

Timing interval important for fungicide applications to control **SEPTORIA LEAFSPOT OF CELERY**

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Difolatan, Daconil 2787, Dyrene and Benlate were significantly better than other fungicides tested for the control of *Septoria apiicola* Speg. when sprays were applied every seven days to plots showing severe disease development. When the same materials were applied at 14-day intervals under similar conditions, control of the fungus was unsatisfactory. Excellent control was obtained with these fungicides, or with TBZ in 1969 when they were applied every 14 days beginning as soon as lesions appeared on the leaves. These trials indicate that under California conditions, *Septoria* leafspot of celery can be controlled with a 14-day spray schedule using either Benlate, Daconil 2787, Difolatan, Dyrene, or TBZ. Of these materials only Dyrene is registered for use on celery but has not yet been included in U.C. pest control recommendations.

SEPTORIA LEAFSPOT OF CELERY (*Apium graveolens*) Speg. caused by the fungus, *Septoria apiicola* Speg., is a serious disease of celery during periods of heavy rainfall in California. Bordeaux mixture and other copper-containing materials were used in early attempts at control. Development of carbamate fungicides led to the use of maneb and related materials and was followed shortly by Dyrene. Recently, several new systemic and nonsystemic fungicides have become available. These studies were initiated to evaluate these new materials

for *Septoria* control, and for persistence under sprinkler irrigation conditions.

Celery transplants (Ferry Morse variety 5270-H) were obtained from a local nursery in the spring of 1967 and were planted at the University of California South Coast Field Station near Santa Ana. Plots were 30 inches wide and 25 ft long in three rows. Plants were spaced 8 inches apart in the row and each treatment was replicated five times. The transplants were started with furrow irrigation but then were sprinkler-irrigated two times per week to stimulate development of late blight.

All plots were inoculated with a suspension of *Septoria* spores several times during the experiment. The inoculum was prepared by placing 30 dried, and severely infected celery leaves in a blender (1 minute), straining through cheesecloth, and spraying the resulting spore suspension over the plants. Sprinklers were then activated for several hours to completely wet the foliage.

The treatments used were as follows (rates of materials are per 100 gallons of water): Dithane D-14 22%, 2 quarts plus $\frac{3}{4}$ lb 36% zinc sulfate; Manzate D 80W 1.5 lb; Polyram 80W 1.5 lb; Dyrene 50W 2 lb; Difolatan 80W 1.5 lb; Daconil 2787 75W 1.5 lb; Dithane M-45 80W 1.5 lb; and the check treatment. Four ounces of Triton B1956 spreader-sticker was used on all treatments except the check and Dithane D-14 treatment. One hundred and fifty gallons of the fungicidal mixture was applied per acre.

Unusually heavy rains during April prevented earlier applications with the

tractor-mounted sprayer; consequently, the plots were sprayed only on March 21, April 10 and May 1. Disease symptoms were rated on a scale of 0 to 5 on May 11. A "zero" rating indicated that no disease symptoms were evident while a "five" rating indicated that lesions completely covered the petiole, numerous lesions were on the leaves, and the plant completely collapsed.

In the spring 1967 trials, significant differences occurred among treatments even though only three fungicidal sprays were applied during the celery growing season (table 1). *Septoria* lesions appeared on many leaves and petioles in the checks or control treatment. Daconil 2787 and Difolatan were significantly better for control than any of the other materials. Dyrene was second best in effectiveness. Common commercial materials such as maneb, Dithane M-45 or nabam plus zinc sulfate did not give adequate control. Control achieved with Polyram would not have been adequate in a commercial growing operation.

TABLE 1. RESULTS OF CHEMICAL TREATMENTS FOR THE CONTROL OF LATE BLIGHT OF CELERY IN SPRING 1967 TRIALS, SANTA ANA

Treatments	Disease rating* May 11
Daconil 2787 75W, 1.5 lb.	1.0 a
Difolatan 80W, 1.5 lb.	1.1 a
Dyrene 50W, 2 lb.	1.9 b
Polyram 80W, 1.5 lb.	2.5 c
Manzate D 80W, 1.5 lb.	2.6 c
Dithane D-14 22%, 2 qt. plus zinc sulfate 36%, $\frac{3}{4}$ lb.	2.8 c
Dithane M-45 80W, 1.5 lb.	2.9 c
Check or no treatment	4.0 d

* Duncan's Multiple Range test (significant at 1% level). Treatments with same letter are not significantly different.

Fall-Winter 1967-68

Since the spring trial indicated that some materials would last at least 14 days, an experiment was set up to test this hypothesis. Variety Ferry Morse 5270-H was again used and transplanted to the field on September 27 at South Coast Field Station. Plots were two rows wide and 25 ft long. Treatments and rates per 100 gallons of water were as follows: Difolatan 80W 1.5 lb; Daconil 2787 75W 1.6 lb; Dyrene 50W 2.4 lb; Dithane M-45 80W 1.5 lb; Manzate D 80W 1.5 lb; Polyram 80W 1.5 lb; Benlate 50W 0.5 lb plus 4 oz of Surfactant F; and the check or no treatment. Triton B-1956 was used at 4 oz per 100 gallons for the Dithane-M-45 Manzate D and Polyram treatments. Fifty gallons of the fungicide mixture was applied when the plants were young and gradually increased to 100 gallons per acre as the plants matured. Sprays were applied on November 28, December 12, 26, January 9, 23, February 6, 20 and March 5. Septoria inoculum was applied to the plot three times during the early part of the experiment. A disease rating index was made on March 18 on a scale of 0 to 5.

Difolatan and Daconil 2787 were significantly better than other treatments when applied on a 14-day schedule in trials in the fall-winter season of 1967-68 (table 2). Next best in effectiveness were Dyrene and Benlate. The data shows again, as in the previous spring trial, that Dithane M-45, maneb and Polyram were not effective for the control of late blight when applied every 14 days and at the rate of 1.5 lb of formulation per 100 gallons per acre. Difolatan, Daconil 2787, Dyrene, Benlate, Dithane M-45 and maneb celery stalks were significantly heavier than the other treatments. These last two experiments suggest that if commercial control were to be obtained with the poorer materials, the dosage of fungicide per acre should be increased, and applied on a 7-day schedule.

An experiment (spring 1968) was designed to determine the effectiveness

TABLE 2. CONTROL OF LATE BLIGHT OF CELERY BY CHEMICAL TREATMENTS IN WINTER 1968, FUNGICIDES APPLIED EVERY 14 DAYS

Treatments	Disease rating*		Weight lb. 10 plants
	March 18	April 21	
Difolatan 80W, 1.5 lb.	1.6 a	38.4 a	
Daconil 2787 75W, 1.6 lb.	1.8 ab	37.9 a	
Dyrene 50W, 2.4 lb.	2.1 b	39.1 a	
Benlate 50W, lb. plus 4 cz. Surfactant F	2.2 b	35.7 ab	
Dithane M-45 80W, 1.5 lb.	3.9 c	28.0 bc	
Manzate D 80W, 1.5 lb.	3.9 c	31.8 ab	
Polyram 80W, 1.5 lb.	4.1 c	27.5 bc	
Check or no treatment	4.9 c	22.8 c	

* Significant at 1% level.

of the different fungicidal materials when sprays were applied at either 7- or 14-day intervals and the fungus was allowed to severely infect young plants before application of the first spray.

Variety Ferry Morse 5270-H was used and transplanted on January 9. Septoria inoculum was applied beginning at the 4- to 5-leaf stage and fungicidal sprays were not applied until numerous lesions developed on the leaves and petioles of the young plants. The plot was sprinkler irrigated two or three times weekly. Treatments were as follows: Daconil 2787 75W 2.15 lb; Difolatan 80W 2 lb; Dyrene 50W 3 lb; Benlate 50W 1 lb; Manzate D 80W 2.5 lb; Polyram 80W 2 lb; and Dithane M-45 80W 2.5 lb (per 100 gallons of water per acre). Triton B1956 was used at 4 oz per 100 gallons with the Manzate D, Dithane M-45 and Polyram treatments. Fungicidal sprays were applied on March 21, 28, April 4, 11, 18, 25, and May 2, 9 for the seven-day spray schedule and March 21, April 4, 18, and May 2 for the 14-day spray schedule.

Disease ratings were made on May 16 as in the previous experiments. Ten stalks were weighted from each treatment in the seven-day schedule plots. The trials in the spring of 1968 showed that only Daconil 2787, Difolatan, Dyrene and Benlate gave satisfactory economic control under the 7-day spray schedule when the disease was allowed to build up before application of the first treatment. Lesions were somewhat prevalent on the leaves of the best 7-day plots indicating that Septoria leafspot is extremely hard to control once severe infection occurs in a planting. Daconil 2787, Difolatan, Dyrene and Benlate gave unsatisfactory commercial control under the 14-day spray schedule because enough lesions were prevalent on the petioles and leaves to make the plants unsalable. Manzate D, Polyram, or Dithane M-45 failed to give satisfactory control under either the 7-

or 14-day spray schedule. All treatments in the 7-day plots produced significantly heavier stalks than the check treatment.

Winter trials—1969

This experiment compared several of the best fungicides in previous trials with copper-containing materials on a 14-day spray schedule. Variety 5270-H was transplanted to the field on December 6, 1968. Plots were in single rows 35 ft long, 10 inches apart in the row, and replicated five times. Treatments were as follows: Difolatan, 2 qts, Benlate 50W, 1 lb; Daconil 2787 75W, 2 lb; TBZ 60W, 1 lb; tribasic copper sulfate 53%, 4 lb; Kocide 101 86%, 2 lb; Kocide 101, 2 lb plus Super 96 mineral oil, 1 qt; TC-90 copper salts of fatty and rosin acids 48%, 3 qts; TC-90, 2 qts (per 100 gallons of water and 100 gallons of the fungicidal mixture applied per acre).

Sprinkler irrigation was used twice weekly to enhance disease. Septoria inoculum was applied to the plots four times during the early part of the experiment. Fungicidal sprays were applied as soon as Septoria lesions were seen in the plot. Fungicidal plots were sprayed on January 17, 31, February 14, March 3, 17, 31 and April 14, 1969. Disease ratings were made as described earlier.

Difolatan and TBZ were significantly better than the other treatments in the winter, 1969 trials. Benlate was next best in effectiveness and was followed closely by Daconil 2787. Tribasic copper sulfate gave fair control of celery late blight. Kocide 101, with or without Super 96 mineral oil, or TC-90 did not provide adequate commercial control.

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TABLE 3. COMPARISON OF 7- VERSUS 14-DAY SPRAY SCHEDULE FOR CONTROL OF LATE BLIGHT OF CELERY UNDER SEVERE DISEASE CONDITIONS BEFORE FUNGICIDAL APPLICATION

Treatments	Weight lb. cf 10 stalks		
	Disease rating* 7 day	14 day	7 day sched.
Daconil 2787 75W, 2.15 lb.	1.7 a	2.8 a	21.4 a
Difolatan 80W, 2 lb.	1.8 a	2.6 a	22.3 a
Dyrene 50W, 3 lb.	1.8 a	2.8 a	20.4 ab
Benlate 50W, 1 lb.	1.9 a	2.8 a	22.2 a
Manzate D 80W, 2.5 lb.	2.8 b	3.8 b	20.3 ab
Polyram 80W, 2 lb.	3.0 b	3.8 b	21.2 a
Dithane M-45 80W, 2.5 lb.	3.2 b	3.9 bc	19.8 ab
Check or no treatment	4.3 c	4.3 c	15.9 b

* Significant at 1% level.

TABLE 4. CONTROL OF LATE BLIGHT OF CELERY WITH FUNGICIDE SPRAYS IN SPRING TRIALS AT SANTA ANA, 1969

Treatments	Disease rating* April 21
Difolatan L, 2 quarts	1.0 a
TBZ 60W, 1 lb.	1.1 a
Benlate 50W, 1 lb.	1.5 b
Daconil 2787 75W, 2 lb.	1.9 c
Tribasic copper sulfate 53%, 4 lb.	2.5 d
Kocide 101 86%, 2 lb.	2.9 e
Kocide 101 86W, 2 lb. plus Super 96 mineral oil, 1 quart	2.9 e
TC-90 48%, 3 quarts	2.9 e
TC-90 48%, 2 quarts	3.3 f
Check or no treatment	3.8 g

* Significant at 1% level.