If registered, fungicide could reduce cavity spot of carrots

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Cavity spot lesions reduce carrot quality.

No control measures are now available for reducing losses to cavity spot, the most damaging carrot disease in California. Researchers have found a fungicide that provides excellent control of the disease, though it is not yet registered for use on carrots.

Cavity spot is a serious disease of carrots in California's San Joaquin Valley, where nearly 25,000 acres are planted annually. Occasionally, whole fields must be abandoned because of a high incidence of disease. No control measures are currently available.

Cavity spot lesions are elliptical, oriented across the breadth of the root, generally smaller than ½ inch in diameter, and no more than ⅛ inch deep. In 1961, cavity spot was reported to be a physiological disorder induced by a deficiency of calcium. Since then, it has also been attributed to anaerobic bacteria and to stress from flooding and high soil temperatures. Recent investigations in Europe showed that *Pythium* species, especially *P. violae*, were associated with cavity spot lesions. The purpose of our study was to determine the cause and control of cavity spot of carrots in the San Joaquin Valley.

To isolate potential pathogens, we collected tissue from the margin of cavity spot lesions on carrots in Kern County fields, placed samples aseptically on a medium selective for *Pythium* and related fungi (corn meal agar plus antibiotics) and on various standard media for the isolation of bacteria and other fungi. These isolations yielded *P. violae* and, less frequently, *P. ultimum*. No other organisms were recovered with any consistency. In controlled greenhouse tests, all the carrots grown in soil inoculated with *P. violae* and 65% of carrots grown in soil inoculated with *P. ultimum* developed typical cavity spot lesions. Both fungi were subsequently recovered from lesions plated on corn meal agar.

Several experiments were designed to test the preplant and postplant efficacy of metalaxyl (Ridomil) on the control of cavity spot in several commercial fields of carrots in Kern County. In one experiment, metalaxyl (2E and 5G formulations) was applied as a single preplant application (1, 2, or 4 lb active ingredient [ai]/acre) or as eight applications (0.125 or 0.25 lb ai/acre [2E formulation only]) made about every 2 weeks throughout the season, for a total of 1 or 2 lb ai/acre. The 5G formulation was spread in the planting furrow, and the 2E formulation was sprayed on the surface of the soil or over the carrots before an irrigation. Six 30-foot-long replications were arranged in a randomized complete block design.

All the carrots in 3 feet of row from each plot (about 115 carrots for each 3-foot sample) were harvested at maturity, washed, weighed, and examined for cavity spots. Results were expressed as the percentage of carrots with cavity spot lesions. The experiment was conducted in two commercial fields in 1987 and in one in 1988. All fields were sprinkler-irrigated.

In another experiment, single applications of 2 lb ai of metalaxyl per acre were applied either 43 or 53 days after planting in one field, and 49 or 59 days after planting in another field. Single applications of metalaxyl at 1 lb ai/acre were also applied 15, 30, 45, 60, or 75 days after planting in an additional trial. Treatments were replicated as previously described.

Metalaxyl significantly reduced the incidence of cavity spot in all trials (table 1). In

TABLE 1. Efficacy of pre- and postplant applications of metalaxyl on the control of cavity spot

	Percentage of carrots with cavity spots		
	Trial 1	Trial 2	Trial 3
Metalaxyl, lbs a.i./acre			
Preplant, 1.0 lb	24.1	7.3	29.5
Preplant, 2.0 lb	20.5	2.1	27.3
Preplant, 4.0 lb	7.9	2.1	20.8
Split-postplant, 0.125 lb (8 appl., 1.0 lb total)	7.6	1.2	25.4
Split-postplant, 0.25 lb (8 appl., 2.0 lb total)	0.9	2.7	21.8
None	59.5	39.7	36.7
Mean squares for selected contrasts			
Metalaxyl vs. none	5,896.0*	4,489.0*	369.8*
Preplant vs. split	1,057.6*	112.3	40.1
Preplant, 1.1+2.2 vs split	1,710.3*	162.2	148.0*
Preplant, 4.5 vs. split	26.5	8.4	32.5
Split, 1.1 vs. split, 2.2	467.6*	10.1	4.8
Preplant, linear	3,936.8*	2,522.6*	498.3*

* P = 0.05. Analysis was performed on arcsine-transformed data.

Table 2. Efficacy of a single postplant application of metalaxyl on the control of cavity spot

	Percentage of carrots with cavity spots	
	Trial 1	Trial 2
Metalaxyl (2 lbs a.i./acre)		
None	33.8 a	29.6 a
43 days after planting	3.8 b	—
49 days after planting	—	10.8 b
53 days after planting	7.8 b	—
59 days after planting	—	13.1 b
LSD, P = 0.05	6.9	9.0

two trials, metalaxyl almost completely eliminated the disease. In two of the three trials, the control achieved with a seasonal total of 1 or 2 lb ai of metalaxyl per acre in split applications was significantly greater than was achieved with the single preplant application of 1 or 2 lb. However, there was no significant difference between the efficacy of the split applications and the efficacy of a single preplant application of metalaxyl at 4 lb ai/acre. There was a significant negative correlation between the rate of metalaxyl applied preplant and the percentage of carrots with cavity spot lesions. There were no significant differences in disease control with the different metalaxyl formulations (5G and 2E). Carrot yields were not influenced by metalaxyl applications or cavity spot incidence.

Single applications of metalaxyl at 2 lb ai/acre applied 40+ or 50+ days after planting also significantly reduced the incidence of cavity spot (table 2). We have other data indicating that single applications of metalaxyl at 1 lb ai/acre applied at different times during the season failed to reduce the incidence of cavity spot.

Conclusions

Pathogenicity tests and field trials with metalaxyl, which is active only on *Pythium* and related fungi, demonstrated the cavity spot on carrots in California is caused by *Pythium* species. Both *P. violae* and *P. ultimum* caused cavity spot lesions in controlled conditions, but *P. violae* was the more virulent fungus on carrots.

Metalaxyl is not currently registered in California for use on carrots, but it shows promise as an effective tool for reducing losses to cavity spot. In our study, soil drenches of metalaxyl applied 40 to 60 days after planting or multiple, dilute applications throughout the season were more efficacious than single preplant applications at comparable rates.

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Phylloxera on rise...

Deadly insect pest poses increased risk to north coast vineyards

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Resistant rootstocks protect grape vines from phylloxera; however, a new form of this insect, Biotype B, threatens the survival of 70% of Napa and Sonoma County vineyards, those which are planted on the rootstock AxR#1. Research demonstrates that different accessions of AxR#1 are equally susceptible to damage by this insect, a form of plant lice. The insect has spread from two sites in 1983 to more than 70 sites in those two counties; spread to other grape-growing counties is likely.

Grape phylloxera is a widespread pest of grapevines. Native to eastern North America, it was introduced into Europe in the 1860s where it devastated vineyards. In response, European researchers developed resistant rootstocks. Many rootstocks available today are a result of breeding and selections made in Europe during the last quarter of the 19th century. One of these, Ganzin 1, known in California as AxR#1, was initially successful. However, in both Europe and South Africa, resistance disappeared after a number of years. The loss of resistance was attributed to a more virulent race of phylloxera.

Phylloxera became an important problem in California with the introduction of the European grape, *Vitis vinifera*. Trials to determine which rootstocks were suited to

TABLE 1. Grape phylloxera utilization of Cabernet Sauvignon and two AxR#1 accessions

Root type	Percent surviving to maturity		Developmental time		Fecundity	
	Mean*	N†	Mean	N	Mean	N
	%		days		eggs/female/day	
Colony I (2 replications) biotype A standard						
Cabernet Sauvignon	54.4 a	160	25.3 a	87	4.8 a	285
AxR1-01A	15.9 b	170	48.0 b	27	1.7 b	78
AxR1-05	19.5 b	200	39.8 b	39	1.7 b	126
Colony II (1 replication) previously tested as biotype A						
Cabernet Sauvignon	48.7 a	80	29.2 a	39	5.0 a	118
AxR1-01A	18.7 b	80	39.8 a	15	4.4 a	47
AxR1-05	43.3 a	60	33.5 a	26	4.8 a	92
Colony III (1 replication) biotype B standard						
Cabernet Sauvignon	52.5 a	40	26.7 a	21	6.0 a	70
AxR1-01A	22.5 b	40	29.3 a	9	4.6 a	22
AxR1-05	18.3 b	60	31.0 a	11	6.9 a	36
Colony IV (3 replications) biotype B						
Cabernet Sauvignon	48.7 a	300	27.6 a	146	5.1 a	484
AxR1-01A	25.0 b	280	29.4 a	70	7.5 a	214
AxR1-05	30.7 b	300	30.3 a	92	6.7 a	326

*Means in the same colony and column followed by different letters are significantly different (P<0.05).
†N is the number of animals from which means were calculated.