FLOWERING RESPONSE OF SOME KANGAROO PAWS TO PACLOBUTRAZOL

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Abstract

Paclobutrazol was applied as a pot drench to immature plants of Kangaroo Paws in active growth - ten varieties x six treatment levels x five replicates. Flowering response was characterized by number of stems per pot and for each stem by date of first flower opening, length of stem, and number of racemes. Significant differences were found across treatment levels for one or more variables for all varieties. However, no completely generalizable pattern of response applied to all varieties.

1. Introduction

The context for this study is an ongoing selection, breeding, and research program with Kangaroo Paws (genus A n i g o z a n t h o s). The possibility of control of aspects of flowering response through the use of exogenous growth regulators "in vivo" is of interest to this program, especially for cultivars being developed for cut flower production and for pot plant production.

Only one small prior study was located (Hughes, 1983) where such agents had been used with Kangaroo Paws - but with only a single species and inconclusive results.

Several studies have been initiated. The present study was designed to examine the consequential effects of a single initial application of Paclobutrazol on flowers, leaf and rhizome over two successive flowering seasons. This paper reports only on the initial flowering response which ended in January, 1986.

Paclobutrazol was chosen on the basis of its claimed mode of action (Anon., 1984) and because small pilot studies indicated phytotoxic responses with other agents. A wide range of treatment levels was employed in the hope of locating dosage rates which could be employed in other studies, and which avoided possible gross pathological effects.

2. Material and methods

Ten varieties of Kangaroo Paws were chosen, and included intra-specific and inter-specific hybrids (including one polyploid), and were judged reasonably representative of the character range in the genus. Half the varieties were relatively uniform full sibling seedlings, while the other half were "in vitro" propagated clones. Further details are presented in table 1.

Immature but actively growing plants were established in 17.5 cm pots in the Autumn and transferred to a "walk-in" polythene-film

covered tunnel at the beginning of June (Winter). A standard soil-less medium (8:3:1::8 mm - composted pine bark:coarse river sand: ligno-peat) and long-term slow release fertilizers (fritted trace elements, colloidal iron oxide, dolomite, and 12-14 month term Osmocote - N:P:K::17:4.3:8.2) were used. All these conditions had proven successful previously for Kangaroo Paws in pot culture in the prevailing environmental conditions of southern Victoria.

Paclobutrazol (PP333, "Bonzi") was applied as a pot drench of 200 ml per pot at rates of 0 (control), 0.00125, 0.0025, 0.005, 0.01, and 0.02 g of active ingredient per pot on 22 June, and pots placed in a randomized array. At the time of treatment, plants of all varieties consisted of three to five leaf fans up to 10 cm tall and with current emergence of further leaf fans. At this time no visible evocation of flower stems could be observed.

Evocation of flower stems of some varieties was first noted in mid-July. The first stem to open its first flower was noted on 31 August and the last on 23 January. Daily observations were made over this period, and on each day all stems opening their first flower on that date were measured and assessed. The date, length of stem, and number of racemes per stem was recorded along with any pertinent qualitative observations (for example, of flower colour). Previous experience had established that stem length (measured from substrate surface to the base of the uppermost - or solitary - raceme) was invariant after first flowering opening.

Each pot was taken as a sampling unit, with the following observations:

- number of flower stems
- mean length of flower stems
- mean number of racemes per stem
- mean number of days, post drenching, to first flower opening

Following drenching, no interruption to active growth was observed. No phytotoxic effects were observed at any stage of the study with any variety. No differences across treatments of flower shape, size or colour hue or intensity were observed for any variety (but developed differences in leaf and rhizome characters not reported here were observed).

Prior to statistical analysis, the direct and/or consequential effects of treatments over time was checked by graphical plots of flower stem length against date of first flower opening for individual stems of each variety. Differences in flower stem length attributable to level of initial treatment (see later) were persistent over the full flowering period for each variety.

Statistical analyses were conducted as one-way analysis of variance for the main effect of treatments (using a form of analysis suggested by Scheffe, 1963). Because of the relatively large number of hypotheses tested, the more stringent type 1 error rate of 0.01 was used. Linear contrasts of treatment means were used for post hoc comparisons, given rejection of null hypotheses.

3. Results

3.1. Number of flower stems (figure 1)

The number of stems per pot was found to be a function of treatment level for all varieties. For nine varieties fewer stems were produced at higher treatment levels. The reverse effect was found with hubi, and the additional stems at higher levels can be attributed in part to the production of stems from lower axillary buds of leaf fans. For one variety (pu) there was a complete inhibition of flowering at the highest treatment levels.

3.2. Length of flower stems (figure 2)

Data did not permit a conclusive test for one variety (pu). Control versus treatment differences were found for all other varieties. For seven varieties (pufl, mavion, ma, vipr, vi, bima and hubi) mean length was found to be a decreasing monotonic function of treatment level. For two varieties (mavi and hufl) mean length for control plants was found to be greater than for treated plants, but otherwise did not differ with dose rate.

3.3. Day of first-flower opening (figure 3)

Data did not permit a conclusive test for one variety (pu). For four varieties (vipr, vi, bima, and hufl) the null hypothesis was accepted. For three varieties (ma, hubi, and mavion) the mean time of flowering was found to be earlier with increasing treatment level. For two varieties (pufl and mavi) the mean time of flowering was found to be later with increasing dosage rate but with that of control plants occupying an intermediate position.

3.4. Number of racemes per stem (table 2)

It can be noted that any substantial departure from numbers for control plants (especially larger numbers) almost always represents an atypical development in the architecture of the flower stem - for example, the development of forks or branches in normally unbranched stems, or the development of much elongated lower branches in branched stems. For ornamental and floricultural applications such departures can be regarded as usually undesirable.

Data did not permit a conclusive test for one variety (pu). For three varieties (hubi, hufl and mavion) the null hypothesis for treatment differences was accepted. For two varieties (vi, pufl) the most atypical development was found at low dosage levels but was more nearly normal at higher dosages. For three varieties (ma, mavi and bima) atypical development increased with increasing dosage rates. For the remaining variety (vipr) atypical departures were accepted as constant for all dosages but above the level shown in control plants.

3.5. Summary

The results establish that initial flowering response of a wide range of Kangaroo Paws is modified by the action of Paclobutrazol. For most genotypes studied the effect is to reduce the number of flower stems, with some reduction in length, with an increase in atypical stem architecture in some genotypes, but with different

effects as to modification of flowering season. The variety hubi was the most exceptional, the effect being to increase the number of stems, with a reduction in length, earlier flowering and little or no change in stem architecture.

4. Discussion

The most frequent response to Paclobutrazol among the Kangaroo Paw genotypes studied is one of inhibition of flowering - although the pattern of inhibition is somewhat variable across genotypes. While not reported here, it is already clear that this inhibition correlates with a promotion of rhizome extension and ramification, and leaf fan initiation, stature, and vigour. The consequences of this for the second flowering are to be examined in the continuation of the overall study.

The final results are seen as having a potential significance for Kangaroo Paws as a cut flower crop, especially under field conditions. Field plantations will have an economic life of at least several years and production in the second and subsequent flowering seasons is of far greater economic significance than that in the first season. An allied phenomenon of economic significance is that the first flowering season of many "in vitro" propagated genotypes is precocious and, where completely unseasonal flowering occurs, this may have gross consequences for quality and marketing. An ability to inhibit precocious flowering and promote earlier clump formation would be an advantage.

Only one genotype of those studied combined increased flower production with shorter stems and no significant atypical stem development when treated with Paclobutrazol, and thus indicated a potential for commercial production of potted plants of greater aesthetic appeal and better physical handling characteristics. Further studies are warranted to gain a better understanding of the basis of this exceptional result so that the conditions and/or genotypes can be identified which would yield a similar result.

References

Anon., 1984. Technical data sheet:Paclobutrazol, plant growth regulator for ornamentals. Imperial Chemical Industries PLC, Plant Protection Division:4-5.

Hughes, S., 1983. Aspects of cultivation of Anigozanthos species as ornamental plants. Diploma of Horticultural Science (thesis), University of Sydney.

Scheffe, H., 1963. The analysis of variance. John Wiley and Sons, Inc., New York, (third printing):112,360-364.

Table 1 - Kangaroo Paw varieties, propagation status (FSS - full siblings, IVC - "in vitro" clones), normal flowering habit (S - unbranched stem, F - sub-terminally forked stem, B - branched and forked stem), and symbol.

Variety (female x male parent)	Propagation status	Flowering habit	Symbol
A.viridis	FSS	S	vi
A.humilis x A.bicolor	FSS	S	hubi
A.viridis x A.preissii	FSS	S and F	vipr
A.bicolor x A.manglesii	FSS	S	bima
A.manglesii	FSS	S	ma
A.humilis x A.flavidus	IVC	B	hufl
A.manglesii x tetraploid (A.viridis x A.onycis)	IVC	S	mavion
A.pulcherrimus	IVC	B	pu
A.pulcherrimus x A.flavidus	IVC	B	pufl
A.manglesii x A.viridis	IVC	S	mavi

Table 2 - Mean number of racemes per stem (treatment levels are denoted 0,1,2,3,4,5, 0 corresponding to control and 1,2,3,4,5 to increasing dosage rates of active ingredient)

Variety	Treatment levels					
	0	1	2	3	4	5
vi	1.03	1.28	1.70	1.07	1.04	1.13
hubi	1.03	1.02	1.04	1.04	1.08	1.10
vipr	1.47	1.58	1.66	1.68	1.68	1.57
bima	1.06	1.00	1.23	1.13	1.18	1.67
ma	1.00	1.00	1.05	1.08	1.12	1.15
hufl	3.68	3.40	3.45	3.11	3.71	3.73
mavion	1.00	1.06	1.00	1.00	1.00	1.13
pu	13.14	16.00	13.00	-	-	-
pufl	12.78	18.50	22.33	14.75	15.50	16.00
mavi	1.00	1.00	1.09	1.03	1.11	1.12

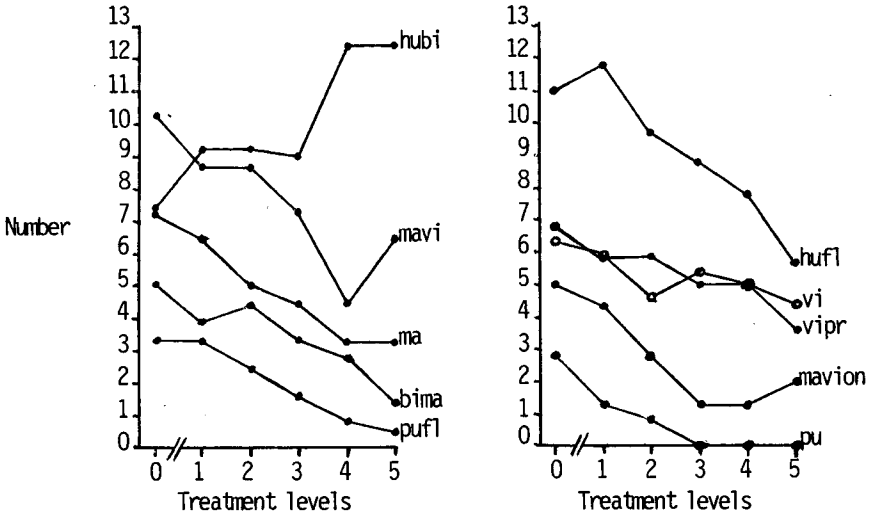

Figure 1 - Mean number of flower stems (five replicates per level per variety)

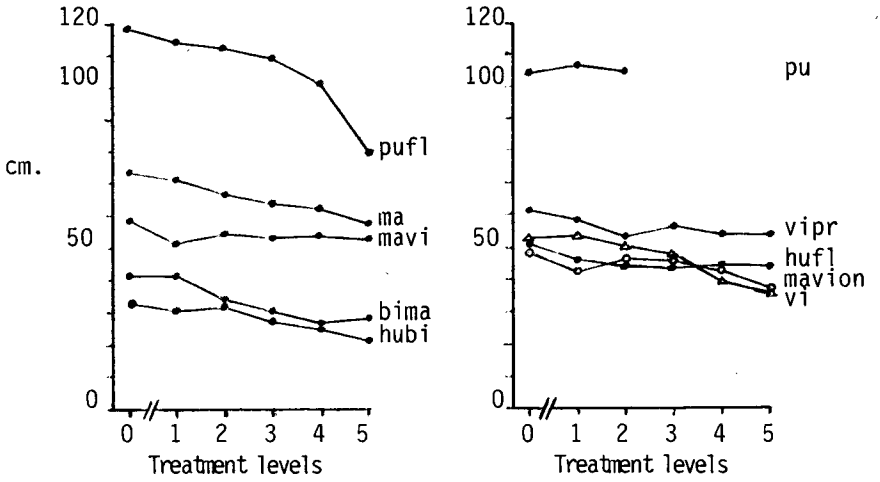

Figure 2 - Mean length of flower stem (five replicates per level per variety)

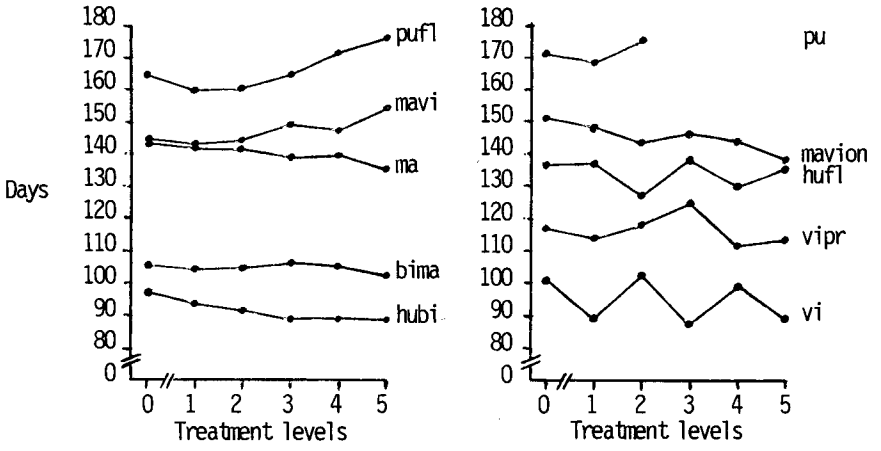

Figure 3 - Mean days/to first flower opening from date of drenching (five replicates per level per variety)