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Effect of 2,4-dichlorophenoxyacetic acid and gibberellic acid in delaying pre-harvest drop and rind senescence on Ellendale mandarin fruit

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Summary

2,4-dichlorophenoxyacetic acid (2,4-D) was applied alone at 10 ppm and in combination with 10 ppm gibberellic acid (GA) at 10 ppm and 20 ppm, to mandarin fruit cv. Ellendale. Gibberellic Acid was also applied alone at 10 ppm. Sprays were applied either at break colour (10 to 15% yellow) or at full colour. Application of 2,4-D reduced fruit fall before harvest and when combined with GA, the chemicals were not antagonistic. The later time of application of chemicals (full colour) was more effective.

INTRODUCTION

The Ellendale mandarin, generally considered to be a tangor, is the major citrus cultivar grown in the central Burnett district of Queensland. Ellendales at maturity have a higher percentage of fruit fall when compared with most other commercial cultivars. Late hanging of fruit in an attempt to take advantage of higher priced markets leads to serious fruit loss.

2,4-D has been used as a fruit retention spray when applied pre-harvest to oranges and grapefruit in other Australian citrus growing areas (Sarooshi and Stannard 1975; Gallasch 1979; Sarooshi 1982). Concentrations of either 10 or 20 ppm 2,4-D are most commonly used. The four different formulations of 2,4-D used by Sarooshi and Stannard (1975) proved equally effective.

2,4-D is registered in Queensland for use on citrus, although only in post-harvest dips for mandarins to maintain calyx buttons.

Gibberellic acid (GA) has been used commercially in Queensland on Ellendale mandarins, particularly those designated for export and late harvest. Chapman, Brook and Peacock (1979) found 10 ppm GA to be effective in reducing fruit puffiness, fruit acidity and delaying loss of fruit green colour when applied within a three week period after colour break (10 to 15% yellow).

Sarooshi (1982) added 10 ppm GA to the standard mid-May spray of 2,4-D applied to late hung Marsh grapefruit and found it improved their colour and appearance and reduced rind thickness and puffiness.

The experiment reported was designed to test the effectiveness of 2,4-D sprays with and without GA in preventing fruit fall and delaying rind senescence of the Ellendale mandarin.

MATERIALS AND METHODS

Design and treatments

The experiment was a (2×5) factorial randomised block design with four replications and single tree plots. The plots were fully guarded between rows and half guarded within rows. The experimental block comprised 16-year old Ellendale mandarins, widely spaced at 7.3×7.3 m, on a Gayndah citrus orchard.

Treatments were as follows:

2 Timings	5 Spray treatments
T_0—break colour (10 to 15% yellow)	S_0—nil spray
T_1—full colour (100% yellow)	S_1—10 ppm GA
	S_2—10 ppm 2,4-D
	S_3—10 ppm GA+10 ppm 2,4-D
	S_4—10 ppm GA+20 ppm 2,4-D

GA sprays were prepared using the liquid formulation registered by Schering as Pro-Gibb. A wetting agent was added as recommended by the manufacturer.

The 2,4-D sprays were prepared from a commercial formulation containing 500 g/L 2,4-D as the amine salt. A wetting agent was added at the same concentration as for the GA spray.

Sprays were applied using a high volume hand gun at 2 MPa. The break colour spray was applied on 7 May 1981 and the full colour spray was applied on 16 June 1981.

Measurements

One week before harvest on 21 July 1981, a field colour fruit assessment of treatments was completed based on a 1 to 5 scale as follows:

1. 0-20% green colour;
2. 20-40% green colour;
3. 40-60% green colour;
4. 60-80% green colour;
5. 80-100% green colour.

One day before harvest, the number of abscissed fruit under each datum tree was counted and weighed to compare fruit fall between treatments. Fruit removal pull force was measured in kilograms by randomly selecting 20 fruit per plot, cutting off each fruit with twig intact and placing individually in a suspended wire cage. The weight required to remove the twig by pulling with a pair of pliers was recorded for each fruit, using a spring balance.

Each fruit in the sample of 20 was cut in half equatorially and the diameter measured. The halves were then rated for puffiness using a 1 to 5 scale as follows.

1. Skin firmly attached to pulp.
2. Small air spaces appearing between the skin and pulp.
3. Skin distinctly separated from the pulp in one area.
4. Skin distinctly separated from the pulp in more than one area.
5. Skin virtually completely separated from the pulp.

Total yield of each datum tree was recorded on 27 July 1981.

The experiment was statistically analysed as an incomplete factorial. The absence of one treatment (nil GA+20 ppm 2,4-D) prevented analysis as a complete 2×2×3 factorial experiment.

RESULTS AND DISCUSSION

Pull force data showed clearly that 2,4-D sprays at either 10 or 20 ppm held fruit more firmly on the tree when compared with unsprayed trees (Table 1). There was no significant difference between 10 to 20 ppm. Spray timing was also important in holding fruit on the tree as sprays applied at the later of the two timings (full colour) held fruit more firmly than the sprays applied at colour break. The GA treatment did not affect pull force.

These results were confirmed by the fruit drop count data (Table 1) where significantly more fruit abscissed on unsprayed trees compared with 2,4-D at 10 ppm. An unexpected result was the high fruit fall at 20 ppm of 2,4-D when the opposite would be expected, especially after viewing the pull force data. The early treatment timing allowed more fruit to absciss than the later timing. The GA treatment had no significant effect on fruit drop.

Table 1. Fruit characteristics and yield in response to GA and 2,4-D concentrations and timing

Treatment	Pull force (kg)	Fruit drop count	Fruit colour 1 to 5 scale 1=coloured 5=green	Puffiness 1 to 5 scale 1=firm 5=puffy	Yield (kg)
nil 2,4-D	4.73*a*	228*a*	1.19*a*	2.10*a*	227*a*
10 ppm 2,4-D	6.79*b*	113*b*	1.17*a*	1.83*a*	307*a*
20 ppm 2,4-D	7.01*b*	147*ab*	1.18*a*	1.83*a*	290*a*
nil GA	6.22*p*	171*p*	1.09*p*	1.99*p*	293*p*
10 ppm GA	6.13*p*	153*p*	1.34*q*	1.85*p*	290*p*
Time break colour	5.38*x*	210*x*	1.28*x*	1.93*x*	278*x*
Time full colour	6.98*y*	114*y*	1.07*y*	1.91*x*	304*x*

Numbers in each of the three sections 2,4-D, GA and Time not followed by the same letter were significantly different at the 5% level.

2,4-D had no effect on field fruit colour (Table 1) when it was rated 1 week before harvest. As expected from an earlier experiment (Chapman *et al.* 1979), GA at 10 ppm delayed the loss of green colour from the rind as did the early treatment spray timing at colour break (Table 1).

Puffiness was not significantly affected by 2,4-D treatments, GA treatment or by timing, although there was a trend which indicated puffiness increasing on the unsprayed trees (Table 1). A greater puffiness difference was obtained by Chapman *et al.* (1979).

Yield was not affected by the spray treatments (Table 1) and there was no effect on fruit size (data not presented).

No interaction occurred between 2,4-D and GA treatments (data not presented). Therefore, when both chemicals are combined, there are no antagonistic effects. Sarooshi (1982) has also effectively combined GA and 2,4-D for use on citrus.

The experiment showed that 2,4-D at 10 ppm is an effective treatment for reducing fruit fall near harvest. If required, 2,4-D may be combined with GA.

The full colour application time was more effective for 2,4-D than the break colour timing when used either alone or in combination with GA.

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