

Soil Fumigation after Methyl Bromide: Managing Concentrations of Drip-Applied Metam Potassium for Nutsedge Control¹

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Isothiocyanate-Generator Fumigants

The search for methyl bromide alternatives has been a vast source of research during the last two decades. Hundreds of trials have been conducted nationwide to examine the efficacy of different soil fumigants on soilborne pests in polyethylene-mulched tomato (*Lycopersicon esculentum*), pepper (*Capsicum annuum*), strawberry (*Fragaria x ananassa*), cucurbits, cut flower, and other commodities. Although a great deal of progress has been achieved in this field, currently there is not a single molecule to replace methyl bromide. Instead, ongoing research focuses not only on the efficacy of the combination of certain fumigants and herbicides, but also on application techniques and formulations. Purple (*Cyperus rotundus*) and yellow (*C. esculentus*) nutsedge are the most troublesome weeds to control in polyethylene-mulched vegetable crops and have the ability to emerge through the mulch, causing yield and quality losses (Figure 1). In the past, methyl bromide applications were used to effectively control nutsedge populations below damage thresholds. However, other fumigants do not have consistent efficacy against these weeds.

Isothiocyanate-generator fumigants break down as either allyl or methyl isothiocyanate (ITC), which are potent



Figure 1. Nutsedge sprouting through white polyethylene mulch. Credits: B.M. Santos

biocides. Commercially, they can be found either as synthetic active ingredients, such as dazomet, metam sodium, and metam potassium, or as natural extracts from mustard seed and oil. They are formulated mostly as solid granules, powder, and liquid products. The solid formulations need to be incorporated into the soil to initiate activation. The fumigants metam sodium and metam potassium are

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available in liquid formulations, which provide application flexibility because they can be either directly sprayed on the soil and incorporated or drip injected.

In Florida, the efficacy of these fumigants against soilborne diseases, nematodes, and weeds has been tested with mixed results, especially with regard to nutsedge (*Cyperus* spp.) control in vegetables and strawberry. An extensive revision of that research is available elsewhere and escapes the scope of this publication. However, various reports have suggested that performance of drip-applied metam fumigants against nutsedge can improve by applying concentrations that expose sprouting tubers to lethal rates. These concentrations are the result of combinations of fumigant rates and water volumes. Thus, studies were conducted to determine the influence of metam potassium concentrations on purple nutsedge control.

Metam Potassium Concentration Levels

Studies were conducted in deep, sandy soil at the University of Florida. The soil was low in organic matter ($\approx 1\%$) and had a pH of 7.3. Selected fields were heavily infested with purple nutsedge (≈ 15 plants/ft²). Planting beds were 8 inches high by 28 inches wide and covered with low-density polyethylene mulch (1.25 mil thick). Two drip irrigation lines (0.45 gal/100 ft per min; T-Tape Systems) were buried 1 inch deep in the bed center under the mulch film. Irrigation emitters were 12 inches apart. Besides drip irrigation, continuous subsurface irrigation maintained the water table at 18 inches deep in order to reduce water stress on weed populations. The applied metam potassium concentrations were 2000, 3000, 4000, 5000, and 6000 ppm, and these were obtained by mixing a rate of 120 gal/acre with 3, 2, 1.5, 1.2, and 1 acre-inch/acre of water, respectively. A nonfumigated control was added. Purple nutsedge densities were determined at 4, 6, and 10 weeks after treatment (WAT). A nontreated control was included. Metam potassium was injected with electric water pumps, which were connected to mixing tanks where the solutions were prepared and constantly agitated. Purple nutsedge was counted at 2, 10, and 15 WAT over the entire experimental area.

The results indicated that metam potassium concentrations affected purple nutsedge densities at 4, 6, and 10 WAT. At 4 WAT, purple nutsedge densities decreased as metam potassium concentrations increased, with a maximum weed density of 12 plants/ft² when no fumigant was applied and declining to 3.5 and 1 plants/ft² when metam potassium concentrations reached 3000 and 6000 ppm, respectively

(Figure 2). Two weeks later, a similar relationship between metam potassium concentration and purple nutsedge densities persisted. However, in the nonfumigated control, weed density reached 23 plants/ft² and decreased to 9 and 4 plants/ft² with 3000 and 6000 ppm, respectively (Figure 2). A linear regression model characterized the purple nutsedge density response to applied concentrations of metam potassium at 10 WAT, which translates into approximately 42% and 85% nutsedge control.

Summary

Previous studies on purple nutsedge interference in vegetable crops have shown that a density of 5 plants/ft² causes relatively marginal yield reductions in tomato and bell pepper, whereas a nutsedge density of more than 10 plants/ft² can reduce tomato yield by 51%. In this study, application of metam potassium decreased purple nutsedge populations, resulting in densities below 5 plants/ft² with 6000 ppm for up to 10 WAT. However, this concentration can be achieved with a metam potassium rate of 60 gal/acre, which is the labeled rate, dissolved in 0.5 acre-inch/acre of water. This is within the recommended rates in the label of the commercial formulation of the product. The results indicated that with the appropriate metam potassium concentrations and uniform delivery throughout planting beds, it is likely to cause longer and more effective exposure of purple nutsedge tubers and other underground structures to the fumigant, thus increasing its efficacy.

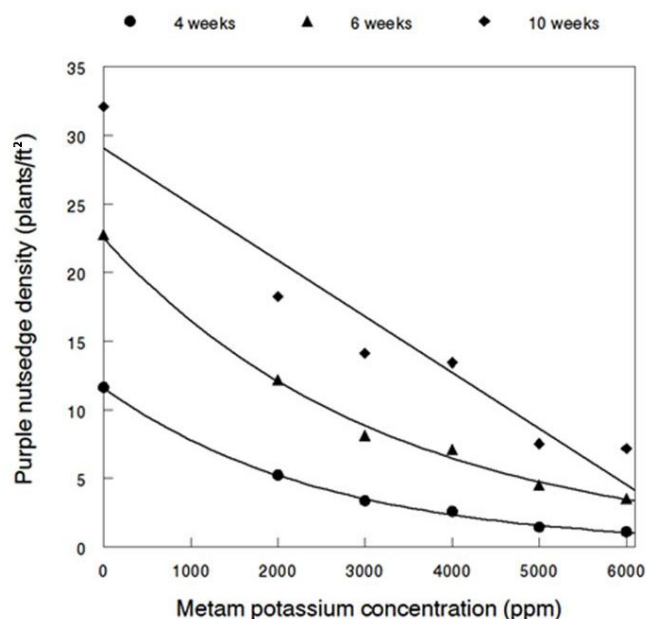


Figure 2. Effects of metam potassium concentrations on purple nutsedge (*Cyperus rotundus*) densities at 4, 6, and 10 weeks after treatment.

Credits: B.M. Santos