Journal of Life Sciences Research
ISSN : 2408-9184
Vol. 1, No. 2, 41-44, 2014
http://asianonlinejournals.com/index.php/Lifsc/index

Study of Seed Orientation in Different Depths in *Jatropha Curcas* L.

P.Srimathi[1] --- N. Mariappan[2] --- L. Sundaramoorthi[3]

[1]Professor and Head- Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbator, Tamil Nadu, India.
[2,3]Assistant Professors- Vanavarayar Institute of Agriculture, Manakkadavu, Pollachi, Tamil Nadu, India.

Abstract

Seeds were sown in three orientations (Radicle downwards, radicle upwards and flat position) at four different depths (1, 2, 3 and 4 centimeters) to improve the germination on *Jatropha curcas.* The results revealed that sowing seed at 2 centimeter depth with radical downwards position enhanced the production of normal seedling and the germination percentage (85%). Compare to radicle downward and flat position of seed at different depth of sowing, speed of emergence and abnormal seedling existence were lower and higher respectively in radicle upward position of seeds with 4 centimeter depth.

Keywords: *Jatropha curcas*, Seed, Orientations, Depth of sowing, Normal seedlings.

1. Introduction

Jatropha curcas is presently getting more importance in plantation forestry in India and worldwide, due to their ecofriendly nature and the depleting levels of fossil fuel. All oil seeds are capable of giving biofuel, but due to other economic uses and wider adaptability, a few crops are focused for research on biofuels as an alternative source of automobile fuel [1]. Among the biofuel crops, J*atropha curcas* which is perennial in nature and non-edible oil tree, preferable for production of biofuel with economic feasibility [2]. Studies on orientation of seeds at different depths of sowing have occupied the attention of many research workers in several species and most of the results are contradictory and species specific. However Thapliyal [3] in Chirpine, Sharma and Pruohit [4] in sal, Swaminathan, et al. [5] in *Derris indica* and Masilamani [6] in *Tectona grandis* reported a positive correlation between seed orientation and seedling quality. *Jatropha curcas* generally propagated through seeds and seedlings are being used for raising plantation. This crop possesses bigger size seeds, indirectly requiring specific sowing methodology for production of good quality transplantable elite seedlings.

Seed orientation is one such technique where the seeds are sown in respect to the genetic structural component *viz.*, embryo and storage tissue [7]. Sivasamy [8], Masilamani [6] and Gunasekaran [9] with their research on, pungam, teak and rubber respectively reported that the seed orientation at depth of sowing had effective influence on production of elite seedlings at nursery and also under laboratory conditions [10]. This emerging biofuel crop is requiring standard technique for testing their quality, which would be helpful in trade of seed / seedlings. Hence, for selection proper method of seed sowing in nursery based on seed orientation and depth, this study was initiated in *Jatropha curcas*.

2. Material and Methods

2.1. Seed Sources

Bulk seeds of Jatropha (*Jatropha curcas)* from Mettupalayam (11.3000°N 76.9500°E) Tamil Nadu (India).

2.2. Experimentation and Experiment Materials

Collected seeds were homogenized based on weight using specific gravity grading. The seeds were sown in germination trays filled with sand media in four replicates of 100 seeds each in three different orientations (method of sowing based on radicle position) *viz.*, radicle upwards, radicle downwards and flat at four different depths (1, 2, 3 and 4 centimeters). The seeds sown were kept in the germination room maintained at 25 ± 2^{0}C and 95 ± 2% RH.

2.3. Observations

After the germination period of 16 days, *Jatropha curcas* seedlings were evaluated for the seed and seedling quality characters. Observations were made on germination, based on normal seedlings [11] percentage and the seedling vigour evaluations on days to first germination, abnormal seedlings (%), speed of germination [12], root length (cm), shoot length (cm) [13] and dry matter production of 10 seedling^{-1} (g). The vigour index values were computed as per Abdul - Baki and Anderson [14].

2.4. Statistical Analysis

The data gathered were analysed as per Panse and Sukhatme [15] at 0.05% probability for understanding the significance of variance.

3. Results and Discussion

Highly significant results were obtained for all the evaluated characters *viz.*, days to first germination, germination (%), abnormal seedlings (%), speed of germination, shoot length (cm), root length (cm), dry weight of 10 seedlings^{-1} (g) and vigour index. The species variation could be attributed to their the genetic variation that expressed their uniqueness in time of emergence, germination expression and seedling growth rate especially, the days to first germination which vary within the species due their specific genetic identity [8, 16]. The seed orientations with different depth of sowing also expressed highly significant variations for the mentioned seed and seedling quality characters (Table. 1).

The days to first germination was observed in five days in radicle downward with 2 cm depth however it was one day earlier than other orientation and depths. But the final germination percentage, based on normal seedlings [11] vary widely with orientation and depths of sowing, the seeds sown as radicle downwards with 2 cm depth recorded the maximum germination of 85 per cent followed by flat orientation with 2 cm depth of the seed was 80 per cent. Germination percent in 1st cm and 4th cm was least compare to other depths of three orientations (Table. 1). The seed sown as radicle upwards with different depths were produced highest number of abnormal seedlings than other orientations with depths.

Thapliyal [3] reported that as per the cholordy-went theory the germination and seedling growth of seeds placed as micropylar (radicle) end upwards were poorer, since the auxin produced were liberated in the root tip and accumulated preferentially in the lower half and moves basipetally into the elongation zone. This polarized lateral movement of auxin was considered to be dependent on metabolic energy. According to the theory (a) there is inherent auxin in the lower side of elongating zone and (b) there is inherent difference in the response of stem and root to auxins. So ,the change in position of seed in relation to gravitational force disturbs the polar flow of auxin from tip to the zone of elongation as the concentration of auxin increase more on the lower than on the upper side of horizontally placed organs. The growth rate increases with the increased accumulation of auxin and as a result, a shoot will grow away showing negative geotropic property and a root because of inherent differences in response will grow towards the lower side showing positive geotropic property. Negative geotropism shows accelerating influence of auxin on the growth of shoots while positive geotropism shows retarding influence of auxin on those roots [7].

Bennet, et al. [17] also suggested that the inversion of seedling might bring about abnormal chemical or prebiotic changes and the manifestations of these changes bring abnormal morphological development in the seedlings. Hence, this might be reasonable to assume that the vigorous seeds produced by upright seedlings by virtue of their inability to maintain functional metabolic integrity and subcellular co-ordination event, under adverse conditions by affecting curvatures the seeds oriented as radical downwards recorded the lower germination and higher abnormal seedlings. The proper directional growth of plumule and radicle, require additional hormones as well as extra energy for better seedling survival and emergence.

Orientation or the placement of seed is known to influence seed germination and seedling growth especially in crops with larger sized seeds, the perennial tree crops, whereas in small seeded crops like wheat, rice and barley, the seed sowing as vertical inverted position with embryo ends upward gave the best germination per cent and seedling vigour [18]. The researchers working with species with larger size seeds also expressed wider variability on seed quality expression with seed orientation. [19] observed that in cucurbitaceous vegetables, emergence occurred early and percentage of emergence as well as seedling vigour were higher when the seeds were sown in vertical orientation (micropylar end upwards), while Gunasekaran [9] convinced that horizontal orientation with micropylar end of seed facing sideways proved superior to vertical and inverted position in Clove (*Syzygium aromaticum*), Nutmeg (*Myristica fragrans*) and Rubber (*Hevea brasiliensis*). Germination behaviour was hypogeal in nutmeg and rubber and epigeal in clove. In spite of such variation horizontal orientation performed uniformly better in all these plantation species. Also Sorensen and Campbell [20] in Douglas-fir (*Pseudotsuga menziesii*), Parameswari [21] in Tamarind (*Tamarindus indica*) and [22] in Sal (*Shorea robusta*) reported that seeds should be sown in upright position of seed sowing produced better seedlings. But Sivagnanam [23] in *Azadirachta indica*, Gurunathan and Srimathi [10] in *Jatropha curcas* and Elfeel [24] *Balanites aegyptiaca* observed that downward micropylar orientation with suitable depths enhanced the germination of the seeds indicating that selection of orientation is crop specific owing to the position of radical in their seed structure and this findings highly supporting present study.

Thus the study revealed that *Jatropha curcas* seeds are to be sown at a depth of 2 cm positioning the radicle downwards for maximization of seed germination and seedling characteristics.

4. Acknowledgement

The authors are grateful to National Oilseeds and Vegetable Oils Development (NOVOD) Board for funding this scheme.

References

[1] P. Nigama and A. Singh, "Production of liquid biofuels from renewable resources," *Progress in Energy and Combustion Science,* vol. 37, pp. 52–68, 2011.

[2] A. Kumar and S. Sharma, "Potential non-edible oil resources as biodiesel feedstock: An Indian perspective," *Renewable and Sustainable Energy Reviews,* vol. 15, pp. 1791–1800, 2011.

[3] R. Thapliyal, "Influence of seed orientation on seedling emergence in chir plant (Pinus Roxburgii Sarg.)," *Indian J. Exp. Biol.,* vol. 17, pp. 119-120, 1979.

[4] M. M. Sharma and S. Pruohit, "Seedling survival and seed germination under laboratory condition in Shorea robusta," *Seed Sci. & Technol.,* vol. 8, pp. 283-287, 1980.

[5] C. Swaminathan, R. S. V. Rai, K. K. Suresh, and K. Sivagnanam, "Improving seed germination of derris indica by vertical sowing," *J. Trop. For. Sci.,* vol. 6, pp. 2, 152-158, 1993.

[6] P. Masilamani, "Seed technological studies in teak (Tectona Grandis Linn)," Ph.D. Thesis. Tamil Nadu Agricultural University, Coimbatore, 1996.

[7] S. Pandey and B. Sinha, *Plant physiology*. New Delhi: Vikas Publishing House Pvt Ltd, 2004.

[8] M. Sivasamy, "Net production effect, seed production spectrum and quality polymorphism as influenced by ecology in Azadirachta indica and Ailanthus excelsa," Ph.D. Thesis, Tamil Nadu Agricultural University, Coimbatore, 1991.

[9] M. Gunasekaran, "Seed technological studies in clove (Syzygium Aromaticum L.), Nutmeg (Myristica Fragrans. Houtt) and Rubber (Hevea Brasiliensis Muell - Arg)," Ph.D. Thesis. Tamil Nadu Agricultural University, Coimbatore - 3, 1997.

[10] N. Gurunathan and P. Srimathi, "Influence of seed orientation at different depths of sowing in Jatropha curcas," *Range Management and Agroforestry,* vol. 32, pp. 100-103, 2011.

[11] ISTA, "International rules for seed testing," *Seed Sci. & Technol. (Supplement Rules),* vol. 27, pp. 25-30, 1999.

[12] J. Maguire, "Speed of germination aid in selection and evaluation for seedling emergence and vigor," *Crop Science,* vol. 2, pp. 176-177, 1962.

[13] N. Tunwar and S. Singh, *Minimum seed certification standards. Central seed committee*. New Delhi: Department of Agriculture and Cooperation, Govt. of India, 1988.

[14] A. Abdul - Baki and J. Anderson, "Vigour determination in soybean seed by multiple criteria," *Crop Science,* vol. 13, pp. 630–633, 1973.

[15] V. Panse and P. Sukhatme, *Statistical methods for agricultural workers*. New Delhi: ICAR, 1985.

[16] Y. Soeda, M. Konings, O. Vorst, A. M. L. Houwelingen, G. Van Stoopen, C. Maliepaard, J. Kodde, R. Bino, S. Groot, and A. V. D. Geest, "Gene expression programs during Brassica Oleracea seed maturation, osmopriming, and germination are indicators of progression of the germination process and the stress tolerance level," *Plant Physiology,* vol. 137, pp. 354–368, 2005.

[17] C. Bennet, T. Younis, and R. Esnauff, "Geotropic behaviour of roots," *J.Expt.Bot.,* vol. 10, pp. 69 - 86, 1959.

[18] O. Bagoury, "The effect of the orientation of some cereal grains in the seedbed on seedling growth," *Seed Science and Technology,* vol. 1, pp. 759-766, 1973.

[19] V. Krishnasamy, "Effect of orientation of seed placement in soil on seedling emergence in some cucurbitaceous vegetables," *Seed Research,* vol. 20, pp. 70-73, 1992.

[20] F. Sorensen and R. Campbell, "Germination rate of douglas-fir [Pseudotsuga Menziesii (Mirb.) Franco] seeds affected by their orientation," *Annals of Botany,* vol. 47, pp. 467-471, 1981.

[21] K. Parameswari, "Seed technological studies in tamarind (Tamarindus Indica Linn.)," M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 1999.

[22] M. Serajuddoula and A. H. M. M. Rahman, "Effect of sowing orientation on germination of sal seed," *Bano Biggyan Patrika,* vol. 14, pp. 1-2, 56-58, 1985.

[23] K. Sivagnanam, "Growth biology, reproductive strategy and seed production spectrum in neem (Azadirachta Indica A. Juss.)," Ph.D., Thesis. Tamil Nadu Agricultural University, Mettupalayam, 1995.

[24] A. A. Elfeel, "Effect of seed pre-treatment and sowing orientation on germination of balanites aegyptiaca (L.) Del. Seeds," *American-Eurasian J. Agric. & Environ. Sci.,* vol. 12, pp. 897-900, 2012.

Table-1. Influence of depth of sowing and seed orientation on seed and seedling quality characters of *Jatropha curcas*.

Depth (cm) (D)	**Seed orientations (O)**							
	Radicle Down	**Radicle Up**	**Flat**	**Mean**	**Radicle Down**	**Radicle Up**	**Flat**	**Mean**
	Day to first germination				**Germination (%)**			
1	6	6	6	6	67 (55.1)	63 (52.5)	68 (55.6)	66 (54.4)
2	5	6	6	6	85 (67.2)	78 (62.0)	80 (63.4)	81 (64.2)
3	6	7	6	6	82 (65.1)	74 (59.4)	78 (61.8)	78 (62.1)
4	6	7	7	7	76 (60.7)	64 (53.3)	68 (55.4)	69 (56.5)
Mean	6	7	6		78 (62.1)	70 (56.8)	73 (59.0)	
CD	D	O	D x O		D	O	D x O	
(P=0.05)	0.7	NS	NS		1.4	1.2	NS	
Depth (cm) (D)	**Abnormal seedlings (%)**				**Speed of germination**			
1	1	4	1	2	5.2	4.7	4.9	5.0
2	0	2	0	1	5.7	5.0	5.3	5.3
3	0	4	1	2	5.3	4.5	5.0	4.9
4	2	5	2	3	5.1	4.4	4.7	4.7
Mean	1	4	1		5.3	4.7	5.0	
CD	D	O	D x O		D	O	D x O	
(P=0.05)	0.5	0.4	NS		0.1	0.1	NS	
Depth (cm) (D)	**Shoot length (cm)**				**Root length (cm)**			
1	26.1	25.9	26.7	26.2	6.6	6.6	6.6	6.6
2	30.2	28.0	30.0	29.4	7.9	7.3	7.5	7.6
3	29.9	27.9	29.4	29.1	7.7	6.8	7.5	7.3
4	26.1	26.0	26.2	26.1	6.6	6.1	6.4	6.4
Mean	28.1	26.9	28.1		7.2	6.7	7.0	
CD	D	O	D x O		D	O	D x O	
(P=0.05)	0.7	0.6	NS		0.3	0.2	NS	
Depth (cm) (D)	**Fresh weight 10 seedlings^{-1} (g)**				**Dry weight 10 seedlings^{-1} (g)**			
1	48.8	47.2	48.3	48.1	2.9	2.6	2.7	2.7
2	50.2	47.8	48.4	48.8	3.6	2.8	3.4	3.3
3	46.2	47.5	47.6	47.1	3.1	2.8	2.7	2.9
4	47.8	45.5	47.3	46.9	2.8	2.7	2.9	2.8
Mean	48.3	47.0	47.9		3.1	2.7	2.9	
CD	D	O	D x O		D	O	D x O	
(P=0.05)	NS	NS	NS		NS	NS	NS	
Depth (cm) (D)	**Vigour index**							
	Radical Down	**Radical Up**	**Flat**	**Mean**				
1	2200	2050	2265	2172				
2	3245	2748	2997	2997				
3	3093	2568	2866	2842				
4	2485	2060	2208	2251				
Mean	2756	2356	2584					
CD	D	O	D x O					
(P=0.05)	85.5	74.0	NS					

Note: * Figures in parentheses are arc sine transformed values
D denotes Depths of sowing
O denotes seed orientations
D x O denotes interaction of depths and orientations
NS denotes Non significant