

## Influence of Growth Regulators on Seed Germination and Seedling Vigour in West Himalayan Banj Oak (*Quercus leucotrichophora* A. Camus)

BIRENDRA PRASAD AND RAJENDRA PRASAD

Department of Seed Science and Technology, Govind Ballabh Pant University of Agriculture & Technology,  
Hill Campus, Ranichauri, Tehri Garhwal 249 199  
bprasadsst@yahoo.co.in

**ABSTRACT** Studies were conducted to evaluate the effect of plant growth regulators on seed germination and seedling vigour in West Himalayan banj oak (*Quercus leucotrichophora* A. Camus). The results showed that all treatments have significantly higher germination and seedling vigour over control. Among different treatments, seeds were soaked for 24h in GA<sub>3</sub>, Ethanol, IAA 100mg l<sup>-1</sup> and 1BA 200 mg l<sup>-1</sup> performed moderate, while NAA of 100 and 200 mg l<sup>-1</sup> both depicted some what lower performance with respect to germination and most of the vigour test.

**Key Words:** Banj oak, plant growth regulators, germination, seedling vigour

Banj Oak (*Quercus leucotrichophora* A. Camus) covers extensive areas in the western Himalaya and play a subsistence role in the economy of rural population, being mainly used as fodder, fuel-wood, for making small agricultural implements and charcoal. It plays an important role in rejuvenating perennial water sources and recharge the hydrological cycle. It chiefly occurs in the Central Himalaya from 1200-2200 m [1], and as a climax species from gregarious forest between 1800-2000 m [2, 3]. It is a moderate sized to a large evergreen tree with almost rounded crown attaining a height of 20m and diameter of 60cm and regenerates naturally [2].

Growth regulators have attracted much attention in recent years for their role in growth and development of plant. Seed germination and seedling growth of many plant species have responded positively to the application of growth regulators [4]. In view of the lack of satisfactory natural regeneration due to severe biotic and abiotic disturbances, the role of seeds in artificial regeneration can not be overlooked. Keeping the

importance of seed in the propagation and multiplication, the present investigation was carried out to assess the effect of growth regulators on seed germination and seedling vigour of Banj Oak.

### MATERIALS AND METHODS

The present investigation was carried out at College of Forestry and Hill Agriculture, Hill Campus, Ranichauri of the G.B.P.U.A.&T., Pantnagar (Uttarakhand) during the year 2005-06. The seeds of Banj Oak (*Quercus leucotrichophora*) were collected from a natural forest surrounding the Hill Campus of Tehri Forest Division located at 2000m, amsl. Well developed, middle aged trees were selected for the collection of seeds. The seeds were collected from the tree itself in the second fortnight of December, 2005. The normal healthy seeds were screened by dipping in fresh water. The seeds which floated over water were removed, only the seeds remained in the bottom of the bucket were used for experiment. The seeds were then buried

under 1 foot deep moist soil at seed science and technology research farms for three and half months during freezing winter. As the seeds were recalcitrant in nature so, time to time sprinkled water to keep the soil moist. After three and half months, buried seeds were dugout, washed and cleaned with fresh water. In the second week of April, when the growing season commences, seeds were treated with different growth regulators viz., GA<sub>3</sub>, IAA, IBA and NAA in 100 and 200 mg l<sup>-1</sup> and ethanol 1 and 2% for 24h. Distilled water was used as control. For germination studies 100 treated seeds were sown in the second week of April in trays having soil media sand: soil: farm yard manure (FYM) 2:1:1. The experiment was conducted in completely randomized design and replicated three times. Watering was done at 5 days interval from the second week of April to July 15, through watering rose can. Germination of seeds was counted after 28 days and the germination expressed as the percentage of seed which produced normal seedlings [5]. After the germination count, five random normal seedlings from every replication of each treatment uprooted without damaging their root system and cotyledons, were measured for their root and shoot length, seedling length, fresh and dry weight of seedlings with and without cotyledons, dry weight of cotyledons, dry weight of cotyledons utilized by the seedlings, number of leaf per plant, leaf length and breadth and leaf index (length x breadth x number of leaf/plant) in the first week of July. Seedling vigour index (SVI) was derived by multiplying per cent germination with total seedling length in centimeter and dry weight of seedlings in gram [6]. Dry weight of cotyledons utilized by the seedlings was calculated by subtracting the dry weight of cotyledons attached with seedling from dry weight of seed which were not subjected to the treatment.

## RESULTS AND DISCUSSION

The results were subjected to 'analysis of variance' and tested for significant differences at 5 per cent level of significance [7]. Seed germination and seedling vigour as influenced by different growth regulators are presented in

Table 1. It is revealed that the highest germination (88.33%) was recorded for GA<sub>3</sub> with 200mg l<sup>-1</sup>, followed by GA<sub>3</sub> 100mg l<sup>-1</sup> (85.00%), IAA 100mg l<sup>-1</sup> (81.33%), Ethanol 1 per cent (76.67%) at par with IBA 200mg l<sup>-1</sup>, Ethanol 2 per cent and IAA 200mg l<sup>-1</sup>.

The germination (71.00%) was recorded for IBA 100mg l<sup>-1</sup> which results at par with NAA 100mg l<sup>-1</sup>, followed by NAA 200mg l<sup>-1</sup> (63.33%). The significantly lowest germination (59.67%) was observed in the control over all the treatments. The per cent germination increases with increasing the concentration of 100mg l<sup>-1</sup> to 200mg l<sup>-1</sup> in GA<sub>3</sub> and IBA, while germination per cent was decreased with increasing the concentration of IAA and NAA from 100mg l<sup>-1</sup> to 200mg l<sup>-1</sup>. It is reported that growth regulators stimulate and promote seed germination in a wide variety of tree crop [8]. An increase of 19 per cent germination over control by the application of 288 x 10<sup>-5</sup> M solution of GA<sub>3</sub> after 24h of soaking the seeds were reported in *Picea smithiana*. Similar results have also been reported in different species [10, 11, 12]. As regards, root, shoot and seedling length GA<sub>3</sub> treatment for 200mg l<sup>-1</sup> resulted in the highest mean root length (17.97 cm), at par with treatment IBA 200mg l<sup>-1</sup> and IAA 100mg l<sup>-1</sup>, the minimum root length (9.17cm) was recorded for control. Mean shoot length (21.83cm) and seedling length (39.80cm) resulted in the maximum also in GA<sub>3</sub> 200mg l<sup>-1</sup> and the minimum values (10.40 cm and 19.57cm) were recorded for control, respectively. The root, shoot and seedling growth were enhanced by the GA<sub>3</sub> seed treatment has already been reported in Banj oak [13] and in Pear [14]. Mean fresh weight of seedling with and without cotyledons (35.17g & 20.36g), respectively was significantly maximum in the treatment GA<sub>3</sub> with 200mg l<sup>-1</sup> and least value was recorded in control (24.03g & 8.81g), while seedling vigour with respect to dry weight of seedling with and without cotyledons was significantly higher in IAA for 100mg l<sup>-1</sup> (18.53g & 12.84g), respectively and the minimum dry weight of seedling with cotyledons (11.22g) and without cotyledons (3.20g) was recorded for control. Maximum seedling vigour index I (3515.63) was for GA<sub>3</sub> treated seed of 200mg l<sup>-1</sup>, followed by IAA 100mg l<sup>-1</sup> (2952.53)

Table 1. Influence of growth regulators on seed germination and seedling vigour of (*Quercus leucotrichophora* A. Camus).

Treatment	Germination (%)	Seedling root length (cm)	Seedling shoot length (cm)	Seedling length (cm)	Fresh wt of seedlings with cotyledons (g)	Fresh wt of seedlings without cotyledons (g)	Dry wt of seedlings with cotyledons (g)	Dry wt of seedlings without cotyledons (g)	Seed index I %	Seed index II %	Dry wt of cotyledons (g)	Dry wt of cotyledons utilized by the seedlings (g)	No. of leaf per plant	Leaf length (cm)	Leaf breadth (cm)	Leaf length x breadth x no. of leaf/plant
100mg l <sup>-1</sup> GA <sub>3</sub>	85.00	15.83	17.33	33.16	33.05	18.04	11.15	5.37	2871.03	456.12	5.79	4.26	8.23	9.17	3.04	242.85
200mg l <sup>-1</sup>	88.33	17.97	21.83	39.80	35.17	20.36	11.54	6.11	3515.63	539.94	5.43	4.62	8.60	9.67	3.29	272.23
100mg l <sup>-1</sup> IAA	81.33	17.60	18.70	36.30	33.24	18.53	12.84	7.65	2952.53	621.95	5.19	4.86	7.27	7.52	3.76	205.70
200mg l <sup>-1</sup>	74.67	14.43	16.60	31.03	30.78	16.11	11.14	5.51	2317.30	411.08	5.64	4.41	5.93	9.10	2.98	160.93
100mg l <sup>-1</sup> IBA	71.00	12.83	15.37	28.20	29.24	14.51	11.87	4.87	2025.43	345.41	7.00	3.05	5.53	8.18	2.79	126.67
200mg l <sup>-1</sup>	75.67	17.90	18.90	36.80	33.23	18.68	12.55	6.10	2784.73	461.81	6.45	3.60	7.37	9.72	3.12	223.47
100mg l <sup>-1</sup> NAA	69.67	10.87	14.50	25.37	28.72	13.56	11.57	4.37	1766.70	304.50	7.20	2.85	6.60	8.57	2.55	144.38
200mg l <sup>-1</sup>	63.33	10.07	13.20	23.27	24.59	9.38	11.35	3.79	1473.50	239.77	7.57	2.48	7.30	8.62	2.93	184.30
1% Ethanol	76.67	13.77	17.27	31.04	32.83	18.30	11.85	6.32	2379.07	484.64	5.53	4.52	8.23	11.47	3.27	308.66
2%	75.00	15.10	17.47	32.57	31.27	17.10	11.27	5.46	2442.43	409.78	5.87	4.18	8.83	10.28	3.39	313.54
Control	59.67	9.17	10.40	19.57	24.03	8.81	11.22	3.20	1167.93	190.96	7.84	2.20	4.50	5.83	2.24	60.73
CD (0.05)	2.43	1.07	0.86	1.43	1.24	1.08	0.28	0.19	141.20	18.77	0.18	0.18	0.35	0.43	0.11	17.67
SE (m) ±	1.17	0.52	0.41	0.69	0.60	0.52	0.13	0.09	68.08	9.05	0.09	0.09	0.17	0.21	0.05	8.52

and GA<sub>3</sub> 100mg l<sup>-1</sup> (2871.03). The lowest seed vigour index I (1167.93) was recorded for control. Although, seed vigour index II (621.95) for IAA 100mg l<sup>-1</sup> treated seed was found significantly maximum, followed by GA<sub>3</sub> 200mg l<sup>-1</sup> (539.94) while least results was obtained for control (190.96). As regards to dry weight of seedling cotyledons which is negatively correlated with seed vigour found minimum (5.19g) for IAA 100mg l<sup>-1</sup> treatment, followed by GA<sub>3</sub> 200mg l<sup>-1</sup> (5.43g) and maximum weight was recorded for control (7.84g), while dry weight of cotyledons utilized by the seedling was also obtained to be maximum (4.86g) for IAA 100mg l<sup>-1</sup> and lowest (2.20g) was recorded for control. Leaf index (No. of leaf/plant x leaf length x leaf breadth) is a real reflection of seedling vigour at field condition that decide the manufacturing of photosynthates for heterotrophic to autotrophic plant. It was calculated maximum (313.54) for the treatment of Ethanol 2 per cent results at par with Ethanol 1 per cent (308.66), followed by GA<sub>3</sub> 200mg l<sup>-1</sup> (272.23), while lowest leaf index was measured for control (60.73).

Over all, gibberellic acid (GA<sub>3</sub>) resulted maximum seed germination and most of the seedling vigour for 200mg l<sup>-1</sup> in 24h soaking duration as compared to other treatments. The increase in seed germination by optimum concentration of gibberellic acid may probably be due to enhancement of hydrolase (specially α-amylase) synthesis as stated by several workers [15, 16, 17]. GA<sub>3</sub> controls mobilization of starch which acts as a respiratory substrate, as a raw material, for synthesis of other growth regulators and increases the somatic pressure of cell, leading to immediate enhancement in cell elongation [18]. Increased seedling vigour has been reported for many tree species especially to produce elite seedlings [19]. The results of the experiment suggest that seeds of Banj oak (*Quercus leucotrichophora*) should be treated with GA<sub>3</sub> (200 mg l<sup>-1</sup> concentration) for 24h duration to get the maximum percentage of germination, seedling length and seed vigour indices while to get the maximum leaf index, seeds should be treated with Ethanol 2 per cent or 1 per cent solution for 24h.

It is recommended that maximum number of vigorous elite seedlings can be produced by treatment with GA<sub>3</sub> at 200mg l<sup>-1</sup> for 24h. However, the seed treated with GA<sub>3</sub> or IAA at 100mg l<sup>-1</sup> or IBA at 200mg l<sup>-1</sup> for 24h also gave high germination and vigorous seedlings. Thus, in spite of non-availability of these growth regulators even the Ethanol 2 per cent or 1 per cent may prove effective for improving germination of seed and to get elite seedlings with maximum leaf index in *Quercus leucotrichophora*.

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