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The effects of previous fertilizer treatments on passion fruit seed quality, and seedling emergence and growth qualities in soilless media

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The effect of fertilizer treatment of mother plants on seed quality, the effect of water soaking and nursery growth media on seed germination, emergence and growth of passion fruit seedlings were undertaken at the University of Nigeria, Nsukka. Results indicated that coefficient of velocity of germination (CVG), days to 50% germination (D50G), cumulative germination percent (CGP) and mycelia occurrence (MO) responded significantly to water soaking of seeds. Seeds that were soaked in water had lower CVG and CGP but higher D50G and MO. Previous fertilizer treatment exerted significant influence over all parameters except complete dormancy period (CDP), percent radicle emergence at first germination (PEFG), and days to highest germination (DHG). Seeds of plants treated with 20t/ha poultry manure + 50kgN/ha + 150kgK/ha (T3) recorded best germination, emergence and seedling growth attributes. The soilless media gave better emergence of passion fruit seedlings compared to the control (topsoil). However, medium 1 (1:1:1 – rice hull: poultry manure: sawdust) produced superior seedlings. Generally, soaking seeds in water proved detrimental to germination and seedling emergence while fertilizer treatment of mother plants had remarkable impact on seed vigour. Soilless media were better for raising of passion fruit seedlings in the nursery.

Key words: Passion fruit, *Passiflora edulis*, Fertilizer treatment, water soaking, germination/emergence, growth.

Introduction

Passion fruit, which belongs to the Pasifloraceae (Dupriez and De Leener, 1989), has two cultivated edible types: the yellow passion fruit (*Passiflora edulis* var. *flavicarpa*) and the purple passion fruit (*Passiflora edulis* var. *edulis*). The former grows best under tropical conditions while the latter prefers subtropical climates (Anonymous, 2010, van Ee, 1999). Besides showing higher fruit productivity and juice content, with higher acid content, the yellow

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passion fruit is tolerant to most of the soil borne pests and diseases that affect the purple type even though the latter has better flavor (Anonymous, 2010). The 30-40% juice content of passion fruit when extracted can be consumed fresh, used as concentrate or as flavours in certain foods (Alegbejo, 2004). Morton (1987) has mentioned the use of the rind in cattle and pig feed, the glycoside passiflorine as a sedative and the fruit juice as a digestive stimulant and treatment for gastric ulcer. Besides, the oil, extracted from the seeds, with properties similar to sunflower and soybean oil, is edible and of industrial importance.

The yellow passion fruit, whose origin has been linked to southern Brazil, was introduced from Europe and Asia into Nigeria in the 1980s and is now being grown in some parts of Northern Nigeria (Alegbejo, 2004). Although, the yellow passion fruit has a bright future in Nigeria, it currently faces the problem of adequate agronomic package for highly successful cultivation (Ani and Baiyeri, 2008). Areas identified as requiring immediate attention includes, among others, fertilizer recommendation for optimum fruit yield and quality (Alegbejo, 2004). Fertilizer recommendations in particular have been variable (van Ee, 1999).

Among factors influencing crop productivity is seed quality. Among desirable seed qualities are high germination capacity and vigour of the resultant seedling (Dupriez and De Leener, 1989). Seed quality is a function of conditions under which mother plants were raised such as moisture and temperature regimes during fruit maturation, and fertilizer application (Cardwell, 1954). Similarly growth media is a critical factor in seedling performance in the nursery and subsequently (Baiyeri, 2005). Viability of passion fruit seeds expires after two months (van Ee, 1999) while germination can take place from 1-3 weeks after sowing (Paull, 1998). Soaking seeds in water has been observed to hasten germination or emergence in species such as jackfruit (Sonwalker, (1951), cashew (Argles, 1976), *Lanea macrocarpa* (Dupriez and De Leener, 1989) and shea (Ugese *et al.*, 2005). Determining the effect of water soaking on germination attributes of passion fruit is considered worthwhile since speed of germination has been linked with vigorous seedling growth and productivity. Thus the objectives of this study were to determine effect of water soaking on seed germination and mycelia growth, investigate the influence of fertilizer treatment of mother plants on seed germination and seedling vigour and assess the suitability of soilless media for seedling emergence and growth of passion fruit seeds.

Materials and methods

The effects of previous fertilizer treatments on seed quality of passion fruit including seedling germination/emergence and growth in nursery media were investigated at the University of Nigeria, Nsukka (6.52^{o}N, 7.24^{o}E and 447.2 m above sea level), in 2009 in 2009. Seeds for the experiment were obtained from fruits of yellow passion fruit plants grown under various fertilizer treatments as outlined in Table 1. The 100 seed weight of seeds from the various sources (previous fertilizer treatments) were determined by counting 10 batches of 100 seeds from each of the seed sources and measuring their weights using sensitive weighing balance.

Effect of soaking and previous fertilizer treatment on germination and mycelia occurrence

This was determined in the Crop Science Laboratory of the University of Nigeria, Nsukka. Passion fruit seeds from each of the 7 previous fertilizer treatments were placed in sterile water for six hours while the control was not soaked as seen in Table 1.

Table 1. Fertilizer treatments applied on yellow passion fruit.

Fertilizer treatment code	Definition
T1	30t/ha poultry manure
T2	20t/ha poultry manure
T3	20t/ha poultry manure + 50kgN/ha + 150kg K/ha
T4	10t/ha poultry manure + 100kg N/ha + 300kg K/ha
T5	5t/ha poultry manure + 200kg N/ha + 600kg K/ha
T6	200kg N/ha + 600kg K/ha
T7	Control

Thereafter, soaked and non soaked seeds were placed on Whatman No. 1 filter papers, moistened with sterile water and placed in 9 cm Petri dishes. Each Petri dish contained ten seeds. The experiment was a 2x7 factorial arranged in completely randomized design (CRD), replicated five times. The Petri dishes were covered and observed for 28 days for germination and mycelia growth.

Effect of previous fertilizer treatment and growth media on seedling emergence and growth of passion fruit seeds

Soilless media were composted from rice hull, poultry manure and saw dust. The media were composted for 10 weeks before seeds were planted. The

composition of the various media, on volume basis was as follows:- medium 1: 1:1:1– rice hull: poultry manure: sawdust, medium 2:3:2 – saw dust and poultry manure, medium 3:3:2 – rice hull and poultry manure and medium 4: top soil collected from the departmental farm at a depth of 5 cm. This was the control treatment. Physicochemical properties of the growth media were determined in the laboratory.

Seeds obtained from passion fruit plants previously grown under the varying fertilizer treatments were planted 1cm deep in perforated 3-litre plastic buckets filled with the various growth media, leaving an allowance of about 2.5 cm at the top. The planting was done on 11th March, 2009. Factorial combinations of seed source (previous fertilizer treatment) and growth media were arranged in completely randomized design (CRD) and replicated four times.

Emergence counts were started 12 days later when first seedling emergence was observed and were continued thereafter for about 4 weeks when seedling emergence ceased. At 4 weeks after planting (WAP), stands in each bucket were thinned to two after taking data on survival percentage. Beginning 4 WAP and at two-weekly intervals data was taken up to the 14th week on plant height and number of leaves. At the terminal point of the experiment (14WAP), data was also taken seedling vigour. Vigour assessment was based on a scale of 0–5 defined as follows: 0 = sickly and no sign of growth, 1 = pale green and retarded growth, 2 = pale green and no retarded growth, 3 = pale green, vigorously growing with broad leaves, 4 = greenish and growing healthily and 5 = Greenish, vigorously growing with broad leaves.

Germination and Emergence parameters

From germination and emergence counts obtained, germination parameters were estimated for the laboratory experiment, while corresponding emergence parameters were estimated for the nursery experiment. The parameters were percentage emergence at first germination/emergence (PEFG/PEFE) was obtained by calculating the percentage of seeds germinated/emerged on the first day germination/emergence was noticed.

Cumulative germination/emergence percentage (GCP/CEP) was the percentage of total germinated/emerged seeds.

Cumulative dormancy period (CDP) was the number of days taken for the seeds to break their dormancy and was calculated by counting the number of days it took the seed coat to break for the radicle to emerge.

Coefficient of velocity of germination/emergence (CVG/CVE) was used to determine germination/emergence speed and consistency using the formula developed by Kotowski (1926) as shown below:

$$\text{CVG} = \frac{NG1}{NG1\,X\,Nd} + \frac{NG2}{NG2\,X\,Nd} + \ldots + \frac{NGn}{NGn\,X\,Nd}$$

Where NG = Number of seeds that germinated at each germination day or interval;

Nd = Number of days taken for the seeds to germinate.

$$\text{CVE} = \frac{NE1}{NE1\,X\,Nd} + \frac{NE2}{NE2\,X\,Nd} + \ldots + \frac{NEn}{NGn\,X\,Nd}$$

Where NE = Number of seeds that emerged at each emergence day or interval;

Nd = Number of days taken for the seeds to emerge.

Days to 50 percent germination/emergence (D50%G/D50%E) was the number of days taken for 50% of the seeds/seedlings to germinate/emerge.
Days to first germination/emergence (DFG/DHE) was the number of days taken for the plumule to germinate/emerge.
Days to highest germination/emergence (DHG/DHE) was the number of days taken for the maximum number of seeds to germinate/emerge.

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) while mean separation where appropriate was done using LSD. The statistical software employed for the analysis was GENSTAT Discovery edition 2, Release 4.23 (GENSTAT, 2005).

Results

Statistical analysis could not detect significant interaction between factors for any of the traits considered. Consequently, results presented reflect only main effects of the treatments. The effect of seed soaking on germination and mycelia growth of seeds of passion fruit from previous fertilizer treatments are presented in Table 2.

Table 2. Effect of water soaking on germination and mycelia growth of passion fruit seeds at Nsukka, Nigeria.

Treatment	CVG	CDP	PEFG	DFPE	D50G	DHG	CGP	MO
Soaked	18.9	10.7	11.4	16.4	20.5	18.6	29.4	15.4
Non Soaked	24.5	9.3	13.4	17.2	16.2	18.6	39.1	4.6
$LSD_{(0.05)}$	3.8	NS	NS	NS	2.0	NS	5.9	4.7

CVG – Coefficient of velocity of germination; CDP – Complete dormancy period; PEFG – Percent radicle emergence at first germination; DFPE – Days to first plumule emergence; D50G – Days to 50% germination; DHG – Days to highest germination; CGP – Cumulative germination percent; MO – Mycelia occurrence.
NS – No significant difference

Coefficient of velocity of germination (CVG), days to 50% germination (D50G), cumulative germination percent (CGP) and mycelia occurrence (MO) were significantly affected by water soaking. The non soaked seeds had significantly higher CVG and CGP but lower D50G and MO. Table 3 is a summary of effect of previous fertilizer treatment on 100-seed weight, germination and mycelia occurrence of seeds of yellow passion fruit. All parameters estimated were significantly influenced by previous fertilization except CDP, PEFG and DHG. It was remarkable that T3 had the highest CVG and CGP, two important germination indices. DFPE was highest for T5 while T3 had the lowest D50G. Mycelia occurrence ranged from a high of 16 (T7) to a low of 1.0 (T4).

Table 3. Effect of previous fertilizer treatment on seed weight, germination and mycelia growth of passion fruit seeds at Nsukka, Nigeria.

Previous fertilizer treatment	100-seed wt (g)	CVG	CDP	PEFG	DFPE	D50G	DHG	CGP	MO
T1	1.74	21.3	10.7	12.0	16.8	21.0	19.2	35.0	15.5
T2	1.84	19.6	9.0	16.0	16.1	18.3	17.9	39.0	12.0
T3	1.84	34.4	7.6	15.0	13.0	14.6	18.8	65.0	6.0
T4	1.82	14.1	13.0	11.0	18.2	18.5	17.7	21.0	1.0
T5	1.78	9.1	11.7	9.0	22.9	18.5	21.5	12.0	8.0
T6	1.80	23.3	10.0	12.0	16.3	19.5	16.1	34.0	12.0
T7	1.93	26.9	8.0	12.0	14.1	19.0	16.7	34.0	16.0
$LSD_{(0.05)}$	0.01	7.2	NS	NS	3.1	3.6	NS	11.1	8.8

CVG – Coefficient of velocity of germination; CDP – Complete dormancy period; PEFG – Percent radicle emergence at first germination; DFPE – Days to first plumule emergence; D50G – Days to 50% germination; DHG – Days to highest germination; CGP – Cumulative germination percent; MO – Mycelia occurrence.
NS – No significant difference

The physicochemical attributes of nursery growth media as presented in Table 4 indicated that the control medium had low values of most of the attributes except bulk density, Na, K and P where the reverse was the case.

Nursery growth media and previous fertilizer influence on emergence attributes of seeds of yellow passion fruit are presented in Table. 5. Nursery media exerted significant effect only on days to 50% emergence (D50E) and cumulative percent emergence (CPE) with the control giving inferior performance. The other soilless media were at par statistically in the two attributes. On the other hand, all emergence attributes considered responded significantly to previous fertilizer treatment. However, T3 was outstanding in terms of speed (CVE) and amount (CPE and PEFE) of seedling emergence. Medium one performed better than all other media ($P<0.05$) in the attributes considered except survival percent which did not respond significantly to growth medium. With respect to previous fertilizer treatment, T3 produced the tallest plants. It also did better in terms of number of leaves, seedling vigour and survival percent though in this later cases, performance was not significantly different from that of T2, T4 and T5, T1, T2, T4 and T5, and T1, T2 T5, T6 and T7 respectively. The growth trend of passion fruit seedlings as presented in Figure 1 showed the better performance of M1, although this was noticeable in leaf production much earlier than in plant height. It was evident that M4 started well but declined thereafter. In terms of previous fertilizer treatment, T3 enhanced outstanding growth right from the first week of measurement, although in the case of leaf number, it was caught up by T2, 12-14WAP.

Table 4. Physicochemical properties of growth media used in assessing.

Growth Media	Bulk Density (g/cm3)	Water Holding Capacity (%)	pH	Organic Carbon (%)	Organic Matter (%)	N (%)	Na (%)	K (%)	Ca (%)	Mg (%)	P (ppm)
M1	1.06	103.29	7.1	24.64	42.48	1.12	0.10	0.04	3.00	1.14	0.48
M2	0.89	134.20	7.4	26.53	45.74	0.84	0.10	0.08	4.00	1.80	0.33
M3	1.17	120.30	6.8	26.53	45.74	1.98	0.12	0.07	3.70	1.38	0.30
M4	1.65	54.10	5.8	0.88	1.51	0.09	2.26	2.62	2.80	1.00	19.68

Table 5. Effect of growth media and previous fertilizer treatment on seedling emergence, growth and survival of yellow passion fruit seeds under nursery conditions at Nsukka, Nigeria.

Treatment	CVE	DFE	PEFE	D50E	CPE	Plant height (cm)	No. of leaves	Seedling vigour	Survival percent
Growth media									
M1	23.8	12.1	15.7	17.8	51.0	18.3	11.5	3.5	85.7
M2	24.6	11.8	16.2	18.2	50.0	12.6	9.4	2.4	78.7
M3	23.7	12.1	13.8	17.4	46.7	9.7	7.9	1.8	92.9
M4	22.4	12.0	14.8	15.7	14.9	14.5	5.2	1.5	95.2
$LSD_{(0.05)}$	NS	NS	NS	1.8	5.4	3.3	1.6	0.5	NS

Previous fertilizer treatment									
T1	19.6	12.8	13.3	19.9	33.3	11.3	7.7	2.1	91.7
T2	26.1	11.8	15.0	15.3	54.2	14.8	10.3	2.8	91.7
T3	31.7	11.3	22.5	13.4	81.7	19.6	9.6	2.8	95.8
T4	20.7	11.8	12.5	23.2	32.5	13.3	8.6	2.5	62.5
T5	17.4	13.2	16.0	17.2	29.7	12.9	9.1	2.3	83.3
T6	25.3	11.3	16.7	15.7	50.0	12.0	7.8	1.9	95.8
T7	25.2	11.8	15.8	16.0	50.8	12.7	6.6	1.8	95.8
LSD $_{(0.05)}$	4.5	0.9	7.1	1.8	7.1	4.3	2.2	0.7	18.9

CVE – Coefficient of velocity of emergence; DFE – Days to first emergence; PEFE – Percent emergence at first emergence; D50E – Days to 50% emergence; CPE – Cumulative percent emergence.
NS – No significant difference.

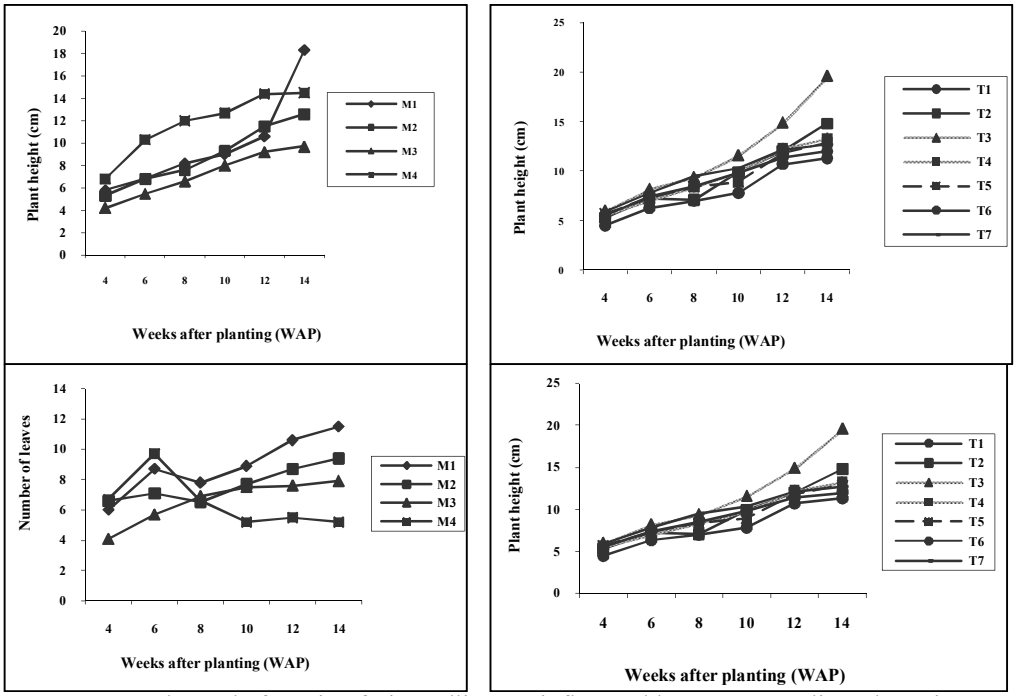

Fig. 1. Growth trend of passion fruit seedlings as influenced by nursery media and previous fertilizer treatment of mother plants.

Discussion

The better germination attributes of non-soaked seeds of passion fruit compared to those that were soaked in water contrasts with results obtained in other species such as jackfruit (Sonwalker, (1951), cashew (Argles, (1976), *Lanea macrocarpa* (Dupriez and De Leener, 1989) and shea (Ugese *et al.,* 2007). Morton (1987) observed that even though water soaking of passion fruit seeds is often recommended, it has never proved useful; in fact it has even

proved deleterious in this case. The high mycelia growth on water soaked seeds of the species could be implicated in the low and sluggish germination. Deleterious effect of water soaking of seeds has been ascribed to microbial action, among others (Hartmann *et al*., 1990). This in the passion fruit is even more pertinent considering that passion fruit is highly susceptible to fungal diseases (van Ee, 1999), thereby increasing the chances of seed infection right from the field. The extent to which seed quality is affected depends on the part of the seed that is most affected (Schmidt, 2000). In the case under consideration, it appears most likely that fungal propagules on or in the seed were activated by the presence of water during soaking, thereby promoting fungal growth while depressing seed germinability.

Fertilizer treatment of mother plants exerted significant influence on resultant seed quality in relation to weight, germination/emergence, growth and survival. Effect of fertilizer nutrients on seed vigour is not direct but has been attributed to their influence on seed maturation and seed chemical composition (Cardwell, 1954). In this study, passion fruit plants treated with 20t/ha poultry manure + 50 kgN/ha + 150 kg K/ha (T3) produced seeds with superior vigour. Although seed weight has strong positive correlation with seedling emergence and growth (Cardwell, 1954; Dupriez and De Leener, 1989; Ugese *et al*., 2007), the better performance of the above treatment (T3) cannot be attributed exclusively to seed weight. This is because other fertilizer treatments which recorded higher or equivalent values could not perform as much. It is therefore likely that seed chemical composition was influenced by fertilization of mother plants in favour of some chemical entity that normally facilitates germination. In grape vine, *Vitis vinifera,* N-fertilization was reported to influence abscisic acid content of xylem sap (Peuke, 2000). Generally, a variety of growth hormones such as gibberellins, abscisic acid and cytokinins are involved in seed germination (Hartmann *et al*., 1990).

The less number of days to 50% emergence and higher cumulative percentage emergence recorded by the soilless media in contrast to topsoil could be attributed to physical qualities of growth media. According to Cardwell (1954), one of the factors determining seedling emergence is soil strength, defined by bulk density and moisture content, and which increases with decrease in soil moisture content. The soilless media had lower bulk densities but higher water holding capacities. As such, they could offer less resistance to seedling emergence while enhancing germination since one of the requirements for seed germination is adequate moisture content (Hartmann *et al*., 1990). Baiyeri and Mbah (2006) also obtained higher percentage emergence of African breadfruit (*Treculia africana*) in soilless media compared to the soil based media.

Medium 1 (M1) was outstanding in growth attributes–plant height, number of leaves and plant vigour-suggesting that its blend of chemical and physical properties were the best for passion fruit seedlings. Interestingly, while the height of seedlings grown in media 1 became outstanding 14 WAP, number of leaves of seedlings grown in same media showed better performance much earlier (Fig. 1). In the later case, medium 4 (topsoil) had higher leaf numbers from 4-6 WAP, dropping thereafter. This is a pointer to the nutrient potential of the growth media. Thus topsoil was able to release its nutrients much more quickly which were exhausted sooner than later. On the other hand, medium 1 in particular, was able to release its nutrients over a longer period due to mineralization of organic matter, hence the higher and more sustained seedling growth. Differential seedling growth response to nursery media has been reported in studies involving species such as cashew (Baiyeri, 2003), African breadfruit (Baiyeri and Mbah, 2006), sheanut tree (Ugese, 2009) and tamarind (Ugese, 2010). Generally, water soaking of passion fruit seeds has been found to be detrimental to seed quality in terms of fungal growth and germination or emergence. Previous fertilizer treatment of mother plants has significant influence on seed quality while soilless growth media provides a better environment for seedling emergence and growth compared to topsoil.

References

Alegbejo, M. D. 2004. Growing passion fruit in Northern Nigeria. Horticulture Magazine 2: 9.

Ani, J. U. and Baiyeri, K. P. 2008. Impact of poultry manure and harvest season on juice quality of yellow passion fruit (*Passiflora edulis* var. *flavicarpa* Deg.) in the sub-humid zone of Nigeria. Fruits 63: 239-247.

Anonymous. 2010. Fact Sheets: Passionfruit. Ministry of Agriculture, Forestry and Fisheries, St. Lucia. Website: http://www.slumaffe.org. Accessed 23/08/2010.

Argles, G. K. 1976. Annarcadium occidentale–Cashew In: Garner, R. J. (Ed) The Propagation of Tropical Fruit Trees. FAO/Commonwealth Agric. Bureaux, 184-222Pp.

Baiyeri, K. P. 2003. Evaluation of nursery media for seedling emergence and early seedling growth of two tropical tree species. Moor Journal of Agricultural Research 4: 60-65.

Baiyeri, K. P. 2005. Response of *Musa* species to macro-propagation. 11: The effects of genotype, initiation and Weaning media on sucker growth and quality in the nursery. African Journal of Biotechnology 4: 229-234.

Baiyeri, K. P. and Mbah, B. N. 2006. Effects of soilless and soil based nursery media on seedling emergence, growth and response to water stress of African breadfruit (*Treculia africana* Decne). African Journal of Biotechnology 5: 1405-1410.

Cardwell, V. B. 1954. Seed germination and crop production, In: Physiological Basis of Crop Growth and Development. American Society of Agronomy/Crop Science Society of America, 53-92Pp.

Dupriez, H. and De Leener, P. 1989. African Gardens and Orchards: Growing Vegetables and Fruits. Macmillan Publishers Ltd., London. 333pp.

van Ee, S. 1999. Fruit Growing in the Tropics, 2nd Ed. Agrodok-series No.5. Agromisa Foundation, 88pp.

Kotowski, F. 1926.Temperature relations to germination of vegetable seeds. Proceedings, American Society of Horticultural. Science 23: 176-184.

Hartmann, H. T., Kester, D. E. and Davies, F. T. Jr. 1990. Plant Propagation: Principles and Practices (5th Edition). Prentice Hall, New Jersey, 647pp.

Morton, J. F. 1987. Passionfruit, in: Morton, J. F. Fruits of Warm Climates, Miami, Florida, 320- 328Pp.

Paull, R. E. 1998. Passionfruits, in: Nakasone, N. Y., Paull, R. E. (Eds), Tropical Fruits. CABI Publishing Company, New York, USA, 275-291Pp.

Peuke, A. D. 2000. The chemical composition of xylem sap in *vitis vinifera* l. cv. Riesling during vegetative growth on three different Franconian vineyard soils and as influenced by nitrogen fertilizer. American Journal of Enology and Viticulture, 51:329-339

Schmidt, L. 2000. Guide to Handling of Tropical and Subtropical Forest Seed. Danida Forest Seed Centre, Denmark, 511pp.

Sonwalker, M. S. 1951. A study of Jackfruit seeds. Indian Journal of Horticulture, 8: 27-30

Ugese, F D., Ojo A. A. and Bello, L L. 2005. Effect of pre-sowing treatment and nut orientation on emergence and seedling growth of seeds of shea butter tree (*Vitellaria paradoxa).* Nigerian Journal of Botany 18:294-304.

Ugese, F. D., Ojo A. A. and Adedzwa, D. K. 2007. Effect of sowing depth and seedsize on emergence and seedling growth of seeds of shea butter tree (*Vitellaria paradoxa).* Nigerian Journal of Botany 20:93-102.

Ugese, F. D. 2010. Effect of nursery media on emergence and growth of tamarind (*Tamarindus indica* L.) seedlings. Journal of Animal and Plant Sciences, 8: 999-1005.

Ugese, F. D. 2009. Characterization and Propagation of the Nigerian Shea Butter Tree (*Vitellaria paradoxa* C. F. Gaertn.) Species. PhD Thesis, University of Nigeria, Nsukka, 199pp.

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