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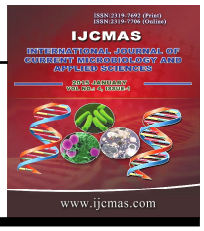

Original Research Article

Effects of varying temperatures, growth media and sowing methods on the germination of *Aframomum melegueta*

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A B S T R A C T

Keywords

Germination, Sowing method, *Aframomum melegueta*, Soil, Sawdust, Water

This study was carried out to investigate the germination of the seeds of *Aframomum melegueta* under different temperatures, growth media and sowing method. The experiment included three different factors which included four different temperatures, two sowing methods (broadcast and drilling) and two growth media (soil and sawdust). 60 seeds each were sown in Petri dishes, containing different growing media (substrates). The Petri dishes were then placed in incubators at 20, 30, 40 and 50 °C. It was observed that temperatures of 30 °C and above favored germination while growth medium and sowing methods did not have any significant effect on the germination of *A. melegueta.*

Introduction

The genus *Aframomum* K. Schum belongs to the Zingiberaceae family. It is represented in Cameroon by over 20 species of rhizomatous herbs. *A. melegueta* is of West African origin. It is a perennial deciduous herb native to the tropics and grows at the swampy habitats of the West Africa coast. It possesses tufted leafy stem that can measure up to 1.5m high. The leaves are simple, alternate and lanceolate. The matured leaves can grow as long as 40cm in length and 12cm-15cm wide. It produces purple coloured flowers which develop into pods that can be as long as 8cm and about 3cm wide. Each pod contains numerous reddish-brown seeds (can be as many as 300 seeds in one pod). The sharp and peppery taste of the seeds is caused by the aromatic ketones; *6-paradol, 6-gingerol and 6-shogaol* present in it (Sugita *et al.*, 2013). The fruits are fleshy, indehiscent and produce spikes. It cannot survive temperatures below 1°C.

All of them are widely used locally in ethno dietary and folk medicinal preparations as well as for cultural and spiritual purposes (Kamnaing *et al.*, 2003; Sob *et al*. 2007). It is very important, and is used locally for medicinal purposes and as a spice in cooking.

According to Gerhardt (1996), the tropical dry forest (TDF) with the dry season lasting for about five months of one or two seasons and annual rainfall between 400-1700 mm generates abiotic conditions that are more severe compared to the tropical rain forest. TDF tolerate conditions of greater stress during the succession process. As a result, the heterogeneity of the spatial and temporal availability of resources largely controls the survival and establishment of seedlings of their flora (Lieberman and Li, 1992; Gerhardt, 1996; Singh, 2001).

The germination of any set of seeds depends on many conditions under which they are placed. If the conditions chosen are favorable for the seeds that germinate with difficulties, such seeds will appear to be homogenous as they germinate. In this case most of the seeds will germinate rapidly. But when they are placed under less favorable conditions, they germinate at different rates and some do not even germinate. Thus germination is said to be heterogeneous when conditions are not favorable and therefore can be used experimentally to demonstrate heterogeneity among seeds or the physiological states among different sets or groups of seeds (Krogh, 2005). Test results on germination vary depending on the origin of the seeds, the treatment to which they where subjected and the germination conditions (Krogh, 2005).

The main aim of this work was to determine the effects of varying temperature regimes, sowing method and growth medium on the germination of *A. melegueta* seeds.

This work was carried out in the University of Dschang which is located between latitude 5°10´ and 5°30´ North and longitude 9°50´ and 10°20´ East. It has an altitude of 1400 m and is located in the Western Highlands of Cameroon with an Equatorial monsoon climate (Nwame, 1997).

Fresh fruits of *Aframomum melegueta* where obtained from traders in Dschang. Seeds were removed from the fresh fruits and nursed in a nursery in February 2012. This test was carried out in three substrates; soil, sawdust and water. The different substrates were put into Petri dishes. Sixty (60) seeds of *Aframomum melegueta* were used in each test. For each test the seeds were sown at two different depths (that is broadcast at 0 cm and drilling at 1.5 cm deep). Those sown at 1.5 cm were first arranged at the periphery of the Petri dishes before the substrate was placed on the grains in order to facilitate observation and counting. Each of the setups was then placed in an incubator. In order to prevent the effect of light intensity on the seeds, an opaque sheet of carton was used to prevent the light rays from reaching the seeds. Each of the setups was then watered with $5cm^3$ of water.

The incubators were set at four different temperatures: 22°, 30°, 40° and 50 °C. The incubators were made up of tungsten filament lamps which served as a source of heat. The bulbs were connected in series to an electrical source of energy. One bulb of 80 W was placed in the first incubator which generated a temperature of 30 °C, in the second incubator, two bulbs of100 and 80 W to generate 40 °C. The last incubator had three bulbs two 80 W and one 100 W which generated a temperature of 50 °C. With the aid of an electronic stopwatch, the temperature of each incubator was determined with mercury in glass thermometer after 20 minutes. This was repeated three times for each temperature. The incubators were switched on twice a day after every six hours for 20 minutes within 7 days till the experiment came to an

end. The seeds were then observed every day during the experiment.

Germinated seeds were counted and removed in the case of those that were sown by broadcast while those that were sown at 1.5 cm were counted each day through the transparent walls of the Petri dishes and those of the previous day(s) were subtracted from the total number of seeds that germinated to get the number of seeds that germinated on a daily bases.

The number of seeds that germinated were then recorded on a data sheet for each setup on a daily bases. The seeds were considered to have germinated as soon as the radicle protruded or burst the scar. The germination test lasted for two weeks from where the data for the Latent period, Germination speed, and Germination Percentage were collected.

Latent period: This is the time taken between the date of sowing and the germination of the first seeds (Ahoton *et al*., 2009).

Germination speed (GS): This is the average time taken for germination to occur where

$GS = \frac{n1}{1} + \frac{n2}{2} + \frac{n3}{3} \ldots + \frac{nx}{x}$. (Singh *et al*., 2010)

Where n1=nx which is number of seeds in effective germination at day x
1=x which is number of days

Percentage of seeds that germinated: This is given by

$$GP = \frac{\text{number of seeds that germinated}}{\text{total number of seeds that were planted}} \times 100$$

(Niang *et al*., 2010)

Results and Discussion

Most of the seeds started germinating seven days after the day of sowing and continued for five days after which no further germination occurred in all the treatments. Out of the 1200 seeds involved in the germination test, it was observed that only 537 germinated.

Latent period: The first germination from the day of sowing occurred seven days after, giving a latent period of 7 days. A total of 337 seeds germinated on the seventh day. Only the seeds in soil at 40 °C and 50 °C started germinating after the 8th and the 9th day respectively.

Germination percentage: The germination percentage in all the tests was 44.75%. 62.8% of seeds germinated on the first day with the highest occurring in soil, giving a germination percentage of 71.7% for seeds that were sown at the surface (broadcast) and occurred at a temperature of 30 °C. It was followed by sawdust with 70% for seeds that were broadcast and those that were sawn at 1.5 cm deep at a temperature of 30 °C. The highest number of seeds germinated in sawdust and those that were broadcast with a germination percentage of 93.3%. (Table 1). No seed germinated for treatments at 22 °C and at both sowing depths in all the substrates.

Germination speed (GS)

This was highest in sawdust when the seeds were broadcast and sown at 1.5 cm deep. The GS was 48 seeds that germinated per day. It was followed by soil for seeds at 0 cm and at a temperature of 30^{0}C and sawdust for seeds sown at the depth of 1.5 cm at temperature of 50^{0}C with GS of 47.2 and 44.3 respectively. The least was observed in all the three substrates at

temperature of 20^0C at both depths. In these treatments, there was no germination at giving a germination speed of zero percent. (Table 2)

A high percentage germination of *A. melegueta* seeds was recorded at 30 °C. This results are similar to those obtained by Scowcroft (1981) in which he found out that soil moisture content and soil temperature were among the factors governing seed emergence from different sowing depths.

With respect to the latent period, there was no great difference observed in the time taken for the seeds to emerge. This might probably be due to the fact that seeds were considered to have germinated as soon as the radical protruded from the testa. This thus must have taken care of the time the plumule would have taken to emerge out of the substrate for those seeds that were sown at 1.5 cm.

The results at hand put the latent period of fresh seeds of *A. melegueta* at 7 days since 62.3% of seeds that germinated in this test did so after 7 days from the day they were sown. This results tie with that of Enti (1988) which put the latent period between 7-12 days. The latent period was neither influenced by substrate (growth medium) or sowing depth but temperature seems to have an effect on the latent period though it did not show any great variation at 30^0, 40^0 and 50^0 C.

Table.1 Germination percentages of *A. melegueta* seeds under different treatments

Substrate	Sd /cm	Temp /°C	N^o of seeds that germinated						% of seeds that germinated					Germination %
			Days					total	Days					
			1	2	3	4	5		1	2	3	4	5	
soil	0	22	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
soil	0	30	43	8	0	0	1	52	71.7	13.3	0.0	0.0	1.7	86.7
soil	0	40	29	10	5	0	0	44	48.3	16.7	8.3	0.0	0.0	73.3
soil	0	50	22	18	5	0	0	45	36.7	30.0	8.3	0.0	0.0	75.0
soil	1.5	22	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
soil	1.5	30	6	9	4	7	0	26	10.0	15.0	6.7	11.7	0.0	43.3
soil	1.5	40	0	23	9	0	1	33	0.0	38.3	15.0	0.0	1.7	55.0
soil	1.5	50	0	0	14	6	0	20	0.0	0.0	23.3	10.0	0.0	33.3
sawdust	0	22	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
sawdust	0	30	42	9	4	1	0	56	70.0	15.0	6.7	1.7	0.0	93.3
sawdust	0	40	27	9	17	0	0	53	45.0	15.0	28.3	0.0	0.0	88.3
sawdust	0	50	22	18	9	1	1	51	36.7	30.0	15.0	1.7	1.7	85.0
sawdust	1.5	22	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
sawdust	1.5	30	42	9	4	1	0	56	70.0	15.0	6.7	1.7	0.0	93.3
sawdust	1.5	40	7	1	10	0	5	23	11.7	1.7	16.7	0.0	8.3	38.3
sawdust	1.5	50	42	2	4	0	0	48	70.0	3.3	6.7	0.0	0.0	80.0
water	0	22	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
water	0	30	21	8	11	2	2	44	35.0	13.3	18.3	3.3	3.3	73.3
water	0	40	20	8	13	1	5	47	33.3	13.3	21.7	1.7	8.3	78.3
water	0	50	14	5	2	0	0	21	23.3	8.3	3.3	0.0	0.0	35.0

sd= sowing depth.

Table.2 Germination speed (GS) of *A. melengueta* in different growth media, sown at different depths and temperatures

substrate	sowing depth/cm	temperature	number of seeds that germinated Days 1	2	3	4	5	GS
soil	0	22	0	0	0	0	0	0
soil	0	30	43	8	0	0	1	47.20
soil	0	40	29	10	5	0	0	35.67
soil	0	50	22	18	5	0	0	32.67
soil	1.5	22	0	0	0	0	0	0.00
soil	1.5	30	6	9	4	7	0	13.58
soil	1.5	40	0	23	9	0	1	14.70
soil	1.5	50	0	0	14	6	0	6.17
saw dust	0	22	0	0	0	0	0	0.00
saw dust	0	30	42	9	4	1	0	48.08
saw dust	0	40	27	9	17	0	0	37.17
saw dust	0	50	22	18	9	1	1	34.45
saw dust	1.5	22	0	0	0	0	0	0.00
saw dust	1.5	30	42	9	4	1	0	48.08
saw dust	1.5	40	7	1	10	0	5	11.83
saw dust	1.5	50	42	2	4	0	0	44.33
water	0	22	0	0	0	0	0	0.00
water	0	30	21	8	11	2	2	29.57
water	0	40	20	8	13	1	5	29.58
water	0	50	14	5	2	0	0	17.17

Fig.1 Fresh fruits and seeds of A. melengueta

It should be noted that no seed germinated at 22^0 C in the entire test. According to Scowcroft (1981), soil temperature is very important in seed germination and seedling survival which surely justifies why no seed germinated at 22^0C. Also pointed out that alongside temperature, soil moisture are among the factors governing emergence from different depths. This implies that seeds sown at deeper depths are prioritized with respect to soil moisture content.
But in this case, it appears it was not the case which might be due to an insignificant difference in moisture, or its duration was too short to favor germination of seedlings at deeper depths. Perhaps it might have also been that the actual effects of soil depth could have been masked by extreme in soil surface temperatures which affected all seeds equally without respect to depth of origin (Scowcroft, 1981). As for the different substrates, it appears they had no effect on the germination of *A. melegueta* for they did not show any great variation in the germination percentages that might have been as a result of the domination of surface temperatures.

High percentage germination of *A. melegueta* seeds was recorded at temperatures of 30 °C. This results are similar to those obtain by Scowcroft (1981) in which he found out that soil moisture content and soil temperature were among the factors governing seed emergence from different sowing depths.

With respect to the latent period, there was no great difference observed in the time taken for the seeds to emerge. This might probably be due to the fact that seeds were considered to have germinated as soon as the radical protrudes from the testa. This thus must have taken care of the time the plumule would have taken to emerge out of the ground for those seeds that were sown at 1.5 cm.

Results at hand show that temperatures between 30- 40 ^{0}C tend to favor germination while temperatures from 22 ^{0}C and below hinder germination. Thus the selection of the appropriate temperature for germination is very important in the domestication and conservation of this very important species of NTFP in the Western Highlands of Cameroon.

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