

Seed germination studies in *Garcinia* spp.

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Abstract

Germination studies conducted at Padannakad (Kerala) on *Garcinia gummi-gutta* and *Garcinia cowa* indicated that soaking seeds in hydrogen peroxide (30%) for 30 min and overnight soaking in cow milk and kinetin (500 ppm) were effective in breaking the dormancy of seeds and resulted in 60.05%, 39.96% and 34.41% germination, respectively in *G. gummi-gutta* and 65.33%, 69.33% and 54.67% germination in *G. cowa* at 7 months after sowing. In *Garcinia tinctoria*, soaking in hydrogen peroxide (30%) for 30 min and overnight soaking in kinetin (500 ppm) and gibberellic acid (500 ppm) induced early germination resulting in 78.6%, 93.3%, and 64.0% germination respectively, at 2 months after sowing.

Key words: *Garcinia* species, seed dormancy, seed germination.

The genus *Garcinia* (Clusiaceae) contains several important economic species such as *G. mangostana* L. (mangosteen), *G. gummi-gutta* (L.) Rob. (camboge) and *G. indica* Choisy (kokum). Thirty one species of *Garcinia* occur in India (Maheshwari 1964), but most of these are under exploited. Most of these tropical fruit species show dormancy, *G. mangostana* being an exception (Normah *et al.* 1997). Seed dormancy either induced or innate, imparts seeds with capacity to germinate at favourable environmental conditions (Vazquez-Yanes & Orozco-Segovia 1993). But prolonged dormancy in many *Garcinia* spp. is a limiting factor for large scale production of planting material. Though *Garcinia* spp. can be propagated by seeds, androdioeciousness (George *et al.* 1992) and long pre-bearing age necessitates vegetative

method of propagation. Softwood grafting technique has been standardized to overcome the dioecious nature of *Garcinia* spp. (KAU 2002). For grafting, either its own seedlings or that of closely related species like *G. cowa* Roxb. or *G. tinctoria* Wight can be used as root stocks. Prolonged seed dormancy of *Garcinia* spp. causes delay in rootstock production and timely grafting. In case of *G. gummi-gutta*, seeds have a dormancy period of 8 to 9 months and on removal of seed coat, germination occurs within 2 months of sowing (KAU 2001). But it is laborious and time consuming when done on a commercial scale. Hence, a study was undertaken to find out simple techniques for breaking the seed dormancy of *Garcinia* spp.

The experiment was conducted at College of Agriculture, Padannakad (Kerala), during

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2000–02 in a completely randomized design with three replications. Seeds of *G. gummi-gutta*, *G. cowa* and *G. tinctoria* were collected from 20 year old trees from District Agricultural Farm, Taliparamba (Kannur District, Kerala). The treatments (Table 1) were determined after conducting preliminary studies. For *G. tinctoria*, all the treatments in Table 1 except T_9 were given. In each treatment, 40 seeds were used per replication. Observations on germination were recorded at weekly interval in all the three species.

Table 1. Treatments imposed for germination studies in *G. cambogia* and *G. cowa* seeds

Treatment	Treatment	Duration
T_1	Control (soaking in water)	18 h
T_2	Sulphuric acid (H_2SO_4) 20%	15 min
T_3	Hot water (55°C)	15 min
T_4	Potassium nitrate (KNO_3) 0.2%	18 h
T_5	Thiourea 2%	18 h
T_6	Hydrogen peroxide (H_2O_2) 30%	30 min
T_7	Gibberellic acid (GA) (500 ppm)	18 h
T_8	Kinetin (500 ppm)	18 h
T_9	Cow milk (fresh)	18 h

The data revealed that at 4 months after sowing (MAS), seed treatment with H_2O_2 (T_6) was highly effective in inducing early germination in *G. gummi-gutta* (Table 2). No germination was noticed in rest of the treatments, within this period. At 5 MAS, treatments with kinetin (T_8), cow milk (T_9) and H_2O_2 (T_6) were significantly superior to control and other treatments and T_6 was the most effective among all treatments. At 6 MAS, treatments with H_2O_2 (T_6), GA (T_7), kinetin (T_8) and cow milk (T_9) were highly effective in enhancing seed germination. Hydrogen peroxide treatment was significantly superior and at 8 MAS 71.04% germination was recorded, whereas germination just started in control at 8 MAS (2.22%).

In *G. cowa*, germination was earliest in H_2O_2 (T_6) and cow milk treated (T_9) seeds at 3 MAS

(Table 3) and their superiority was retained in subsequent stages also. Seed treatment with kinetin (T_8) was also highly effective. Gibberellic acid did not give any desirable effect in *G. cowa* even though it was effective in *G. gummi-gutta*. At 10 MAS, H_2O_2 and cow milk treatments gave 76% germination compared to 36% in control. After 10 months, no significant difference was observed between the treatments and control.

In *G. tinctoria*, soaking in KNO_3 (T_4) and H_2O_2 (T_6) resulted in early germination (17% germination at 1 MAS). At $1\frac{1}{2}$ MAS, KNO_3 (T_4), kinetin (T_8) and H_2O_2 (T_6) gave higher germination compared to other treatments (Table 4). Thiourea was ineffective in breaking dormancy at all stages. At 2 MAS, H_2O_2 , gibberellic acid and kinetin gave more than 60% germination against 1.3% in control. But at 4 MAS, H_2SO_4 (T_2), H_2O_2 (T_6), GA (T_7) and kinetin (T_8) were on par for their effect on germination. Acid treatment and hot water treatment were also superior to control though their beneficial effect became apparent only 3 MAS. In *G. tinctoria*, polyembryony was observed in all the replications (4%–6% of germinated seeds).

Mathew & George (1995) reported that *G. gummi-gutta* seeds take more than 1 year for germination if they are sown soon after harvest and as the storage time increases, the time taken for germination decreases. In their studies, GA 250 ppm gave the highest germination percentage. In the present study, treatments like soaking in H_2O_2 30%, kinetin 500 ppm and cow milk were found to be highly effective in inducing early germination. Similar results were also observed in *G. cowa*. Overnight soaking in cow milk was equally effective in breaking the dormancy and favoured early germination in *G. gummi-gutta* and *G. cowa* which otherwise required one year or more for germination. However, in *G. tinctoria*, along with H_2O_2 , KNO_3 was also effective in inducing early germination. Both H_2O_2 and KNO_3 are reported to remove inhibitors from seed coat and enhance germination (Sadhu 1996).

Table 2. Evaluation of various treatments on germination of *Garcinia gummi-gutta* seeds

Treatment	4 MAS	5 MAS	6 MAS	7 MAS	8 MAS	9 MAS	10 MAS	11 MAS
Control	0.00 (0.09)	0.00 (0.09)	0.00 (0.09)	0.00 (0.09)	2.22 (0.15)	2.22 (0.12)	3.33 (0.18)	8.88 (0.18)
H ₂ SO ₄ 20% - 15 min	0.00 (0.09)	0.00 (0.09)	6.66 (0.24)	11.10 (0.33)	13.32 (0.37)	17.76 (0.43)	21.09 (0.48)	28.86 (0.48)
Hot water (55°C) - 15 min	0.00 (0.09)	0.00 (0.09)	0.00 (0.09)	1.11 (0.09)	2.22 (0.15)	7.77 (0.28)	9.99 (0.32)	14.43 (0.32)
KNO ₃ 0.2% - 18 h	0.00 (0.09)	2.22 (0.15)	4.44 (0.21)	7.77 (0.28)	11.10 (0.34)	18.87 (0.45)	26.64 (0.54)	34.41 (0.54)
Thiourea 2% - 18 h	0.00 (0.09)	0.00 (0.09)	2.22 (0.15)	4.44 (0.21)	5.55 (0.24)	8.88 (0.29)	15.54 (0.40)	21.09 (0.40)
H ₂ O ₂ 30% - 30 min	13.32 (0.37)	39.96 (0.68)	43.29 (0.72)	60.05 (0.90)	71.04 (1.01)	73.26 (1.03)	77.7 (1.08)	77.70 (1.08)
GA 500 ppm - 18 h	0.00 (0.09)	4.44 (0.21)	15.54 (0.40)	32.19 (0.60)	35.52 (0.64)	36.63 (0.65)	42.18 (0.71)	47.73 (0.71)
Kinetin 500 ppm - 18 h	0.00 (0.09)	8.88 (0.29)	23.31 (0.50)	34.41 (0.62)	44.40 (0.73)	52.17 (0.81)	55.5 (0.84)	60.00 (0.84)
Cow milk (fresh) - 18 h	0.00 (0.09)	21.09 (0.47)	28.86 (0.56)	39.96 (0.68)	48.84 (0.77)	53.28 (0.82)	63.27 (0.92)	64.44 (0.92)
CD (P=0.05)	0.06	0.12	0.12	0.15	0.18	0.18	0.18	0.18

Values indicate % germination; Values in parenthesis indicate transformed values ; MAS=Months after sowing; H₂SO₄=Sulphuric acid; KNO₃=Potassium nitrate; H₂O₂=Hydrogen peroxide; GA - Gibberellic acid

Table 3. Evaluation of various treatments on germination of *Garcinia cowa* seeds

No.	Treatment	3 MAS	4 MAS	5 MAS	6 MAS	7 MAS	8 MAS	9 MAS	10 MAS
T ₁	Control	0.00 (0.09)	0.00 (0.09)	0.00(0.09)	2.67 (0.15)	24.00 (0.45)	34.67 (0.57)	36.00 (0.58)	36.00 (0.58)
T ₂	H ₂ SO ₄ 20% - 15 min	0.00 (0.09)	2.67 (0.15)	20.00(0.41)	32.00 (0.54)	34.67 (0.56)	42.67 (0.64)	42.67 (0.64)	44.00 (0.65)
T ₃	Hot water (55°C) - 15 min	0.00 (0.09)	0.00 (0.09)	4.00(0.18)	13.33 (0.33)	21.33 (0.43)	36.00 (0.58)	38.67 (0.60)	41.34 (0.63)
T ₄	KNO ₃ 0.2% - 18 h	0.00 (0.09)	9.33 (0.26)	14.67(0.32)	28.00 (0.49)	30.67 (0.52)	38.67 (0.60)	40.00 (0.61)	44.00 (0.65)
T ₅	Thiourea 2% - 18 h	0.00 (0.09)	2.67 (0.15)	16.00(0.36)	21.33 (0.43)	25.33 (0.47)	32.00 (0.54)	37.33 (0.59)	37.33 (0.59)
T ₆	H ₂ O ₂ 30% - 30 min	12.00 (0.32)	32.00 (0.54)	49.33(0.70)	64.00 (0.82)	65.33 (0.83)	73.33 (0.90)	73.33 (0.90)	76.00 (0.92)
T ₇	GA 500 ppm - 18 h	0.00 (0.09)	0.00 (0.09)	5.30(0.20)	16.00 (0.37)	25.33 (0.48)	26.67 (0.49)	29.33 (0.52)	29.33 (0.52)
T ₈	Kinetin 500 ppm - 18 h	0.00 (0.09)	18.67 (0.40)	26.67(0.49)	42.67 (0.64)	54.67 (0.74)	57.33 (0.76)	57.33 (0.76)	62.67 (0.81)
T ₉	Cow milk (fresh) - 18 h	8.00 (0.26)	20.00 (0.42)	46.67(0.67)	60.00 (0.79)	69.33 (0.86)	73.33 (0.90)	73.33 (0.90)	73.33 (0.90)
	CD (P=0.05)	0.06	0.09	0.12	0.12	0.12	0.09	0.09	0.09

Values indicate % germination; Values in parenthesis indicate transformed values; MAS=Months after sowing; H₂SO₄=Sulphuric acid; KNO₃=Potassium nitrate; H₂O₂=Hydrogen peroxide; GA=Gibberellic acid

Table 4. Evaluation of various treatments on germination of *Garcinia tinctoria* seeds

No.	Treatment	1 MAS	1½ MAS	2 MAS	2½ MAS	3 MAS
T ₁	Control	0.00 (0.09)	0.00 (0.09)	1.30 (0.12)	41.30 (0.62)	44.00 (0.65)
T ₂	H ₂ SO ₄ 20% - 15 min	0.00 (0.09)	0.00 (0.09)	22.70 (0.45)	76.00 (0.92)	80.00 (0.96)
T ₃	Hot water (55°C) - 15 min	0.00 (0.09)	2.70 (0.15)	28.00 (0.50)	40.00 (0.62)	48.00 (0.69)
T ₄	KNO ₃ 0.2% - 18 h	17.30 (0.39)	32.00 (0.54)	41.30 (0.62)	68.00 (0.85)	81.30 (0.97)
T ₅	Thiourea 2% - 18 h	0.00 (0.09)	4.00 (0.17)	5.30 (0.20)	50.70 (0.71)	56.00 (0.75)
T ₆	H ₂ O ₂ 30% - 30 min	17.30 (0.38)	62.70 (0.81)	78.60 (0.98)	88.00 (1.03)	89.30 (1.04)
T ₇	GA 500 ppm - 18 h	6.70 (0.22)	9.30 (0.27)	64.00 (0.84)	80.00 (0.96)	85.30 (1.01)
T ₈	Kinetin 500 ppm - 18 h	4.00 (0.17)	48.00 (0.68)	93.30 (1.08)	96.00 (1.11)	96.00 (1.19)
	CD (P=0.05)	0.09	0.18	0.21	0.12	0.12

Values indicate % germination; Values in parenthesis indicate transformed values; MAS=Months after sowing; H₂SO₄=Sulphuric acid; KNO₃=Potassium nitrate; H₂O₂=Hydrogen peroxide; GA = Gibberellic acid

Prolonged seed dormancy found in *Garcinia* spp. increases the time and expenses required for raising rootstocks for grafting. The study established that seed germination can be significantly improved in *G. gummi-gutta* and *G. cowa* by pre-treatment with H₂O₂, kinetin or cow milk instead of practicing the laborious and time consuming process of seed coat removal. In *G. tinctoria* also, a satisfactory level of germination can be attained within 2 months by pre-treating seeds with H₂O₂, gibberellic acid or kinetin as against 4 months in control. Adoption of appropriate pre-treatment in each *Garcinia* species will reduce the cost of graft production by reducing the dormancy period and increasing percentage germination.

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