the work of Aigbe *et al*. (2016), who opined that seed germination capacity is due to provenance effect. Similarly, Gosh and Singh (2011) also revealed the influence of seed source on germination performance of *Jatropha curcas*.

In most plant species, seeds vary in their degree of germinability between and within populations as well as between and within individuals (Singh *et al.,* 2012; Masood and Muhammed, 2018; Niamjit, *et al*., 2014; Wu *et al.,* 2015). This difference in germination performance due to different sources of seeds could be attributed to longitudinal location. Ginwal *et al*., (2005) reported that+ speed of germination, as determined by the germination energy has significant positive correlation with the longitude of the seed source. Environment has a lot of effects on seed physiology which include genetic origin, moisture content at storage and at harvest, storage techniques used, handling procedures both at harvest and during storage but much of it is known to be phenotypic, i.e. caused by the local conditions under which the seed matured (Ghaderi-Far, *et al*., 2010; Han *et al.*, 2018; Lei *et al.*, 2022). Apart from seed source, which is due to geo-climatic variables of seed origin, other factors cannot be ruled out. Han *et al*. (2018) reported that the germinability of seeds can be markedly influenced by maternal factors, such as position of the seed in the fruit and the age of the mother plant during seed maturation, as well as environmental factors. The performance of a provenance depends partly on the site and seed source (Mamiro and Clement., 2014).

## CONCLUSION

Findings from the present study provide evidence that seed germination and seedling growth parameters vary considerably among different *Celosia argentia* seed sources. The significant difference in seed germination performance was attributed to the effect of seed source. The seedlings growth parameters were also significant for the different seed sources. Seed sources with higher longitude tend to perform better in terms of germination and produced higher quality seedlings. This finding is useful in the seed collection practices. This will prevent the use of poorly adapted genotypes for restoration and domestication programmes. Finally, selecting and analysing additional seed sources in future studies could be considered in order to get more precise relationship with geographic information.

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