THE POTENTIAL FOR USING BRASSICAS AS AN ALTERNATIVE TO METHYL BROMIDE IN CONTROLLING SOILBORNE DISEASES

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An estimated 49 million pounds of methyl bromide am applied annually for preplant soil fumigation in the United States (Ferguson et al., 1994). Many strawberry and tomato growers have depended on methyl bromide for control of nematodes, weeds, and fungal pathogens. The elimination of methyl bromide in accordance with *the U.S.* Clean Air Act poses a critical challenge to these growers, whose crops are valued at more than $2.5 billion annually (USDC, 1996).

One alternative approach to control of soilborne diseases is to exploit biotoxic chemicals present in plant tissue. The aldehydes (E)-2-hexenal, n-hexanal, and (Z)-3-hexenal, and the alcohol (Z)-3-hexenol suppressed the pathogens *Botrytis cinerea, Rhizoctonia solani, Fusarium oxysporum, Didymella lycopersici*, and *Cladosporium fulvum* (Urbasch, 1984). (E)-2-hexenal, hexanal, (Z)-3-hexenal, and (Z)-3-hexenol we commonly produced by crushed green plant material (Buttery, 1981). Other research has shown that macerated Brassica tissues release isothiocyanates (ITCs), particularly effective pesticidal plant chemicals. The incorporation of freshly chopped Brassica residues into soil is promising as a means of soilborne disease control. In our study, we tested several plant species for their biotoxicity
to *B. cinerea***.**

Materials and Methods

Experiment 1: A 5-mm diameter agar plug with B cinerea hyphae was transferred from a stock culture plate to the center of a petri dish containing fresh agar Ten g of freshly macerated leaf tissue was added to a 500-ml jar The agar plate with B cinerea hyphae was inverted, placed over the mouth of the jar, and scaled with Parafilm®. This procedure was performed for 4 replications each of leaf material from Indian mustard, 'Florida Broadleaf mustard "Premium Crop' broccoli, 'Italian Green broccoli, 'Charmant' cabbage 'Florida Dutch' cabbage, 'Seven Top' turnip, 'Bin Scotch Curled' kale, upland cress, Michili Chinese cabbage, 'Long Island' Brussels sprouts, and a control treatment that contained no plant tissue. Plates were incubated for 4 days at 22 C in constant fight. After 4 days, the diameters of the *B. cinerea* colonies were measured, and calculated as a percentage of the colony diameters in the control jars.

Experiment 2: The procedure for Experiment I was followed using leaf tissue from Indian mustard, 'Premium Crop' broccoli, Michili Chinese cabbage**,** 'Celebrity' tomato, and 'Chandler' strawberry. *B. cinerea* diameters were measured daily for 4 days.

Results and Discussion

Experiment 1: Indian mustard was the most suppressive plant tested followed by 'Florida Broadleaf mustard. Differences in supressive activity were observed among most. plant species, between the two broccoli cultivars, and between the two cabbage cultivars (Figure 1). These results that selection of the plant to be incorporated into the sod for disease control is important. Consideration should be given to the pesticide potential of the plant, as well as the overall pest control strategy. For some fields, the use of a highly biotoxic crop such as an Indian mustard may be necessary. In other cases, a crop such as broccoli or cabbage night sufficiently inhibit pest populations; the marketable heads could be harvested and the remaining plant residues incorporated into the soil.

Experiment 2: As in Experiment 1, Indian mustard, 'Premium Crop', broccoli, and Michili Chinese cabbage inhibited *B. cinerea* growth. Leaves from ' Celebrity' tomato and 'Chandler' strawberry also were inhibitory, although less so than the *Brassica* species. These results are consistent with prior research indicating that *Brassicas* produce an especially effective array of volatile pesticidal chemicals.

B. cinerea growth was insignificant by day 2 when exposed to leaf tissue from Indian mustard, 'Premium Crop' broccoli, Michili Chinese cabbage and 'Chandler' strawberry. 'Celebrity' tomato slowed colony expansion without stopping it. (Figure 1). We are presently evaluating the susceptibility of other plant pathogens to chopped plant material. In addition, we will determine the components of the jar atmospheres that are exerting the suppressive activity. Our objective is to apply the laboratory results to field experiments that evaluate the use of *Brassica* residues for disease control under commercial conditions.

Literature Cited

Buttery, R.G. 1981 - Vegetable and fruit flavors. p. 175-216. In: R. Teranishi and RA. Flath (ads.). Flavor research: recent advances. Marcel Dekker, Now York, NY.

Ferguson, W., and A. Padula. 1994. Economic effects of banning me" bromide for soil Resources aid Technology Division. Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report Number 677.

Urbasch, 1. 1984. Production of C6-wound gases; by plants and the effect on some Phytopathogenic fungi. Z Naturforsch. 39c:1003-1007.

USDC (United States Department of Commerce). 1996. Statistical Abstract of the United States I996. The National Date Book. 116th ed.

Table 1. A cinerea colony diameters at Day 4 as % of control.

Plant Species	Percentage of Control
Michili Chinese cabbage	35.1 a[z]
'Florida Dutch' cabbage	24.3 b
'Charmant' cabbage	21.6 c
'Seven Top' turnip	21.5 c
'Italian Green' broccoli	19.2 d
upland cress	19.6 d
'Long Island' Brussels sprouts	17.8 d
'Premium Crop' broccoli	17.7 d
'Blue Scotch Curled' kale	15.5 e
'Florida Broadleaf mustard	12.8 f
Indian mustard	8.2 g

[z] Mean separation by Duncan's multiple range test. P=0.05.

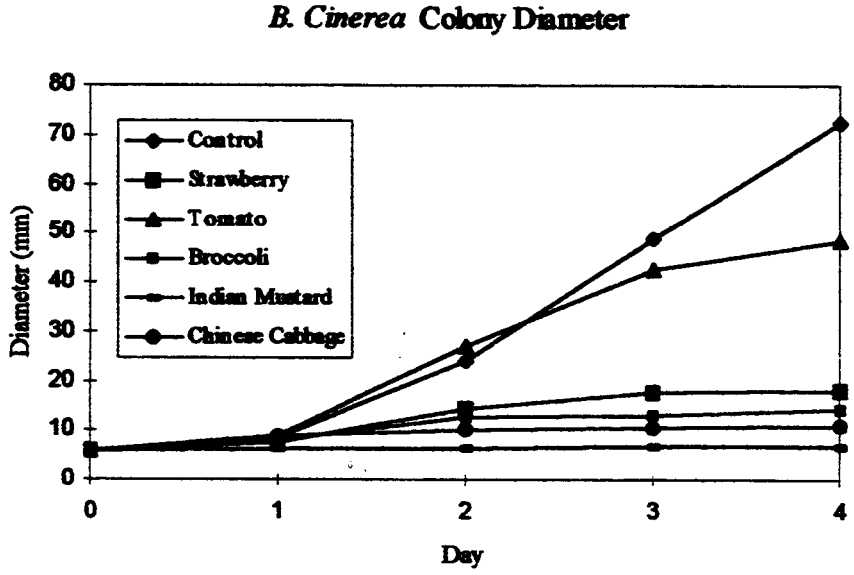

Figure 1. Diameter of *B. cinerea* colonies vs. time.