Journal of Tropical Forest Science 9(1): 1 - 5 (1996)

EFFECT OF SEED SIZE ON SEED GERMINATION AND VIGOUR IN *PONGAMIA PINNATA*

V. Manonmani, K. Vanangamudi & R.S. Vinaya Rai

Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam 641 003 Tamil Nadu, India

Received December 1993

MANONMANI, V., VANANGAMUDI, K. & VINAYA RAI, R.S. 1996. Effect of seed size on seed germination and vigour in *Pongamia pinnata*. Studies carried out to investigate the influence of three different seed sizes on germination and vigour in *Pongamia pinnata* revealed large seeds to be characterised by better germination and vigour index. A linear relationship between seed size and quality attributes was also discernible. Seed size, however, had no bearing on either germinability or vigour under storage. In general, seed deterioration set in at the end of three months and therefore the seeds can be stored well for only two months.

Key words: *Pongamia pinnata* - seed size - germination - vigour - storage

MANONMANI, V., VANANGAMUDI, K. & VINAYA RAI, R.S. 1996. Kesan saiz biji benih ke atas percambahan dan kecergasan biji benih *Pongamia pinnata*. Kajian yang dijalankan untuk mengkaji kesan tiga saiz biji benih *Pongamia pinnata* yang berbeza ke atas percambahan dan kecergasan menunjukkan biji benih besar adalah dicirikan oleh percambahan dan kecergasan yang lebih baik. Perhubungan linear di antara saiz biji benih dan kualiti-kualiti yang ditunjukkan juga telah dapat dilihat. Walaubagaimanapun, saiz biji benih tidak mempengaruhi percambahan ataupun kecergasan semasa penyimpanan. Secara umumnya, biji benih akan rosak pada akhir bulan ketiga, jadi biji benih boleh disimpan dengan baik untuk dua bulan sahaja.

Introduction

Seed management, which determines to a large extent the productivity, has so far received scant attention for forest tree species. In view of the explosive demand for quality seeds imposed by expanding social and agroforestry programmes, there is an imperative need to formulate seed management prescriptions for quality seed production and storage. *Pongamia pinnata* is an oilseed bearing tree increasingly being employed in these forest renewal programmes. The oil is used in leather tanning, soap manufacture and pharmaceutical preparations. The residual seed cake serves as poultry feed (Mandal & Banerjee 1979). Its leaves are used as green manure for rice crop (Rao & Purkayastha 1972) and sugarcane (Nagarajan *et al.* 1984). Containing 17.6% crude protein (Gupta *et al.* 1975), the leaves also serve as good fodder. The species occurs mostly in natural stands and as scattered trees. Pods are 3.80 - 5.08 cm long, 1.80 - 2.54 cm broad, woody, yellowish grey when ripe, ultimately becoming dark grey. These are indehiscent and contain, rarely, two reddish brown seeds. The seeds are usually manually separated and are not given

any pretreatment. Despite such wide assortment of uses, there is little published information on seed management in the species. Though a close parallel between seed size/weight and seed quality has been documented in many tropical hardwoods (Aquiare & Nakane 1983, Ponnammal *et al.* 1993, Gupta *et al.* 1983, Halos 1983), medium sized seeds out-performing large ones was reported in *Acacia mellifera* (Srimathi *et al.* 1991). The influence of seed size on seed quality attributes was hence investigated in the species.

Materials and methods

Pods of *Pongamia pinnata* were collected from 15-y-old trees at two locations, viz. Coimbatore and Tiruppur. Extracted seeds were visually separated into three size classes, viz. small, medium and large and evaluated for the following parameters: (i) 100-seed weight; (ii) seed size in terms of length, breadth, thickness and L/B ratio; (iii) percentage germination; (iv) root length; (v) shoot length; and (vi) vigour index. For estimation of germination, four lots (replications) of 100 seeds each were sown on sand medium in the laboratory (ISTA 1985). The number of normal seedlings was counted on the 28th day and expressed as percentage. Root and shoot lengths were measured on 10 random seedlings in each replication and vigour index computed as the integral of germination per cent and seedling length (Abdul-Baki & Anderson 1973). To assess their shelf-life, seeds of the three size-classes were stored separately in plastic containers at room temperature (30 to 32 °C) and evaluated for percentage germination and vigour at monthly intervals for three months. Data were subjected to an analysis of variance after Panse and Sukhatme (1967).

Results and discussion

Irrespective of the seed source, large seeds proved distinctly superior in terms of both percentage germination and vigour and a positive relationship between seed size and quality attributes was manifest (Table 1). While large seeds of the Tiruppur source recorded a 6% increased germination over the medium-sized seeds of the same source, the corresponding figure for the Coimbatore source was 12%. The performance of the large seeds relative to the medium was even more spectacular from the standpoint of vigour index, the increase being respectively 52 and 55% in the Tiruppur and Coimbatore sources. In a study on slash pine (*Pinus elliotii*), correlation between seed weight components (like seed coat, gametophyte and embryo weights) and seedling growth was high at 12 weeks and remained significant throughout the 80-week measurements period and it was suggested that embryo weight in particular may be useful in genetic selection (Surles *et al.* 1993). But Sorenson and Campbell (1993) found a direct effect of seed weight on seedling height in Douglas fir (*Pseudostsugn menzeii*). The performance of the seed immediately after germination is governed by seed size (Willan 1985). Seedling dimension also appeared to be a function of seed size. Larger shoot and root were associated with heavier seeds in *Pinus roxburghii* (Chauhan & Raina 1980).

The better performance of large seeds may be ascribed to the availability of greater food reserves and the presence of a larger embryo (Siddiqui *et al.* 1991). There was a close parallel between seed size and seed weight barring seed thickness of the Coimbatore seed source which was the same in both large- and medium-sized seeds. The study underscores the need for size-grading the seeds and using only the large ones for seedling production.

Table 1. Effect of seed size on seed morphometric and quality attributes in *Pongamia pinnata* of two geographic locations

Attribute	Small	Medium	Large	CD*($p<0.05$)
100 seed weight (g)				
T	80.2	109.9	133.0	8.2
C	88.4	112.5	137.0	14.9
Seed length (mm)				
T	16.4	17.3	18.1	2.83
C	17.4	18.2	20.2	1.77
Seed breadth (mm)				
T	15.1	16.1	15.8	ns
C	11.9	13.5	12.9	ns
Seed L/B ratio				
T	1.0	1.1	1.2	0.07
C	1.4	1.3	1.6	0.09
Seed thickness (mm)				
T	5.7	5.8	8.9	1.1
C	6.5	8.4	8.8	0.9
Per cent germination				
T	45	52	58	5.0
C	53	65	77	4.0
Root length (cm)				
T	13.5	16.6	23.1	1.4
C	12.8	18.9	23.8	0.6
Shoot length (cm)				
T	13.9	17.3	23.5	1.2
C	14.6	22.2	25.7	1.9
Vigour index				
T	1260	1789	2720	220
C	1479	2466	3840	184

T : Tiruppur; C : Coimbatore; * CD : Critical difference

Storability

Since results on storability were almost similar with the two seed sources, only those relating to Tiruppur are presented (Table 2) and discussed. Seedling attributes or vigour index were not affected by seed size; while decline in germination was evident only at the end of the 3rd month of storage in small and large-sized seeds, it was so at the end of the 2nd month in medium-sized seeds. This inconsistency indicates lack of any relationship between seed size and percentage germination under storage. Depression in shoot length and vigour index was observed at the end of the 3rd month in all seed sizes. In other oilseed trees like

Table 2. Effect of seed size on storability in *Pongamia pinnata*

Seed size	Germination %				Root length (cm)				Shoot length (cm)				Vigour index			
	0*	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
Small	45	42	37	31	13.5	13.5	13.2	11.8	13.9	13.8	13.3	11.2	1250	1161	995	720
Medium	52	52	35	40	16.6	16.7	16.1	14.5	17.3	17.2	17.2	13.1	1789	1827	1544	1111
Large	58	57	50	43	23.1	22.7	22.1	21.1	23.5	23.0	22.9	21.0	2720	2280	2634	1850
Mean	51	50	40	38	17.7	17.6	17.1	15.8	18.2	18.0	17.8	15.1	1923	1874	1724	1227
CD $p \leq 0.05$																
Seed size (S)		5				1.4				1.2				220		
Storage period (P)		5				ns				1.4				254		
S × P		10				ns				ns				ns		

*: Months after storage; ns: not significant

Madhuca longifolia (Vanangamudi & Palaniswamy 1989) and *Azadirachta indica* (Vanangamudi *et al.* 1993), seed deterioration was observed to set in 20 days and 3 months respectively after storage. Seeds in *Pongamia pinnata* can therefore store well for 2 months.

References

ABDUL-BAKI, A.A. & ANDERSON, J.D. 1973. Vigour determination in soybean seed by multiple criteria. *Crop Science* 130 : 630 - 633.

AQUIARE, I.B. DE & NAKANE, J.T. 1983. Seed size of *Eucalyptus citridora*, influence on germination and vigour. *Brasil Florestal* 13(53) : 25 - 28.

CHAUHAN, D.S. & RAINA, V. 1980. Effect of seed weight on germination and growth of chirpine (*Pinus roxburghii* Sarget). *Indian Forester* 106 : 53 - 59.

GUPTA, P.C., SINGH, R., SANGWAN, D.C. & PRADHAN, K. 1975. Chemical composition and *in vitro* nutrient digestability of some of the tree leaves. *Indian Forester* 101: 674 - 680.

GUPTA, S.K., PATHAK, P.S. & DEBREY, R. 1983. Seedling growth of *Leucaena leucocephala* II. Effect of seed size. *Indian Journal of Forestry* 5(3) : 202 - 204.

HALOS, S.C. 1983. Casuarina in Philippine forest development. Pp. 89 - 98 in *Casuarina Ecology, Management and Utilization. Proceedings of an International Workshop on Casuarina Management Ecology and Utilization.* Canberra, Australia.

ISTA. 1985. International rules for seed testing. *Seed Science and Technology* 13 : 299 - 495.

MANDAL, L. & BANERJEE, G.C. 1979. Studies on the utilisation of karanja (*Pongamia glabra* Vent) cake in layer diet. *Indian Journal of Poultry Science* 14(2): 105 - 109.

NAGARAJAN, S., JAIN, H.C. & CHADHA, Y.R. 1984. Industrial exploitation of forest based minor oil seeds. Pp. 50 - 58 in Suri, R.K. & Mathur, K.C. (Eds.) *Recent Trends in Forest Utilisation.* International Book Distributors, Dehra Dun.

PANSE, V.G. & SUKHATME, P.V. 1967. *Statistical Methods for Agricultural Workers.* Indian Council of Agricultural Research, New Delhi. 380 pp.

PONNAMMAL, N.R., ARJUNAN, M.C. & ANTONY, K.A. 1993. Seedling growth and biomass production of *Hardwickia binata* Roxb. as affected by seed size. *Indian Forester* 119 : 59 - 62.

RAO, R.K. & PURKAYASTHA, S.K. 1972. *Indian Woods - Their Identification, Properties and Uses.* Volume III. Manager of Publications, Government of India, New Delhi : 121 - 122.

SIDDIQUI, N.A., SHAHIDUKA, M. & SHALYABAL, M.A.H. 1991. Studies on seed viability and germination of seeds of sundara. *Indian Journal of Forestry* 14(2): 119 - 124.

SORENSEN, F.C. & CAMPBELL, R.K. 1993. Seed weight seedling size correlation in coastal Douglas fir - genetic and environmental components. *Canadian Journal of Forestry Research* 23 : 275 - 285.

SRIMATHI, P., VINAYA RAI, R.S. & SURENDRAN, C. 1991. Studies on the effect of seed coat colour and seed size on seed germination in *Acacia mellifera. Indian Journal of Forestry* 14 : 5 - 7.

SURLES, S.E., WHITE, T.L., HODGE, G.R. & DURYEA, M.L. 1993. Relationship among seed weight components, seedling growth traits and predicted field breeding values in slash pine. *Canadian Journal of Forestry Research* 23 : 1550 -1560.

VANANGAMUDI, K. & PALANISAMY, V. 1989. Viability of illupai (*Madhuca longifolia* var. *larifolia*) seed. *Seed Research* 17(2) : 186 - 187.

VANANGAMUDI, K., MANONMANI, V., SURENDRAN, C. & ANNAMALAI, R. 1993. Storage of neem seed. *Tamil Nadu Agricultural University Newsletter* 23(6) : 1.

WILLAN, R.L. 1985. *A Guide to Forest Seed Handling with Special Reference to the Tropics.* FAO Publication: 379.