METAM SODIUM A POTENTIAL ALTERNATIVE TO METHYL BROMIDE

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Introduction

Research on the use of metam sodium (metam) for the control of nematodes, weeds and soil borne diseases has been a major component of my research program at Washington State University-Mount Vernon Research & Extension Unit. This activity was initiated because of the lack of herbicides, nematicides and soil fungicides for use on minor crops. The demonstrated efficacy of metam for weed, nematode and disease control developed at WSU-MVREU is directly applicable to the use of metam as an alternative for methyl bromide-chloropicrin soil fumigation.

Metam soil incorporation treatment of surface 15-20 cm of the soil profile.

Research on metam efficacy has been conducted over the past 20+ years at WSU-MVREU using soil incorporation and power sealing. Treatment of the surface 15 - 20 cm of soil using soil incorporation, in combination with sealing the surface with a powered roller, has resulted in excellent control of weeds and soil borne diseases (see Table 1). The major disease on cucumbers was *Pythium* spp and on peas *Fusarium solani*. Rates of application at 89 and 178 kg/ha a.i. of metam reduced the weed population from 307 in the control to 13 and 5 respectively in the metam treated plots. Yield of cucumbers was increased from 3.53 to 6.04 kg/plot with metam applied at the rate of 178 kg/ha (1A). The reduction in weed populations and yield response were similar for peas. The colony forming units (cfu) of *Fusarium* were reduced to non-detectable levels after 14 days, and from 2556 per gram to 111 after 28 days with a metam rate of 178 kg ai/ha (1B)

The addition of plastic tarp laid over the soil following incorporation of metam increased the efficacy of metam for weed control (Table 2). The effect of soil incorporation with plastic tarp was equivalent to methyl bromide on strawberries in NW Washington for weed control and yield response (Table 2A). Metam at 71 kg ai/ha reduced weed populations from 660 per plot (11.4 m^2) to 25 and 0 respectively for incorporated metam without tarp and with tarp (Table 2B).

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Metam soil incorporation and injection for control of pests in surface 45 cm of the soil profile.

To achieve weed and disease control in the upper 10 cm of the soil profile, soil incorporation is the preferred method of treatment. Soil injection is required to achieve economical pest control in the 15 cm to 45 cm. zone in the soil profile. A combination of injection and incorporation has been successful in Mount Vernon for the control of weeds, diseases and nematodes (Table 3). The major pests in this field were cyst nematodes, *H. gottingiana, Equisetum, Fumaria,* and *Fusarium* spp. (Table 3B). Table 4 presents data on the control of nematodes and weeds with metam, the combination of metam + Telone C-35 and Methyl bromide + chloropicrin.

Treatments include 1) metam +&- tarp, 2) metam + Telone C-35 +&- tarp, and 3) the standard methyl bromide-chloropicrin. Treatments were applied 7/19/99 and soil samples collected for nematodes on 8/06/99. Soil samples were collected from 3 soil zones 0-15, 15-30 and 30-45 cm below the soil surface. Each treatment was replicated 3 times. The only plant parasitic nematode in this field was *Pratylenchus* spp. Data reported in Table 4 refer to total free living nematodes recovered from 50 grams of soil. All of the tarped treatments were equally effective for weed and nematode control. The nematode recovery was equal for all depths of sampling. The F value for depths was .02 with a P value of 0.999.

The applications of metam noted in Table 4 were applied with equipment designed by J. Roozen, Washington Bulb Co., Inc., 16031 Beaver Marsh Rd., Mount Vernon, Washington and fabricated by D. Smiley, Smiley s Inc., 1600 Memorial Highway, Mount Vernon, Washington. All other fumigants were applied by M. Conway, Trident Ag. Products, Woodland, Washington.

Conclusions:

The efficacy of metam as a soil treatment for the control of soil borne pests such as nematodes, insects, diseases, weeds and weed seeds is well documented in the literature. The control achieved, as reported in the literature, is not always consistent and in some instances control has been marginal. Metam should not be considered a drop-in replacement for the combination of methyl bromide + chloropicrin. Because of the limited movement of metam in the vapor phase in the soil, standard shank injections are not always efficacious. Data generated in the maritime climate of northwest Washington have demonstrated that when metam is used to control pests in the surface 30-45 cm of soil and applied in a manner that will maximize efficacy, it will result in excellent pest control without the use of a plastic tarp. When metam is applied using a method combining soil incorporation and injection with a plastic tarp it is equivalent to standard methyl bromide + chloropicrin treatments for pest control in the surface 45 cm. of the soil profile

Research at Washington State University-MVREU using several methods of metam application and methods of sealing the soil surface have demonstrated that:

1. Metam incorporated into the surface 15 cm of soil and the surface compacted with a power roller will give excellent control of weeds, diseases and nematodes.
2. Metam applied as in 1) above and sealed with a plastic tarp is comparable to the standard methyl bromide + chloropicrin treatment for control of nematodes, weeds and diseases in the treated zone.
3. Metam applied at multiple levels by subsurface spraying in combination with incorporation in the surface 15 cm and surface compacted results in excellent control of pests to depths of 45 cm.
4. Applying metam as in 3 above and sealing the surface with a plastic tarp has been comparable to standard methyl bromide + chloropicrin for weed, disease and nematode control.

Table 1. Metam sprayed on the soil surface, incorporated to a depth of 15 cm and compacted with a powered roller. Spraying of metam, incorporation and power rolling all completed in a single operation. Cucumber (1A) fumigated on 5/15/88 and planted 6/15/88. In test 1B colony forming units (cfu) *Fusarium oxysporum* and *F. solani* were determined using Snyder and Nash selective medium.

1A- Cucumbers treated 5/15/88 **1B- Peas treated 5/16/89**

Rate kg/ha a.i.	Weeds No. 6/15	Yield kg/plot	Weeds No. 6/13	Yield/g 8/01	Fusarium * cfu/g/14/da	Fusarium cfu/g/28 da
0	307	3.53	121	156	3000	2556
89	13	4.99	62	280		
178	5	6.04	7	404	ND**	111
267	2	4.39				

*14 days post fumigation, ** ND = not detected

Table 2. Metam applied as in Table 1. Strawberries (2A) metam fumigation on the flat, soil immediately formed into beds and covered with 1.5 mil polyethylene tarp; methyl bromide applied as bed fumigation with shanks on 12 inch centers, 2 shanks per bed. In test 2B metam applied by incorporation and power roll (R&R). R&R (2x) = plots R&R a second time 24 hours after metam applied, SM = plots treated with an asphalt spray mulch, tarp = plots covered with 1.5 mil polyethylene tarp.

2A Strawberries fumigation 9/98 **2B Weed control 71 lbs/ac**

	Rate kg/ha	Weeds No 6/17/90	Runner Wt/g 6/30/90	Yield kg/plot 8/24/90	Metam applied 6/25/90	Weed No. 8/10	Weed No. 8/30
Control	0	57	647	5.87	0 metam	660	nd*
Metam	89	2	1275	7.13	R&R	25	102
Metam	178	1	1552	6.52	R&R (2x)	12	50
Metam	267	0	1600	6.26	R&R +SM	18	96
MBr	448	1	1325	6.55	R&R + tarp	0	0

* No data, weeds too numerous to count

Table 3. Commercial application of metam at 258 kg/ha/ai. for control of weeds, root rot, and cyst nematodes. Metam applied with spray blades at 22 and 28 cm below soil surface, incorporated into surface 15 cm with rotary tiller. Each of the three treatment levels received 1/3 of total metam

3A Total number of nematodes recovered from 50 grams of soil from each of 3 zones.

Treatment	Site*	Date Tr.	Sampled	0-15 cm	15-30 cm	30-45 cm
Control	A	5/4/98	5/18/98	1644	872	364
Met-258	A	5/4/98	5/18/98	12	3	13
Control	B	5/11/98	5/18/98	1340	378	100
Met-258	B	5/11/98	5/18/98	42	16	16
Control	C	7/19/99	8/6/99	816	348	508
Met-310	C	7/19/99	8/6/99	11	7	21

* Sites A and B = four replicates, site C = three replicates

3B Control of cyst nematode (*H. gottingiana*) and yield response of peas at site A above.

Treated 5/4/98	Site	RRI 5/25	Stand m/row	Plant wt./g 7/3/98	cysts/g 7/17/98	Vine wt/g 8/01/98	Pod wt 8/01/98
Control	A	5.23	31.7	3.48	915	21	5
Metam 258	A	1.57	31.7	16.58	39	1153	518

Planted 5/25: RRI=greenhouse tests to evaluate *Aphanomyces* root rot of peas, lists green weight of peas in grams (Bolero cv); cysts/g=white cysts of *H. gottingiana* per gram of root and rhizosphere soil, vine and pod weight=grams of tissue harvested from 2 meters of row at processing maturity. All data based on 4 replications of each treatment.

Table 4. Efficacy of metam and combination of metam with and without plastic tarp.
Metam at 210 kg/ha was applied at a depth of approximately 10 cm with spray blades.
Metam at 315 was applied at 3 levels with 105 kg/ha at each level, 10 , 24 and 38 cm
MBr and Telone C35 injected on 12 inch centers at a depth of 25-30 cm

Treatment and rate *	Tarp	Nematodes/50 g soil** Zone soil collected/cm			Weeds ***	
		0-15	15-30	30-45	8/13	8/24
Control	no	718	589	361	73.3	193.3
Metam 315	no	5	5	28	0.4	7.3
Metam 315 incorporated	yes	7	12	4	0.0	0.0
Metam 315 no incorporation	yes	5	0	9	0.0	0.0
Metam 210 inc. + T- C35-@ 205	yes	12	4	4	0.0	0.0
Metam 210 inc + T-C35 @ 205	no	13	13	9	0.0	3.3
M Br + chloropicrin @390 kg/ha	yes	5	5	1	0.0	0.0

* Rates: Metam in kg/ai/ha and T-C35 Telone C35 in l/ha.
** Nematode data from 6 probes in each of the 3 replicates.

**Weeds data from 3 replication and 3 areas within each replicate.