THE INFLUENCE OF SODIUM AZIDE AND CARBOFURAN ON CROP RESPONSE, NEMATODE AND WEED CONTROL FOR CHRYSANTHEMUM MORIFOLIUM

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Abstract. **Sodium azide was rototilled into chrysanthemum beds at rates of 10, 20, or 40 lb AI/A. The 40 lb AI/A rate was phytotoxic to rooted cuttings set 2, 7 and 12 days later. Furadan (carbofuran), similarly applied at 10 lb AI/A, increased flower stem weight 19 percent. Application of a sodium azide-Furadan combination, each at 10 lb AI/A, increased stem weight 12 percent over the untreated control. Twenty and 40 lb AI/A of sodium azide alone reduced pigweed (Amaranthus retroflexus), but had no effect on goosegrass (Eleusine indica). Furadan and the high rate of sodium azide reduced the severity of root-knot nematode infestations.**

A successful pest management program for high value crops such as chrysanthemum must include economic control of weeds, nematodes, soil-borne pathogens and insects. Recent observations indicate that, currently, preplant soil fumigants or steam are used at least once a year in all commercial chrysanthemum ranges for production of quality cut flowers and planting stock. Cost estimates range from 150 to 600 dollars per acre. Because of the high cost and inconvenience of current fumigation practices, new methods and materials are constantly being sought to reduce cost, improve crop timing, increase safety of the operation to employees and crop plants, and reduce possible environmental pollution. Development of a program utilizing a relatively inexpensive nematicide has been limited by lack of an adequate soil fungicide-herbicide to complete the control spectrum.

Sodium azide may possibly serve this purpose. It is a solid material which can be easily applied in granular form with relatively inexpensive equipment. Sodium azide has shown herbicidal activity against burmuda grass (*Cynodon dactylon*) (3) and mugwort (*Artemisia vulgaris*) (2). Potassium azide, like the sodium salt an enzyme inhibitor, reduced loss of peanut yield to *Sclerotium rolfsii* and controlled Florida beggarweed (*Desmodium tortuosum*) (5). Adams, et al. (1) demonstrated that, although biological effectiveness was greatest in an acid soil, phytotoxicity increased with increasing soil pH from 5.0 to 7.0.

Carbofuran also is most effective as a nematicide in acid soils; at pH 7.5 and higher, the chemical degrades. Results with both chemicals are dependent on moisture level: carbofuran diffuses into the soil water from the granule and the hydrazoic acid active breakdown product of the azides dissolves in the soil water (4).

The objective of this study was to evaluate sodium azide alone and combined with the contact nematicide Furadan (carbofuran) for control of weeds, soil-borne disease organisms and root-knot nematodes (*Meloidogyne* spp.) in chrysanthemum cutflower production on an acid sandy soil. Planting dates were included as a variable in the test to determine the waiting period necessary for dissipation of the chemical from the soil before plants may safely be set into treated areas.

Materials and Methods

Chrysanthemum beds which had supported 2 crops annually for 8 years were selected for the evaluation of sodium azide alone and in combination with Furadan, At the time of treatment the seep irrigated Myakka fine sand was characterized by a pH of 5.1, <1 percent organic matter and 13 percent moisture. Air temperature was 72 F (22 C), soil temperature at a 4-inch depth was 46 F (8 C) at treatment.

Ten percent granular formulations of sodium azide and Furadan were broadcast alone and in combination at the rate of 10 lb AI/A on 12 x 4-ft plots. Sodium azide was also applied at 20 and 40 lb AI/A. Four replications including each treatment and an untreated control were rototilled to a depth of 8 inches, bedded and compacted with a press. Treatments were arranged in a split-plot design.

Rooted cuttings of chrysanthemum (cv. 'Showoff' and 'Dark Red Beauregard') were set 2, 7 and 12 days after soil treatments. Resets were made as

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required. Both cultivars were grown single-stemmed and the mature flower stems were counted and weighed at harvest. The experimental area was seep irrigated continuously through tile buried 18 inches below the bed surface. Additionally, all cuttings were hand watered lightly several times daily for 17 days after planting to facilitate survival of the plants. Rainfall during the first 21 days after treatment totaled 0.9 inch. Only one appreciable rainfall occurred during the growing season: 1.8 inches 35 days after the last planting. Following harvest the plant roots were dug and examined for incidence and severity of root-knot nematode galling.

Results

Rooted cuttings set 2 days after soil treatment with 20 lb/A sodium azide and cuttings set up to 12 days after application of 40 lb/A began to wilt on day 19 and declined rapidly. Examination of root systems indicated that the base of the stem and original roots were severely damaged. New

Table 1. Percent change in flower production following soil treatment with sodium azide (NaN_3) and Furadan.

Treatment	Lb/A	Days after Treatment 2	7	12	21
NaN_3	10	-10	2	9	
	20	*	-19	2	- 7
	40	*	*	*	10
NaN_3 + Furadan	10+10	4	10	12	
Furadan	10	7	21	19	

*Plants declined at 19 days and were replaced at 21 days.

Table 2. Effect of sodium azide (NaN_3) and Furadan on flower production (lb/plant) and survival of root-knot nematodes in chrysanthemum, based on the last planting date of each treatment.

Treatment	Lbs AI/A	Stem Wt (lb/plant) Showoff	Stem Wt (lb/plant) Beauregard	Root-knot Index[y] Showoff	Root-knot Index[y] Beauregard
Control		.35ab[z]	.57b	1.9bc	4.7c
NaN_3	10	.31b	.57b	2.2c	4.2c
	20	.26c	.54b	2.3c	3.4b
	40	.39a	.56b	1.2a	3.5b
NaN_3 + Furadan	10+10	.31b	.63a	1.5ab	2.5a
Furadan	10	.40a	.62a	1.0a	3.2b

[y] 0=none
5=severe galling

[z] Numbers followed by the same letter within each column do not differ at the 5 percent level of probability.

roots had emerged along the stem just beneath the soil line. Apparently, when hand watering was abandoned 17 days after the chemicals were incorporated, these shallow adventitious roots were no longer able to sustain the plants.

Resets planted 21 days after plots were treated with 20 and 40 lb/A sodium azide survived although production was improved only 10 percent with the high rate and not at all with the low rate (Table 1).

Furadan, compared to the untreated control, improved stem weight 20 percent when plants were set 7 to 12 days after treatment (Table 1). Sodium azide applied alone at 10 lb/A was phytotoxic to plants set 2 days after treatment and it improved yield less than 10 percent when plants were set after 12 days. Furadan and sodium azide combined produced intermediate results which reflected nematode control by Furadan and phytotoxicity of sodium azide. The cultivar 'Showoff' was more sensitive to sodium azide than 'Dark Red Beauregard' (Table 2).

Beauregard supported a larger population of root-knot nematodes than Showoff (Table 2). Severity of nematode galling was reduced on Beauregard by all treatments except the 10 lb/A rate of sodium azide. Similar results pertained for Showoff with failure of both 10 and 20 lb/A of azide.

The efficacy of sodium azide as a herbicide differed with the weed species. The number of pigweed seedlings (*Amaranthus spinosus*) per square foot of soil treated with 20 and 40 lbs/A azide was reduced significantly (Table 3). Goosegrass (*Elusine indica*) numbers were not significantly affected by the chemical; however, the total weight of both weed species in the higher rates of azide was reduced. Furadan did not affect the number of seedlings which emerged, but did increase the weight of weeds produced.

The following observations are made from these data:

1. In an acid (pH 5.1) sandy soil exposed to only one appreciable rain while being seep irrigated continuously, rates of 10-40 lb AI/A sodium azide were not adequate for the broad-spectrum soil-borne pest control necessary for quality high value crops like chrysanthemum.

2. Even at low application levels, the dissipation and degradation pattern of sodium azide indicates a waiting period requirement of 3 weeks or possibly longer, eliminating the possibility of shortening the current practice of waiting 2 to 3 weeks after soil fumigation before planting.

3. There were significant differences in response of chrysanthemum cultivars and weed species susceptibility to sodium azide.

4. Furadan alone compared favorably with sodium azide alone in all parameters recorded during the experiment except for the mass of weeds which infested the plots. Furadan did not increase the number of weeds which germinated; however, weeds in Furadan-treated soil excelled in weight.

Table 3. Weed infestations per square foot of chrysanthemum beds treated 5 weeks previously with sodium azide (NaN_3) and Furadan.

Treatment	Lbs/A	Weeds/Square foot: Pigweed[x]	Goosegrass[y]	Weed Weights (g)
Control		154c[z]	128	152c
NaN_3	10	109bc	144	132bc
	20	65ab	215	97b
	40	21a	126	45a
NaN_3 + Furadan	10+10	88abc	145	105b
Furadan	10	142c	140	191d

[x] *Amaranthus spinosus*
[y] *Eleusine indica*
[z] Numbers followed by the same letter within each column do not differ at the 5 percent level of probability.

Literature Cited

1. Adams, P. B., H. L. Warren, and C. J. Tate. 1971. Potassium azide: fungicidal activity as affected by pH. Plant Dis. Reptr. 55(12):1077-1081.
2. Danielson, L. L. 1965. Herbicidal effects of sodium and potassium azides on mugwort. Weeds 13:96-98.
3. Hill, G. D., G. C. Klingman, and W. C. Woltz. 1953. Chemical weed control in tobacco plant beds. North Carolina Ag. Exp. Sta. Bull. 382. 43 p.
4. Parachetti, J. V. and G. F. Warren. 1970. Behavior of potassium azide in the soil. Weed Science 18:555-560.
5. Rodriguez-Kabana, R., P. A. Buckman, Henry Ivey, and L. L. Farrar. 1972. Plant Dis. Reptr. 56(4):362-367.