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Exploitation of seed variability in *Pongamia pinnata* (L) Pierre–A Bio-fuel species

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ABSTRACT

An experiment on variability of *Pongamia pinnata* seeds on germination rate and early seedling growth was conducted at College of Agriculture, Bheemarayanagudi in Yadagiri district of Karnataka-India. In the present investigation higher germination percentage was recorded with single seeds (96.2%) followed by double seeds (91.98%) and lower germination percentage was recorded in single seeds plus chaffy (84.74%). However, higher seedling vigour index was observed in single seed (4577) followed by single seed plus chaffy (4164) and significantly lower seedling vigour index was recorded in double seed (3990). In conclusion the pods with single seeds must be used for multiplication for better performance and quality seedlings production for large scale plantations.

Key words: *Pongamia pinnata, Biofuel, Single seeds, Double seeds, Biodiesel and vigour index.*

Introduction

Pongamia pinnata is a medium sized evergreen tree species being native to Indian subcontinent, south-east Asia. Further it has been introduced to many parts of the tropical regions in the world for its utility and wide adoptability (Gawali *et al.,* 2015). Traditionally, in India this plant is being used as medicine, green manure, fish poison and fuel. The seeds of *Pongamia* contains 30-40% of oil. Further, the composition of fatty acid with high oleic acid content acts as source for bioactive compounds which has medicinal value used in curing rheumatism, skin diseases etc and the extracts of *Pongamia* also used in controlling insect pest and nematodes (Chutarat *et al.,* 2013). Earlier, oil being largely used in tanning industries but recently this has been recognized as one of the viable sources for biodiesel. Besides this being a leguminous plant is grown on marginal and degraded lands to restore soil fertility (Gaurav *et al.,* 2011; Doddabasawa *et al.,* 2014 and Patil *et al.,* 2016 and 2018). Hence, *Pongamia* has become one of the promising non edible sources of biodiesel which made to think of tree improvement for the establishment of extensive plantations with elite trees which meet out the future demand of biofuel industries and also helps in the utilization of waste and salt affected land in the country (Arjun *et al.,* 2008; Halder *et al.,* 2014 and Patil *et al.,* 2017).

Generally, the tree improvement programme begins with identifying the best geographical sources. However, the seed variability characteristics also play an important role in the production of quality seedlings and which can be screened at early stages for germination, seedling survival and growth. Harnessing such kind of variability is also useful for the

tree improvement programme. As the *Pongamia pinnata* is open cross pollinated tree species result in seed polymorphism which in turn affects the germination, seedling survival and growth. Generally in *Pongamia pinnata* one of the two ovules develops into a seed in most of the pods. However, pods also have double seeds and seeds with chaffy (Arpiwi *et al.,* 2012). Hence, in the present investigation characteristics of seed abortion was taken into consideration.

Materials and Methods

The present investigation was carried out at Biofuel Research Information and Demonstration Centre (BRIDC), College of Agriculture, Bheemarayanagudi, Yadagir district, Karnataka, India. The *Pongamia pinnata* pods were collected from matured candidate plus trees during March to May in Agroclimatic Zone II of Karnataka. Later the seeds were separated from the pods, further categorized into single seed, double seeded and seeds with chaffy than these seeds were used separately for studies such as germination rate and early seedlings growth characteristics. 100 seeds in each categories were taken separately and sown in germination trays consisting media of 1:2:1 (Sand:Soil:FYM) with four replicates (Mbora *et al.,* 2008; Nure *et al.,* 2010 and Ravikumar *et al.,* 2016). Then the germination percentage and early growth parameters were recorded. The seeds were directly sown without any pretreatment and the germination was initiated after 7 days and continued upto 21 days. While calculating germination percentage the appearance of radical and plumule of about 1 mm was considered to have germinated and early growth parameters such as shoot length (SL), root length (RL), collor diameter (CD), total seedling length (TSL) and shoot: root's fresh and dry weight was recorded. Further, seedling vigour index was also calculated by using the following equation (Abdul-Baki and Anderson, 1973).

Seedling vigour index (SVI) : The Seedling vigour index (SVI) of seedlings were determined by the formula of Abdul-Baki and Anderson (1973).

SVI = Total seedling length Germination Percentage

Results and Discussion

The growing demand of fossil fuels made to think of alternative sources of energy. Biofuel is one such option which can substantially help to meet out the energy requirement that apart biofuels are eco-friendly in nature. There are many plant species in the nature which bears oil seeds. Among the tree borne oil seeds *Pongamia* is considered to be a promising biofuel species for its substantial oil content (30-40%) with high oleic fatty acids. Hence, in order to meet out the future demand of biofuel feed stock the extensive plantation of this species needs to be planted with elite sources. Further, variability in *Pongamia* is not only associated with geographical sources but also variability in seed characteristics. Similarly few researchers also reported twin and triple seeding in many species like *Swietenia mahagoni* (Raut *et al.,* 2014), *Pongamia pinnata* (Arathi *et al.,* 1999); triple seeds in *Mammea suriga* (Smita *et al.,* 2013). The other species like *Mangifera indica, Calophyllum inophyllum, Garcinia indica*, *Bombax ceiba, Acacia farnesiana, Robinia pseudocasia, Terminalia arjuna, Tectona grandis, Santalum spicatum, Dalbergia sissoo, Shorea robusta, Putranjiva roxburghii, Saraca asoca, Nothapodytes nimmoniana,* and *Mammea suriga* (Gunaga and Vasudeva, 2008 and 2011).

The present investigation revealed that the single seed exhibited higher germination percentage (96.2%) followed by double seeded (91.98%) and lowest was recorded in single seed with chaffy (84.74%) (Table 1). However, the early growth characteristics of seedlings such as total seedling length, collar diameter and total seedling weight were found to be higher with single seed (49.14cm, 3.75 mm and 4.03 g respectively followed by single seeds with chaffy (47.58 cm, 3.60 mm and 3.99 g) whereas lower as total seedling length, collar diameter and total seedling weight were observed with double seeds (43.38 cm, 3.30 mm and 2.80, respectively) (Table 2). Similarly the higher seedling vigor index (SVI) was noticed with single seed (4577) followed by single seeds with chaffy (4164) and lower SVI was recorded with double seed (3990). This could be

Table 1. Germination percentage of different categories of seeds of *Pongamia pinnata*

Sl No	Treatments	Germination (%)*
1	Single seed	96.20 (±1.23)
2	Double seed	91.98 (±2.16)
3	Single seed with chaffy	84.74 (±1.92)

Note: The values within the parenthesis indicates the standard deviation

Table 2. Early growth and seedling characteristics of different categories of *Pongamia* seeds

Sl. No.	Treatment	Shoot length in cm	Root length in cm	Total seedling length in cm	Collar Diameter in mm	Total seedlings weight in gm	Fresh weight in gm		Dry weight in gm	
							Shoot	Root	Shoot	Root
1	Single seed	27.90 (±2.46)	19.67 (±1.97)	49.14 (±4.33)	3.75 (±0.09)	4.03 (±0.44)	2.34 (±0.28)	1.68 (±0.21)	0.41 (±0.05)	0.30 (±0.05)
2	Double seed	24.24 (±1.57)	19.14 (±1.71)	43.38 (±1.60)	3.30 (±0.35)	2.80 (±0.45)	1.92 (±0.30)	0.87 x(±0.14)	0.36 (±0.05)	0.19 (±0.02)
3	Single seed with chaffy	28.08 (±3.40)	21.06 (±4.28)	47.58 (±3.54)	3.60 (±0.33)	3.99 (±0.39)	2.51 (±0.33)	1.47 (±0.14)	0.49 (±0.08)	0.28 (±0.03)

Note: The values within the parenthesis indicates the standard deviation

Table 3. Seedling vigour index (SVI) of seedlings raised from the single seeds, double seeds and single seed with chaffy

Sl. No	Treatment	Total seedling Length (TSL) in cm	Germination rate in %	Seedling vigour index (SVI) in number
1	Single seed	47.58 (±3.54)	96.2 (±1.23)	4577
2	Double seed	43.38 (±1.60)	91.98 (±2.16)	3990
3	Single seed with chaffy	49.14 (±4.33)	84.74 (±1.92)	4164

Note: The values within the parenthesis indicates the standard deviation

due to the maternal share of resources during the fertilization wherein the accumulation of resources in single seed gives quality seedlings than those of double seeded and of single seed with chaffy where the maternal resources during fertilization were shared between the seeds that might have resulted lower germination and growth characteristics of seedlings. In conclusion, although 90 per cent of the seed produced in *Pongamia* is of single seeds. However, while selecting seeds for the production of seedlings for extensive plantation the seedling variability like seed abortion and other characteristics like weight, size should be taken into consideration which enhances the tree improvement programme.

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