

METHYL BROMIDE ALTERNATIVES FOR RASPBERRY NURSERIES

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Introduction. Raspberry nurseries must produce plants free from disease to meet marketplace and export requirements. Minor disease infestations in nurseries can cause severe epidemics in production fields. Raspberry nurseries presently qualify for critical use and quarantine/preshipment exemptions to use Methyl Bromide (MB), but there is increasing pressure to find alternatives.

Root rot caused by *Phytophthora rubi* (PR) and the root lesion nematode *Pratylenchus penetrans* (PP) are the most serious root diseases of red raspberries in many growing regions. Spread of PR was associated with infected nursery stock in Scotland [1], and growers rely upon nematode-free planting stock produced in fumigated soil for PP management [2]. Crown gall (*Agrobacterium tumefaciens*, AT) is common in the coarse-textured soils favorable to raspberry nursery production. Soil fumigation with MB reduces but does not consistently eliminate crown gall. Improved AT control would be a very attractive feature of a MB alternative for raspberry nurseries. MB is also valued by raspberry nurseries for its role in eliminating other pathogens and weeds. Our objective was to evaluate alternatives to MB:chloropicrin fumigation for reduction of pathogens and weeds in raspberry nursery production.

Methods. A field trial was established in September 2008 on a Skagit silt loam soil at WSU-NWREC, Mount Vernon. Replicated treatments (Table 1) were established in five randomized complete blocks, with each plot 7.5 ft x 70 ft. Non-replicated treatments (Table 1) were established at a demonstration trial located in Lynden, WA, with each plot 150 ft by 7.5 ft.

Nylon mesh bags containing PR and AT inoculum were buried at 15, 30 and 45 cm prior to treatment. Bags containing quackgrass rhizomes and nutsedge nutlets were also buried at this time, but only at 15 and 30 cm. Inoculum bags were removed 15 Jan. AT survival was evaluated by bioassay (30 cm depth) and by dilution plating (all depths). PR survival was evaluated by greenhouse bioassay for all depths. Weed propagules were germinated in the greenhouse. Plant-parasitic nematodes were counted from soil samples taken prior to treatment and one month after treatment.

Results. *Perennial and Annual Weeds.* All of the treatments except 175 lb/A MIDAS 50:50 under HDPE film eliminated quackgrass germination at Mount Vernon ($P < 0.001$, Fisher's protected LSD). Quackgrass germination was also lower in all of the fumigated plots at Lynden. Nutsedge germination was low in

bags from both of the trials, and there were no significant differences among treatments.

The most common native weeds in non-fumigated plots were common groundsel, annual grasses, pepperweed and mouseear chickweed. White clover emergence was elevated in fumigated plots. Other weeds were best controlled by Telone C-35 under VIF film, MIDAS 50:50 at 350 lb/A under HDPE film, or MIDAS at 175 lb/A under VIF film.

Pratylenchus penetrans. Non-fumigated plots at Mount Vernon contained 77 PP/100g soil. All of the treatments eliminated PP from the Mount Vernon plots.

Agrobacterium tumefaciens. At Mount Vernon, all of the treatments reduced AT cfu/g (Fig. 1A). The best control was provided by MIDAS 50:50 at 350 lb/A under HDPE film, followed by Telone C-35 under VIF film, and MB:pic. All of the treatments provided good control of AT at 30 and 45 cm, but differences among treatments were more pronounced at 15 cm. At Lynden, none of the treatments controlled AT except for Telone C-35 under VIF film at 30 cm (Fig. 1B). In contrast with results in previous years, bioassay data were inconclusive.

Phytophthora rubi. At Mount Vernon, results were similar at 15, 30 and 45 cm, so results from the three depths were combined (Fig. 2A). All of the treatments reduced PR, but the most effective treatments were Telone C-35/VIF or HDPE, MIDAS 50:50 at 350 lb/A under HDPE film and MB:pic. At Lynden, none of the treatments controlled PR except for MB:pic at 30 cm (Fig. 2B).

Summary

- MIDAS 50:50 at 350 lb/A under HDPE film and Telone C-35 at 39 gal/A under VIF film were as effective as MB:pic in these trials. MIDAS is quite expensive, and it is not yet labeled in Washington and California, the major states for raspberry nursery production. Telone C-35 is available, but widespread implementation of this alternative would require a better system for gluing the VIF film. Telone C-35 under conventional HDPE film controlled PR and PP well, and may be suitable when AT is not a problem.
- MIDAS 50:50 at 175 lb/A under HDPE or VIF films did not provide adequate control of PR and AT in these trials.
- Control of PR and AT at Lynden was not as complete as at Mount Vernon. This could be an artifact of lack of replication at Lynden, or soil conditions at Lynden (such as extremely high organic matter) may have significantly affected fumigant performance.

References

1. Duncan, J.M. and L.E.M. Cooke, *Work on raspberry root rot at the Scottish Crop Research Institute*. Acta Horticulturae, 2002. **585**: p. 271-276.
2. McElroy, F.D., *Nematode parasites*, in *Compendium of raspberry and blackberry diseases and pests*, M.A. Ellis, et al., Editors. 1991, APS Press: St. Paul, MN. p. 59-62.

Table 1. List of Treatments in 2008 field trials*

Treatment	rate	film	Mount Vernon	Lynden
Non-fumigated		HDPE	X	X
Telone C-35 (1,3-dichloropropene:chloropicrin 63:35)	39 gal/A	HDPE	X	
Telone C-35	39 gal/A	Blockade XL (VIF)	X	X
MIDAS 50:50 (methyl iodide:chloropicrin)	350 lb/A	HDPE	X	
MIDAS 50:50	175 lb/A	HDPE	X	X
MIDAS 50:50	175 lb/A	Blockade XL (VIF)	X	X
Methyl bromide:chloropicrin 67:33	350 lb/a	HDPE	X	X

*Mount Vernon: replicated trial, Lynden: non-replicated demonstration trial

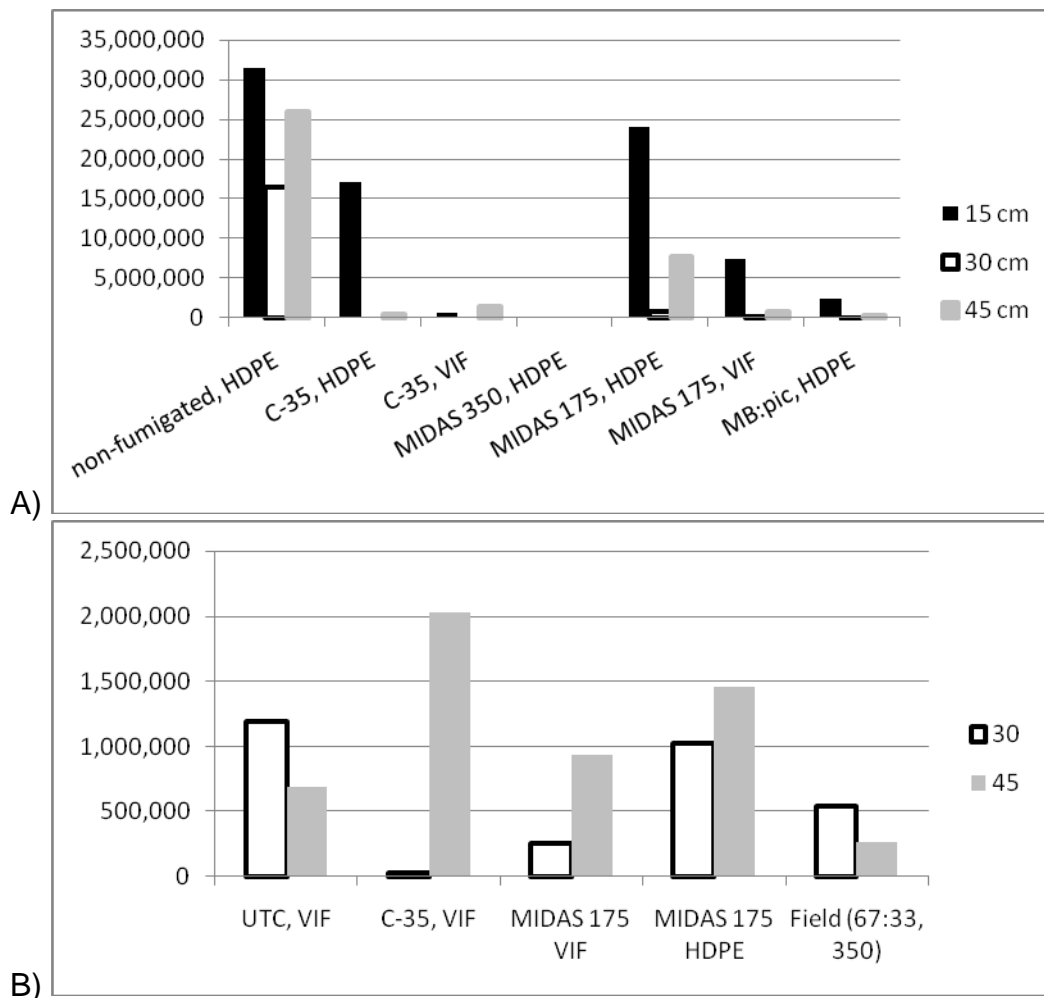


Figure 1. *Agrobacterium* survival measured as colony forming units/g soil. Inoculum bags were buried in all plots at 15, 30 and 45 cm Sept 2008 prior to treatment. Bags were removed March 2009 just prior to planting. A) replicated trial at Mount Vernon, B) non-replicated trial at Lynden.

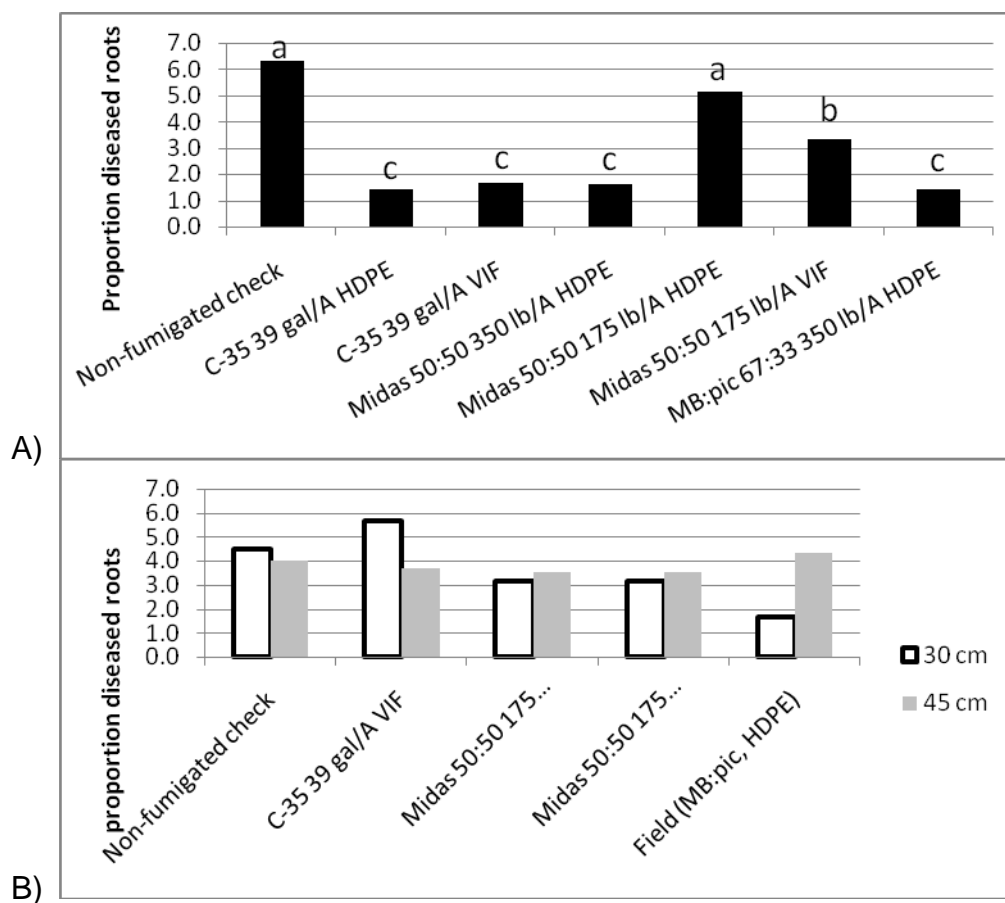


Figure 2. Proportion of roots affected by raspberry root rot in greenhouse bioassays of *P. rubi* inoculum bags buried in plots. Bags were removed on March 10, just prior to planting. Proportion of diseased roots was rated on a 1-7 scale, with 1= 0-12.5% roots affected, and 7=87.5-100% roots affected A) replicated trial at Mount Vernon, WA (average of all depths) B) non-replicated trial at Lynden, WA.