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CHLORINE DIOXIDE TREATMENT ON SURVIVAL OF SOILBORNE PESTS AND STRAWBERRY GROWTH

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Chlorine dioxide has been demonstrated to be a potent disinfectant, in aqueous solution or gaseous state, against a broad spectrum of microorganisms, including bacteria, fungi and molds. It has been approved by the USEPA, USFDA and USDA for disinfecting drinking water, food processing water, meats, produce, etc. Under normal atmospheric conditions, ClO_2 is in gaseous state and will rapidly decompose in sunlight, unlike methyl bromide, which is stable and can reach the stratosphere, causing ozone layer depletion. Chlorine dioxide has been suggested to be a methyl bromide alternative, but information regarding its use in soil as a biocide in the public domain is generally lacking. A systematic study was carried out to investigate ClO_2's biocidal effect against common pests in strawberry fields, namely weeds, *Verticillium, Phytophthora* and nematodes, as well as the phytotoxicity that may have resulted from the treatment.

Soil in 6-in flowerpots was incubated in growth chambers after being purged with 3.9 V% or 7.8 V% ClO_2 gas at a rate of 1.0 L/min for 5, 10, 15 or 20 min. Comparing to untreated soil or to soil treated with nitrogen gas purging for 30 min, purging with 7.8 V% ClO_2 gas for 10 min or more was found to effectively inhibit the germination of 12 commonly found weeds: annual ryegrass (*Lolium multiflorum*), Australian brass buttons (*Cotula australis*), corn spurry (*Spergula arvensis*), hairy nightshade (*Solanum sarrachoides*), henbit (*Lamium ampexicaule*), pineapple-weed (*Chamomilla sauveolens*), red maids (*Calandrinia ciliata*), scarlet pimpernel (*Anagallis arvensis*), shepherd's purse (*Capsella bursa-pastoris*), speedwell (*Veronica persica*), stinging nettle (*Urtica urens*) and white stem filaree (*Erodium moschatum*), but was ineffective against the germination of common chickweed (*Stellaria media*) and annual bluegrass (*Poa annua*). The 10-min treatment reduced inoculated citrus nematode (*Tylenchulus semipenetrans*) by 93%, inoculated *Phytophthora cactorum* by 76% and naturally occurring *Verticillium spp.* by 56%. Increasing treatment time to 15 min improved the reduction of *P. cactorum* to 82% and *V. spp.* to 78%. But growing in treated soil dulled the shining-green color of the strawberry plant leaves. The phytotoxic

effect, dry and brown leaf edges, became prevalent in treated soil with high doses of ClO_2. Treatment with 7.8 V% ClO_2 for 10 min seemed to provide the best control of weeds and microorganisms with a tolerable phytotoxicity to strawberry plants.

The ClO_2 treatments resulted in a small pH decrease in soil; an increase of chlorate ion, from 0 to 119 ppm depending on treatment doses; an increase of chloride ion, from 8.8 ppm to 243 ppm; but a negligible production of chlorite. Chlorate residues decreased rapidly when the pots were incubated in the growth chamber, perhaps as a result of watering and decomposition. The chloride residue also diminished steadily through watering. Chlorate is a biologically active oxidant. Its role in the treatment is being elucidated. Chlorine dioxide was totally consumed during the treatment, and is the primary active agent responsible for the control of weeds, nematodes, *Phytophthora*, and *Verticillium*. The results show ClO_2 gas could be a potential alternative to methyl bromide in soil treatment.