

(0°C) to be ideal for maximum holding of strawberries, 41°F (5°C) is considered typical of many cooling and transit conditions. Alternate cooling and warming patterns were compared with constant temperatures. Treatments and results are shown in the accompanying graph.

#### First test

In the first test, fruit was held for 72 hours before grading. During grading the fruit was separated into three major classifications: sound fruit, soft fruit, and fruit showing visible rot. Sound fruit was firm with no evidence of breakdown whereas soft fruit showed evidence of deterioration and softening but no rot. The deterioration of the fruit appeared to be related to the length of exposure to the 68° F temperature (test 1). In this test the fruit at the higher temperature showed a rapid rate of deterioration and high incidence of rot primarily from gray mold (*Botrytis cinerea* Pers. ex Fr.). These results are consistent with earlier studies showing rapid deterioration from short delays at field temperatures before the start of cooling. In this test the deterioration of berries did not appear to be related to the pattern of cooling and warming, but apparently was influenced only by the length of exposure to the higher temperature.

To verify the relationship between length of exposure to warm temperature and fruit deterioration, two additional tests were conducted. In these tests constant cold temperatures and constant warm temperatures were compared to two combinations of alternate warming and cooling, both of which provided the same length of exposure to the higher temperature (tests 2 and 3). In addition, a holding period of 48 hours was used to explore the magnitude of the deterioration during very rapid marketing. The results of the two tests were essentially similar and compared closely with those of test 1. In the latter tests there was no difference in fruit deterioration between 12-hour and 24-hour cooling and warming cycles. These results indicate that quality is mainly influenced by the total time at warm or cold temperatures rather than by temperature fluctuations. These results also indicate that strawberries are subject to severe deterioration during marketing periods as short as 48 hours.

The tests reported here show that cooling of strawberries is vital to their successful marketing, even when the fruit is consumed within 48 hours of harvest. High quality strawberries can be marketed only when the fruit is held at a constant low temperature, but the rate of deterioration is a time-temperature

function and is independent of the pattern of cooling and warming. Thus, if a constant low temperature cannot be maintained, cool temperatures should still be provided whenever possible during the handling of the fruit.

These comparisons are based on separation into sound, soft, and decayed fruit classifications. Such an evaluation does not take into account differences in the overall brightness and consumer appeal of the fruit. Sound fruit which was held at the lower temperature had greater eye appeal and showed promise of giving the consumer more satisfaction than sound fruit held at the higher temperature. Thus, holding at a low temperature would result in a higher percentage of marketable berries, greater sales appeal, and a more satisfied customer.

Air transit has made possible the rapid marketing of a large volume of California strawberries. However, if the true potential of rapid marketing is to be realized, a sound program of temperature management must be incorporated into the handling procedures.

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## CONTROL OF DODDER IN ALFALFA WITH DCPA

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**D**ODDER causes sufficient agricultural losses to be considered a noxious weed in many states. Seed certification regulations help to restrict the spread of this prolific seed producer, but it is very difficult to clean out of many small-seeded crops. Once dodder has infested a seed production area, susceptible crops may be limited for several years since many species of dodder may infest more than one host.

In California, dodder continues to spread and cause problems for producers and consumers. In 1951, 86% of the alfalfa seed lots submitted for certification from the south San Joaquin region was rejected because of dodder.

In seed-producing areas where dodder infestations are limited, spot treating with oil, contact herbicides, or burning is often used. When the infestations are more extensive, CIPC (isopropyl N-(3-

chlorophenyl) carbamate) has been used with good success. Unfortunately, this material has a relatively short-lived soil residue; and therefore provides only short-term dodder control. Recently, it has been reported that DCPA (dimethyl 2,3,5,6-tetrachloroterephthalate), an herbicide with a relatively long soil residual life, will control dodder in alfalfa without injuring the crop.

During April 1961, several herbicides

TABLE 1. DODDER INFESTATION IN PLOTS OF ALFALFA TREATED FOR DODDER CONTROL IN APRIL 1961

| Herbicide lb/A | Per cent of area covered with dodder | Per cent of area covered with dodder |                       |
|----------------|--------------------------------------|--------------------------------------|-----------------------|
|                |                                      | Alameda County                       | San Bernardino County |
| DMPA 5         | 47                                   | 37                                   |                       |
| 10             | 50+                                  | 43                                   |                       |
| DCPA 10        | 18                                   | 5                                    |                       |
| 20             | 0                                    | 0                                    |                       |
| Diphenamid 5   | 10                                   | 15                                   |                       |
| 10             | 18                                   | 18                                   |                       |
| Dichlobenil 5  | 28                                   | 40                                   |                       |
| 10             | 50+                                  | 50+                                  |                       |
| CIPC 6         | 20                                   | 10                                   |                       |
| Check ..       | 50+                                  | 50+                                  |                       |

TABLE 2. DODDER INFESTATION IN DCPA-TREATED ALFALFA IN 1962

| Herbicide lb/A | Per cent of area covered with dodder |      |     |                               |      |     |
|----------------|--------------------------------------|------|-----|-------------------------------|------|-----|
|                | July readings treated in:            |      |     | November readings treated in: |      |     |
|                | Dec.                                 | Mar. | May | Dec.                          | Mar. | May |
| DCPA 5         | 10                                   | 5    | 25  | 35                            | 12   | 50+ |
| 7½             | 0                                    | 0    | 27  | ..                            | 8    | 50+ |
| 10             | 0                                    | 0    | 17  | 18                            | 2    | 50+ |
| Check ..       | 50+                                  | 50+  | 50+ | 50+                           | 50+  | 50+ |

were applied in established alfalfa stands, heavily infested with largeseed dodder (*Cuscuta indecora* Choisy) in previous years. One trial was established in Alameda County, and another in San Bernardino County. These tests were designed for applications just prior to germination of dodder. Each treatment was replicated four times and one test area was left untreated as a check plot. Herbicides used included: *O*-(2,4-dichlorophenyl) *O*-methyl isopropylphosphoramidothioate (DMPA) at 5 and 10 lb/A; DCPA at 10 and 20 lb/A; *N,N*-dimethyl-2,2-diphenylacetamide (diphenamid) at 5 and 10 lb/A; 2,6-dichlorobenzonitrile (dichlobenil) at 5 and 10 lb/A; and CIPC at 6 lb/A. The plots were flood irrigated. Evaluations were made in June when maximum differences in dodder infestation were apparent.

### Timing trial

Following the preliminary tests conducted during the spring and summer of 1961 (indicating DCPA was a promising herbicide for the control of dodder), a timing trial was established in San Bernardino County to evaluate effects of dates of application of DCPA for dodder control in established alfalfa. This trial was conducted on a two-year-old stand of alfalfa on a deep phase, Adelanto sand.

Applications were made on three dates: December 16, 1961; March 6, 1962; and May 11, 1962. Two rates of DCPA, 5 and 10 lb/A, were applied on December 16, and 5, 7½, and 10 lb/A were applied on the other dates.

The December 16 treatment was to evaluate an early winter application,

while the alfalfa was completely dormant; the March 6 treatment was to evaluate a spring application made just prior to spring growth of the alfalfa; and the May 11 treatment was to evaluate an application made just prior to germination of the dodder. The alfalfa in the third treatment had been cut once, and treatment was applied to regrowth about 6 inches in height. All plots were flood irrigated as in the normal field practice. Observations on the control of dodder were made on July 10, 1962, when maximum differences were apparent. Additional observations were made November 13, 1962, following the sixth and final harvest, to evaluate the dodder control for the full season.

### Established weeds

On August 13, 1963, a trial was established after the dodder had become attached and well established on the alfalfa growing on deep-phase Adelanto sand, to evaluate possible systemic dodder control with DCPA. Treatments included DCPA at 10 lb/A, and a combination of DCPA at 10 lb/A, plus 1% surfactant (containing alkylaryl polyoxyethylene glycols, free fatty acids, and isopropanol). DCPA and the combination of DCPA plus surfactant were applied just prior to an irrigation. The same treatments, DCPA and DCPA plus surfactant, were also applied five days after an irrigation, as soon as it was possible to get on the land.

### Longer residual

Table 1 indicates that DCPA at 10 and 20 lb/A gave dodder control equivalent to, or better than, CIPC. Since DCPA gave better and more consistent dodder control than diphenamid and has a longer soil residual life than CIPC,

further studies with this herbicide were initiated.

DCPA will control dodder in established alfalfa when applied preemergence at the germination of the dodder seed as shown in table 2; however, date of application was important. The December application did not provide the control for the entire season that the March application provided. However, the December application gave good early season control. The May treatment was apparently too late to give satisfactory control. This treatment followed the first harvest of hay, and some dodder seed may have germinated before the application was made. However, no dodder plants had attached themselves to the alfalfa plants at that time. It appears that at least 7½ lb/A of DCPA are necessary to provide satisfactory control of dodder and the application should be made in February or March.

### Systemic control

In one trial it was noticed that dodder appeared to be controlled by more than just control of germinating seedlings. In some areas, invasion of the dodder stopped abruptly at the treatment border, which gave rise to the possibility of systemic control of dodder from DCPA treated alfalfa. However, this evidence was not consistent throughout the entire experimental area, nor was it apparent in the May 11 treatments. In fact, it was very difficult to detect any control of dodder from May 11 treatments.

No control was demonstrated from any treatment in trials established on August 13, 1963, to evaluate the possible systemic control of dodder previously established on alfalfa—even though the DCPA was thoroughly leached into the soil where it could be picked up by the alfalfa roots. The combination of DCPA plus surfactant was made to determine if the surfactant would enhance the uptake of DCPA, either through the soil, or through the dodder or alfalfa foliage—but neither approach, used in these preliminary studies, resulted in a practical level of dodder control.

### Conclusions

Results of these trials indicate that no practical systemic control may be expected from DCPA with or without the use of a surfactant. Fair-to-good dodder control was obtained with applications of DCPA at 7.5 lb, or more, per acre when made previous to germination of the dodder seed (February or March in most areas of the state. However, neither DCPA

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or any other chemical used in these tests, except CIPC, has either Federal or State registration for dodder control in alfalfa and are not recommended by the University of California. (See 1966 Weed Control Recommendations—Leaflet 168).

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