VALUE OF 2,4,5-TP AS A PRE-HARVEST DROP SPRAY IN APPLES AT STANTHORPE

By T. J. BOWEN, B.Sc., formerly Horticulturist, Horticulture Branch, Division of Plant Industry.

SUMMARY.

Trials were carried out with 2,4,5–TP as a pre-harvest drop spray on Gravenstein apples.

When 2,4,5–TP was applied at a concentration of 50 p.p.m. at or shortly before the commencement of natural fruit fall, pre-harvest drop was reduced to negligible proportions (8.7 per cent. as against 25.7 per cent. in the case of ANA at the standard concentration of 10 p.p.m.). Observational data suggest that the concentration of 2,4,5–TP could be substantially reduced, if necessary, but such reduction is normally unjustified in view of the variable tree vigour in commercial orchards and other factors.

The efficiency of 2,4,5–TP as a pre-harvest drop spray can be largely attributed to its long period of effectiveness (26 days as against 14 days in the case of ANA) and the consequent increased permissible latitude in timing.

I. INTRODUCTION.

For some years past, alpha-napthalene acetic acid (ANA) has been widely used as a pre-harvest drop spray in apple orchards at Stanthorpe on early-maturing varieties such as Gravenstein, Jonathan and Delicious, which are very prone to premature fruit fall.

As in other countries, the results obtained in commercial practice have been highly variable, ranging from very good to very bad. Such variability has been ascribed to a number of causes, chief among which are :—

(1) *Faulty timing.*—Normally the spray is applied just before fruit drop is expected to occur but the precise date varies according to seasonal conditions and is not always easily determined.

(2) *Limited period of effectiveness.*—If treatment ceases to be effective before the fruit is fully mature, fruit drop may be accentuated.

(3) *Vigour of the trees.*—Response to ANA treatment is reduced in trees which are lacking in vigour owing to nutrient deficiencies, inadequate soil moisture or disease infection. Double treatment at short intervals is not a complete solution to the problem.

The possibility of other hormones being of greater value than ANA for the prevention of pre-harvest drop in apples has recently attracted attention. 2,4,5-T (2,4,5-trichlorophenoxy acetic acid) was one of the first materials tested; it showed considerable promise at concentrations between 25 and 75 p.p.m. (Hatton 1955). A closely related product, 2,4,5-TP (2,4,5-trichlorophenoxy propionic acid), gave just as good a result as 2,4,5-T in a wide range of varieties.

II. PRELIMINARY OBSERVATIONS—1953-54.

In 1954, limited stocks of 2,4,5-TP became available for experimental purposes and an observational trial was established at Thulimbah on 16-year-old trees of the early-maturing variety Gravenstein.

Treatments were:—(1) ANA (10 p.p.m.); (2) 2,4,5-TP (10 p.p.m. prepared from a concentrated solution in methyl alcohol); (3) 2,4,5-TP (20 p.p.m. prepared from a concentrated solution in methyl alcohol); (4) 2,4,5-TP (20 p.p.m. prepared direct in water); and (5) control.

Sprays were applied through a knapsack pump on Jan. 4, 1955, and harvesting took place between Jan. 17 and Jan. 24.

The percentage fruit drop (means of duplicate trees) recorded were as follows:—ANA, 39·3; 2,4,5-TP (10 p.p.m.), 4·2; 2,4,5-TP (20 p.p.m. methyl alcohol), 5·1; 2,4,5-TP (20 p.p.m. water), 4·5; control, 16·9.

From these preliminary observations, there seemed little doubt that 2,4,5-TP warranted further investigations as a pre-harvest drop spray. The relatively high fruit drop in trees treated with ANA in this trial (39·3 per cent.) is noteworthy as an example of the hazards associated with its use in years when harvesting is preceded by hot, dry weather.

Table 1.

CLIMATIC DATA FOR STANTHORPE (1953–1955).

Rainfall (points).

June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Season.
3	37	185	6	158	270	46	124	1,193	115	91	90	1953–54
185	291	221	230	746	425	322	98	243	311	256	331	1954–55
189	199	169	220	251	275	349	372	332	269	161	179	Average
Temperatures—Mean Maximum (°F.).												
59·1	57·3	56·8	62·0	68·4	75·7	86·0	74·6	75·2	78·0	78·3	63·6	1953–54
57·6	59·0	61·2	63·0	68·7	74·7	76·3	80·0	79·5	76·1	70·6	60·3	1954–55
Temperatures—Mean Minimum (°F.).												
31·7	28·2	33·8	38·8	47·4	52·8	58·0	59·7	62·5	56·7	50·0	40·1	1953–54
36·6	38·0	38·5	41·4	48·9	54·0	57·5	59·5	61·5	63·7	53·5	42·5	1954–55

III. REPLICATED TRIAL—1954-55.

Following the observational trial in 1953-54, a replicated field trial was established in the same orchard at Thulimbah in 1954-55 on Gravenstein apples. Treatments were:—

(1) ANA (10 p.p.m.) applied Dec. 23 at the commencement of fruit drop.

(2) ANA (10 p.p.m.) applied Dec. 23 and again on Jan. 6.

(3) 2,4,5-TP (50 p.p.m.) applied Dec. 23.

(4) 2,4,5-TP (50 p.p.m.) applied Jan. 6.

The trial was established as a 6 x 4 randomised block with single tree plots. Treatment with ANA was withheld from five trees outside the experimental series in order to get an estimate of fruit drop under natural conditions.

Sprays were applied through high volume delivery equipment at a pressure of 400 lb. per sq. in. and at a rate of approximately 1·5 gal. per tree.

Unlike the previous year, soil moisture supplies in 1954-55 were adequate throughout the whole growing period (Table 1) and the trees at no time showed signs of stress.

Fruit falling to the ground under the experimental trees was collected daily from the time of the initial spray treatment on Dec. 23 until the end of the harvesting period. Progress fruit-drop totals on Jan. 6, Jan. 18 and at the close of harvesting are presented in Table 2 as percentages of the total crop.

Table 2.

FRUIT DROP (PERCENTAGE EQUIVALENT MEAN VALUES).

Treatment.	Jan. 6.	Jan. 18.	Total.	Mean Number of Fruit per Tree.
(A) ANA (single spray)	5·3	21·6	25·7	673
(B) ANA (double spray)	4·2	11·0	13·6	
(C) 2, 4, 5–TP (Dec. 23)	2·7	6·3	8·7	
(D) 2, 4, 5–TP (Jan. 6)	7·1	8·2	10·2	
	C < B, D B < D	C < B, A D, B < A	C < B, A D, B < B	
Control	10·2	30·5	32·5	

IV. DISCUSSION.

(1) Fruit Fall and the Season.

The incidence of natural pre-harvest drop is apparently highly variable from season to season—16·9 per cent. in 1953-54 and 32·5 per cent. in 1954-55. In the former year, rains in the early summer and midsummer periods were below normal (Table 1), the crop was light (Table 3) and the bulk of the fruit remained on the trees to maturity. In 1954-55, however, when fruit fall was heavy, soil moisture was ample throughout the whole drying period. It is inferred, therefore, that variations in soil moisture content are less conducive to fruit fall than the size of the crop and nutritional deficiencies when the fruit is approaching maturity.

Table 3.

YIELDS PER TREE AND PERCENTAGE FRUIT FALL.

	1953–54.	1954–55.
Range	2–3 bus.	4–6 bus.
Mean	2·5 bus.	5 bus.
Fruit drop (%)	16·9	32·5

The relatively heavy fruit crop in 1954-55 may have been due to the effect of (*a*) excessive transpiration during the later stages of fruit development when the uptake of moisture from the soil was reduced by waterlogging; and/or (*b*) insufficient nutrient reserves, following leaching after heavy rains earlier in the year, to mature the developing fruit.

(2) Time of Application.

It is normal practice to apply pre-harvest drop sprays just before the onset of fruit drop, which usually begins some 10-12 days before the anticipated time of the first harvest. In the Gravenstein apple, harvesting usually begins in early to mid-January and sprays were therefore applied on Dec. 23. Substantial fruit drop occurred in the orchard by Jan. 6 and increased sharply during the next fortnight in all trees other than those receiving 2,4,5-TP. The failure of the ANA single-spray schedule and the moderate performance of the double-spray schedule suggest that the initial treatment applied on Dec. 23 was too early or alternatively that, under the conditions of this experiment, ANA applied at any time would have been ineffective. Certainly, the initial application had lost its efficiency shortly after Jan. 6—i.e., 14 days after treatment. The second spray applied on Jan. 6 reduced the amount of fruit drop but did not eliminate it.

The most effective treatment schedule was a single spray of 2,4,5-TP applied on Dec. 23. It was more efficient than the ANA double-spray schedule (Dec. 23 and Jan. 6) and the single 2,4,5-TP spray on Jan. 6. The latter was clearly applied too late. It would, therefore, appear that 2,4,5-TP remained effective over a period of at least 26 days.

(3) ANA versus 2,4,5-TP.

Although ANA sprays have for long been used to prevent pre-harvest drop in some varieties of apple in Queensland, failures are rather common and a substitute has been needed for some time.

The experimental evidence presented here suggests that, other things being equal, 2,4,5-TP at 50 p.p.m. is more efficient and should be used in commercial practice. It retains its effectiveness over a long period and times

of application need not be so precise. The risk of a breakdown under diverse climatic conditions, variable tree vigour and other factors is therefore remote.

The concentration of 2,4,5-TP used in the 1954-55 trial (50 p.p.m.) is much greater than that used in the observational trial of the previous year. It represents a middle concentration based on investigations in the U.S.A. and may be much higher than is strictly necessary. However, the cost of materials is of negligible importance in the pre-harvest drop spray programme and there is therefore little point in establishing power limits of usefulness which must inevitably vary from orchard to orchard and from year to year.

(4) Other Effects.

2,4,5-T and 2,4,5-TP have both been credited with the ability to hasten fruit maturity and intensify skin colour in the fruit (Thompson 1952). No such changes were observed in this trial.

These sprays are also said to reduce the storage life of the fruit. This point is of little interest in the Granite Belt, as the varieties which are most prone to pre-harvest drop (i.e., Gravenstein and Jonathan) are both early-maturing types which are not normally stored for long periods.

V. CONCLUSIONS.

(1) 2,4,5-TP at 50 p.p.m. is much more efficient in controlling pre-harvest fruit drop in the Gravenstein apple than ANA at 10 p.p.m., which has been in commercial use for many years in the Stanthorpe district.

(2) The period of effectiveness of the 2,4,5-TP spray is at least 26 days, as against 14 days with the ANA spray. The additional period of effectiveness allows a greater margin of safety in timing spray applications. This is an advantage in years when difficulties arise in relating the time of treatment to the anticipated date of fruit maturity. The risk of lack of response or induced fruit fall just before normal maturity, both of which are recognised hazards with ANA, is therefore negligible.

(3) 2,4,5-TP had no obvious effect on the time of fruit maturity or the skin colour of the fruit.

(4) The percentage fruit fall in 1953-54, a relatively dry year, was considerably less than in 1954-55, when the soil was consistently near field capacity. In the latter year, fruit fall may have been accentuated by high transpiration in January when the soil was partly waterlogged or, alternatively, by a deficiency of plant nutrients in the soil following leaching earlier in the season.

REFERENCES.

GARDNER, F. C., MARTH, P. C., and BATJER, L. P. 1940. Spraying with plant growth substances for the control of pre-harvest drop in apples. Proc. Amer. Soc. Hort. Sci. 37: 415-428.

HATTON, T. T. 1955. Responses of the Delicious apple to sprays of 2,4,5-trichlorophenoxy acetic acid. Proc. Amer. Soc. Hort. Sci. 65: 59-62.

HOFFMAN, M. B., and EDGERTON, L. J. 1952. Comparison of naphthalene acetic acid and 2,4,5-trichlorophenoxy propionic acid and 2,4,5-trichlorophenoxy acetic acid for controlling harvest drop of McIntosh apples. Proc. Amer. Soc. Hort. Sci. 59: 225-230.

THOMPSON, A. A. 1952. Further experiments with 2,4,5-trichlorophenoxy propionic acid sprays for control of the pre-harvest drop of apples. Proc. Amer. Soc. Hort. Sci. 60: 175-183.

A. H. TUCKER, Government Printer, Brisbane.