SODIUM AZIDE [SEP 100[R]] FOR CONTROL OF ROOT-KNOT NEMATODE, WEEDS, AND SOIL BORNE DISEASE IN CANTALOUPE PRODUCTION

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ABSTRACT

The efficacy of sodium azide [NaN_3] for control of root-knot nematode [*Meloidogyne incognita*], weeds, and soil-borne diseases in cantaloupe [*Cucumis melo* var. *cantalupensis*] was studied with three field experiments two in 2003. NaN_3 was delivered pre-plant into soil by drip irrigation using the SEP 100[R] [American Pacific Corporation, Las Vegas, Nv, U.S.A.]. The compound was applied at rates within the range of 0 - 200 lbs a.i./A and methyl bromide [MB 67-33] was injected at 350 lbs/A to serve as positive control. The experiments were sited in fields naturally infested with the nematode, and with severe nutsedge [*Cyperus strigosus*] and other weed problems. Application of NaN_3 at rates $\geq$ 50 lbs a.i./A eliminated root-knot and controlled damping-off and and root rot caused by species of *Rhizoctonia* and *Fusarium.* Effective weed control was obtained with rates $\geq$ 75 lbs a.i./A. Total and marketable yield increased significantly in response to rates of 50 and 75 lbs; however, there was no additional yield benefit obtained with the use of higher rates. Applications of NaN_3 at rates $\geq$100 lbs, in either no change or in gradual decline in yields with severe phytotoxicity observed for the two highest rates [175 & 200 lbss]. Control of root-knot, seedling and root diseases, and weeds with NaN_3 at rates of 50 and 75 lbs was equivalent to that obtained with MB. Results suggest that NaN_3 may be a good substitute for soil fumigation with MB in cantaloupe production.

Key Words: azides, cantaloupe, cuburbits, inorganic azides, herbicide, horticultural crops, hydrazoic acid, methyl bromide alternatives, nematicide, pest management, root-knot nematodes, soil-borne pests, soil fumigation, weed control.

INTRODUCTION

Na and K azides are salts of hydrazoic acid [HN_3] that have been explored in a limited manner for their pest controlling properties in the past [MBTOC, 2002]. These compounds are solids, readily soluble in water, and can be formulated as granules or liquids. Azides are potent metabolic inhibitors affecting the activities of a variety of oxidative enzymes, notably those involved in the electron transport system of respiration. There is ample information on the toxicological properties of sodium and potassium azides on humans [TOXLINE, 2001]. While azides of heavy metals such as Cu, Pb, Hg, are unstable and explosive, those of Na and K are considered safe and stable under ordinary conditions [Moeller, 1952]. Field research at Auburn University in the 1970's showed that granular formulations of Na azide applied to soil had broad spectrum activity against weeds, nematodes, and soil-borne phytopathogenic fungi (Kelley & Rodríguez-Kábana, 1979b; Rodríguez-Kábana, *et al.*, 1975; Rodríguez-Kábana *et al.*, 1972). Similar results were obtained in other areas of the U.S. and in Belgium with high-value horticultural crops (van Wambeke *et al.*, 1984, 1985; van Wambeke & van den Abeele, 1983). The mode of action of Na and K azides on soil-borne pathogens is based on short-term direct toxicity, but may also involve as yet undetermined long-term effects through enrichment of the soil with microbial species antagonistic to the pathogens.

Sodium and K azides can be formulated as granules or in a variety of liquid formulations. Key to the stability of these formulations is that pH remains greater than 9.00 [Rodriguez-Kabana, 2001b; Rodriguez-Kabana & Robertson, 2000]. Liquid formulations allow for uniform distribution of the chemical by means of applications through drip irrigation. One such formulation SEP 100^R has been tried successfully by our team in field trials with tomato and bell peppers for control of weeds, plant pathogenic nematodes and other soil-borne pests [Rodriguez-Kabana, 2002b; Rodriguez-Kabana & Akridge, 2003; Rodriguez-Kabana *et al.*, 2003]. This paper presents additional information from field trials with cantaloupe on the value of SEP 100^R for control of weeds and other soil-borne pests.

MATERIALS AND METHODS

Field experiments were conducted in 2003 to assess the value of Na azide in the SEP 100^R formulation, for control of weeds, plant pathogenic nematodes and other soil-borne pest problems. To this end one experiment in 2003 was set up at the E. V. Smith Center, near Auburn, AL, and another at the Brewton Agricultural Research Unit, near Brewton, AL.

E. V. Smith Center [EVSC]. The experiment was conducted at the Horticultural Research Unit within the Center, in a field infested near 100% with false yellow nutsedge [*Cyperus strigosus*] and no other serious pest problem The soil was a sandy loam [pH 6.2; org. matter <1.0%; C.E.C. <10 meq/100 gms soil].SEP 100^R was applied at rates of: 0, 50, 75, 100, 125, and 150 lbs a.i./A. A treatment with methyl bromide [300 lbs/A; 2% chloropicrin] was included in the experiment. The material was delivered through 2 drip tapes set 10" apart on the surface of plant beds covered with standard black polyethylene. The beds were 3' wide, 100' long and approx. 6" high. SEP 100 was applied in 3/4" water during a 5 hr period and this was followed 7 days later with an additional 1" of water to move the residual material deeper in the soil profile, and ½" one week later right before planting of 'Mission' cantaloupe on 4 June, 2003. The number of weeds per metre of bed was determined for each treatment 7 July, 2003 and there were 5 harvest dates beginning on 4 August with the final harvest on 18 of the same month. For each treatment and controls there were 8 replications each 17' of bed length.

Brewton Agricultural Research Unit [BARU]. The experiment at BARU was similar to the one at EVSC and was set up in a field severely infested with root-knot nematode [*Meloidogyne incognita*], and severe incidence of soil-borne disease caused by fungi [species of *Fusarium* and *Rhizoctonia*]. The soil was a silt loam of similar characteristics to the one in the EVSC experiment. SEP 100^R was applied at rates of: 0, 50, 75, 100, 125, 150, 175, and 200 lbs.a.i./A in in the manner described for the EVSC experiment and 'Hale's Best' cantaloupe was planted 14 May, 2003. A methyl bromide [2% chloropicrin] treatment [300 lbs/A] was included for comparative purposes. The beds were 100 ft long and of the same width and height as for the EVSC expt. The beds were divided in 17' long plots and there were 6 plots per treatment. Cantaloupes were harvested beginning on 22 July with the final harvest on 1 August. Degree of crop coverage of beds was determined on 30 July using a scale from 1 - 10 where 10 represented no plants and 1 was 100% of the plot surface covered by plants. Soil samples for nematode analyses were taken from every plot on 11 August when the plots were rated for crown rot incidence, and the number of weeds was determined. Soil samples consisted of 1-inch diam. soil cores taken from the root zone of each plant to a depth of approx. 10" have 8-10 cores/plot. The cores were composited and a 100 cm^3 sub-sample was used to extract nematodes with the salad bowl incubation technique [Rodriguez-Kabana & Pope, 1981]. Roots from 2 plants/plot were dug out [8 August] and after washing were rated for root-knot according to a 0-10 scale where 0 represents no galls and 10 maximal galling [Zeck, 1971].

For both experiments fertilization and control of insects and foliar diseases were according to standard recommendations for the area. All data were analysed following standard procedures for analyses of variance. Fisher's least significant differences [FLSD] were calculated when F values were significant. Unless otherwise stated all differences referred to in the text were significant at $p \leq 0.05$.

RESULTS

In the **EVSC Experiment** applications of SEP 100^R at all rates reduced weed populations as illustrated for nutsedge in Figure 1. The relation between numbers of weed and SEP 100^R dosage was best described by a negative exponential model with the greatest reductions in weed population obtained with doses [D] in the range $50<D\leq150$. Marketable and total yields increased in a manner inverse to the pattern observed for weed populations [Fig. 2,3]. Applications rates > 100 lbs a.i./A resulted in yields equivalent to those obtained with methyl bromide.

Results from the **BARU** experiment are presented in Figures 4-6. All application of SEP 100^R resulted in crop cover equal to that obtained with methyl bromide [Fig. 4] and practically eliminated root-knot and juvenile populations of *M. incognita* [Fig. 5]. Total and marketable yield increased significantly in response to rates of 50 and 75 lbs [Fig. 6]; however, there was no additional yield benefit obtained with the use of higher rates. Indeed, applications of NaN_3 at rates $\geq$100 lbs resulted in gradual decline in yields with severe phytotoxicity observed for the two highest rates [175 and 200 lbs].

CONCLUSION

Applications of Na azide using the SEP 100^R formulation resulted in cantaloupe yield response and control of weeds and root-knot nematodes equal that obtained with methyl bromide fumigation. As for tomato and greenpepper sodium azide in the SEP 100^R formulation is a viable, practical, and safe compound for substitution of methyl bromide

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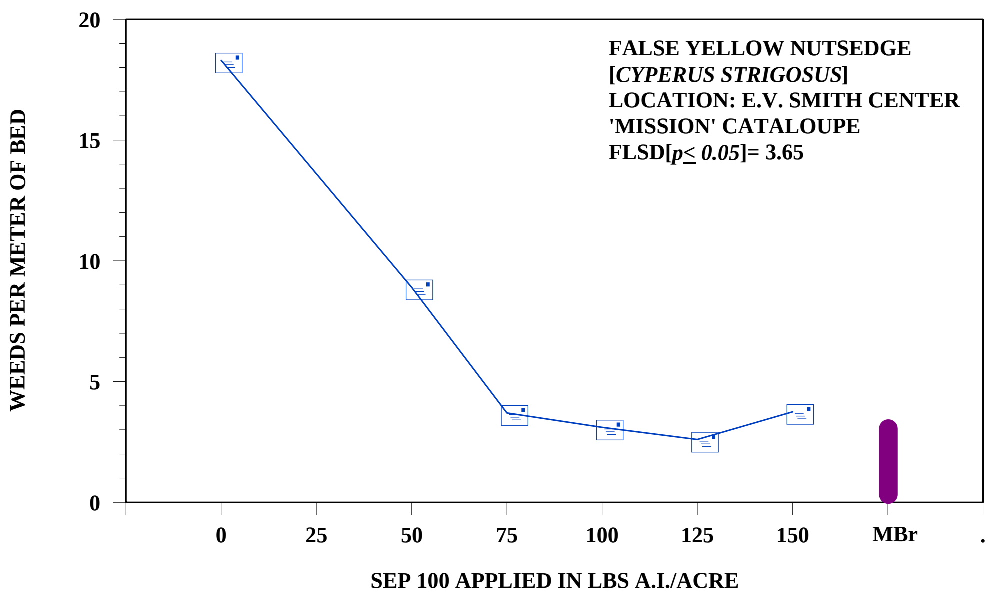

Figure 1. Effect of pre-plant applications of sodium azide [SEP 100] on populations of false yellow nutsedge [*Cyperus strigosus*] in a field experiment at the E. V. Smith Centre, near Auburn, Alabama, in the summer 2003.

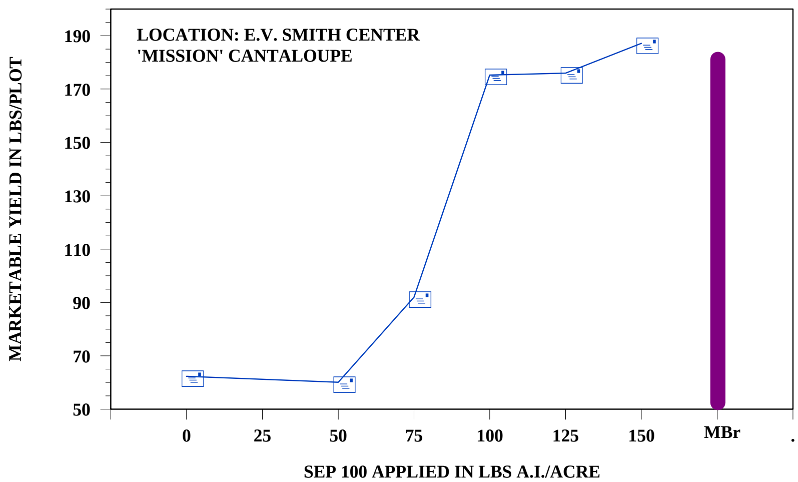

Figure 2. Relation between applications of sodium azide [SEP 100] and marketable yield of 'Mission' cantaloupes in a field experiment at the E. V. Smith Centre, near Auburn, Alabama, in the summer 2003.

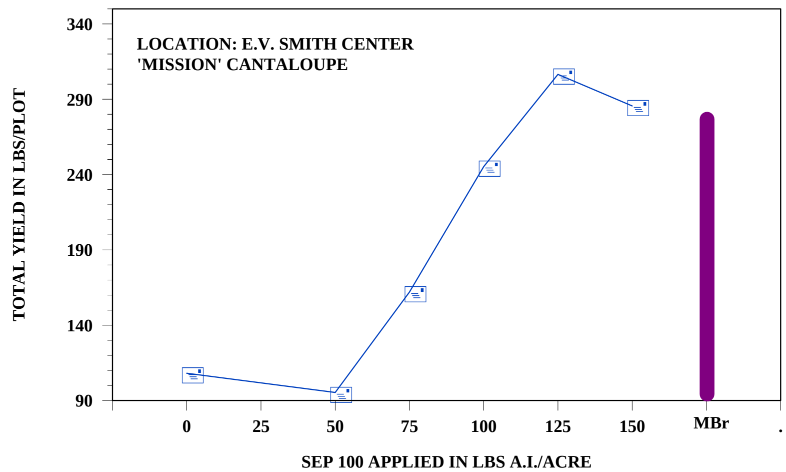

Figure 3. Effect of applications of sodium azide [SEP 100] on total yield of 'Mission' cantaloupes in a field experiment at the E. V. Smith Centre, near Auburn, Alabama, in the summer 2003.

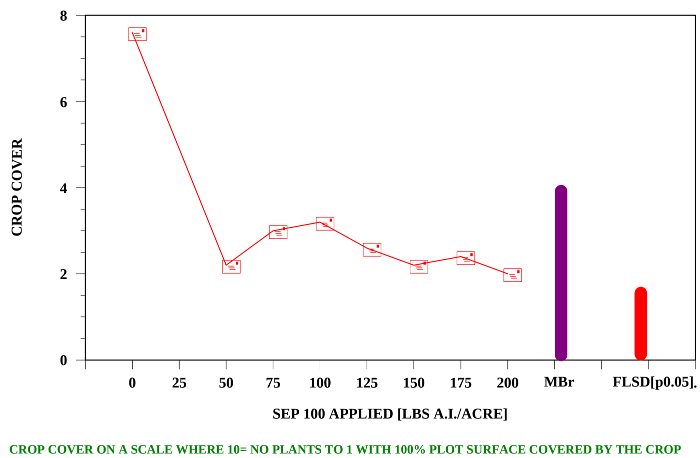

Figure 4. Degree of crop cover of bed surface and applications of sodium azide in a field experiment at the Brewton Agricultural Research Unit, Brewton, Alabama, conducted in the summer 2003.

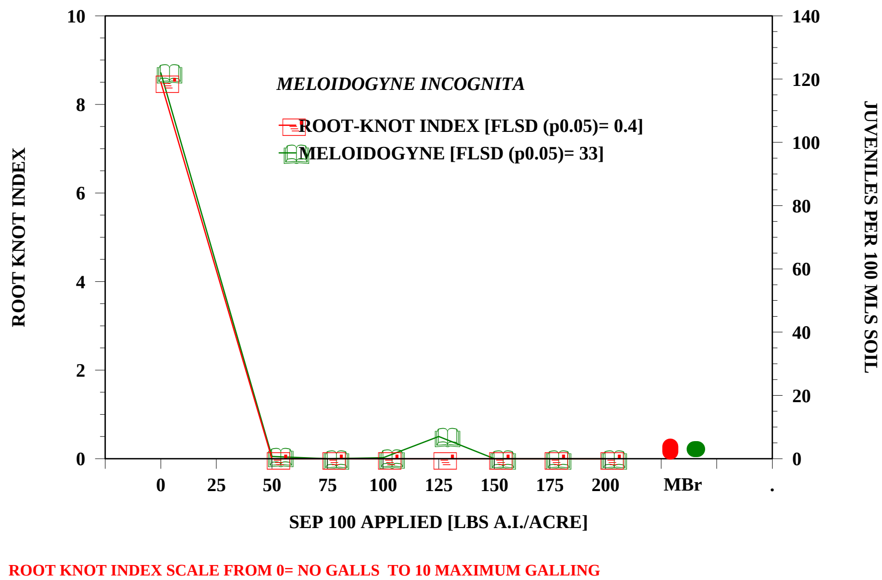

Figure 5. Control of root-knot nematode [*Meloidogyne incognita*] with applications of sodium azide [SEP 100] in a field experiment established in the summer 2003 at the Brewton Agricultural Research Unit, Brewton, Alabama.

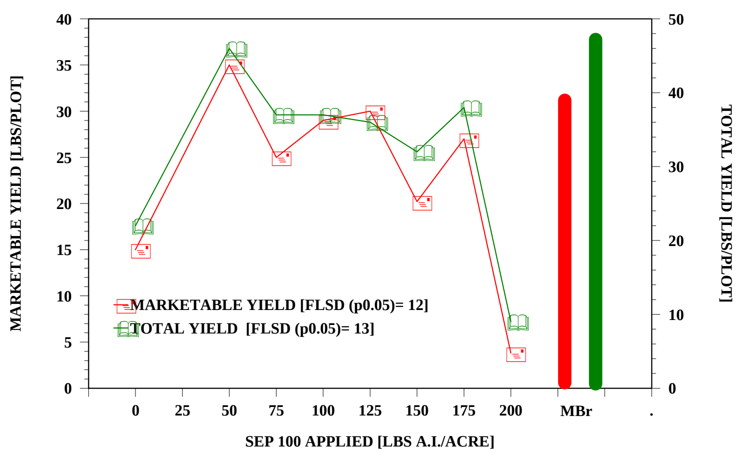

Figure 6. Relation between applications of sodium azide [SEP 100] and yield of 'Hale's Best' cantaloupes in a field experiment at the Brewton Agricultural Research Unit, Brewton, Alabama, in the summer 2003.