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Fig. 1.—Ruby Red peach trees—1953; (left), sprayed with 1-40 DNC dormant oil; (right), unsprayed. Earlier blossoming and fruit set supported by vigorous leaf development were notable features of the sprayed trees

## DNC OIL SPRAYS FOR DECIDUOUS FRUITS

By F. MELVILLE, B.Sc. (Agric.), Senior Horticultural Adviser, and  
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**T**HE climate of any particular place plays a very important part in determining the kinds and varieties of fruits which can be successfully grown, and one of the most common manifestations of unfavourable weather conditions in deciduous fruits is a condition usually termed "delayed foliation." It is characterised by delayed and irregular blossoming and foliation, failure of many fruit and leaf buds to open and shedding of blossom buds.

All varieties of apples and certain varieties of peaches, nectarines and apricots grown under mild conditions may be affected, while in relatively cold situations these fruits may also suffer after very mild winters.

### WINTER CHILLING

Deciduous fruits require a period of chilling during the winter months before the dormant buds will burst into life the following spring. Almonds, most varieties of plums and early peaches and apricots have very moderate requirements and the climate in all the main fruit-growing districts of Western Australia is sufficiently cold in winter to produce normal budburst with these fruits in spring.

Apples require the greatest amount of winter cold and cannot be grown successfully on the coastal plain nor in the Hills areas except in cold pockets. In southern districts such as Donnybrook, Capel, and

Albany, where apples are grown at low elevations near the coast evidence of lack of winter chilling can also be seen.

Peaches exhibit great variability in their reaction to climatic conditions. Briggs Red May for instance is not grown commercially because its chilling requirements cannot normally be met in the stone fruit districts. Varieties such as Anzac, Ruby Red, Triumph and Elberta are more tolerant, but are still subject to delayed foliation in milder situations. Early peaches such as Dunhelm and Edward VII will however grow well under moderate winter conditions in such areas as the Swan Valley and foothills.

Each variety has a fairly definite chilling requirement which must be met before the winter rest period is broken. In other words there must be a certain total period measured in days or hours during the winter months when the temperature remains below a critical level.



In certain parts of South Africa it has been found that the critical level is a mean monthly temperature of 54°F during June and July. In California it is considered that 1,000 hours below 45°F or a critical mean temperature for June and July of 49.5°F is necessary.

However complete reliance should not be placed on the measurements of winter chilling in this manner as varietal differences and growing conditions preceding the winter period are also important. Cloudy or foggy conditions by impeding the passage of the sun's rays, not only reduce air temperatures, but also minimise the heating of the buds which is what matters. On clear sunny days the buds may reach a temperature considerably above that of the surrounding air and a difference of up to 20°F has been recorded elsewhere. Atmospheric temperatures can therefore be misleading where much sunny weather is experienced during the winter months, particularly June and July.

The morning fogs at Bridgetown may therefore be of considerable value to apple orchards in the area as they are in the San Joaquin Valley of California. Records available in this State as shown in Table 1 indicate that winter temperatures in most fruit districts are considerably above the limits suggested for California and run very close to the critical level found in South Africa. It is surprising therefore that the effects of delayed foliation are not more marked. Probably the effect is more widespread than realised and particularly in the apple districts trees would probably respond to treatment in most years. However only in certain years are the symptoms very obvious.

TABLE 1.

Mean Monthly Temperatures at Various Centres.

		Degrees Fahrenheit.	
		June.	July.
Perth	....	57.1	55.4
Kalamunda	....	55.1	53.2
Donnybrook	....	52.8	51.3
Bridgetown	....	51.2	49.7
Manjimup	....	51.3	49.6
Mount Barker	....	51.3	49.7
Albany	....	55	53.6

The mean monthly temperature is calculated from the maximum and minimum daily temperatures.

In 1948 and again in 1949 apple trees throughout most of the fruit growing districts exhibited very pronounced delayed foliation. Blossoming was erratic and flowers were still opening when the earlier settings were well grown. A number of stone fruit varieties was also affected. Since then the trouble has been present to a lesser degree and in 1954 budburst was more normal than it has been for many years.

### OTHER FACTORS AFFECTING DELAYED FOLIATION

The degree of delayed foliation depends upon the interaction of a number of factors all associated in some way with the rest period and the amount of winter chilling. The lateness of summer vegetative growth and its effect on delaying the onset of leaf fall and dormancy are of considerable importance. Trees which grow late in the summer thus delaying the commencement of the rest period are much more liable to the trouble. The hot dry summer experienced in this State may therefore be of value in promoting early maturity of the buds. The budburst in the 1954 season was more normal than for many years, and this can be related to the autumn conditions of that year. Leaf fall occurred early, rainfall was below average until mid-April, minimum temperatures were lower than normal, and frosts were reported more frequently than usual during March, April and May.

The spring weather following bud swell will influence the rate of growth and therefore the effects of delayed foliation. The retarded growth of some varieties due to cold spring weather will accentuate the trouble while with a warm spring following a sufficiently cold winter, growth will be more normal. The good blossoming and leaf development in 1954 resulted from ideal autumn and winter conditions followed by warm weather in August and September. Delayed foliation will be worse in years when the trees are late going dormant, the winter is mild with an abnormal number of sunny days and is followed by a cool spring.



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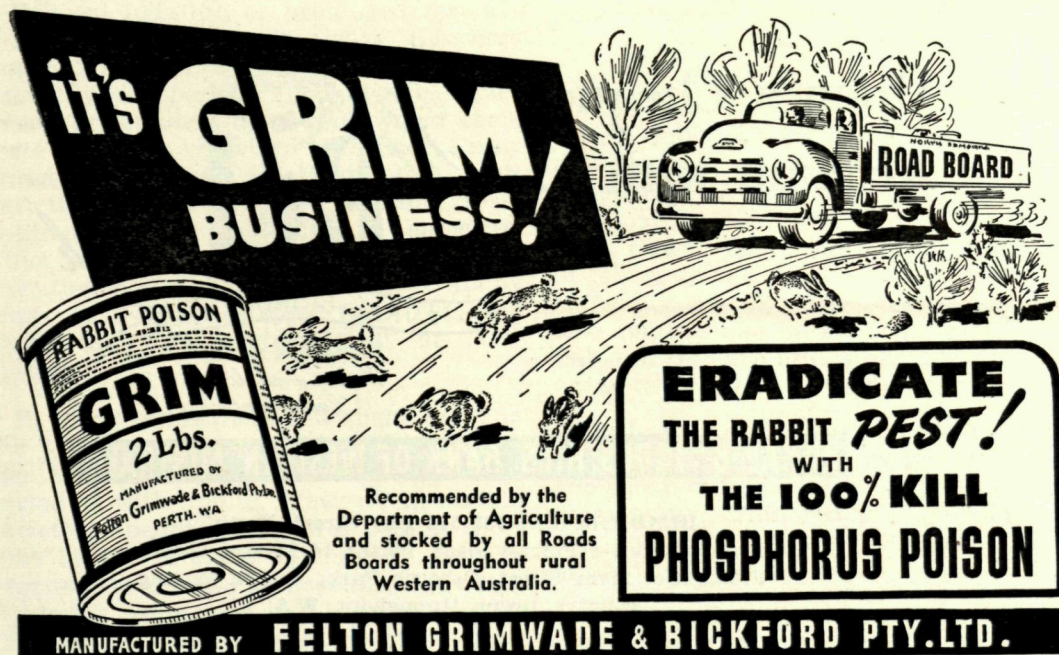
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Fig. 2.—Granny Smith apple trees—1953; (left), sprayed with 1-20 DNC dormant oil; (right), unsprayed. The early development of large healthy leaves was associated with advanced concentrated blossoming on the sprayed trees

## BLOSSOMING

Delayed foliation or prolonged rest affects fruit trees in various ways. Blossoming is delayed and extended over an abnormally long period. For instance, apples which under ideal conditions would complete flowering in two to three weeks may straggle on for six weeks or more. All varieties are not affected alike and cross-pollination may therefore be defective. Thus the setting is erratic, and a large variation occurs in the size of the young fruit. Late blossoms often fail to set and those that do produce fruit of later maturity.

In stone fruits there is a slight delay in the opening of blossoms, but there is not the same extension of the blossoming period as with apples. However in certain varieties, shedding of flower buds a short time before budburst is common. Spinks peaches are notably susceptible, and often Goldmine nectarines and certain apricots are affected. The pruning of such varieties is therefore often delayed until blossom-

ing, when the extent of shedding is apparent, or else the trees are left almost unpruned.

## FOLIAGE

Leaf buds require a greater degree of chilling and are therefore always more affected by mild winters. They open very late and a large proportion may fail to burst at all. This results in a serious lack of foliage to sustain the young fruit which suffer accordingly. The lack of leaf cover also renders the bark of the main limbs liable to sunburn and serious damage may occur to peach trees from this cause.

On leaders and strong growth of apples, often only a few buds towards the tip of the shoot will grow leaving the rest of the stem bare. This restricts spur development and may create difficulties in the training of young trees.

With peaches, in severe cases no shoot development at all occurs from pruned leaders while many laterals may produce



only a terminal growth. Apart from the lack of supporting leaves for the young fruit the regeneration of fruiting wood for the following season is inadequate.

At a later date, buds situated on older wood grow strongly to produce numbers of water shoots. By mid-December the trees appear normal but on close examination it is found that the crop is deficient and there is a dearth of suitably placed new fruiting wood.

The overall effect of delayed foliation is to reduce the yield of fruit, firstly by restricting the setting, secondly by affecting the size of the fruit and thirdly by limiting the fruit-bearing surface of the tree.

### MEANS OF MINIMISING DAMAGE

There are several ways of minimising the effects of delayed foliation. The choice of non-susceptible varieties and planting in an area where climatic conditions are suitable are of course the most satisfactory means of overcoming the difficulty. Management methods which restrict late summer growth will also assist. However these methods are often not entirely practicable and it is necessary to use artificial means of treatment where conditions are not ideal.

It has long been observed that oil sprays applied as ovicides or scalcides have a beneficial effect on budburst. However the effective period of application is short and variable from year to year. More recently it has been found that the addition of dinitro ortho cresol (DNC) to the dormant oil not only gives added effect but also increases the period during which the spray may be applied.

Field investigations of the value of DNC oil sprays on Ruby Red peaches and Granny Smith apples have been carried out for the past three years, while last year spot treatments of a number of other deciduous fruits were made. The results have demonstrated that these sprays are beneficial on the varieties in question but the magnitude of the effect will vary from year to year. The work was carried out in the Hills districts near Perth, but the findings are applicable to much of the fruit growing areas.

### Ruby Red Peaches.

The Ruby Red is grown extensively in Hills orchards and is a valuable peach on the local market because of its attractiveness and excellent handling properties. Reasonable crops are obtained, but yields are variable from year to year. Low yields are usually associated with delayed foliation as the results of the investigations have shown. For instance in 1952 and 1953 when delayed foliation was quite marked, DNC oil sprays produced very definite results. In 1954, which was a particularly good year for budburst, the difference between sprayed and unsprayed trees was much less apparent.

In 1952, 12 trees were sprayed with a mixture consisting of one part of a pre-emulsified winter oil containing 2.5 per cent. dinitro ortho cresol to 39 parts of water. The spray was applied during the second week of August, that is approximately six weeks prior to budburst. A further 12 trees received a straight oil spray and 12 unsprayed trees were left as controls. In 1953 and 1954 the oil spray was omitted and 24 trees were used in each of these years for the DNC oil treatment.

The blossoming of DNC oil sprayed trees was profuse and concentrated into a relatively short period. Full blossom was approximately ten days ahead of unsprayed trees which continued with straggly blossom some time after sprayed trees were well in leaf. Leafage followed rapidly on blossoming so that the young fruits were being well supported by large healthy-coloured leaves by the time they started to develop. The foliage on unsprayed trees was very retarded (Fig. 1) and not until mid-December did the trees develop normal appearance. The straight dormant oil spray advanced blossoming slightly but had little effect on leaf buds.

DNC has fungicidal properties and in 1952 it was noted that trees sprayed with this material appeared less infected with Peach Leaf Curl. 1953 was a particularly bad year for this disease and the difference between DNC treated and untreated trees was very evident even though routine copper sprays were applied throughout by the grower. It seems possible that apart from any fungicidal value of DNC the earliness of leaf development may be a factor



in reducing infection by this disease. Heavy leaf drop occurred on the control trees due to leaf curl and this would have a decided influence on the final crop.

A record of fruit removed in thinning in 1953 showed that an average of 141 fruits was removed from DNC oil sprayed trees and 29 fruits per tree from the control. Many of the latter trees were carrying very poor crops and required practically no thinning. At harvest the average yield from sprayed trees was 2.75 bushels as against 1.5 bushels from unsprayed trees. The range of sizes on both treatments was very similar, in other words sprayed trees carried almost twice as many fruits of the same size as the controls. They also ripened a few days earlier. 1953 was generally a light year for the Ruby Red variety.

In 1954 the beneficial effects of early blossoming and leaf development were noted but subsequently little differences could be seen mainly because control trees had set heavy crops following the very light crops of the year before. No attempt was therefore made to compare the yields at harvest time.

### Granny Smith Apples.

Granny Smiths grow and crop very well under Western Australian conditions but, in certain years and in particular in milder situations, there is a reduction in crop which may be attributed to the effects of delayed foliation. Beneficial results of DNC oil sprays on apples were reported from Palestine some years ago, and it was thought that certain apple varieties in this State, notably Granny Smiths and Jonathans, might respond to this treatment.

In 1952, ten Granny Smith trees situated in a Hills orchard were sprayed with DNC oil and an equivalent block was left unsprayed. This work was repeated in 1953 with the inclusion of a straight dormant oil treatment and a similar set of treatments were set up on another orchard. In 1954, treatments on the second block were repeated. Spray treatments consisted of 1 part of DNC oil to 19 parts of water and 1 in 20 straight dormant oil. These were applied at the end of August except in a few instances where later sprays were tried.

In 1952 and 1953, marked benefits were obtained. However in 1954, owing to the favourable season, there was no clear-cut difference between sprayed trees and controls. The following remarks therefore apply mainly to the former two seasons.

Spurburst of DNC oil sprayed trees was uniform and at least a week earlier than unsprayed trees. Leaf development was very rapid; blossoming was also well ahead and confined to a much shorter period than unsprayed trees which straggled on for weeks. Fruit set was complete and a healthy coverage of leaves had formed by the time the unsprayed trees reached full blossom with only poor leaf development. Not only were the leaves of sprayed trees larger and more plentiful but they were distinctly greener in colour. Fig. 2 illustrates the difference in the appearance of trees in the two treatments. Trees sprayed with straight dormant oil without DNC were at all stages better than unsprayed trees but never equal to the DNC treatment. The initial gain obtained by the latter trees was more than maintained during the growing period. Besides the large even size of the young fruit and increased shoot growth, the general health of the trees was far superior. In contrast, fruit on unsprayed trees was generally backward and very uneven in size.

At harvest the crop from DNC treatments was considerably greater than that from either unsprayed or straight oil sprayed trees, as shown by the following yield figures.

Year.	Treatment.					
	DNC Oil Spray.		Dormant Oil Spray.		Unsprayed.	
	Average No. of fruits per tree.	Average Bushels per tree.	Average No. of fruits per tree.	Average Bushels per tree.	Average No. of fruits per tree.	Average Bushels per tree.
1952 ....	959	5.8	....	....	687	4.0
1953—						
Block A	830	5.25	545	3.8	136	1.4
Block B	1,241	7.6	948	6.0	725	5.2

The large increase in harvested fruit resulting from DNC oil sprays illustrates the commercial value of the treatment.



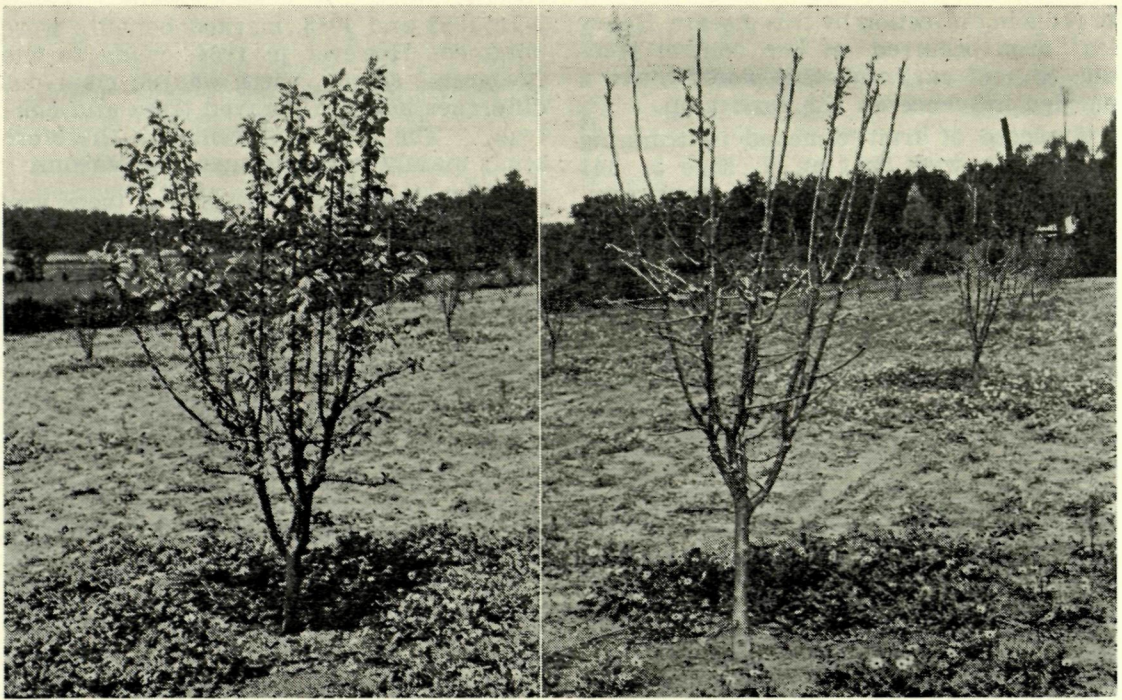


Fig. 3.—Three-year-old Granny Smith—1953; (left), sprayed with 1-20 DNC dormant oil; (right), unsprayed. The percentage of buds breaking dormancy was greater, and leafage was earlier and more vigorous on the sprayed tree

The main influence of DNC oil on the crop was to increase the number of fruit. In each year, DNC trees carried many more fruits than either straight oil treatments or control trees. Nevertheless practically all the fruit reached commercial size. Fruit on DNC trees was almost the same average size as on straight oil trees but somewhat smaller than on the controls. On light crop unsprayed trees, the apples were oversize.

#### Other Varieties of Apples.

A number of other varieties of apples were spot sprayed during 1954 to determine their reaction to DNC oil spray.

As this was a favourable season, effects were less than they might otherwise have been. Nevertheless, some useful indications were obtained. Rome Beauty, Yates, Golden Delicious and Doughertys responded very well to treatment. Even, early spurburst, with a good development of leaves prior to a concentrated blossoming were notable features with these varieties. Jonathans, Delicious and Dunns

showed less benefit, but still responded slightly and in a less favourable year would probably give greater comparison. Jonathans have been tried in previous years but effects have not been as spectacular as with Granny Smiths. A most important feature with all DNC treated trees was the uniformly good size of the young fruit. This is particularly important with Yates as the initial size advantage is maintained in the mature fruit.

#### Bartlett Pears.

A DNC spray was applied to Bartletts in mid-August which is considered to be too late for optimum effect during a season such as the past. However spur burst was advanced by the treatment and leaf size at blossoming was considerably greater than on unsprayed trees.

#### Other Stone Fruit Varieties.

Initial responses were obtained with Elberta, Triumph and Carmen peaches and President plums and some benefit can be expected with these varieties. Further



work is necessary to determine the optimum time of application but it appears that late July would be suitable.

### Young Trees.

A further interesting effect of DNC oil was noted on young Granny Smith apple trees. Three-year-old trees sprayed at the end of August with 1 in 20 strength DNC oil produced much earlier leaf development. This is well illustrated in Fig 3, which shows similar sprayed and unsprayed trees photographed on the same day. Apart from earlier leafage, a greater percentage of buds burst on the leaders of sprayed trees than either unsprayed trees or others where the dormant buds had been notched. Greater leader extension and shoot growth also resulted. This development of buds which otherwise would remain dormant should be of assistance in the training of young trees.

### CONCLUSION

From a study of the climatic conditions and their effect on the growth of deciduous fruits it appears that a definite problem of delayed foliation exists in many of the fruit-growing districts of this State. This is substantiated by the reaction of certain varieties to dormant sprays on DNC oil and it is considered that a worthwhile response could be obtained on these and possibly other varieties over a wide area. In many instances the symptoms may not be obvious, but nevertheless there is an insidious effect which would respond to DNC oil sprays.

In particular, Granny Smiths have been tested and outstanding results have been obtained, but other apple varieties can also be expected to benefit materially. In certain years, overcropping may result but this would allow for selective thinning, thus improving the final quality. It is possible that the difficulties associated with cropping of the Bartlett pear, which in the Hills districts necessitates the retention of untipped laterals, may also be partly alleviated by this type of treatment. The ready application of the method to pome fruits lies in the fact that the spray is simply a dormant winter oil with DNC as an additive. Its use does not entail extra cost or the application of an extra spray.

Peaches have responded well to DNC sprays and to date no damage has been seen. However, in view of the reports of oil damage to certain varieties in South Africa, DNC sprays should not be used at a strength greater than 1 part in 40. For other fruits, however, 1 in 20 mixtures are suggested as this conforms to the recommendations for dormant oil sprays. However on Granny Smith apples little if any, difference was noted between 1 in 20 and 1 in 40 mixtures.

There is some latitude in the time of application of DNC oil sprays but late applications, that is, less than six weeks prior to blossoming should be avoided. On the other hand it is not desirable to spray peaches earlier than mid-July, nor apples before the end of July. More information is needed on this aspect before optimum times can be definitely stated.

DNC oil mixtures have been used elsewhere for many years, but only recently has attention been focused on their usefulness in this State. DNC is a yellow dye-stuff which has a number of uses in the horticultural field. Apart from its physiological effects, on budburst, it is a selective weedicide, an ovicide for mites, a scalicide and fungicide. Some damage to cover crops and annual plants around sprayed trees can be expected but this is of little importance. Detailed observations were not made during the investigations of the insecticidal value of DNC, but no obvious differences were noted between straight dormant oil and DNC oil sprays with regard to Bryobia mite and San José Scale. Both these pests did, however, build up on unsprayed trees.

The spray material is sold under several different trade names such as Shell DNC Universal Winter Spray, Capsine and Lanes DNC Winter Spray Oil.

### ACKNOWLEDGMENT

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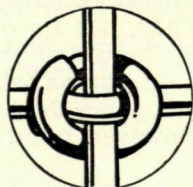




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