Journal of Agricultural and Crop Research
Vol. 2(11), pp. 218-221, November 2014
ISSN: 2384-731X
Research Paper

Effect of liquid biofertilizers on enhancement of germination in stored seeds of *Pongamia pinnata*

N. Mariappan[1]* • P.Srimathi[2] • L. Sundaramoorthi[1]

[1]Vanavarayar Institute of Agriculture, Manakkadavu, Pollachi-642103, India.
[2]Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore-641 003, India.

*Corresponding author. E-mail: mariappann21@gmail.com.

Accepted 10th November, 2014

Abstract. Effect of biopriming of seed with liquid biofertilizers (*Azospirillum* and *Phosphobacterium*) was studied in stored seeds of *Pongamia pinnata* to improve the seed and seedling quality characters. The result revealed that seed treatment with liquid *Phosphobacterium* at 1.5% recorded higher germination (35%) followed by *Azospirillum* 0.5% (30%) after six months of storage.

Keywords: Biopriming, biofertilizers, seed storage, enhancement, seedling vigour, *Pongamia pinnata.*

INTRODUCTION

Pongamia pinnata (L.) Pierre (Leguminoseae, subfamily Papilionoideae) is a leguminous tree commonly called as Karanj or pungam having the potential of producing high seed oil and as a source of biofuel industry. For the past one decade, oil from pungam seeds has been seen as a potential source for biodiesel. *Pongamia pinnata* have the potential for high oil production from its seeds. It can grow on marginal land. Thus it is suitable for large-scale vegetable oil production for a sustainable biodiesel industry. The success of *P. pinnata* as a sustainable source of feedstock for the biofuels industry is dependent on an extensive knowledge of the genetics, physiology and propagation of this legume (Scott et al., 2008). The Government of India launched has a national programme to promote the large scale cultivation of the plants *Jatropha curcas* and *Pongamia pinnata* for biodiesel production and these are propagated from seeds (Handa et al., 2005; Karmee and Chadha, 2005).

Use of biomanures and biofertilizers for the production of quality planting stock in forest nurseries is well-known. Biofertilizers are biologically active products or microbial inoculants of bacteria, algae and fungi (Revathi et al., 2013). Microbes are effective in inducing plant growth as they secrets plant growth promoters (auxins, abscisic acid, gibberellic acid, cytokinis, and ethylene) and enhance seed germination and root growth (Santner et al., 2009).

Seed priming is a controlled hydration process that involves exposing seeds to low water potentials that restrict germination, but permits pre-germinative physiological and biochemical changes (Khan, 1992). Good seed germination and seed and seedling quality characters are important for forestry, horticulture and agriculture. Uneven or poor germination and subsequently inhomogeneous seedling growth can lead to great financial losses (Ghiyasi et al., 2008). Karthika and Vanangamudi (2013) reported that, seed priming is an effective seed invigouration method to increase the rate and uniformity of emergence and crop establishment. Biopriming, a seed treatment system that integrates the biological and physiological aspects of enhancing growth, disease control and increase in yield, involves coating the seed with biological agents and incubating the seed under warm, moist conditions. Seed may be planted moist or dried for storage. Many scientists and researchers are now recommending seed priming with liquid formulations of biofertilizers (Gomathy et al., 2007; Thamizh and Thangaraju, 2007; Martin and Maria, 2009), since they spread well and mix uniformly without any sticking agent over the seed surface (Rice

and Olsen, 1992). The main goal of this study was to look for the best biological treatments that could be applied to *P. pinnata* to get good quality of seedlings.

MATERIALS AND METHODS

Experimental materials

Bulk seeds were collected from phenotypically superior *Pongamia pinnata* trees in Coimbatore (11°1′6″N 76°58′21″E) region, Tamil Nadu. Good quality graded seeds were dipped with liquid *Azospirillum* and *Phosphobacterium* in different concentrations for 30 min viz., T_1 (*Azospirillum* 0.5%), T_2 (*Azospirillum* 1.0%), T_3 (*Azospirillum* 1.5%), T_4 (*Phosphobacterium* 0.5%), T_5 (*Phosphobacterium* 1.0%) and T_6 (*Phosphobacterium* 1.5%). Primed seeds were evaluated for initial seed quality characters and were stored under ambient condition and subsequently evaluated for seedling quality characters after third and sixth month of storage and compared with the unprimed seeds.

Seedling quality parameters

The treated seeds were evaluated for their seedling quality parameters viz., germination (%), root length (cm), shoot length (cm), fresh weight of 10 seedlings^{-1}(g), dry matter production of 10 seedlings^{-1}(g) under ambient room conditions (RH 95 ± 2% and 25 ± 2°C). Vigour index values were also computed by using the formula; Vigour index = Germination (%) x Total seedling length (cm) as per Abdul–Baki and Anderson (1973).

Storage of seeds

The seed were stored in cloth bags under the ambient conditions Coimbatore (11°1’6 N 76° 58’21 E and 320 MSL) for a period of six months and were observed for seed and seedling quality characters one in three months intervals as mentioned above room conditions.

Statistical analysis

The data gathered were statistically scrutinized as per Panse and Sukhathme (1985) under F test of significance for understanding the level of significance among the seed treatments, seed and seedling quality characters.

RESULTS AND DISCUSSION

Seeds bio-primed with liquid Phophobacterium at 1.5% registered higher germination (88 and 35%) at initial and after six months of storage compared to the non-primed seed. An increase of 20 and 57 per cent germination was noticed for phophobacterium at 1.5% than nonprime seeds at initial and six months of storage respectively (Table 1). Phophobacterium at 1.5%, Azospirillum 0.5% recorded 78 and 30 per cent germination for initial and after six months of storage respectively, which showed 10 and 50 per cent higher germination, respectively than non-primed seeds. Other seedling quality characters such as shoot and root length, dry matter production and vigour index values were expressed superior for the treatments viz., Phophobacterium at 1.5% and Azospirillum 0.5% than other bio-primed seeds and non-primed seeds (Table 1).

Seeds pelleted with biofertilizers might be due to the increased cytokinin production which actively involved in cell division (Suma et al., 2014) and production of growth regulating substances like auxin, GA and cytokinin (Kucey, 1988). An increase in the seedling growth due to liquid phosphobacteria seed treatment was reported by researchers (Ponnusamy, 1993) in *Azdirachta indica*; Vijaya kumari (2003) in *Azdirachta indica*, C*eiba pentandra* and *Emblica officinalis* which supported our findings. However, Suma et al, (2014) concluded that seeds of *Sesamum indicum* treated with *Azospirillum* enhanced the seedling vigour and the treated seed could be stored well up to 4 months. The relative enhancement of germination and seedling vigour might be attributed to the role of phosphorus solubilizing bacteria known as phosphobacteria in enhancing the solubilization of insoluble phosphorus and making it available to the germinating seed with consequent enhancement in the metabolic activity which resulted in higher germination (Cooper, 1979). Similar findings in the attempt of quality seedling production with biofertilizer application by Al-Hadad et al. (2014) in *Eucalyptus camaldulensis*; Vasantha et al. (2014) in *Tamarindus indica*; Revathi et al. (2013) in *Dalbergia sissoo*; Bhadauria et al. (2000) and Verma et al. (2008) in *Emblica officinali;* Verma et al. (2008) *in Tectona grandis;* and Krishna et al. (2008) in medicinal plants.

CONCLUSION

It is concluded that seed bioprimed with liquid biofertlizers such as Phophobacterium at 1.5% and Azospirillum at 0.5% were the best biopriming seed treatment for improving germination and seedling vigour and storability of *Pongamia pinnta* seeds.

ACKNOWLEDGEMENT

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

Table 1. Influence of liquid biofertilizers on stored seeds of *Pongamia pinnata.*

Liquid bio-fertilizer (T)	Periods of storage in months (S)							
	0	3	6	Mean	0	3	6	Mean
	Germination (%)				Shoot length (cm)			
T_1	78 (61.7)	65 (53.8)	30 (33.4)	58 (49.6)	29.8	35.5	26.0	30.4
T_2	73 (58.4)	43 (40.7)	25 (30.1)	47 (43.0)	29.2	30.7	31.1	30.3
T_3	72 (58.0)	48 (43.6)	15 (22.9)	44 (41.1)	28.8	30.2	21.0	26.6
T_4	83 (66.9)	45 (42.1)	25 (30.1)	51 (46.4)	29.2	29.6	24.0	27.6
T_5	83 (65.3)	48 (43.6)	25 (30.1)	52 (46.3)	35.0	29.4	20.0	28.1
T_6	88 (69.4)	58 (49.4)	35 (36.3)	60 (51.7)	25.6	30.1	25.5	27.0
Control	70 (56.9)	37 (37.2)	15 (22.9)	41 (39.0)	29.1	28.2	20.1	25.8
Mean	78 (62.2)	46 (44.3)	24 (29.4)		29.5	30.5	23.9	
CD (P = 0.05)	T	S	TxS		T	S	TxS	
	6.8	4.5	NS		1.4	0.9	2.4	
Liquid bio-fertilizer (T)	**Root length (cm)**				**Fresh weight 10 seedlings (g)**			
T_1	18.6	17.9	16.2	17.5	48.8	48.4	47.0	48.0
T_2	17.7	20.9	15.1	17.9	59.3	49.6	36.3	48.4
T_3	16.3	16.6	12.0	15.0	47.2	41.6	40.0	42.9
T_4	17.6	17.8	12.1	15.8	52.0	51.1	45.5	49.5
T_5	23.1	19.3	13.1	18.5	61.3	51.7	36.3	49.7
T_6	19.9	23.1	13.5	18.8	51.8	44.3	41.9	46.0
Control	18.7	16.8	12.0	15.8	49.0	39.5	35.8	41.4
Mean	18.8	18.9	13.4		52.7	46.6	40.4	
CD (P = 0.05)	T	S	TxS		T	S	TxS	
	1.2	0.8	2.1		3.8	2.5	6.5	
Liquid bio-fertilizer (T)	**Dry weight 10 seedlings (g)**				**Vigour index**			
T_1	12.9	11.1	10.8	11.6	3744	3473	1278	2831
T_2	11.5	10.1	12.2	11.3	3397	2194	1160	2250
T_3	13.2	13.0	9.8	12.0	3154	2225	502	1960
T_4	13.4	11.2	11.0	11.9	3883	2120	906	2303
T_5	11.4	10.9	8.8	10.3	4794	2311	832	2646
T_6	13.2	11.8	8.4	11.1	3979	3054	1362	2798
Control	9.4	9.0	8.5	8.9	3344	1637	488	1823
Mean	12.1	11.0	9.9		3756	2278	933	
CD (P = 0.05)	T	S	TxS		T	S	TxS	
	1.1	0.7	1.9		424.0	277.6	734.4	

* Figures in parentheses are arc sine transformed values. NS denotes Non-Significant value

REFERENCES

Abdul-Baki AA, Anderson JD (1973). Vigour deterioration of soybean seeds by multiple criteria. Crop Sci. 13:630-633.

Al-Hadad Z Kh, Soliman A Sh, Morsy EM, Kamel SM, El-Sayed AA (2014). Effect of Different Bio Fertilizers and Soil Media on Growth and Chemical Composition of *Eucalyptus camaldulensis* in North Africa. Journal of Horticultural Science & Ornamental Plants. 6(2): 59-70.

Bhadauria S, Pahari GK, Kumar S (2000). Effect of Azospirillum biofertilizer on seedling growth and seed germination of *Emblica officinalis*. Indian J. Plant Physiol. 5(2):177-179.

Cooper R (1979). Bacterial fertilizers in the Soviet Union. Soil Fert. 22:327-333.

Ghiyasi M, Seyahjani AA, Tajbakhsh M, Amirnia R, Salehzade H (2008). Effect of osmopriming with polyethylene glycol (8000) on germination and seedling growth of wheat (*Triticum aestivum* L.) seeds under salt stress. Res. J. Biol. Sci. 3(10):1249-1251.

Gomathy M, Thangaraju M, Gopal NO, Sarathambal C (2007). Comparative performance of liquid formulation of phosphobacteria with carrier based inoculants on the growth and yield of maize (CO 1). J. Soil Biol. 27(1&2):7-12.

Handa AK, Nandini D, Uma (2005). An alternative source of biofuel, seed germination trials of *Pongamia pinnata*. Int J. for Usufructs Manage. 6:75-80.

Karmee SJ, Chadha A (2005). Preparation of biodiesel from crude oil of *Pongamia pinnata*. Bioresour. Technol. 96:1425-1429

Karthika C, Vanangamudi K (2013). Biopriming of maize hybrid COH(M) 5 seed with liquid biofertilizers for enhanced germination and vigour. 8(25):3310-3317.

Khan AA (1992). Pre plant physiological seed conditioning. Hort. Rev. 13:131-181.

Krishna A, Patil CR, Raghavendra SM, Jakati MD (2008). Effect of Bio-Fertilizers on Seed Germination and Seedling Quality of Medicinal Plants Karnataka J. Agric. Sci. 21(4):588-590.

Kucey RMN (1988). Alteration of size of wheat root systems and nitrogen fixing bacteria measured under field conditions. Can.J.Microbiol. 34:735-739.

Martin D, Maria VF (2009). Field performance of a liquid formulation *Azospirillum brasilense* on dryland wheat productivity. Eur. J. Soil Biol. 45:3-11.

Panse VG, Sukhatme PV (1985). Statistical Methods for Agricultural Workers, Indian Council of Agricultural Research, New Delhi. p. 381.

Ponnusamy AS (1993). Seed technological studies in neem. M.Sc. (Agri.) Thesis, Tamil Nadu Agricultural University, Tamil Nadu, Coimbatore.

Revathi R, Mohan V, Jha MN (2013). Integrated nutrient management on the growth enhancement of *Dalbergia sissoo* Roxb. Seedlings. J. Acad. Indus. Res. 1(9):550-557.

Rice WA, Olsen PE (1992). Effect of inoculation method and size of *Rhizobium meliloti* population in the soil on nodulation of alfalfa. Can. J. Soil. Sci. 72:57-67.

Santner A, Calderon-Villalobos LIA, Estelle M (2009). Plant hormones are versatile chemical regulators of plant growth. Nature Chem. Biol. 5:301-307.

Scott PT, Pregelj CN, Hadler JS, Djordjevic MJ, Gresshoff PM (2008). *Pongamia pinnata*: an untapped resource for the biofuels industry of the future. Bioener. Res. 1:2-11.

Suma N, Srimathi P, Roopa VM (2014). Influence of Biofertilizer pelleting on seed and seedling quality characteristics of *Sesamum indicum*. Int. J. Curr. Microbiol. App. Sci. 3(6):591-594.

Thamizh VR, Thangaraju M (2007). Influence of liquid and cyst formulations of Azospirillum with inorganic fertilizers on the growth and yield of tomato. Afr. J. Biotech. 6(19):30-35.

Vasantha PT, Vijendrakumar RC, Guruprasad TR, Mahadevamma M, Santhosh KV (2014). Studies on effect of growth regulators and biofertilizers on seed germination and seedling growth of tamarind (*Tamarindus indica* L.). Plant Archiv. 14(1):155-160.

Verma RK, Jamaluddin, Thakur AK (2008). Effect of biofertilizers on growth of Aonla (*Emblica officinalis*) in nursery. Indian Forester. 134(1):125-130.

Verma RK, Jamaluddin, Dadwal VS, Thakur AK (2008). Economics of biofertilizer application on production of planting propagules of teak in a commercial nursery. Indian Forester. 134(7):923-931.

Vijaya kumari B (2003). Seed quality enhancement in neem, kapok and amla. Ph.D. Thesis. Bharathiar University, Tamil Nadu, Coimbatore.