MANAGEMENT OF VERTICILLIUM WILT IN STRAWBERRY USING VEGETABLE CROP ROTATION

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Strawberry is an important horticultural crop in the state of California, with an annual farm gate value of over $700 million. Pre-plant soil fumigation of strawberry fields with methyl bromide is the prevailing production practice to control weeds, soilborne pathogens, and nematodes. The imminent loss of methyl bromide due to environmental concerns has accelerated the search for sustainable alternatives. Among the soilborne pathogens, Verticillium wilt is the most important as it causes death of plants. There is no resistance against Verticillium wilt in currently grown cultivars.

Verticillium dahliae, the causal agent of wilt disease, has a wide host range and is distributed in most California agricultural soils. In some production systems crop rotation can be considered as an economically viable means of reducing the soilborne propagules of Verticillium and yield losses from wilt disease. Effective management of Verticillium wilt in cauliflower has been reported with broccoli rotation and residue amendment (1,2). The objectives of the present studies were to determine the effects of rotations with broccoli, brussels sprouts, cauliflower, and lettuce on strawberry yield, disease severity and on soil populations of pathogen propagules.

The effect of vegetable crop rotations and residue amendment on strawberry plant diameter, disease severity, and marketable yield were compared with methyl bromide+chloropicrin fumigation during 1997-98 at two sites. Experimental plots were located at Monterey Bay Academy (MBA), near Watsonville, CA on an Elder sandy loam soil and at the Spence Field Site, Salinas, CA on a Chualar loam soil. At both locations strawberry and vegetable production were done by commerical growers. Disease pressure for Verticillium wilt was moderate - high at the MBA site (10 *V. dahliae* microsclerotia/g soil) but with below detectable levels for the Spence site. Both locations were naturally infested with other soilborne strawberry root pathogens (*Pythium*, binucleate *Rhizoctonia*, and *Cylindrocarpon* spp.)

There were three rotation treatments at each location. The crops were planted in the following sequence 1). lettuce-lettuce-strawberry; 2). broccoli-broccoli-strawberry; and 3). Brussels sprout-strawberry (MBA only) or cauliflower-cauliflower-strawberry (Spence only). The rotational crops were transplanted during mid-April and the planting cycles were timed to include two rotational crops of lettuce, broccoli, or cauliflower but only one brussels sprouts cropping cycle. After harvest, all crop residue was flail shredded, air dried, and incorporated into the soil using a rototiller. Four weeks after incorporation, the beds in all plots were reworked for the next crop cycle. Strawberries

(cv. Selva) were planted November in all plots (including a replicated plot fumigated with methyl bromide+chloropicrin for comparison of rotation treatments).

In 1997, at the MBA site, there were moderate levels of inoculum at the start of the experiment and rotation crops influenced the inoculum levels. In lettuce rotation treatments, the inoculum levels remained constant in the range of 11-17 microsclerotia g^{-1} soil through the entire season. Whereas in brussels sprouts and broccoli rotations the inoculum was reduced significantly. No detectable microsclerotia were present in the Spence field soil. At both locations, higher strawberry plant canopy diameter was recorded in broccoli rotation treatment. Plants grown in lettuce treatments at both the locations had significantly lower plant diameter than the rest of the treatments.

The repeated measures analysis of variance indicated that the rotation treatments had a significant ($P \leq 0.05$) effect on the strawberry disease severity rating during all of the observation points at both the locations. Strawberry plants grown in lettuce rotation treatment plots had the highest disease severity rating, about 25-27% higher than in the broccoli treatment. At Spence, plants grown in broccoli rotation treatment showed the lowest disease severity rating among all the treatments, and at MBA, the broccoli treatment had the lowest disease severity rate among the rotation treatments and was next only to that of methyl bromide+chloropicrin control. Strawberry plants in broccoli rotation treatment showed a consistently lower disease severity than in the rest of the rotation treatments during all six observation dates. Petioles from diseased plants from MBA site when plated on NP-10 medium yielded *V. dahliae*. The diseased plants from Spence site did not yield *V. dahliae*, indicating other soil borne pathogens were responsible for growth and yield reductions.

Methyl bromide+chloropicrin fumigation produced the highest marketable strawberry yields obtained in both test locations. The analysis of yield data from final harvest at Spence did not indicate any significant difference among rotation treatments. However, at MBA the broccoli treatment plot marketable yield was significantly higher than the lettuce treatments. The yield loss in broccoli and lettuce plots were 23% and 39% lower, respectively, compared with fumigated control. For strawberry production in California central coast, under moderate inoculum levels broccoli rotation has the potential to be an effective and compatible management practice for reducing disease severity.

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2. Xiao, C. L., K. V. Subbarao, K. F. Schulbach, and S. T. Koike. 1998. Effects of crop rotation and irrigation on *Verticillium dahliae* microsclerotia in soil and wilt in cauliflower. Phytopathology 88:1046-1055.