SOLARIZATION AND COVER CROPS AS ALTERNATIVES TO METHYL BROMIDE

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A variety of non-chemical practices are available for use against plant-parasitic nematodes and soil-borne plant parasitic fungi. However, most of these methods are not as effective as methyl bromide in achieving rapid reductions in pest population levels. In this study, combinations of solarization and a summer cover crop were compared to the standard methyl bromide fumigation for management of plant-parasitic nematodes and fungal disease.

Experiments were conducted at the University of Florida, Gulf Coast Research and Education Center, Bradenton, Florida. The experimental plots were subjected to one of these treatments: 1) summer cover crop of 'Iron Clay' cowpea (*Vigna unguiculata*), 2) soil solarization during autumn, 3) cowpea + solarization, 4) untreated control, or 5) fumigation with 400 lb/A of a mixture of 67% methyl bromide and 33% chloropicrin. Treatments were arranged in a randomized complete block design with 6 replications. Cowpea was planted on 16 July, 2001, maintained for 2 months, and then rototilled. The solarization treatment utilized a double layer of clear, 25-µm-thick, low-density polyethylene mulch, maintained for three weeks. To better assess effects on nematodes and soil fungi, all plots were hand-weeded in early November to remove nutsedge (*Cyperus* spp.). Two experiments were set up in these plots, one with basil (*Ocimum basilicum*) and one with Chinese cabbage (*Brassica chinensis*).

Marketable basil leaves and cabbage were harvested between December, 2001and January, 2002. At the final harvest, the root systems of 6 plants per plot were removed to determine fresh root weight, and root discoloration caused by fungi was rated visually. Soil samples for plant-parasitic nematode assay were collected on 14 November (at planting, after summer treatments) and 9 January (after final harvests). Nematodes were extracted from a 100 cm^3 soil subsample using a modified sieving and centrifugal flotation procedure.

By 14 November, the previous cowpea cover crop had efficiently reduced the population densities of root-knot (*Meloidogyne incognita*) and stubby-root nematodes (*Paratrichodorus minor*) as compared to the control, slightly reduced stunt nematodes (*Tylenchorhynchus* spp.), but failed to reduced awl nematode (*Dolichodorus heterocephalus*) (Table 1). Due to the cloudy weather in the autumn, 2001 in Florida, soil solarization did not perform well as would have been expected. In fact, solarization enhanced awl and stunt nematodes (Table 1).

Therefore, combining solarization with the cowpea cover crop did not help the nematode-suppressive effect of the cover crop. Methyl bromide suppressed 100% of most kinds of plant-parasitic nematodes and reduced the most abundant nematode, stunt nematode, by 67% compared to the unfumigated control (Table 1).

At the end of the growing season, most nematodes remained effectively suppressed by methyl bromide on both crops (Table 2, 3). On Chinese cabbage, methyl bromide treatment had decreased nematode levels by >97% compared to the control treatment (Table 3). Solarization was ineffective against nematodes, and actually increased stunt nematode numbers on cabbage (Table 3). Suppression of root-knot nematodes by the cowpea cover crop treatment persisted through the end of the basil crop (Table 2), although numbers of root-knot nematodes present were relatively low. The cowpea treatment improved the root discoloration rating of basil relative to the control, however, in general root ratings were unaffected by most treatments, including methyl bromide.

Yield and root weight of basil following the cowpea cover crop, while greater than that in the control plots, was 80-82% of the level achieved following methyl bromide fumigation (Table 2). However, yield of Chinese cabbage was not significantly increased by fumigation, and the highest yield occurred in plots that received the cowpea cover crop (Table 3) possibly due to a green manure effect from nitrogen fixation in the cover crop. It is not clear why the yield of basil was improved by methyl bromide fumigation while the yield of Chinese cabbage was not. The data suggest that the nematodes present in this site were more pathogenic to basil than to Chinese cabbage. Root-knot nematodes are a concern on basil, although numbers were low. The awl nematode was more abundant on basil, but its pathogenicity to these crops is unknown.

In these experiments, nutsedge was eliminated so that effects of fumigant and alternatives on nematodes and fungal disease could be evaluated directly. The results of the Chinese cabbage experiment indicate that no yield advantage of methyl bromide over the alternatives could be obtained when pest and disease pressure is low and nonpathogenic. However, even when low populations of damaging pathogens are present, methyl bromide fumigation was beneficial and superior to the alternatives on a highly susceptible crop such as basil. The use of a cowpea cover crop was encouraging in that it outperformed the other nonchemical treatments and resulted in a basil yield equivalent to 80% of that provided by methyl bromide fumigation. It was hoped that combining soil solarization with the cover crop could recover some of the 20% shortfall in yield, but the solarization was completely ineffective during this unusually wet and cool fall season. The combination of solarization and cowpea cover crop should be reevaluated under more favorable conditions to assess their performance relative to methyl bromide.

Table 1. Effect of cowpea cover crop and soil solarization on plant-parasitic nematodes as compared to methyl bromide fumigation prior to crop planting (14 November, 2001).

	% reduction of nematodes[a]			
	Awl	Root-knot	Stubby-root	Stunt
Cowpea (C)	-4	100	53	27
Solarization (S)	-89	80	33	-160
C + S	27	100	87	-206
Control	0	0	0	0
Methyl bromide	100	100	100	67

[a] % reduction refers to percent of reduction as compared to the control.

Table 2. Effect of cowpea (C) and soil solarization (S) on plant-parasitic nematodes, root discoloration rating, and yield and root weight of basil as compared to methyl bromide fumigation (MBr) on 9 January, 2001.

	% reduction of nematodes or root discoloration[a]						% of MBr[b]	
	Awl	Root-knot	Sting	Stubby-root	Stunt	Root-rating	Yield	Root weight
C	36	89	30	10	51	12	80	82
S	34	28	29	24	-2	-3	70	74
C+ S	42	61	80	32	-1	14	78	84
Control	0	0	0	0	0	0	71	69
MBr	86	100	99	59	98	16	100	100

[a] % reduction refers to percent of reduction as compare to the control.
[b] % of methyl bromide refers to percent compared to the value for methyl bromide treatment.

Table 3. Effect of cowpea (C) and soil solarization (S) on plant-parasitic nematodes, root discoloration rating, and yield and root weight of Chinese cabbage as compared to methyl bromide fumigation (MBr) on 9 January, 2001.

	% reduction of nematodes or root discoloration[a]						% of MBr[b]	
	Awl	Root-knot	Sting	Stubby-root	Stunt	Root-rating	Yield	Root weight
C	41	60	30	-15	12	1	126	100
S	26	20	0	34	-75	0	95	90
C+ S	43	-180	77	44	-75	2	98	93
Control	0	0	0	0	0	0	102	94
MBr	97	100	98	97	97	6	100	100

[a] % reduction refers to percent of reduction as compared to the control.
[b] % of methyl bromide refers to percent compared to the value for methyl bromide treatment.