Stimulation of Seed Production in *Eucalyptus* by Paclobutrazol Application

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INTRODUCTION

In Tasmania more than six million eucalypts are established in plantations each year. The seed requirement for such a planting is quite large. Many eucalypts tend to be biennial in flowering but often flowering at much longer intervals. This causes seed production to be erratic and supply nonuniform.

The growth regulator paclobutrazol has been shown to enhance flowering and seed set in *Eucalyptus* (Hetherington et al., 1991). Application of paclobutrazol in late February to March can promote flower bud production (a reproductive effect) within the first year of application; whereas November application does not produce a reproductive effect until the second year after application. The aim of the current work was to examine timing effects and to broaden our knowledge of the reproductive effects of paclobutrazol application.

METHOD

Trunk Application. Holes were drilled 5 cm deep every 15 cm around the tree. Clipper, 2% active ingredient (ai) paclobutrazol, was applied through a tube placed in each hole. This enables passive uptake by the xylem. Application rates varied from 0.017-0.067 g ai/cm circumference (circ.) (Table 1).

Collar Drench. Weeds were removed from an area (0.5 m radius) around the base of the tree. Solutions of Cultar (25% ai) were poured over the base of the trunk and the cleared area adjacent to the tree. Application rates varied between 0.25-1.0 g ai/cm circ. (Table 1).

Current Trials. Six experiments were initiated between August 1990 and May 1991. None of the trees had produced flower buds, to any significant degree, prior to treatment. Experiments were conducted at 3 sites in northern Tasmania.

Tree height and circumference were measured to assess tree size. Visual assessment of all trials was carried out during February to April 1992. The intensity of flower buds on each tree was recorded as a visual score: 1 = no buds, 5 = heavy crop. A mean bud score was calculated by averaging individual tree scores. Statistical significance was tested by using a t test for each treated vs control comparison.

RESULTS

Reproductive effects of paclobutrazol, applied as Clipper or Cultar, over a number of experiments are shown in Table 1. Stimulation of flower bud production was most apparent in experiments 3, 4, and 6. Precocious bud production was not evident in experiments 1 and 2. The intensity of flower buds on treated trees in

Table 1. Flower bud production on six experiments using paclobutrazol on *Eucalyptus nitens* and *E. globulus*.

Exp. No.	Species	Treatment: Age at	Treatment: Date	Treatment: Mode	Paclobutrazol rate (g ai/cm circ)	Trees with flower buds (%): Treated	Trees with flower buds (%): Control	Mean bud score [1,2]: Treated	Mean bud score [1,2]: Control
1a	*globulus*	3	13/8/90	Cultar drench	0.3	30	5	1.5 [a]	1.1 [a]
1b	*globulus*	2	13/8/90	Cultar drench	0.9	25	0	1.3 [a]	1.0 [a]
2	*nitens*	3	2/10/90	Cultar drench	0.3	70	40	2.3 [a]	1.4 [a]
3	*nitens*	4	10/5/91	Trunk application	0.03	100	71	3.6 [a]	1.4 [a]
4	*globulus*	4	10/5/91	Trunk application	0.03	75	15	3.1 [a]	1.3 [a]
5a	*nitens*	7	24/5/91	Trunk application	0.017-0.067	83	50	2.7 [a]	2.0 [a]
5b	*nitens*	7	30/5/91	Cultar drench	0.25-1.0	58	50	1.9 [a]	2.0 [a]
6	*nitens*	10	25/5/91	Trunk application	0.017-0.067	100	50	3.8 [a]	1.5 [a]

[1] Trees assessed Feb.-March 1992. 1=no buds, 2=poor crop, 3=average crop, 4=good crop,5=heavy crop.

[2] Within each horizontal line, means followed by different letters are significantly different at 5% level.

experiment 5 was not greatly different to that of the controls, however, no significant reduction in vegetative growth was observed in this experiment. Tree growth, measured as trunk girth, was reduced more by paclobutrazol than was height growth (data not presented). The results of experiment 5 suggest that Clipper is superior to Cultar for stimulating flower bud production.

Paclobutrazol applied in spring 1990 (experiments 1 and 2) did not produce a reproductive effect until more than one year after application. Autumn application generally produced a reproductive response within one year of application (experiments 3, 4 and 6).

DISCUSSION

One explanation for the observed effects of paclobutrazol is that it reduces vegetative growth, thereby diverting more assimilates to reproductive growth (Shearing et al., 1986). Jones et al. (1988, 1989) have found a negative correlation between vegetative growth and flowering in apples. Buds of *E. nitens* are initiated in late spring to early autumn (November-March), whereas in *E. globulus* buds are initiated in spring and summer. Paclobutrazol applied to *E. nitens* in October or *E. globulus* in August did not induce bud initiation in the forthcoming season (experiments 2 and 3); whereas application in March to *E. globulus* (experiment 4) and *E. nitens* (experiment 6) induced bud initiation in the forthcoming spring-summer.

Our results suggest that paclobutrazol does not have an immediate effect on flower bud production but needs to reduce vegetative growth to some degree, prior to the normal bud initiation time, before a reproductive result can occur. Perhaps the reason for the lack of significant response (in terms of flower bud intensity) in experiment 5 was that vegetative growth was not greatly reduced. This may have occurred for two reasons. Firstly, application in May could have been too late and the trees may already have entered a winter dormancy. Secondly, the trees may have been suffering from water stress. It is suggested that the reason for bud stimulation in experiment 6, which was treated at the same time as experiment 5, was that these trees were actively growing at the ti ne of treatment.

With the dosage rates used in experiment 5, trunk application stimulated more trees to produce flower buds than collar drenching. This agrees with previous work (Hetherington, unpublished data). Cultar may become absorbed by soil particles when soil moisture is low, whereas Clipper is immediately available to the tree.

Precocious flower bud production was not observed in experiments 1 and 2. A reason for this could be that trees in these trials had predominantly juvenile form at treatment and may not have been physiologically capable of flowering.

This study has focused on *E. nitens* and *E. globulus,* however, Clipper application to 4-year-old *E. grandis, E. perriniana, E. johnstonii,* and *E. nitida* (under the same conditions as experiment 4) has stimulated flower bud production (Hetherington, unpublished data). There is evidence that paclobutrazol can induce precociousness in *E. gunnii* hybrids (Cauvin, 1991) and *E. globulus* (Hasan, et. al., 1992). Paclobutrazol treatment can also enhance flowering in other ornamental trees such as *Jacaranda* and lillypilly (Pettenon, pers. comm).

CONCLUSION

Early autumn is the best time to apply paclobutrazol in order to obtain a reproductive response in *E. nitens* and *E. globulus.* Our results suggest that only actively growing trees should be treated.

Possible effects of paclobutrazol on precocious bearing need to be investigated in order to maximize genetic progress in eucalypt breeding. Further work on optimum dose rates and the differences between Clipper and Cultar application should be undertaken in order that paclobutrazol can be used effectively in seed orchard management.

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