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Full length Research paper

Effect of organic seed pelleting on seed storability and quality seedling production in biofuel tree species

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***Jatropha curcas* and *Pongamia pinnata* are the promising biofuel species worldwide that contained 35 to 45% seed oil, respectively. Due to the reason of high oil content of these seeds are liable to getting easily deteriorated by fungal and insects during storage and that could hold the limitation of spreading through afforestation. To resolve this problem, the present study was carried out with *J. curcas* and *P. pinnata* seeds pelleted with leaf powders of *Azadirachta indica*, *P. pinnata* and *Adhatoda vasica* in order to study the effects of botanical pelleting storability and production of quality seedlings at nursery. This experiment was conducted at Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India during 2009 to 2010. The results revealed that *J. curcas* and *P. pinnata* seeds pelleted with pungam and neem leaf powder showed the maximum germination percentage and growth characters at nursery, respectively. From the study, it was also observed that *Jatropha* seeds pelleted with pungam leaf powder recorded 169% higher germination and *P. pinnata* seeds pelleted with *A. indica* leaf powder registered 92% higher germination than control after 9 months of storage. We conclude from this study that, botanical leaf powder seed pelleting not only improve the longevity of seeds through protecting the seeds from fungal and insect attack but also improve the seed and soil relationships through enriching the rhizosphere region of seed to produce better growth and development.**

Key words: Jatropha, pungam, leaf powder pelleting, seed storage, growth, development.

INTRODUCTION

Jatropha curcas and *Pongamia pinnata* seeds are having a strong trend to deterioration because of their high oil content, demanding special attention and care during storage for the maintenance of their viability and vigour. Such aspect can be also considered valid for seeds of physic nut (*J. curcas*), which belongs to the Family Euphorbiaceae and pungam (*p. pinnata*) it belongs to the family Leguminaceae has stood nationwide for its potential potential production of biodiesel, due to the high oil content in the seeds about 40 and 35 to 45%, respectively (Beniwal and Chauhan, 2011).To address the continuing need for fuel in India, research on *J. curcas* and *P. pinnata* seeds are being done to explore its potential for producing bio-diesel.

Seed pelleting is applied to seeds to improve the outer structure into uniformly round seeds, which enable precision

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planting. Seed pelleting with plant parts can augment the seed quality, hence improving the seedling value and reduce cost of transplanting (Govinden and Levantard, 2008). At present we need to approach ecofriendly ideas and alternatives that recent time, the use of different plant parts and their byproducts has given the impression to bean effective alternative to noxious chemical insecticides and fungicides for controlling various insect pests and diseases in storage. As many as 2400 plant species in the world has been identified that have properties and biological activity against awide range of pests (Grainge and Ahmed, 1988).

Seed management techniques are employed to invigourate the seed by modifying the physiological stamina of the seed. Seed pelleting is one such physical treatment given to seed to invigorate the seedling vigour. Some of the common benefits of pelleting are uniformity in seed size, precision planting, uniform stands with reduced seed rate, more insect and disease resistance, better performance under stress conditions and additional nourishment to the seedlings (Peterhalmer, 2003). In addition it is also employed to add needy substance to the individual seed so that the seeds get invigourative effect on absorption of such materials, at initial watering by enriching the rhizosphere region of each and every seed as nutritive without physiological modification of seed but by simple physical alterations of the seed (Suma, 2005).

During the storage seeds or grains that might be infected by fungi which cause a deteriorate its viability, discoloration, various biochemical changes, heating and mustiness, loss in weight, and production of toxins when it is consumed by human and animals may injurious to their health (Arya and Perello, 2010). In many cases, fungi infecting seeds are seed-borne pathogens, they play an important role in the transmission of numerous pathogenic species to seedlings as well as to the soil (Dharmaputra et. al, 2009).

The oil seeds such as soybean, sunflower, and peanut are contributing much of the world's biodiesel production, thus oilseeds species currently beingwidely studied. Though, little importance has been given to the processes of seed storage, which constitutes a major problem for agriculture (Tekrony, 2006). There are several factors that are known to influence the progress of deterioration during seed storage but high temperatures and humidity during storage increase the deterioration speed of seeds (Pukacka et al., 2009).

Uses of different chemicals are costly and may cause natural hazard, whereas botanicals are less costly, easily available to the farmers, safe to handle and they can prepare easily. Comparative study of botanicals helps to choose the suitable one for storing the seeds. The study on seed pelleting in agriculture especially in field crops were well exploited but in case of tree species it is very scanty. Hence, there is an urgent need to develop appropriate seed pelleting technology for enhancing the growth and development of Jatropha and Pungam since these two tree species are very important biodiesel yielding trees. So keeping all the above facts in view, an attempt was made with Jatropha and pungam seeds to study the efficacy of botanical seed pelleting on storage and quality seedling production.

MATERIALS AND METHODS

Seed sources

The bulk seeds of *J. curcas* from Mettupalayam (11.3° N 76.95° E) and *p. pinnata* from Pillur (11.24251° N 76.96009° E) seed source of Karamadai, Coimbatore district of Tamil Nadu, India.

Experimental materials

The collected seeds were pelleted with leaf powders *viz.,* pungam (*P. pinnata*), neem (*A. indica*), and adathoda (*Adhatoda vasica*) leaf powders at 300 g $^{kg-1}$ of seed, as filler material using 10% maida as common adhesive (250 to 300 ml/kg^{-1}) and were dried in shade to reduce the moisture content to 9%.

Seedling quality parameters

The treated seeds were evaluated for their seedling quality *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 1 = 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 of Coimbatore (11°1'6 N 76° 58'21 E and 320 MSL) for a period of nine months and were observed for seed quality characters as mentioned above room conditions.

Statistical analysis

The data gathered were statistically scrutinized as per Panse and Sukhathme (1999) under F test of significance for understanding the level of significance among the seed treatments, seed and seedling quality characters.

RESULTS AND DISCUSSION

In the present investigation, significant mean performance for seedling growth were recorded by seeds pelleted with leaf powders of pungam (*P. pinnata*), neem (*A. indica*) and adathoda (*A. vasica)* as filler material using 10% maida as common adhesive (250 to 300 ml/kg) in jatropha and pungam at all periods of storage (Tables 1 and 2). There was a significant effect in terms of seedling quality characters on *J. curcas* germination using different botanicals (Table 1). The germination

Table 1. Influence of botanical seed pelleting on storability of Jatropha seeds.

Botanicals (B)	Periods of storage in Months(M)				
	Initial	After 3months	After 6months	After 9 months	Mean
			Germination (%)		
Neem	77 (61.13)	61(51.57)	48(44.03)	32(34.13)	55 (47.71)
Pungam	70(56.83)	69 (56.40)	48(43.67)	35(36.17)	56 (48.27)
Adathoda	78(62.27)	62 (51.83)	47(43.07)	25(29.93)	53 (46.78)
Control	67(54.83)	42 (40.57)	25(29.93)	13(34.13)	37 (39.87)
Mean	73(58.76)	59(50.09)	42(40.17)	26 (33.59)	
CD (P=0.05)	M		B		MB
	3.0*		3.0*		NS
Botanicals (B)			**Shoot length (cm)**		
Neem	28.5	26.3	22.9	23.1	25.2
Pungam	25.6	28.2	23.2	26.1	25.8
Adathoda	28.1	28.1	24.9	23.9	26.3
Control	27.7	21.7	22.3	22.3	23.5
Mean	27.5	26.1	23.3	23.8	
CD (P=0.05)	M		B		MB
	NS		NS		3.0
Botanicals (B)			**Root length (cm)**		
Neem	7.8	6.2	7.3	6.7	7.0
Pungam	7.5	8.2	6.3	7.7	7.4
Adathoda	7.9	6.6	6.3	5.9	6.7
Control	6.9	6.4	5.5	5.0	6.0
Mean	7.5	6.8	6.4	6.3	
CD (P=0.05)	M		B		MB
	NS		NS		1.4
Botanicals (B)			**Fresh weight 10 seedlings^{-1}(g)**		
Neem	49.7	47.7	47.2	38.5	45.8
Pungam	47.8	47.3	44.0	39.0	44.5
Adathoda	48.3	43.9	44.1	38.4	43.7
Control	47.4	41.5	34.8	34.8	39.6
Mean	48.3	45.1	42.5	37.7	
CD (P=0.05)	M		B		MB
	2.3*		2.3*		NS
Botanicals (B)			**Dry weight 10 seedlings^{-1}(g)**		
Neem	4.6	4.4	3.9	3.6	4.1
Pungam	3.7	4.6	3.3	3.9	3.9
Adathoda	4.4	4.4	3.2	3.7	3.9
Control	3.3	3.6	3.1	3.1	3.3
Mean	4.0	4.3	3.4	3.6	
CD (P=0.05)	M		B		MB
	0.3*		0.3*		NS
Botanicals (B)			**Vigour index**		
Neem	2786	1995	1460	938	1795
Pungam	2314	2524	1405	1182	1856
Adathoda	2820	2138	1446	735	1785
Control	2306	1183	693	368	1138
Mean	2556	1960	1251	806	
CD (P=0.05)	M		B		MB
	152.2*		152.2*		304.5*

*, Significant at P=0.05 level; NS, non-significant; M-period of storage in months; B, botanicals; MB, interaction between months of storage and botanicals.

Table 2. Influence of botanical seed pelleting on storability of pungam seeds.

Botanicals (B)	Periods of storage in Months(M)				
	Initial	3	6	9	Mean
			Germination (%)		
Neem	92(73.1)	70(56.9)	55(47.9)	23(28.3)	60(51.5)
Pungam	89(70.7)	68(55.6)	56(48.2)	19(25.8)	58(50.1)
Adathoda	95(76.5)	69(56.0)	50(45.0)	15(22.8)	57(50.1)
Control	84(66.4)	53(46.7)	44(41.3)	12(19.6)	48(43.5)
Mean	90(71.7)	65(53.8)	51(45.6)	17(24.1)	
CD (P=0.05)	B		M		BM
	3.9*		3.9*		NS
Botanicals (B)			**Shoot length (cm)**		
Neem	36.7	29.6	27.7	24.5	29.6
Pungam	32.1	26.2	27.0	23.8	27.3
Adathoda	33.8	27.7	27.1	27.8	29.1
Control	31.1	30.8	25.5	21.6	27.2
Mean	33.4	28.6	26.8	24.4	
CD (P=0.05)	B		M		BM
	NS		2.0*		NS
Botanicals (B)			**Root length (cm)**		
Neem	17.3	13.8	13.4	11.5	14.0
Pungam	17.8	13.2	12.8	12.6	14.1
Adathoda	16.0	13.3	11.6	17.7	14.6
Control	16.8	13.7	12.3	10.8	13.4
Mean	17.0	13.5	12.5	13.1	
CD (P=0.05)	B		M		BM
	NS		1.5*		3.0*
Botanicals (B)			**Fresh weight 10 seedlings (g)**		
Neem	58.3	46.6	49.2	45.9	58.3
Pungam	59.4	51.2	49.4	41.6	59.4
Adathoda	54.6	38.7	49.6	37.8	54.6
Control	55.1	44.3	47.7	43.5	55.1
Mean	56.8	45.2	49.0		56.8
CD (P=0.05)	B		M		BM
	3.2*		3.2*		NS
Botanicals (B)			**Dry weight 10 seedlings (g)**		
Neem	14.0	10.9	12.3	11.5	14.0
Pungam	13.6	11.8	12.1	10.8	13.6
Adathoda	13.1	10.0	11.9	10.7	13.1
Control	13.0	11.3	11.5	10.7	13.0
Mean	13.4	11.0	11.9		13.4
CD (P=0.05)	B		M		BM
	NS		0.7*		NS
Botanicals (B)			**Vigour index**		
Neem	4932	3035	2082	880	4932
Pungam	4441	2660	2206	692	4441
Adathoda	4701	2805	1933	681	4701
Control	4024	2359	1640	373	4024
Mean	4524	2714	1965		4524
CD (P=0.05)	B		M		BM
	286.9*		286.9*		NS

*, Significant at P=0.05 level; NS, non-significant; M-period of storage in months; B, botanicals; MB, interaction between months of storage and botanicals.

percentage was the highest in the seeds pelleted and stored with pungam leaf powder that recorded 35% followed by neem and adathoda were recorded 32 and 25%, respectively after nine months of storage. Untreated seeds showed only 13% germination thus revealed that 13, 11, and 7 time lower performance than pungam, neem and adathoda leaf powder pelleting. Similarly root length (cm), shoot length (cm), fresh weight (%), dry weight (%) and vigour index expelled significantly higher value in pungam pelleted seeds followed by neem and adathoda than control. However all pelleted seeds performed better than that of the unpelleted seeds due to their influence in enriching the efficiency of rhizosphere soil for production of quality seedlings. The better performance of pungam leaf powder might be because it acts as a wick in absorbingregulating and correcting the soil moisture availability and thus enhanced the better seed soil relationship (Lu et al. 1983). The leaf powders also contains gibberellins like substances, the saponins and micronutrients the zinc, which have synergistically activated to form the indole acetic acid (IAA).

In addition the chlorophyll molecules of leaf powders, amino acids and humic acid present in the soil rhizosphere might have acted as a chelating agent and activated the growth and development of pungam leaf powder pelleted seeds into robust seedling at nursery. The energy of the seed recorded through the seedling vigour parameters also highlighted that pungam leaf powder followed by neem leaf powder pelleting served as the better seed invigourative treatment. However, Bharathi (1999) expressed that seed pelleting with *Albizia amara* enhanced the seedling quality characters and helps in improving the germination of seeds under stress condition such as soil salinity. Gurunathan et al. (2006) also revealed that seed pelleting with pungam leaf powder at 300g kg^{-1} of seed followed by Azospirillum at 100g kg^{-1} of seed maximized quality seedling production at nursery. The storage studies with the pelleted seed revealed that the seed pelleted with pungam leaf powder could be stored up to six months with 48% germination.

It was observed that, *P. pinnata* seeds pelleted with neem leaf powder leaf powder at 300 g kg^{-1} of seed maximized the seedling germination percent to 25% which was 92% higher than the controlat the end of 9 months of storage period. The order of performance of other pelleting treatments such as pungam and adathoda compared to control the germination percent was improved 58 and 25%, respectively after nine months storage (Table 2). The better performance of neem leaf powder might be because it contains quercetin (flavonoid) and nimbosterol (β-sitosterol) as well as number of liminoids (nimbin and its derivatives), these properties are having antibacterial and antifungal properties that may lengthen seed longevity in storage. Neem products may also repel insects, stop their feeding, inhibit reproduction and cause other interruptions (Schumuttere, 1990).

Pal and Basu (1995) reported that wheat seeds treated with neem leaf powder at 2 g kg^{-1} of seed recorded maximum germination and seedling vigour after 7 months of storage underambient condition. Sharma (1995) recommended treatment of maize seeds with neem leaf powder (100 g/kg^{-1}) and ash (10 g/kg^{-1}) for effective reduction in percent seed damage during storage. Ogunwolu and Odunlani (1996) reported that cowpea seeds treated with neem leaf powder (3 g/kg^{-1}) seeds showed reduced bruchid infestation after five months of storage. Anil et al. (1998) observed that soybean seeds treated with neem products and untreated seeds did not show any significant differences in germination. But seed treatment controlled association of mycoflora up to 120 days of storage period.

Hossain et al. (1999) observed that soybean seeds coated with neem leaf powder showed excellent control of seed borne disease of *colletotrichum dematum* and maintained better seed health during the storage period. Arati (2000) reported that Bengal gram seeds treated with neem leaf powder recorded higher germination (65.91%) and vigour index (1282) compared to control at the end of 10 months of storage period. Maraddi (2002) observed that cowpea seeds treated with neem leaf powder (5 g/kg^{-1}) recorded higher germination (39.5%) and vigour index (1072) compared to control (34.2% and 864, respectively) at the end of 10 months of storage period. Khatun et al. (2011) reported that the lentil seeds were treated with neem leaf powder and stored till next planting time; it has improved the seed quality, such as moisture content, germination capacity, root length, shoot length of the seedlings and vigour index.

The pelleted seeds stored up to nine months under ambient conditions also exposed the better performance of leaf powder pelleting treatment in storage highlighting consistent efficacy of pelleting treatment on production on quality seedlings. The increment in germination *J. curcas* with pelleting treatments ranged between 169 to 92% compared to control and *Pongamia pinnata* seeds pelleted with neem leaf powder increased the range of germination per cent from 92 to 25% compared to un-pelleted seeds. The vigour parameters of stored seeds also found to be influence due to pelleted seeds compared to un-pelleted control seeds. Thusthe study revealed that seed pelleting with pungam and neem leaf powder at 300g kg^{-1} of seed maximized the seedling quality characters of *J. curcas* and *P. pinnata* initially and on storage.

Conclusion

We conclude from this study that, botanical leaf powder seed pelleting are not only improve the longevity of seeds through protect the seeds from fungal and insect attack but also improve the seed and soil relationships through enriching the rhizosphere region of seed to produce

better growth and development.

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REFERENCES

Abdul-Baki AA, Anderson JD (1973). Vigour determination in soybean seed by multiple criteria. Crop Sci. 13:630-633.

Anil KN, Gaur A, Sunk SSK, Devkumar C (1998). Performance of neem products on storability of soybean. Seed Res. 26(2):138-146.

Arati P (2000). Influence of containers and seed treatment on storability of chickpea. M.Sc. (Agric.) Thesis. University of Agricultural Sciences, Dharwad.

Arya A, Perello AE (2010). Management of fungal plant pathogens. CAB International. P. 388.

Beniwal RS, Chauhan R (2011). *Pongamia pinnata* as an alternative source of renewable energy. APA News (Asia Pacific Agroforestry Newsletter) 38:19.

Bharathi A (1999). Studies on handling, management and storage of neem seed (*Azadirachta indica* A. Juss). Ph.D. Thesis. Tamil Nadu Agricultural University, Coimbatore.

Dharmaputra OS, Worang RL, Syarief RM (2009). The Quality of Physic Nut (Jatropha curcas) Seeds Affected by Water Activity and Duration of Storage. Microbiol. Indonesia 3(3):139–145

Govinden SJ, Levantard M (2008). Comparative studies of seed priming and pelleting onpercentage and mean time to germination of seeds of tomato (*Lycopersicon esculentum* Mill.). Afr. J. Agric. Res. 3(10):725-731.

Grainge M, Ahmed S (1988). Handbook of Plants with Pest Control Properties. John Wiley and Sons. New York, P. 470.

Gurunathan N, Srimathi P, Paramathma M, Kumaran K, Parthiban KT (2006). Seed pelleting for production of quality seeding in *Jatropha curcas*. Abstr. XII National Seed Seminar, 24-26, Feburary 2006, ANGRAU, Hyderbad.

Hossain I, Suratuzzaman M, Khalil MI (1999). Seed heath of soybean and control of seed born fungi with botanicals. Bangladesh J. Train. Develop. 12(2):99-105.

Khatun A, Kabir G, Bhuiyan MAH, Khanam D (2011). Effect of preserved seeds using different botanicals on seed quality of lentil. Bangladesh J. Agric. Res. 36(3):381-387.

Lu S, Ming D, Jiang T (1983). A preliminary report on the effect of $CaCO_3$ pelleted seeds of Chinese milk vetch on its yield. Shanghai Agric. Sci. Technol. 6:9170-9173.

Maraddi B (2002). Influence of growth regulators on seed yield and quality and seed treatments on storabilityof cowpea cv. C-252, M.Sc. (Agri.) Thesis. University of Agricultural Sciences. Dharwad.

Ogunwolu EO, Odunlani AT (1996). Suppression of seed bruchid (*Callosobruchus maculates*) development and damage on cowpea (*Vigna ungiculata*) with *Zantoxylemz antoxyloider* L. (Rutaceae) root bark powder when compared to neem seed powder and primiphos methyl. Crop Protect. 15:603-607.

Pal P, Basu RN (1995). Effect of powdered chilli, turmeric and neem leaf on pre and post storage germinability of wheat seed. Indian Agric. 57(4):267-271.

Peterhalmer (2003). Enhancing seed performance for better yield and quality. Asian Seed Planting Mater. 10(2):4-6.

Pukacka S, Ratajczak E, Kalemba E (2009). Non-reducing sugar levels in beech (*Fagus sylvatica*) seeds as related to withstanding desiccation and storage. J. Plant. Physiol. 166:1381–1390.

Schumuttere H (1990). Properties and potential of natural pesticides from the neem tree Azadirachta indica. Annu. Rev. Entomol. 35:271-297.

Sharma RK (1995). Neem leaf powder and cobash against *Rhyzopertha dominica* (F), in stored maize. Indian J. Entomol. 57:15-17.

Suma N (2005). Studies of seed quality enhancement techniques in sesamum (*Sesamum indicum*. L) cv. Co 1 in sesamum. M.Sc. Thesis. Tamil Nadu Agricultural University, Coimbatore.

Tekrony DM (2006). Seeds: the delivery system for crop science. Crop Sci. 46:2263–2269.