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Effect of Different Treatmenton Seed Germination and Breaking of Seed Dormancy in Capsicum annuum Linn.,Aframomum melegueta K. Schum. andCapsicum chinenseJacq.

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Abstract

Effects of chilling and soaking in sulphuric acid on germination and early seedling growth of Capsicum chinense, Capsicum annuum and Aframomum melequata seeds were investigated in the laboratory. Parameters such as Percentage germination, Germination rate, Shoot length, Root length, Leaf area, Moisture content and Numbers of nodes were evaluated. Standard procedures outlined by the Association of Official Analytical Chemists were used. The results showed that in all the three plant species tested, growth parameters were significantly ($P<0.05$) stimulated above the control in chilling, drying and H_2S0_4 treatments. The best germination rate and percentage were recorded in Capsicum chinense followed by Capsicum annuum and Aframomum melequeta. These results suggest that dormant seeds should be treated with sulphuric acid and chilling before planting to facilitate its germination and early seedling growth of spices. Based on these findings, Agriculturist are encouraged to practice the use of chilling and sulphuric acids on dormant seeds to promote their growth.

Key Terms–

Aframomum,*Capsicum*, Chilling, Dormancy,DryingandSulphuric acid.

1. Introduction

The knowledge and use of plants as spices and condiments is as old as the history of mankind (Garland, 1972). Spices seeds are characterized by seed dormancy, small fruit size, deciduous fruit and the inhibition of flowers (Yamamoto and Nawata, 2006, 2009). The seed phase is the most important stage in the life cycle of higher plants as regards survival; dormancy and germination are natural mechanism to ensure this. The seed is often well equipped to survive extended periods of unfavourable conditions and the embryo is protected by one or several tissues including endosperm, peristerm, seedcoats and fruit tissues that protect the embryo from physical damage (Whistler, 1992).Seed is a small meristematic axis made of storage tissue and enclosed with membranes and sometimes with stony shells that forms the seedcoat which prevents entry of water, oxygen and may limit the enlargement of the embryo or may change the growth substance relationship of enclosed tissues (Carter, 1998). Seed dormancy is a physical or physiological condition of viable seed which prevents germination even in the presence of favorable conditions for germination. Seed often reveal complex and effective mechanisms which ensure survival under many environments and temporal situations while most vegetable species and commercially important cultivars are relatively free of dormancy mechanisms; members of Apiaceae, Asteraceae, Chenopodiceae, Malvaceae and Solanaceae are among the families with erratic germination due to seed dormancy (Carter and Vavrina, 2001; Gray, 1975; Leskovar *et al*., 1999; Nascimente *et al*., 2000).Dormancy may be broken by an instant event like gap formation, ingestion or fire, in other cases, dormancy is broken gradually by the influence of external factors, example sand abrading, hard seed coats (Brown 1987) leaching of inhibitors by rainwater (Viller, 1972) or natural decay of fleshy fruit substance (Mayer and Poljakoff-Mayber, 1982). These spices (*Capsicum annuum*, *Aframomum melegueta*and *Capsicum chinense*) under investigation in this study are widely used and widely cultivated in Africa and other parts of the world. They serve as important spices for a large number of people in all parts of the world.*C. chinense* is an excellent source of vitamin A and C.*A. melegueta* is repeatedly reported as worm expellant, stimulant and diuretics as well as in bleeding after childbirth. It is taken for nausea and vomiting, abdominal pain, indigestion, gas and loss of appetite, morning sickness, pains and discomfort during pregnancy; involuntary urination (Lee, 1998). *Capsicum annuum*is taken internally in the treatment of cold stage of fevers, debility in convalescence or old age, asthma and digestive problems. Thus, this study is aimed at determining the effect of different treatment on seed germination and

breaking of seed dormancy in *Capsicum annuum, Aframomum melegueta*and *Capsicum chinense.*

2. Materials and Methods

2.1 Seed source

The mature seeds (fresh and dry) of *Capsicum annuum, Capsicum chinense* and *Aframomum melegueta* were obtained from Akwa Ibom state Agricultural Development Project (AKADEP), local farmer and markets. The viable seeds were used for this study.

2.2 Implementation of The Experiment

2.2.1Soaking In Concentrated Tetraoxosulphate VI (H_2SO_4)

Seeds were soaked in H_2SO_4 for two different periods (5 and 10 minutes) and there after rinsed with sterile water and then transferred to the germination test process (Whistler, 1992).

2.2.2Cold Stratification (Chilling)

The dry seeds of *Aframomum melegueta, Capsicum annuum and Capsicum chinense* were chilled in refrigerator at 6.0^{o}C for 14 days. Fresh and dry mature seeds were also used for this experiment (Whistler, 1992).

2.3 Germination Studies

Germination experiments were tested using three replications of 20 seeds per treatment. After every treatment, seeds were placed on 15 cm sterilized petri dishes containing double layered Wathman No. 1 filter papers moistened with 10ml of double sterilized water and incubated at 23 ± 2^{o}C under 16hours photoperiod supplied by two Philips TL 40W florescent tubes. Germinated seeds and rotten seeds were counted and observed. A seed was considered germinated when the tip of the radicle had grown up to 2cm long, in the petri dishes. For each experiment, a batch of untreated seeds served as control. This experimental study was carried out in-vitro.

2.4 Determination of Growth Parameters

The growth parameters such as seedling heights, root length, number of nodes, leaf area, moisture content and percentage germination were determined. The leaf Area was determined by multiplying leaf length by leaf width with the correction co-efficient (r) which is 0.72 as proposed by Hoyt and Bradfield (1962), Umoh and Esenowo (1996).

$LA = L \times W \times r$

Where LA = Leaf Area

W= Leaf Width

r = Correction co-efficient (0.72)

2.5 Germination Rate

The germination rate was calculated as follows (based on Yang *et al.*, 2007).

$$\text{Germination rate} = \sum_{n=1}^{60} \frac{Gt}{Dt}$$

Where "Gt" is the number of germinated seeds after't' days (Dt).

2.6 Statistical Analysis

Results were processed and expressed as mean ± Standard Error of mean (SEM) of three replicates. Statistical significance between the different treatments was determined by two-way analysis of variance (ANOVA) $P< 0.05$ was considered statistically significant (Ubom, 2004).

3.0 Results

Seed germination and rate was significantly different among various treatments. Together with untreated control (fresh seeds) and low treatments resulted in the lowest germination percentage and rates (Figure 3.1, 3.2 and 3.3). *Capsicum chinense* recorded 52.5± 7.50% in 10 minutes soaked in H_2S0_4 and the least was recorded in fresh seed (control) 27.5± 2.05%, Chilling was 50.0± 2.11% while 42.5 ± 7.50% showed in dry seeds. (Fig. 3.1)

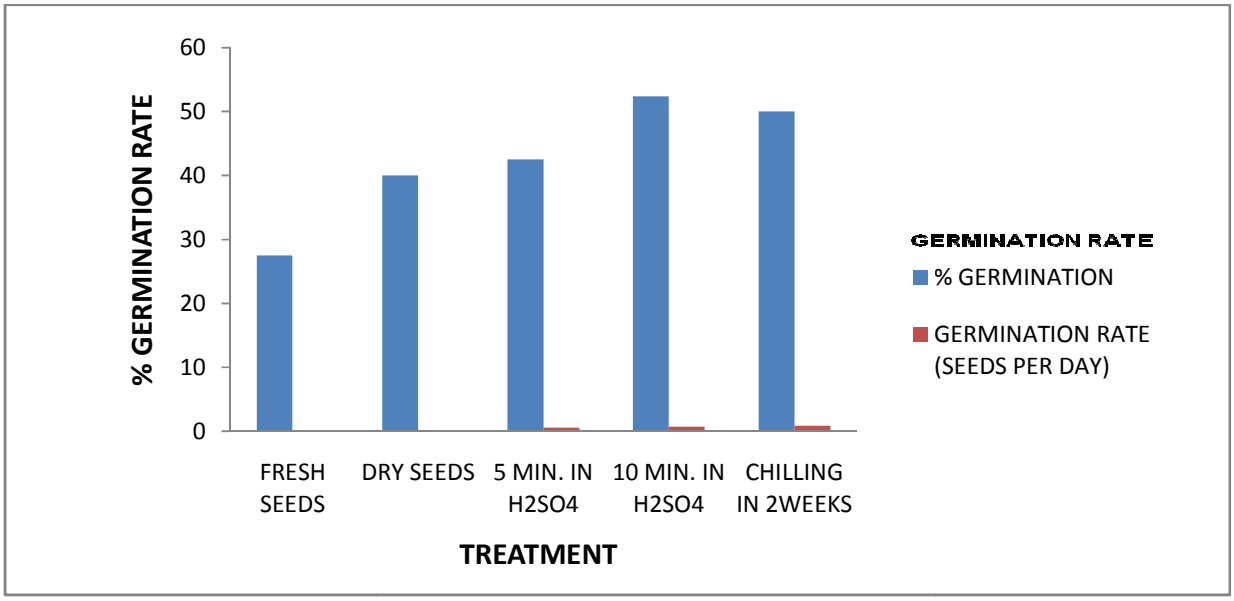

Figure 3.1: Effect of Different Treatment on Percentage Germination of *Capsicum chinense* Jacq.

Similarly, *Capsicum annum* fell within similar trends i.e. percentage germination were as follows: Fresh seeds (25.0±0.75%), Chilling (55.0 ±1.11%), Dry seeds (50.0±15.0%), soaking in 5minutes (47.5±17.50%) and soaking in 10 minutes (57.5±17.50%) (Figure 3.2).

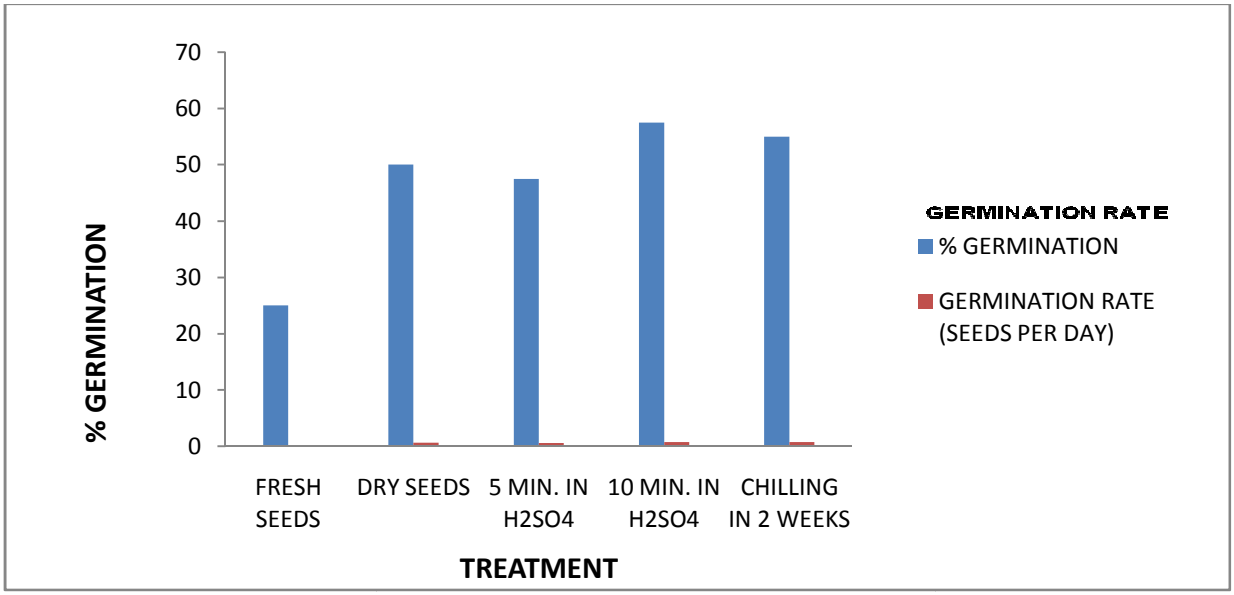

Figure 3.2: Effect of Different Treatment on the Percentage Germination of *Capsicum annuum.*

Aframomum melequeta recorded thus, Fresh seeds (25.0 ± 0.13%), chilling (40.0 ± 10.00%), and dry seeds (61.0±5.20%) soak in 5 minutes H_2S0_4 (60± 5.0%) and soaked in 10 minutes H_2S0_4 (82.5 ± 12.50%) Fig. 3.3

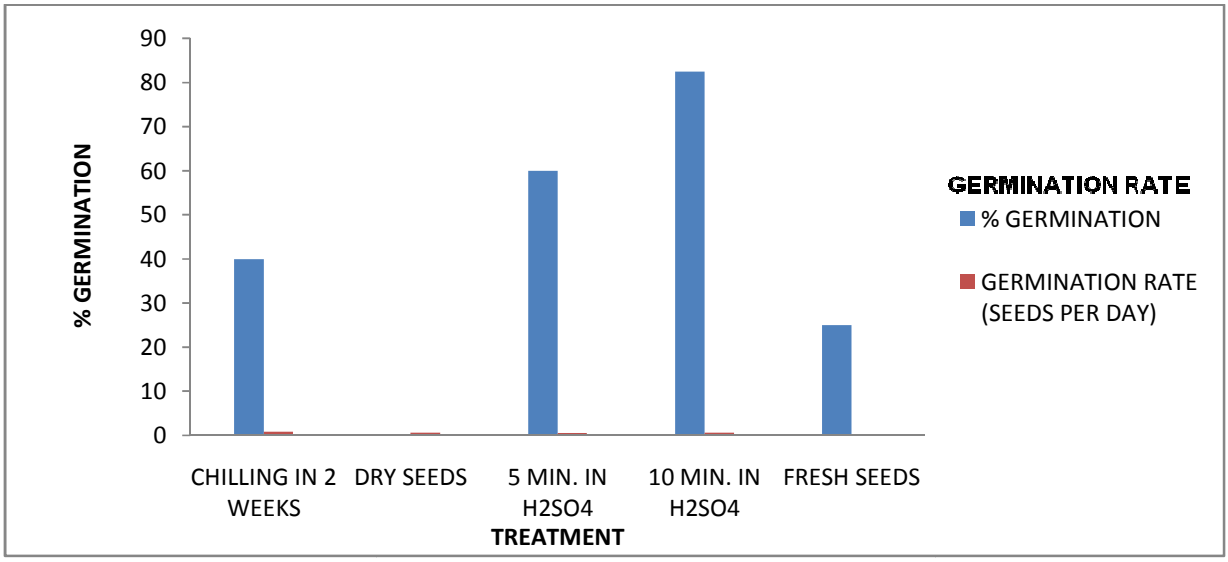

Figure 4.3: Effect of Different Treatment on Percentage Germination of *Aframomum melegueta*.

The germination rates per day were very high in treated seeds compared with the fresh seed (control). *Capsicum chinense* fall within 0.012–0.875 with chilling being the highest. Also *C. annum* were 0.018 – 0.792 and *Aframomum melequeta* was 0.034–8.34 (fig.3.1 – 3.3). Other growth parameters such as shoot height, root length, leaf area and moisture content showed stimulation above the control (Table 1–3). Comparatively, growth responses in *Capsicum chinense* was better than *Capsicum annuum* followed by *Aframomum melequeta* and chilling in refrigerator was considered to be the best followed by dry seeds, 10 minutes in H_2S0_4 and 5 minutes in H_2S0_4. The highest seedlings height was recorded in chilling in *Capsicum chinense* (6.50±0.22%).

Table 1: Effects of Different Treatment on Germination and Early Seedling Growth of *Capsicum chinense*.

Treatments	Seedling height (cm)	Root length (cm)	No. of nodes	Leaf Area (cm^2)	Moisture content (%)	% Germination	Germination rate (seeds per day)
Fresh seeds	4.17 ± 0.37	3.59 ± 0.09	4.0 ± 0.00	0.10 ± 0.01	40.3 ± 12.03	27.5 ± 2.05	0.012
Chilling seeds	6.50± 0.22	6.67 ± 0.01	5.0 ± 0.00	0.58 ± 2.11	82.1 ± 5.22	50.0 ± 2.11	0.875
Dry seeds	5.69 ± 0.19	4.50 ± 1.00	6.0 ± 0.00	0.53 ± 0.05	60.0 ± 1.20	40.0 ± 0.00	0.647
5 minutes in H_2S0_4	5.90 ± 0.05	5.88 ± 0.03	6.0± 0.00	0.66 ± 0.20	78.5 ± 21.43	42.5 ± 7.50	0.543
10 minutes H_2S0_4	5.98 ± 0.09	7.72 ± 0.09	6.0 ± 0.00	0.71 ± 0.65	98.4 ± 20.55	52.5 ± 7.50	0.724

Data is expressed as mean ± Standard Error of mean (SEM) of three replicates

Table 2: Effects of Different Treatment on Germination and Early seedling growth of *Capsicum annuum*.

Treatments	Seedling length (cm)	Root length (cm)	No. of nodes	Leaf Area (cm^2)	Moisture content (%)	% germination	Germination rate (seeds per day)
Fresh seeds	2.65 ± 021	2.94 ± 0.19	3.0 ± 0.00	0.38 ± 0.09	45.24 ± 21.43	25.0 + 0.75	0.018
Chilling seeds	5.21± 0.01	6.42 ± 2.01	5.0 ± 0.00	0.82 ± 0.11	121.4 ± 23.11	55.0 + 1.11	0.792
Dry seeds	4.96 ± 0.00	70 ± 0.05	6.0 ± 0.00	0.58 ± 0.10	82.29 ± 48.96	50.0 + 15.00	0.662
5 minutes in H_2S0_4	3.0 ± 0.16	5.6 ± 0.27	4.0 ± 0.00	0.79 ± 0.01	80.75 ± 80.75	47.5 + 17.50	0621
10 minutes H_2S0_4	3.6 ± 0.06	5.11 ± 0.58	4.0 ± 0.00	0.89 ± 0.08	225.0 ± 0.00	57.5 + 17.50	0.779

Data is expressed as mean ± Standard Error of mean (SEM) of three replicates

Table 3: Effects of Different Treatment on Germination and Early Seedling Growth of *Aframomum melequeta*.

Treatments	Seedling Height (cm)	Root Length	No. of nodes	Leaf Area (cm^2)	Moisture content (%)	% Germination	Germination Rate (seeds per day)
Chilling for 2 weeks	0.88 ± 0.03	1.80 ± 0.00	2.0 ± 0.00	1.21 ± 0.35	131.25± 118.75	40.0 ± 10.00	0.834
	0.60 ± 7.11	1.49 ± 0.11	2.0 ± 0.00	0.30 ± 0.12	100.02± 2.40	61.00 ± 5.20	0 .624
Dry seeds	0.79 ± 0.06	1.55 ± 0.05	2.0 ± 0.00	0.29 ± 0.06	151.65± 5.50	60.0 ± 5.0	0.532
5 minutes in H_2S0_4	0.95 ± 0.15	1.87 ± 0.24	2.0 ± 0.00	1.00 ± 0.37	162.01 ± 1.22	82.5± 12.50	0.621
10 minutes H_2S0_4	0.40 ± 0.11	0.69 ± 2.10	1.0 ± 0.00	0.10 ± 0.11	30.1 ± 1.21	25.0 ± 0.13	0.034

Data is expressed as mean ± Standard Error of mean (SEM) of three replicates

5. Discussion

From the results obtained from this study, it was observed that seeds sown showed significant stimulation in percentage germination and germination rate above the control (fresh seeds). This result has been shown to be in close agreement with germination test results and has been mentioned for over 650 plant species (Moore, 1985, Leist and Kramer, 2003). This high percentage germination rate could be attributed to the fact that the seeds were preserved in high temperature which could break dormancy easily. To further support the high percentage obtained, it is possibly due to days of chilling and hours of soaking in H_2S0_4. Schippers *et al.* (2002) added that *Corchorus* seeds could germinate fasters by means of high temperature treatment when compared with the control which germination was zero (0).The work of Nkomo and Kambizi (2008) supported that 7 day pre-chilling treatment followed by exposure to a temperature higher than 30^{o}C encourages germination of *Corchorus olitorius* seeds and nursery establishment under such conditions improved its length of availability. The trend observed in this study shows a considerable increase in all the parameters tested in different treatment when compared with the untreated control (fresh seeds). Soaking seeds in H_2S0_4 for 10minutes significantly ($P<0.05$) stimulated root length of *Capsicum* spears and *Aframomum melequeta* seeds in this study. A similar trend has been noted in response to priming (15-20^{o}C) (Jones and Gosling, 1994, Doody and O'Reilling, 2005) treatments (Chaisurisri *et al*., 1993,Leinonen, 1998, Wang and Berjak, 2000) in the seeds of several other tree species. H_2S0_4 treatment may provide a chilling-like effect, resulting in the breakdown of polymeric storage compound. It is likely that the H_2S0_4 and chilling treatment used in this study stimulated dormancy–mediated responses especially since germination root and shoot length were relatively high. Dormant seeds of these species germinated poorly in fresh seeds (control). Chaisurisri *et al*., (1993) suggested that this reduction was due to the increase in seed moisture content which contain high amount of growth inhibitor (ABA). Several studies were made to study the effect of different factors on germination in crops plants. For example, the effects of soaking duration on germination (Sabongari and Aliero, 2003) and pre-sowing treatment on emergence and seedling growth (Arin and kiyak, 2003) of tomato, priming in annual ryegrass (Tiryaki *et al*., 2004). The effect of chilling on growth responses of *Gossypium* species (Anjum and Khatoon, 2003). The obtained results showed that beside known agents affecting germination and growth responses of these test plant, chilling and soaking. H_2S0_4 of *Capsicum* species and *Aframomum melequeta* seeds can affect responsive germination.

6. Conclusion

From this research, it can be concluded that treatment by chilling and soaking in H_2S0_4 solution can promote the germination process of *Capsicum chinense*, *Capsicum annum* and *Aframomum melequeta* seeds improving growth characteristics of the subsequent seedlings. This can be a useful pretreatment operational practice if there is insufficient time to carry-out moist chilling.

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