UTILIZATION OF ORGANIC SOIL AMENDMENTS FOR CONTROL OF THE SOILBORNE PATHOGENS *VERTICILLIUM DAHLIAE* AND *STREPTOMYCES SPP*

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Organic soil amendments, including animal and green manures and wastes from processed animal products such as blood meal, bone meal, have been used for centuries as soil supplements. In the chemical era the impact of amendments on plant diseases was ignored, although in the past, the use of amendments was a recognized means for disease control. Wilhelm(2) reported that blood or fish meal, when incorporated into soil at 1% (w/w), completely inhibited *Verticillium dahliae* infection of tomatoes. Preliminary experiments in our laboratory confirmed the ability of high nitrogen containing materials to reduce the viability of Verticllium microsclerotia. The efficacy of disease control by organic materials however, has never been extensively examined. The objective of this study was to evaluate the capacity of high nitrogen containing organic amendments for reducing the populations of the soilborne plant pathogens, *V. dahliae* and *Streptomyces spp*.

A spectrum of organic materials were tested under laboratory conditions for reduction of the pathogens including: feather meal (FeM), meat & bone meal (MBM), hydrolyzed pig hair, blood meal (BM), fish byproducts (FM), chitin, etc. Various quantities of product were mixed with soil from potato fields in Ontario with a history of scab and wilt. The amended soils were placed in plastic boxes and bags of Verticillium microsclerotia, (MS), were then buried in the soil or suspended in the headspace (1). The containers were incubated covered at 24 C and MS recovered at intervals. Survival was tested by measuring colony development on agar after 2 weeks. Populations of *Streptomyces* were determined by plating serial dilutions of soils onto agar media.

The efficacy of a product for reducing MS viability and *Streptomyces* populations was found to be related to its nitrogen content. Whether a product is effective or not however, is soil-dependent. Generally, lower rates of amendments required longer times to reduce MS viability and scab populations. A critical value exists below which an amendment in a particular soil will not reduce MS viability. The effect of temperature on the efficacy of an amendment also depends on soil properties. Incorporation of amendments was followed by a temporary increase in pH above 8.0 but the final soil pH was lower than the original. More than one mechanism is involved in MS eradication. Early effects kill MS rapidly and involve volatile toxic gases; later effects are slower and likely involve biological control.

The effect of amendments on wilt and scab incidence was tested in microplots. Soils from 2 potato farms, with high wilt and scab incidence were amended in June 94 with either BM, FeM, (at 1%, w/w) or soymeal (2% w/w, SM) using a cement mixer. The soils were placed in 2 m^2 fibreglass lined microplots to a depth of 30 cm. Control soils were left untreated or treated with two rates of granular formalin. Soil samples from the plots were collected biweekly and tested for *Streptomyces* populations and pH. MS survival was monitored by burial of bags of MS at 5 and 15 cm depths. Samples of amended soils from the plots were simultaneously assayed for reduction of MS germination in the laboratory. Weed populations were counted prior to planting. Potatoes were planted in early July 94 and harvested in Sept. Wilt incidence was monitored by isolating the fungus from petioles collected from each plant. Scab incidence were determined from visual inspection of tubers. A 2nd crop of potatoes was planted in these plots in May 95 and tubers harvested in August 95. The efficacy of spring application was tested with soils from 2 new locations. These soils received fish meal (1.3% w/w), MBM, and SM (both at 2% w/w) as previously described. Potatoes were planted in early June 95 and will be harvested in mid Sept 95.

Organic amendments reduced MS viability in both soils (Fig 1). Wilt incidence was found to be near zero even in the 2nd crop (Fig 2). Broad leaf and grassy weeds were also significantly reduced in amended soils. Yields of tubers of the 2nd crop in the amended plots in both soils were nearly double those in control or formalin treated plots (Fig 3). The incidence of scab in organic amendments was negligible in both crops (Fig 3). Plants in amended soils were much greener, more vigorous and survived the entire season whereas, those in untreated soil, were dead by late July. Spring incorporation of amendments had a slower effect on reduction of MS germination and on reducing *Streptomyces* populations than the summer or fall applications. The SM treatment was phytotoxic but plants eventually recovered.

Three on-farm site tests with amendments are in progress. BM, FeM, and SM were incorporated to a 25 cm depth in an area of about 50 m^2 with a rototiller in mid Oct 94 at 2 sites. An equal area for each treatment was used as a control. A spring treatment in May of 95, comprising of the above amendments plus MBM, was initiated using the same design. Soils were sampled biweekly and analyzed as previously described. Potatoes were planted into the fall treatments in May 95. In the spring treatment we also planted 1 row each of peppers, tomatoes and eggplants in June. Wilt was assessed as previously described..

Streptomyces were reduced at both sites following fall application of amendments. Significant reduction in wilt incidence was seen in plants at both locations. Plants in treated blocks were more vigorous, taller, greener and survived well beyond those at untreated sites. The spring application, particularly FeM, was slower in reducing Streptomyces populations. SM treatment was phytotoxic to tomatoes and all plants died. Wilt incidence in BM, MBM and SM treated plots was zero, whereas the average disease incidence in control plots and FeM treated plots was 35%.

The results show that organic amendments are good candidates as a replacement for methyl bromide. Before these products can be used however, the soils should be tested for evaluating their capacity to render the material bioactive. It appears that the effect of organic treatments may persist for several years which would make the cost competitive with that of methyl bromide treatment. Studies in progress are designed to reduce the quantity of material required and to make the material more universal in its activity.

Hawke, M.A. and G. Lazarovits. 1994. Phytopathology 84:883-890.
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Fig 1. Effect of organic amendments on the germination of *V. dahliae* microsclerotia (MS) buried in two types of soil under microplot conditions.

Values represent mean (-SEM), n=3. Soils amended in June 1994.

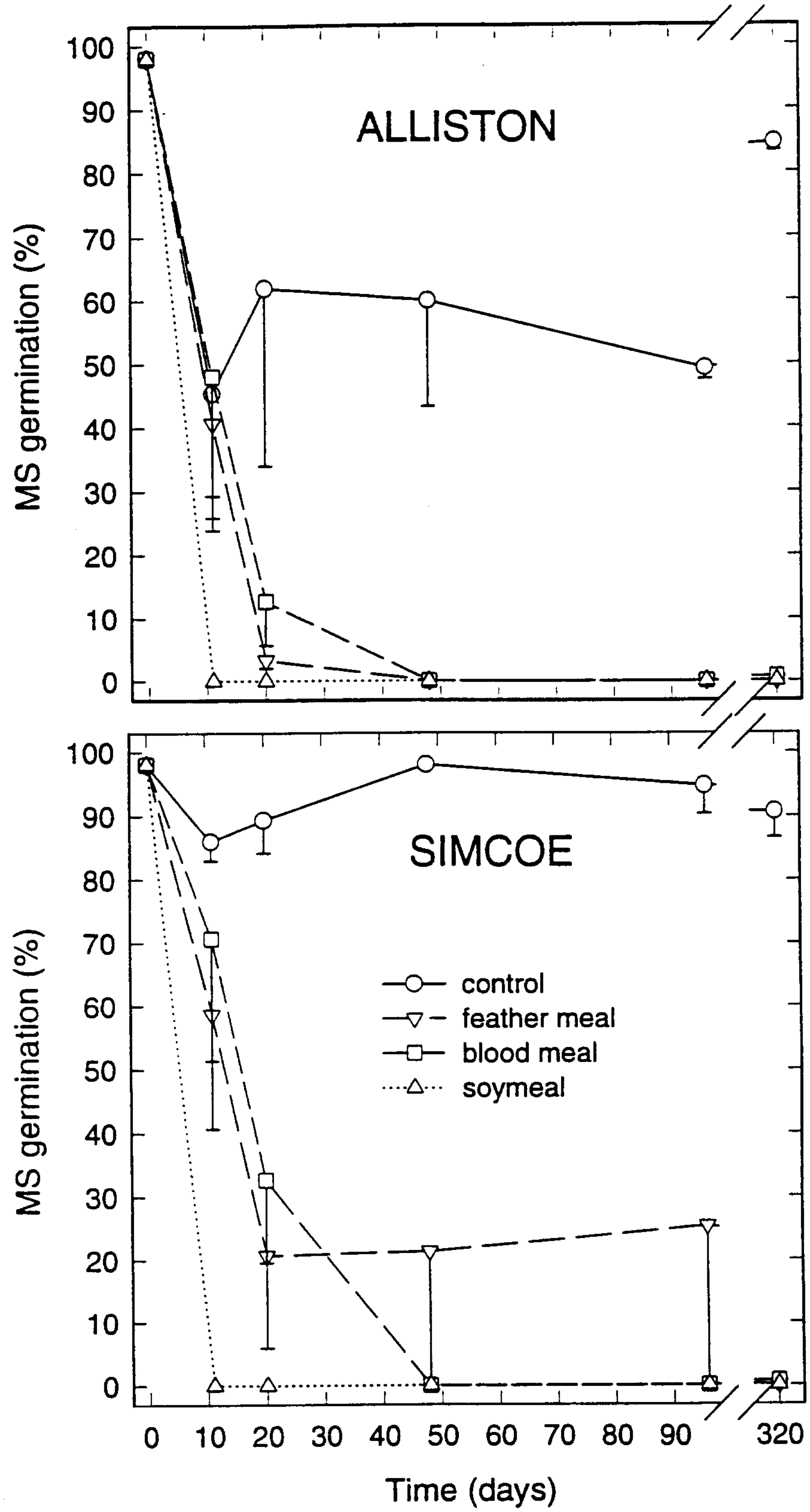


Fig 2. Verticillium wilt incidence in second crop of potatoes grown in microplots containing soils from Alliston and Simcoe amended - June 1994, 10 plants per plot sampled July 12, 95 error bars = SEM, n=3, * = values are 0

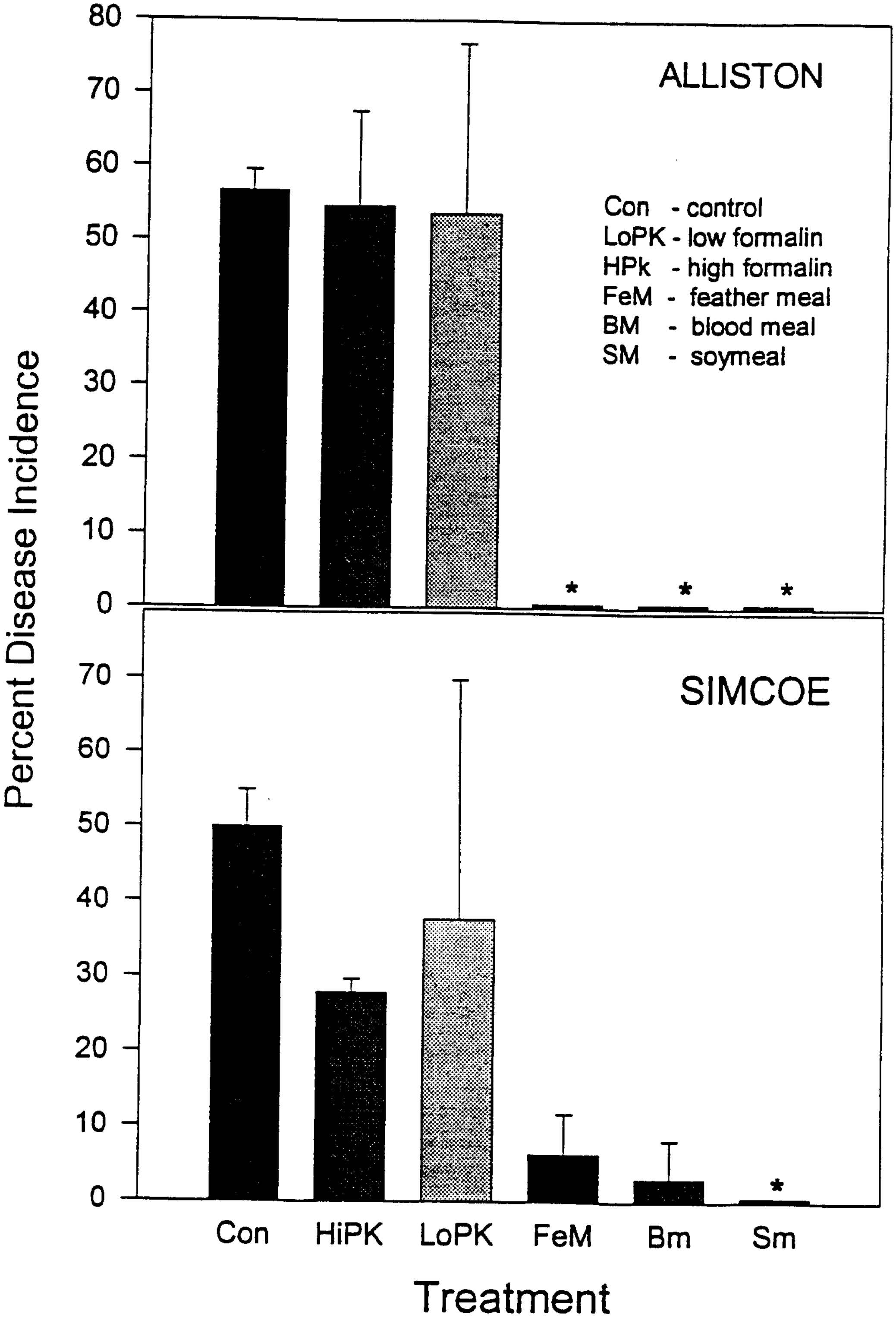
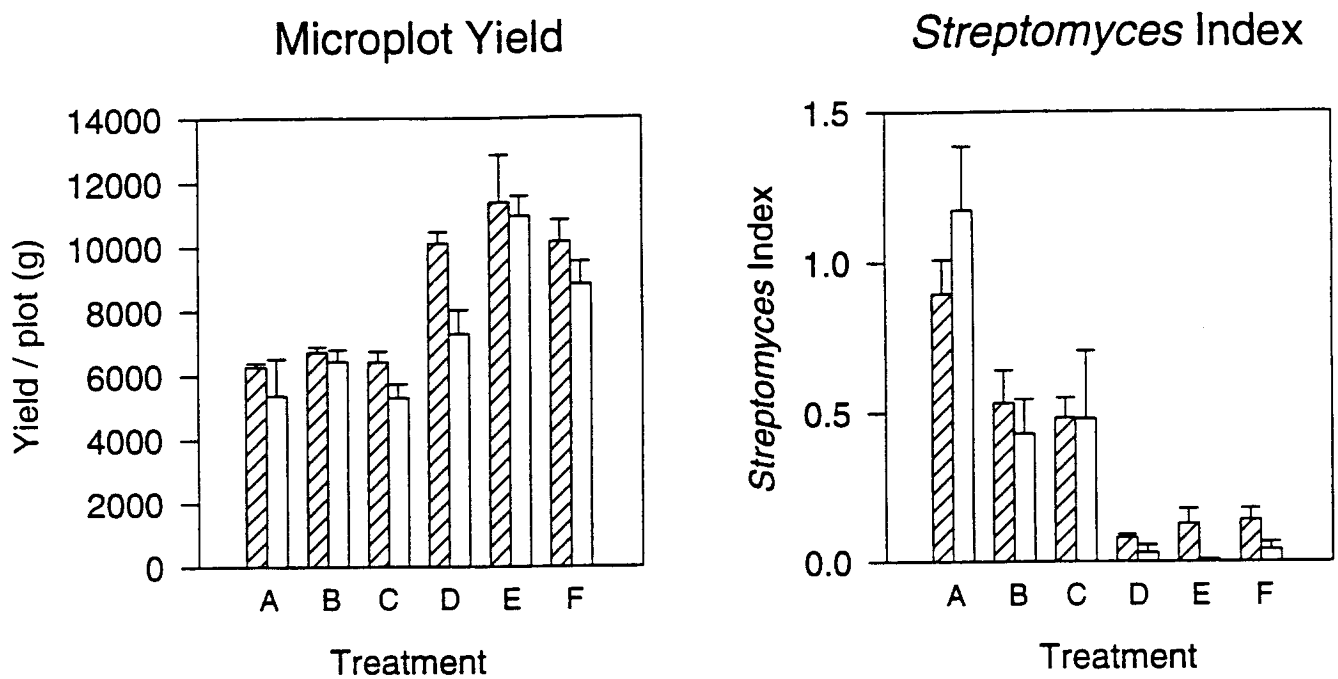


Fig 3. Yield of potatoes (cv. Snowden) and incidence of scab in soils from Simcoe and Alliston an the second season after amending with various organic materials or formalin



A = control
B = formalin (high conc.)
C = formalin (low conc.)
D = feather meal
E = blood meal
F = soymeal

Alliston

Simcoe