 J Biodiversity, 2(1): 27-30 (2011)

Seed and Fruit Variability in *Pongamia Pinnata* (L.) Pierre from Konkan Region of Maharashtra

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KEY WORDS Seed and Fruit Variability. *Pongamia Pinnata.* Biofuel

ABSTRACT *Karanj* (Leguminoceae, subfamily Papilionoideae) is a medium sized tree. Native to humid and subtropical environments, mature trees can withstand water logging and slight frost. A thick yellow-orange to brown oil is extracted from seeds. The oil has a bitter taste and a disagreeable aroma, thus it is considered as non- edible oil. In India, the oil is used as a fuel for cooking and burning of lamps. The oil is also used as a lubricant, water-paint binder, pesticide, and in soap making and tanning industries. Seeds of *Karanj* have about 30-35 percent oil and upto 27-28 percent oil can be expressed in crusher and most of the physical and chemical properties of the oil are almost similar to those of the diesel. Twenty seed sources of *Pongamia pinnata* were collected from Konkan region of Maharashtra from different agro climatic zones. Pod length varied from 14.50 mm to 69.69 mm and Pod thickness also varied significantly among all seed sources. Avg. pod weight varied from 2.80 g to 7.64 g. Maximum value for seed length (27.75 mm) was observed and maximum avg. seed weight (3.18 g) was recorded. The seed thickness varied from 5.00 to 10.00mm. The oil contain varies from 31.17 to 42 percent was recorded. The variability in seed source attributes is largely attributed to the heterogeneity of the genotypes and the genotype X environment interactions.

INTRODUCTION

Karanj (Leguminoceae, subfamily Papilionoideae) is a medium sized tree that generally attains a height of about 10-20 meters and a trunk diameter of more than 50 cm. Native to humid and subtropical environments, *karanj* thrives in areas having an annual rainfall ranging from 500 to 2500 mm. in its natural habitat, the maximum temperature ranges from 27 to 38 ^{0}C and the minimum 1 to16 ^{0}C. Mature trees can withstand water logging and slight frost. *Karanj* can grow on most soil types ranging from stony to sandy to clay, including verticals. It does not do well on dry sands (Champion and Seth 1968). The natural distribution of *Karanj* is along coasts and river banks in India. Commonly found in Raighad district of Maharastra all along the river bank and largely planted all along road side in Konkan region of Maharashtra.

Nowadays, the tree has drawn the attention for its oil as a source of biodiesel. Seeds of Pongamia have about 30-35 percent oil and up to 27-28 percent oil can be expressed in crusher and most of the physical and chemical properties of the oil is almost similar to those of the diesel, though 'conardson carbon' residue is higher in case of it and due to high viscosity preheating is needed to start a diesel engine (Shrivastava and Prasad 2000). Pongamia oil is commonly known as Honge oil. Oil is also used as a fuel for cooking and lamps, as a lubricant, water-paint binder, pesticide, and tanning industries. Extracts from the plant are known for the medicinal properties and their effects on a wide array of organisms including insect and pests, molluses and nematodes.

The effectiveness of tree improvement programme depends upon the nature and magnitude of existing genetic variability and also on the degree of transmission of traits or heritability, because genetic variation is the fundamental requirement for maintenance and long-term stability of forest ecosystem. The rate of tree improvement can be increased or decreased by influencing the selection differential or heritability, or by reducing the total variance. The knowledge of genetic variability and association between pod and seed traits is considered to provide considerable help in genetic improvement of the species. Hence, the present investigation was envisaged to evaluate the source variation in different pod and seed parameters collected from various agro-climatic zones of Konkan region of Maharashtra

MATERIALS AND METHOD

The present study was conducted to study the variability seed and fruits characters of *Pongamia pinnata* from Konkan region of Maharashtra. The survey for the selection of seed source was carried out during months of February to May 2009 in different agro-climatic zo-

nes of Konkan region. Trees growing at one location will be considered to be one population. Such different 20 locations with 25-30 random trees from each location were selected as seed source. Among the population from one individual seeds were collected. 20 trees were marked and seeds were collected. The Latitude and Longitude of each selected tree was recorded with the help of GPS (Table 1).

Mature pods of such selected trees were collected for analysis of the seed attributes/characters. Pod and seed characters viz. length (mm), breadth (mm), thickness (mm) and weight (gm) were recorded for all the genotypes. A total of 100 pods of each CPT (four replications) were taken and average was computed for the pod and seed characters. The oven dry, cleaned kernels were crushed in crusher and oil extracted in Super Critical Fluid Extractor using CO_2 as extracting agent under high pressure. To study the variability in seed source the observations recorded were subjected to statistical methods to estimate the variability.

RESULTS AND DISCUSSION

Populations were surveyed in the Konkan region for variability studies of seed and fruit in *Pongamia pinnata.* Amongst these 20 seed sources were selected from Konkan region of Maharashtra. The analysis of variance indicated that there was significant variation among the 20 seed sources for all pod and seed characters studied (Table 2). Maximum pod length (69.69 mm) was observed in KKVPP-10 and minimum (14.50 mm) in KKVPP-15. Pod thickness also varied significantly among all the seed sources. Avg. pod weight varied from 2.80 g in KKVPP-15 to 7.64 g in KKVPP-4. Maximum value for seed length (27.75 mm) was observed in KKVPP-2. Maximum avg. seed weight (3.18 g) was recorded in the seeds collected from KKVPP-4. The seed thickness varied from 5.00 in KKVPP- 3 to 10.00 in KKVPP-4. Oil content varied from 31.17 percent to 42.00 percent.

The above result for *variation in fruit and seed characters among different CPTs or seed sources* are similar to those reported many research workers for tree species viz. *Prosopis juliflora* (Sharma et al. 1994), *Prosopis cineraria* (Bahadur and Hooda 1995), *Terminalia chebula* (Thakur et al. 2008), *Acacia nilotica* (Chhillar et al. 2002), *Dalbergia sisoo* (Dhillon et al. 1995) and *Pongamia Pinnata* (Divakara et al. 2010; N. Sunil et al. 2009; Ukey et al. 2008; Narkhede et al. 2009; Reddy et al. 2008 and Kaushik et al. 2007) .

Table 1: Ancillary data for the trees selected in *Pongamia pinnata* from Konkan Region of Maharashtra

	Location	*Latitude*	*Longitude*	*Age of tree*	*Tree ht (m)*	*Canopy diameter*	*Number of pod in 1 m*	*Seed yield in kg*	*Oil contain in %*
KKVPP-1	Soangaon,Alibaug	18^0 42’ 47.6"	72^0 53’ 39.3"	20-25	7.5	9.2	35	18.67	34.23
KKVPP-2	Pezari, Poynad.	18^0 40’ 50.5"	72^0 59’ 29.5"	45-50	9.5	12.4	57	79.48	31.17
KKVPP-3	Sarve, Phansad.	18^0 25’ 29.3"	72^0 55’ 29.6"	15-20	8	7.9	40	10.24	38.41
KKVPP-4	Roha.	18^0 25’ 37.5"	73^0 10’ 10.9"	35-40	7	9.7	62	58.43	33.04
KKVPP-5	Bamnoli, Mangaon.	18^0 14’ 08.6"	73^0 16’ 07.4"	20-25	10.5	10	30	17.81	33.43
KKVPP-6	Bamnoli, Mangaon.	18^0 14’ 12.9"	73^0 16’ 06.9"	20-25	7	8.45	35	17.51	34.02
KKVPP-7	Talsure, Dapoli.	17^0 45’ 35.0"	73^0 13’ 03.8"	30-35	10	15	45	58.22	38.22
KKVPP-8	Ladghar, Dapoli.	17^0 43’ 33.7"	73^0 09’ 06.7"	30-35	10	12	30	23.06	38.40
KKVPP-9	Bhandarwada, Ladghar, Dapoli.	17^0 43’ 16.3"	73^0 08’ 29.8"	45-50	17	19	32	61.62	36.40
KKVPP-10	Karajgaon, Dapoli.	17^0 42’ 14.7"	73^0 08’ 23.3"	15-20	4	8	51	23.00	35.74
KKVPP-11	Gimhavane, Dapoli.	17^0 45’ 44.0"	73^0 10’ 22.6"	35-40	9	15	29	35.39	37.52
KKVPP-12	Gimhavane, Dapoli.	17^0 46’ 16.7"	73^0 09’ 29.1"	45-50	8	19	40	70.19	34.80
KKVPP-13	Asudbag, Dapoli.	17^0 46’ 59.9"	73^0 08’ 02.8"	45-50	8	17	53	115.12	34.20
KKVPP-14	Kudawale, Dapoli.	17^0 47’ 34.6"	73^0 14’ 08.9"	30-35	14.5	15	32	36.00	32.82
KKVPP-15	Khed.	17^0 43’	73^0 25’	35-40	10	15	35	26.82	34.88
KKVPP-16	Guhagar.	17^0 30’ 30.5"	73^0 11’ 02.5"	30-35	11	13	40	40.59	37.49
KKVPP-17	Sangmeshwar.	17^0 07’ 78.3"	73^0 29’ 15.7"	20-25	10	12	30	21.38	42.00
KKVPP-18	Devbaug, Malwan.	15^0 59’ 52.1"	73^0 29’ 23.0"	30-35	11	10.7	45	31.93	36.56
KKVPP-19	Devbaug, Malwan.	15^0 59’ 13.6"	73^0 29’ 27.3"	30-35	9	10.75	40	30.48	34.00
KKVPP-20	Bijghar, Dodamarg.	14^0 42’	72^0 53’	30-35	7	9	42	16.35	36.08

Table 2: Variation for fruits and seed characters amongst the different sources of *Pongamia pinnata*

	Fruit characters					*Seed Characters*					
	Length (mm)	*Width (mm)*	*Thick-ness (mm)*	*Weight (gm)*	*Volume (cc)*	*Length (mm)*	*Width (mm)*	*Thick-ness (mm)*	*Weight (gm)*	*Volume (cc)*	*Seed to kernel ratio*
KKVPP-1	52.83	24.33	11.65	4.59	4.10	23.44	16.77	8.21	2.00	1.83	2.29
KKVPP-2	68.67	28.27	12.35	6.28	5.84	27.76	19.97	8.45	2.89	2.67	2.18
KKVPP-3	44.58	25.96	9.60	3.37	3.08	20.67	17.28	6.00	1.31	1.20	2.58
KKVPP-4	63.38	28.94	14.76	7.64	7.48	26.55	19.97	10.00	3.19	2.65	2.42
KKVPP-5	54.03	27.98	10.79	4.28	3.88	22.21	17.88	7.41	1.89	1.63	2.29
KKVPP-6	62.15	28.33	12.21	5.63	5.38	23.62	19.42	8.30	2.23	1.93	2.57
KKVPP-7	52.56	27.46	9.90	3.83	3.55	22.66	18.42	6.86	1.83	1.64	2.09
KKVPP-8	52.48	27.97	10.20	4.04	3.73	22.58	18.26	6.93	1.70	1.61	2.38
KKVPP-9	56.15	24.85	10.87	4.10	3.78	22.13	16.27	7.95	1.70	1.81	2.41
KKVPP-10	69.70	28.47	11.90	5.73	5.33	23.34	18.19	8.16	2.24	1.98	2.61
KKVPP-11	54.09	28.43	10.64	4.03	3.85	21.80	18.10	7.07	1.73	1.51	2.33
KKVPP-12	65.29	32.66	10.01	5.07	4.85	21.98	16.78	6.06	1.55	1.40	3.28
KKVPP-13	58.36	29.57	11.56	5.05	4.80	24.09	19.64	7.76	2.39	2.20	2.11
KKVPP-14	63.98	24.71	9.69	3.92	3.68	19.65	16.63	7.12	1.59	1.48	2.47
KKVPP-15	41.50	21.06	9.96	2.81	2.55	21.15	14.71	6.28	1.08	1.00	2.59
KKVPP-16	52.80	26.61	11.57	4.46	4.03	21.23	16.72	8.16	1.91	1.70	2.34
KKVPP-17	50.30	22.36	10.31	3.59	3.23	21.14	15.59	7.39	1.57	1.46	2.29
KKVPP-18	50.30	25.75	11.59	4.36	4.00	23.75	16.51	7.76	1.97	1.81	2.22
KKVPP-19	66.70	29.85	13.10	6.03	5.58	22.56	17.45	8.78	2.10	1.82	2.87
KKVPP-20	49.67	26.92	9.98	3.37	3.00	21.45	17.45	6.49	1.53	1.36	2.21
Mean	56.48	27.02	11.13	4.61	4.28	22.69	17.60	7.56	1.92	1.73	2.43

Table 3: Variability estimates for different characters of seed sources in *Pongamia pinnata*

Genetic estimates	*Fruits character*				*Seed Characters*		
	Length (mm)	*Thickness (mm)*	*Weight (gm)*	*Volume (cc)*	*Width (mm)*	*Thickness (mm)*	*Volume (cc)*
Vg	62.80652	1.637708	1.329048	1.347464	1.668037	0.939514	0.172323
Ve	0.283735	0.054414	0.018737	0.013936	0.030845	0.04168	0.001653
Vp	63.09025	1.692122	1.347785	1.361401	1.698882	0.981194	0.173977
PCV	14.06445	11.68521	25.18944	27.24158	7.405822	13.10926	24.0597
GCV	14.03279	11.4958	25.01374	27.10179	7.338284	12.8278	23.94512
H	99.5503	96.7843	98.6098	98.9763	98.1844	95.7521	99.0497
GA	16.28886	2.59351	2.358292	2.378984	2.636279	1.953859	0.851071
GG	28.84247	23.29747	51.16889	55.54318	14.979	25.85793	49.09201

One way ANOVA of the CPT's was observed to be statistically significant, thus the variation existing in the seed source is due to phenotypical and genotypic differences. The plant height recorded ranged between 4 to 17 m, with the average height of 9.45 m. The CPT selected was of different ages between 15-50 years. The canopy diameter was recorded between 7 to 19 m, having 39.55 pod per meter length. The estimated seed yield per tree recorded was 10.24 kg. to 115.11 kg. The similar seed source variability in seed and pod characters had been reported in this species (Narkhede et al. 2009). In Neem, large scale variation provenance variation in seed characteristics and germination behaviour had been reported (Jain et al. 2003). The variation in different seed source is due to the fact that the species grows over a wide range of latitude and longitude in different environmental conditions. The variability in seed source was largely attributed to the heterogeneity of the genotypes and the genotype X environment interactions (Thompson 1973).

The magnitude of differences between PCV and GCV was minimum indicating the little role of environment in expression of various traits. In general, all characters studied in the magnitude of PCV were greater over the respective GCV. The character 100 pod volume (27.27 and 27.13), average pod volume (27.24 and 27.10), average pod weight and 100 pod weight (25.19 and 25.01) shows higher estimates of both PCV and GCV, respectively. Similar genetic variability and relationship of pod and seed traits

with respect to genetic parameters have been observed and reported earlier in *Pongamia pinnata* (Kaushik et al. 2007; N. Sunil et al. 2009; Divakara et al. 2010) in which the CPT's collected from different locations exhibit variability in respect to character under study.

Heritability in broad sense was categorized as very high (above 95 percent) for all characters, which from 95.75 per cent (seed thickness) to 99.55 per cent (pod length). The genetic gain in the character studied ranges between 10.57 (pod to seed ratio) to 55.61 (100 pod volume). The present results are similar of the findings of earlier work reported by various workers with respect of seed sources.

Thus, from the studies it is evident that the seed sources selecting in the three districts of Konkan regions, representing different agro-climatic zones, had wide range of variability in respect of all the characters studied. The existing variability in respect of seed yield and oil yield potential could be very well utilized for making of trees, as promising seed sources for mass multiplication of the species and future selection of plus trees.

CONCLUSION

In general, KKVPP-02 (Pezari, Poynad) and KKVPP-04 (Roha) was observed to be best seed sources in terms of growth parameters, while KKVPP-10 (Karajgaon, Dapoli) seed source could be the best in respect of number of pods. KKVPP-04(Roha), KKVPP-02(Pezari, Poynad), KKVPP-13 (Asudbag, Dapoli) and KKVPP-19 is superior in respect of seed length, thickness, width and weight. KKVPP-04(Roha) followed by KKVPP-02 (Pezari, Poynad) are superior in terms of seed width, thickness and weight. Maximum seed oil percent was recorded by the genotype KKVPP-17 (Sangmeshwar) followed by KKVPP-03(Sarve, Phansad), KKVPP- 08 (Ladghar, Dapoli) and KKVPP-07 (Talsure, Dapoli). Hence, it can be concluded that the CPTs KKVPP-02 and KKVPP-04 are best followed by KKVPP- 03, KKVPP- 07, KKVPP- 08, KKVPP- 10, KKVPP- 17 and KKVPP- 19.

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