REDUCING METHYL BROMIDE IN PREPLANT SOIL TREATMENT FOR GINGER ROOT

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Introduction

Edible ginger (*Zingiber officinale* Roscoe) is a regional commodity exclusively grown in the Hilo district along the northeast coast on the island of Hawaii. Ginger is mainly used as an herb to add pungency in oriental cooking and the major cultivar grown in Hawaii is the "chinese ginger". The use of methyl bromide as a pre-plant soil treatment has been an important component in the culture of ginger root for the control of the rootknot nematode, weeds, and certain soil borne diseases. Over the past ten years, industry usage of methyl bromide has been decreasing mainly due to the reduced approved application rate and to the higher cost of applying this fumigant. Concurrently, in recent years, a soil borne bacteria, *Pseudomonas solanacearum*, has been afflicting growers' fields, resulting in heavy crop losses. Control strategies basically focussed on good management practices utilizing proper seed selection, new land selection, good sanitation procedures, and increasing chloropicrin along with methyl bromide fumigation. The crisis situation stabilized and the industry production level recovered but the threat of the bacterial wilt of ginger still remains a major challenge. The purpose of this trial was to compare the efficacy of several methyl bromide and chloropicrin formulations on land previously infected with the bacterial wilt and to establish a baseline for further related studies in regards to alternative control strategies.

Materials and Methods

A grower-cooperator was chosen who had land on which ginger was previously grown and infected with the bacterial wilt during the 1997 season. This grower estimated his losses to be at least 15% with the majority of his crop having been harvested by the end of November 1997. The bacterial wilt organism was identified from harvested rhizomes using the PCR method on December 1997. This experiment compared four methyl bromide/chloropicrin formulations in randomized block design. The treatment plot dimensions were 46 x 16 feet and each treatment was replicated three times. The treatment plots were fumigated under a 6 mil black plastic tarp using a plastic tubing apparatus. The fumigation date was April 16, 1998 and the tarp was removed two weeks after treatment. The pre-plant soil fumigation treatments and rates are listed in Table 1. On April 30, 1998, "chinese ginger" seed material, previously grown in hydroponic culture and each weighing approximately 4 ounces, were planted in furrows four feet between rows and 1 foot apart within rows. A three feet high wire fence was erected around the perimeter of the experimental trial and five feet wide furrow borders were constructed around each individual plot to reduce the risk of contamination. Clorox footbaths (20%) were also employed during the crop maintenance operation.

Results/Discussion

On June 3, 1998, ginger seeds had already germinated and the shoots were approximately 8 inches tall. The plants were well established with no apparent symptoms of the bacterial

wilt. On July 8, 1998, bacterial wilt symptoms showed up in three plots. Samples of the diseased plants were analyzed and found to be infected with *P. solanacearum.* Two of the samples were from the 67:33 treatment plots and the other was from the 98:2 at 375 lb per acre treatment. Observations on bacterial wilt infection continued up to October 22, 1999 and the results are shown in Graph 1. Based upon the averaged percent infection, differences among the fumigant formulations were apparent within the first two months after wilt symptoms first appeared. The treatment with the highest methyl bromide rate, 98:2 at 617 lb per acre, resulted in the lowest infection rate. Chloropicrin appeared to have a lesser role, possibly having a suppressive effect, as the ratio with methyl bromide approached 1:1. In a previous trial, chloropicrin in excess of 700 lbs per acre did not reduce the spread of infection. By mid-November, all of the treatments were severely damaged as a result of the bacterial wilt and no data on harvestable yield could be taken. Considering the high level of the bacterial wilt at the experimental site and only a 5 month fallow period, a high rate of methyl bromide appeared to exhibit a suppressive action on this soil borne disease in the early plant growth phase. Although it is apparent that sanitation practices play a much more important role in the control of bacteria, high rates of methyl bromide may have a contributing role.

A survey on weed control was conducted on June 9, 1998 and the only weed species present was the yellow nutsedge (*Cyperus esculentus* L.). The average number of yellow nutsedge per plot are shown in Graph 2. Methyl bromide 98:2 at 617 lb per acre, the treatment with the highest amount of methyl bromide, resulted in the best nutsedge control. The treatments with lower amounts of methyl bromide resulted in less control with the 57:43 formulation having the least amount of control. These results are very much consistent with what is commonly known about the performance of methyl bromide on weed control. If methyl bromide is further reduced in future formulations for ginger culture, growers will realize reduced levels of yellow nutsedge control.

Methyl bromide is known to offer excellent control of the rootknot nematode, soil borne fungi and a wide range of weed species that replacing the loss of methyl bromide, the fumigant of choice, will be a major challenge for the ginger industry in the impending future. Research programs have already started that will address nematode and weed control issues incorporating cover crops and crop rotation systems.

Conclusions

Good sanitation practices play a much greater role in the control of the bacterial wilt of ginger but nevertheless a high rate of methyl bromide may offer a contributing role. The treatment with the highest methyl bromide rate, 98:2 at 617 lb per acre, resulted in the lowest initial infection rate on land previously infected with the bacterial wilt. Reducing methyl bromide in pre-plant soil treatments increased the percent infection. The highest methyl bromide rate of 98:2 at 617 lb per acre also resulted in the best yellow nutsedge control. Alternative pest control methods for ginger are needed with the imminent phase-out of methyl bromide.

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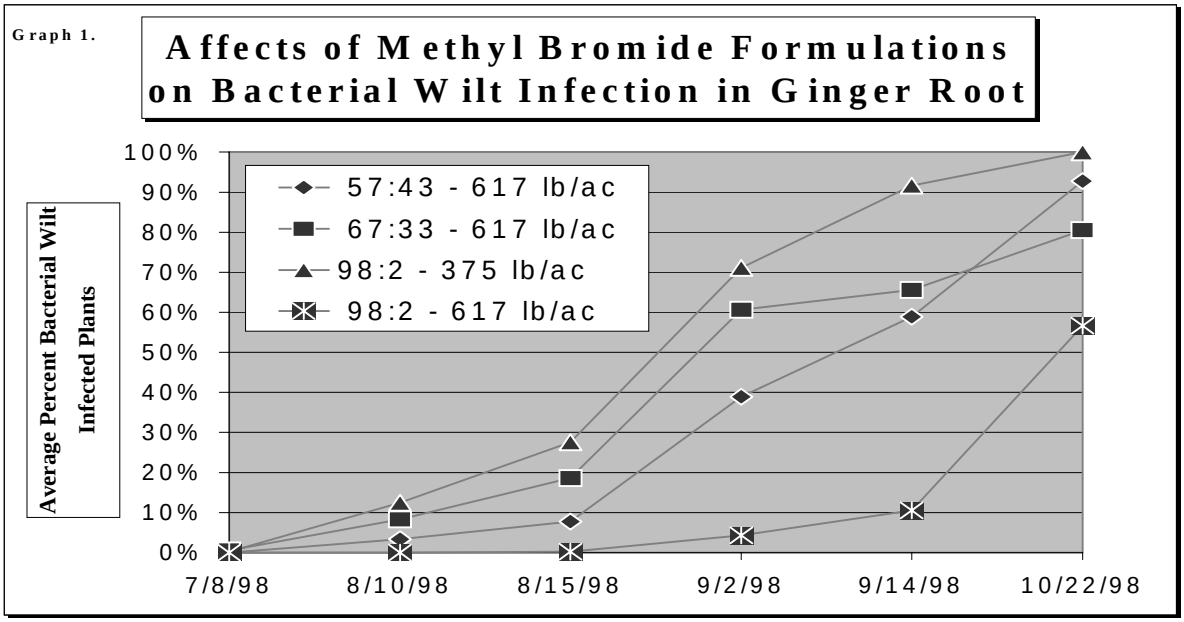
Table 1.

No.	Pre-plant Soil Fumigation Treatments	Formula Rate (lb/ac)	Methyl bromide (lb/ac)	Chloropicrin (lb/ac)
1	Methyl bromide 57%: Chloropicrin 43%	617	352	265
2	Methyl bromide 98%: Chloropicrin 2%	375	367	8
3	Methyl bromide 67%: Chloropicrin 33%	617	413	204
4	Methyl bromide 98%: Chloropicrin 2%	617	605	12

Graph 1.



Graph 2.