EFFECT OF GIBBERELLIC ACID (GA_3) AND PRE–CHILLING ON GERMINATION PER CENT OF *Nothofagus obliqua* MIRB. AND *N. Procera* OERST. SEEDS[1]

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Resumen

El humedecimiento de las semillas de N. obliqua *Mirb y* N. procera *Oerst., en soluciones de 50, 100, 150 y 200 ppm de GA_3 durante 24 horas, tuvo un efecto altamente significativo en la tasa y el por ciento de germinación. El periodo de germinación se redujo a 8-14 días y 6-10 días respectivamente, en vez de 28 días*

El pre-enfriamiento de N. obliqua *y* N. procera *durante intervalos diferentes incrementó significamente la tasa y el por ciento de germinación y disminuyó el periodo de germinación a 8-14 días, solamente en* N. procera.

Las combinaciones de tratamientos tuvieron un efecto altamente significativo en la tasa y el por ciento de germinación en ambas especies. Las mejores combinaciones para N. obliqua *fueron 100, 150 y 200 ppm GA_3, con 14 y 42 días de pre-enfriamiento, mientras que las mejores combinaciones para* N. procera *fueron de 150 ppm con 7 días de pre-enfriamiento y de 200 ppm con 14 días de pre-enfriamiento.*

Introduction

Many authors have shown gibberellic acid (GA_3) to promote germination of seeds (1, 2, 3, 6, 9, 13). On the other hand, pre-chilling or stratification has been found to be an effective method for germinating seeds (7, 10, 11, 12).

Nothofagus obliqua Mirb. and *N. procera* Oerst. are fast-growing species: they grow fairly well under Mediterranean climatic and soil conditions. Their timber is rather lighter than *Fagus* spp. timber; it is easily worked, split, and has resistance to rot; therefore it is used for buildings, bridges, posts, railway sleepers, shingles and weather-boarding, etc. (8). There is also evidence that plantations of Nothofagus may be more profitable in Britain than those of some other commonly planted conifers and hardwoods (4).

Seeds of *Nothofagus* species have been found to possess a substantial degree of dormancy and irregularity in germination, and because no detailed investigations have been made on these species, this study was undertaken to investigate the effects of gibberellic acid (GA_3), pre-chilling and the combination of GA_3 with pre-chilling on the germination of *N. obliqua* and *N. procera* seeds.

Materials and methods

Seeds of *N. obliqua* and *N. procera* were collected from artificial stands at Weston Common, Hampshire, England in 1976. A purity test was done. A Dakota

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blower was used for discarding empty seeds, and X-radiographs used for a quick check of soundness of seeds. Cleaned and dried seeds were used for the following specific treatments:

Seeds were pre-chilled at 3-5°C for 0, 7, 14, 28, 35 and 42 days, after soaking for 24 hours in 0, 50, 100, 150 and 200 ppm GA_3 (solutions prepared with distilled water).

Seeds were germinated on filter paper in Copenhagen tanks at the Forestry Commission Research Station, Alice Holt Lodge, Farnham, Surrey, England, with four replications of 25 seeds for each treatment. The tanks were maintained at 30/20°C (day/night) temperature and maximum deviation of the temperature was 2°C. The room temperature was 27/19 (day/night). Light was provided by fluorescent tubes for eight hours daily (intensity 1200 – 1400 lux). Daily counts of germination were made for 28 days (ISTA, 1976). Germinated seeds were removed from the tanks.

Results and discussion

Nothofagus obliqua

Table 1 and Figure 1 indicate that soaking the seeds for 24 hours in solutions of different concentrations of GA_3 had a significant ($p < 0.001$) effect on the rate and average germination percentage. The mean average germination percentage obtained from treated seeds was 100 per cent, while the mean average germination percentage of untreated (control) seeds was 20 per cent. Simultaneously GA_3 treatments caused an appreciable decrease in germination period to 8 days with treatment 200 ppm GA_3, 10 days with treatments 100 and 150 ppm GA_3 and to 12 days with 50 ppm GA_3.

Likewise, pre-chilling for different intervals had a significant ($p < 0.001$) effect on the rate and average percentage of germination. The mean average germination percentages obtained from pre-chilling for 0, 7, 14, 21, 28, 35 and 42 days were 20, 41, 45, 60, 74, 87.5 and 88.5 per cent respectively.

On the other hand, the combination of GA_3 with pre-chilling had a significant ($p < 0.001$) effect on

Table 1. Analysis of variance of germination percentage of *Nothofagus obliqua* after gibberellic acid and pre-chilling treatments.

Source	df	MS	Var/Ratio
Blocks	3	31.16681	0.78
Gibberellic Acid (GA_3)	4	10172.33596	214.40***
Pre-chilling (pc)	6	579.15673	12.20***
GA_3 x pc	24	352.36700	7.42***
Residual	102	47.44406	
TOTAL	139		

*** Significant at level $p < 0.001$.

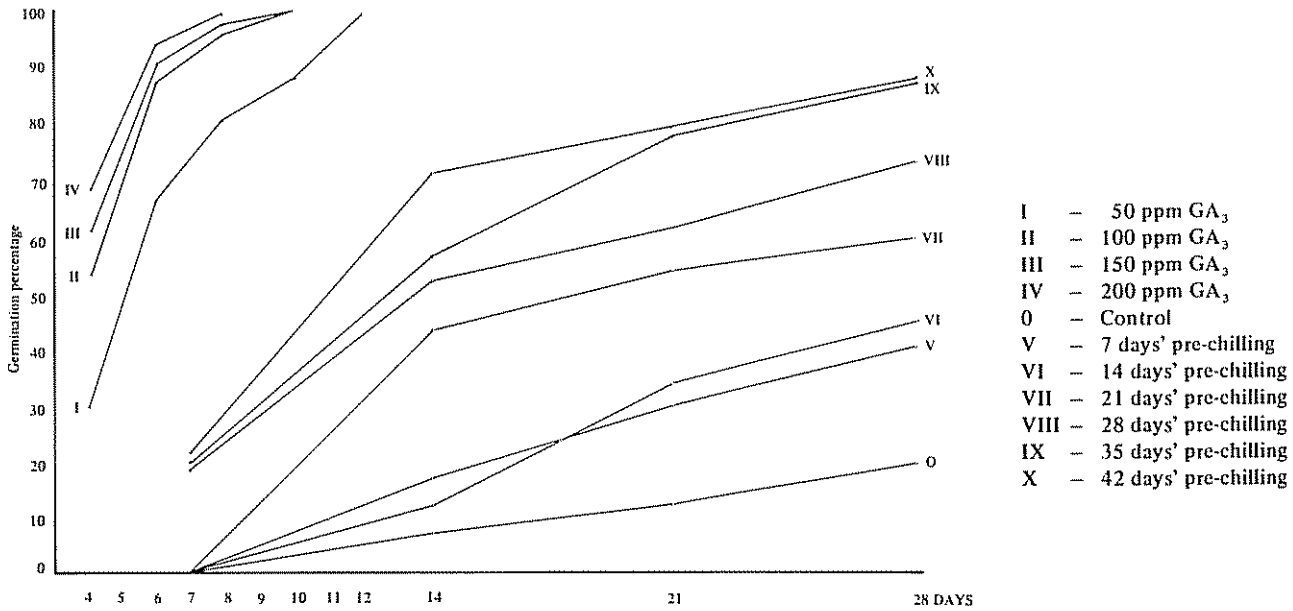

Fig. 1 Effect of Gibberellic acid (GA_3) and pre-chilling on germination percentage of *N. obliqua* seeds

rate and average percentage of germination and decreased the period of germination to 7-14 days instead of 28 days. According to the results obtained, 200 ppm GA_3 or 42 days pre-chilling or 100 ppm GA_3, + 14 days pre-chilling could be recommended as a best treatment for *N. obliqua* seeds.

Nothofagus procera

The data in Table 2 and Figure 2 show that GA_3 and pre-chilling had a significant ($p < 0.001$) effect on the rate and average percentage of germination The period of germination decreased to six days with treatments of 150 and 200 ppm GA_3 and to ten days with 50 and 100 ppm GA_3 instead of 28 days. Pre-chilling decreased the period of germination to 8-14 days; furthermore, pre-chilling for 42 days produced 100 percent germination in eight days.

On the other hand, treatment combinations decreased the germination period to 4-10 days. Combinations of 150 ppm with seven days pre-chilling and 200 GA_3 with 14 days pre-chilling yielded 100 percent germination in four days. In comparison with GA_3, pre-chilling and combination treatments no significant differences were detected among them, but treatments of 200 ppm GA_3, 42 days pre-chilling and 150 ppm GA_3 with 7 days pre-chilling, obtained better results in a shorter period; therefore they could be recommended for treating *N. procera* seeds.

Table 2. Analysis of variance of germination percentage of *Nothofagus procera* after gibberellic acid and pre-chilling treatments.

Source	df	MS	Var/Ratio
Blocks	3	73.50727	2.00
Gibberellic acid (GA_3)	4	310.59088	8.25***
Pre-chilling (pc)	6	204.89535	5.57***
GA_3 x pc	24	91.21144	2.48***
Residual	102	36.72161	
TOTAL	139		

*** Significant at level $p < 0.001$

Abstract

Soaking *N. obliqua* Mirb and *N. procera* Oerst. seeds in 50, 100, 150 and 200 ppm GA_3 solution for 24 hours had a highly significant effect on rate and percentage of germination; it decreased the germination period to 8-14 days and 6-10 days instead of 28 days, respectively.

Pre-chilling *N. obliqua* and *N. procera* for different intervals significantly increased rate and percentage of germination and decreased the period of germination to 8-14 days only with *N. procera*.

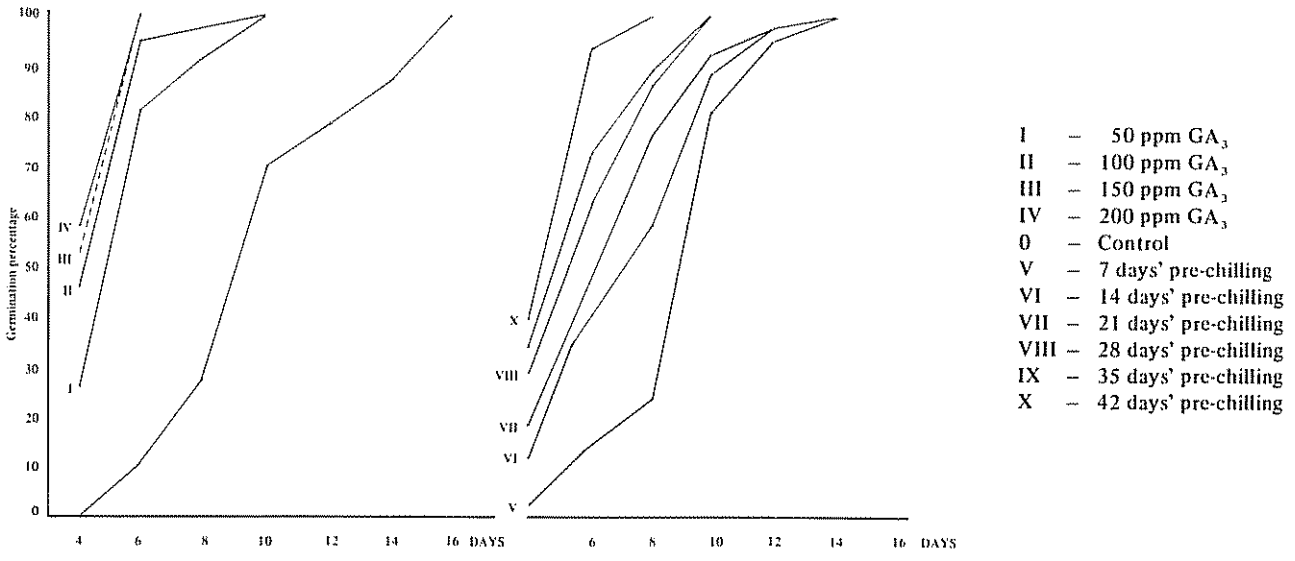

Fig. 2. Effect of Gibberellic acid (GA_3) and pre-chilling on germination percentage of *N. procera* seeds

Treatment combinations had a highly significant effect on germination rate and percentage for both species. The best combinations for *N. obliqua* were 100, 150 and 200 ppm GA_3, with 14 and 42 days pre-chilling, while the best combinations for *N. procera* were 150 ppm with 7 days pre-chilling and 200 ppm with 14 days pre-chilling.

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