Do We Need Flower Stimulation In Seed Orchards?

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Abstract

After long-term studies, an application of growth regulators, mostly gibberellins, became an efficient method of flower stimulation practically used in seed orchards. However, results of experiments indicate also some other possibilities of flower regulation, i.e. control of the strobili sex, changes in the strobili distribution within the crown, and differential effectiveness of growth regulators depending on the natural ability of clones to flowering. These effects are shortly discussed in the paper with regard to question of proposed selective stimulation of strobili bearing.

Introduction

Studies on physiology of hormonal flower induction in seed orchards of forest trees started on the turn of the 1950s and they were developing extensively until the 1990s (for review see, e.g. Pharis and Kuo 1977, Zimmermann et al. 1985, Owens and Blake 1985, Bonnet-Masimbert 1987, Chałupka 1991a and 2007). After several years of investigations, many practical recommendations were formulated for seed orchard managers how to apply growth regulators more efficiently and on a large practical scale (e.g. Philipson 1990, Almquist 2007).

However, from the past research activity in that field we are able to draw some additional conclusions which could be also useful in practical application of hormones to stimulate flowering in seed orchards.

Harmonization of inter-clonal variability in flowering

One of the main principles of seed orchards management is the promotion of genetic diversity in progeny. For that reason, when planning the lay-out of seed orchard, the same or very

similar number of grafts of each clone is initially planted, assuming that this will result in an equal or at least similar contribution of clones to the genetic composition of seed orchard progeny. However, from many literature data it is known, that finally more or less half of the clones in the seed orchards produces nearly all male or female strobili (and seed crop as a consequence) (e.g. Jonsson 1976, Wesoły 1984, Nikkanen and Ruotsalainen 2000) (Fig. 1).

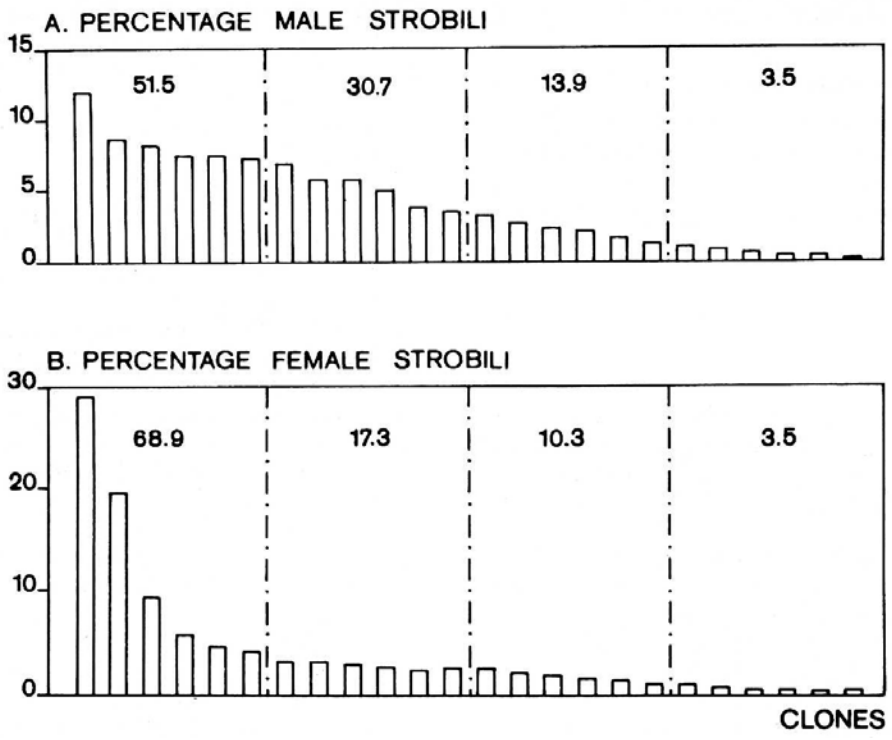

Fig. 1. Mean percentage of male and female strobili produced by 24 clones in a Polish Scots pine seed orchard (after Wesoły 1984).

This means that significant disparity exists between the level of genetic diversity in seed orchard progeny expected from the proportions of planted clones, and the level of genetic diversity resulted from observed participation of clones in genetic diversity of seed crop.

It was revealed in some investigations that the efficiency of flower inducing treatments could be higher in poor flowering clones than in good flowering ones (Fig. 2) . Such increase in the number of strobili in poor flowering clones creates a possibility to equalize to some extent a strobili production by clones and support the participation of poor flowering clones in progeny gene pool.

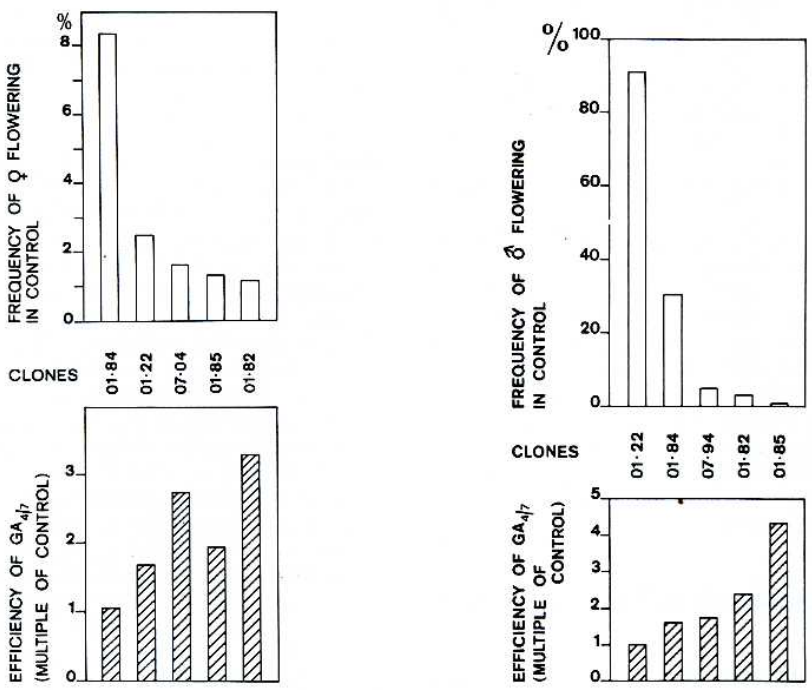

Fig. 2. Efficiency of GA4/7 treatment in Scots pine clones with different female and male flowering ability (after Chalupka 1991b).

Changing in the distribution of strobili in crown

Natural differences exist in the distribution of female and male strobili in the crown of grafts (Fig. 3).

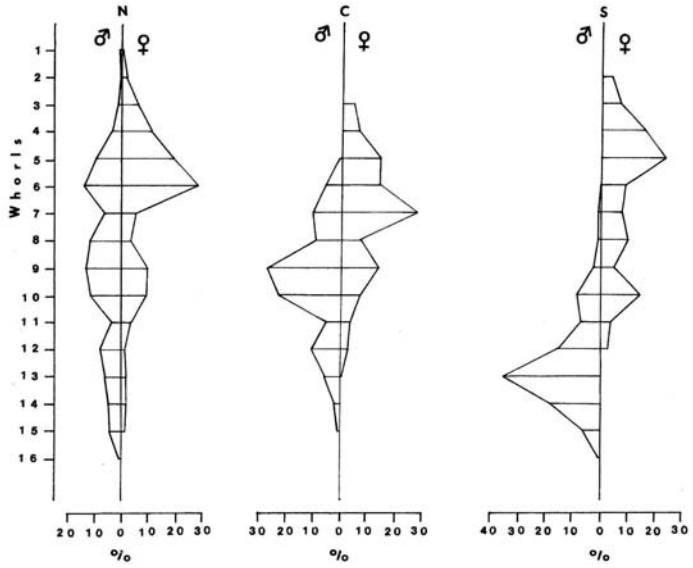

Fig. 3. Distribution of male and female strobili in the crown whorls of 16-year-old grafts of Scots pine in northern (N), central (C) and southern (S) Finland (based on data of Bhumibhamon 1978).

It has been established that gibberellins were effective in promoting female flowering in the lower part of graft crowns in *Larix* sp. (Bonnet-Masimbert 1982), and *Picea glauca* (Marquard and Hanower 1984 b). Also in *Pinus sylvestris* (Chałupka 1980) the efficiency of the gibberellin treatment was much higher in the middle and lower branches that in upper ones (Fig. 4).

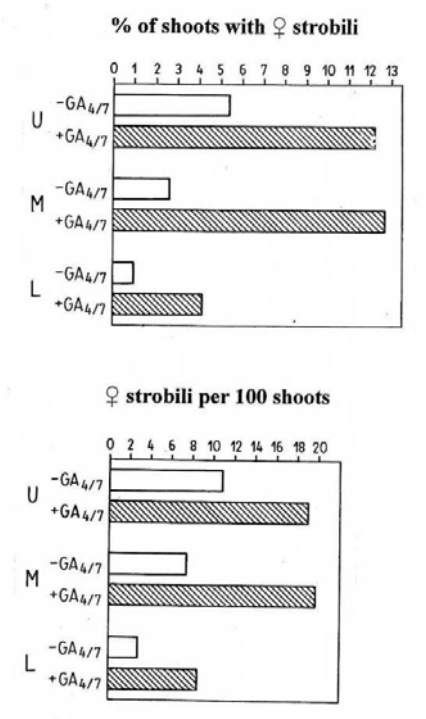

Fig. 4. Effect of GA4/7 on the percentage of shoots flowering female and number of female strobili in upeer (U), middle (M) and lower (L) branches of Scots pine grafts (after Chałupka 1980).

Timing

There are some disproportions between clones and/or grafts in the ratio of female to male strobili produced. Some timing experiments revealed that the sex of strobili initiated depends on time of gibberellins application.

Table 1. Summary of results on timing experiments with Scots pine grafts (after Lukkanen 1980, Chałupka 1984 and Almqvist 2003).

Timing and GA4/7 stimulation effect (*Pinus sylvestris*)

Time of treatment	Stimulation effect
V – VI	♂
VII – VII	♀

It has been established that application of gibberellins at early stage of the growing season promoted the initiation of male strobili, while application in later stages increased female strobili production (Luukanen 1980, Chałupka 1980 and 1984, Almqvist 2003). The summarized results of those experiments are presented in Table 1.

Conclusions

Results demonstrated above, i.e. higher efficiency of gibberellin treatment in poor flowering clones and in lower part of crowns, and effect of timing of treatment application on sex of strobili induced, allow us to modify strobili production in seed orchards by treating only selected clones with gibberellins application at proper time. Therefore, the possibility exists to harmonize participation of clones in genetic diversity of seed crop.

Answering the title question it is obvious that the flower stimulation in seed orchards is needed, however it could be selective one. A more or less equal contribution of all clones to genetic diversity of seed crop should be a target of such selective stimulation. However, further detailed studies on morphogenesis of generative organs are necessary to develop hormonal treatment more effective.

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