

POTATO CONFERENCE: 2001 WEED CONTROL WORKSHOP

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Dr. Scott Nissen, Weed Scientist, Bioagricultural Sciences and Pest Management Department, Colorado State University, presented information on Eptam chemigation. Dr. Pamela J.S. Hutchinson, Weed Scientist, University of Idaho – Aberdeen Research and Extension Center, presented information on weed control and potato crop safety research trials conducted in Idaho in 1999 and 2000.

Potential Losses of Eptam During Sprinkler Application and the Influence of Soil Moisture Levels at Time of Application on Efficacy. Dr. Scott Nissen, Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO. Eptam is effective for the control of annual grasses and several important broadleaf weeds species such as pigweed, black nightshade and hairy nightshade. It can be applied PRE or POST and can be ground applied and mechanically incorporated, ground applied and sprinkler incorporated, or chemigated. Chemigation is an efficient method of application that eliminates the need for mechanical incorporation and provides very uniform herbicide distribution.

Eptam controls weed when absorbed by emerging shoots. Research suggests that this absorption can occur because Eptam is present in the soil as a vapor. Eptam's volatility is important for weed control, but this characteristic also means that the herbicide can be lost to the environment under certain conditions. Producers need to understand the potential for Eptam volatility in order to properly and efficiently use this product.

In addition to herbicide losses due to volatility, Eptam is also susceptible to enhanced degradation by soil microorganisms. Corn growers in the mid-west have known for 15 years that repeated applications of carbmothioate herbicides, such as Eptam, can result in increased rates of herbicide degradation in the soil. Microorganisms that can rapidly degrade Eptam and other related herbicides increase in the soil and begin to metabolism Eptam immediately after application. Residual soil activity is significantly reduced, resulting in poor weed control and yield losses due to weed competition. It is possible that the extensive use of Eptam in the San Luis Valley could already have selected for soil microorganisms that can effectively metabolism Eptam, limiting its usefulness for potato weed control in the SLV.

A field study was conducted in 1995, 1996, and 1997 in a potato production field near Monte Vista, CO., consisting of three PRE Eptam treatments, and a control: 1) chemigation to dry soil, 2) chemigation to wet soil, 3) surface application with immediate sprinkler incorporation and 4) an untreated control. Water samples were collected at the sprinkler head and at ground level. These samples were analyzed for Eptam concentration to determine Eptam losses during chemigation.

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Chemigation treatments were applied by the grower as part of his normal operations. The target application rate was 4 pt/ac applied in 0.5" irrigation via low pressure center pivot irrigation with drop nozzles. The amount of water applied during chemigation varied over the three years between 0.4" and 0.8". Impact sprinklers were used to pre-wet soil with approximately 0.5" of water applied immediately prior to chemigation. Broadcast ground-applications were made with CO₂ backpack sprayer and Eptam was incorporated using impact sprinklers prior to chemigation. Broadcast ground applications and control plots were covered with black plastic prior to chemigation. Immediately after chemigation, the plastic was removed to facilitate collection of soil samples.

In 1995, Eptam losses during chemigation were minimal. Eptam concentrations at the soil surface were 10% less than at the sprinkler head. However, this loss was not statistically significant. Eptam losses during chemigation were 28% in 1996 and 15% in 1997 and statistically significant both years.

Although the losses of Eptam from the soil over time varied between years, results were of interest. In 1995, results demonstrated that chemigating on wet soil resulted in the lowest Eptam levels 1 day after applications compared to chemigating on dry soils, or sprinkler incorporating immediately after a ground application; and that the half-life of Eptam was less than 15 days. The results from 1996 and 1997 also illustrated the potential for significant Eptam losses to occur if the soil is wet before chemigation (Figure 1). There was conflicting evidence about the potential half-life of Eptam based on results from 1996 and 1997: in 1996 the half-life of Eptam was estimated at 10 to 15 days; however, data from the 1997 study suggests that the half life is about 1 day.

Air temperature had a significant impact on Eptam volatility during chemigation trials conducted in 1997 and 1998 using a portable chemigation unit. The portable unit consisted of an Agri-Inject (Yuma, CO) chemigation system attached by garden hose to rectangle of PVC pipe. The PVC frame had 12 nozzles spaced 30" apart. At 25 psi pressure the system would apply 0.5" of water over an area of approximately 10 by 20 ft in seven minutes. Nozzles were held at a height of 6 ft or 3 ft and water samples were collect from the nozzles and ground level at 6:30 am, 10:30 am and 2:30 pm to provide a range of air temperatures. The study was conducted in early September 1997 at the Agriculture Research Development and Education Center (ARDEC) and in mid August 1998 at the San Luis Valley Research Center in Center, CO. Eptam losses during chemigation were compared to Frontier and Dual chemigation with the same portable unit. The range of air temperatures was 55 to 90 F in 1997, and 50 to 80 F in 1998. Water samples were analyzed for Eptam, Frontier, and Dual concentrations to determine differences between initial herbicide amount at the nozzle compared to ground level concentrations.

The portable chemigation unit was an effective tool for evaluating chemigation in general, and effect of temperature on herbicide loss during chemigation. Eptam losses ranged from 15% at 55F to 45% at 90F at ARDEC during 1997 and from 20% at 50F to 45% at 80F at the SLV Research Center in 1998 (Figure 2). Reducing the nozzle height from 6 ft to 3 ft reduced Eptam losses by only 8 to 12%. Temperature accounted for 78%

of the variation in Eptam concentration at ARDEC and 66% of the variation in concentration at the SLV Research Center. Frontier or Dual losses were not significant, and there was no effect of temperature on these two herbicides. The Eptam data regression lines at SLV and ARDEC were significantly different, indicating that the two environments were significantly different. Eptam losses at SLV Research Center were similar to those at ARDEC, even though temperatures were 5 to 10F cooler at SLV. This suggests that barometric pressure may have an impact on Eptam losses in a manner similar to how water boils at a lower temperature at higher altitude.

A laboratory experiment was conducted to determine Eptam movement in a soil profile with different amounts of water used for incorporation. Eptam was applied to field-collected soil profiles of 0 to 6 inches, and 7 to 12 inches, reconstructed in PVC columns. Soil moisture conditions were varied from air dry to field capacity. Eptam was incorporated with 0.25, 0.5, or 1 inch of water. The tops of the soil columns were treated with 1 mL of sodium bromide solution in order to determine the wetting depth of water. The columns were dismantled and soil was analyzed for Eptam.

Even though Br⁻ was detected below the 6 inch depth, indicating that water had moved down that far, very little Eptam movement was detected below 1 in soil depth regardless of amount of water used for incorporation. Optimum amount of water for incorporation appeared to be 0.5 inches (Figure 3).

Since chemigating Eptam may not be the most efficient way to use this product, the alternative ground application/sprinkler incorporation method was evaluated. A field study was established at the SLV Research Center to determine how long growers could wait between Eptam ground applications and sprinkler incorporation. The plot area was planted to barley and Eptam was applied at rate of 3 pt/ac. The herbicide was sprinkler incorporated 0, 12, 24, or 48 hours after application. Herbicide applications were made on July 13, 1998 and plots were evaluated in early August. In addition a rate study was conducted to evaluate barley response to Eptam at 0, 1, 2, 3, and 4 pt/ac. Eptam was broadcast applied on July 15, 1998 and immediately incorporated using a solid set sprinkler system. All sprinkler incorporation timing experiments provided 100% barley control, indicating that adequate amounts of ground-applied Eptam at 3 pt/A remained to be incorporated 48 h after application. Eptam rates as low as 1 pint/A provided 100% control in the rate-response trial.

A greenhouse bioassay study was conducted to determine the relative sensitivity of important weed species - volunteer barley, wild oat, redroot pigweed, and hairy nightshade - to Eptam, and in turn, estimate the potential length of residual Eptam control. Eptam was applied to barley and wild oat at rates equivalent to 0.4 to 4 pints/A, and to redroot pigweed and hairy nightshade at rates equivalent to 0.4 to 5 pints/A. The Eptam rate required to significantly reduce barley and wild oat biomass was 0.4 and 1.0 pt/ac, respectively.

In a separate trial, Eptam degradation under controlled conditions was evaluated because of the inconsistent field trial results. Similar to previously published results, the half-life

of Eptam was initially 7 days under controlled conditions in a SLV soil. Three exposures of SLV soil to Eptam completely changed the rate of Eptam dissipation reducing the half-life from 7 days to less than 3 days.

Conclusions: Eptam remained bonded to dry soil while significant losses occurred from saturated soil during field chemigation trials conducted over three years. Even soil at a moderate moisture level (field capacity) resulted in a 50% loss of Eptam within one hour of application. These results strengthen previous work indicating that when Eptam is applied through chemigation, applications should be applied to dry soil in order to have the highest possible concentration reach ground level for the longest possible residual activity during the growing season. Optimum Eptam sprinkler incorporation water amount is 0.5 inches. Even though the water itself is moving below 6 inches, Eptam does not move below 1 inch soil depth even when incorporated with as much as 1 inch sprinkler irrigation amount.

Increased air temperature alone accounted for 66% to 78% of variation in Eptam losses during chemigation, while there were no significant losses and no temperature effect on chemigated Frontier or Dual. Eptam losses during chemigation were significant even at temperatures below 55 F. Reducing nozzle height by 50% (from 6 to 3 ft) reduced Eptam losses only 8 to 12%. Losses could be influenced by barometric pressure. Growers should not only chemigate Eptam on to dry soils, they should also pay strict attention to environmental conditions while chemigating Eptam in order to optimize Eptam concentrations at ground level.

Based on greenhouse bioassay results and half-life determinations, Eptam could be expected to provide 10 to 15 days of control for volunteer barley and wild oat. Redroot pigweed and hairy nightshade were more tolerant to Eptam than barley or wild oat. Significant reductions in hairy nightshade growth required Eptam rates of 4 to 5 pt/ac. This suggests that since the necessary Eptam amount needed to control these weeds is present in the soil for only a short time after application, volatility losses that can occur during chemigation could be high enough to reduce initial soil residues to levels that would not provide adequate pigweed or nightshade control.

Growers appear to have up to 48 hours to sprinkler incorporate ground applications of Eptam, based on the response of barley to ground applied/sprinkler incorporated Eptam. In addition, the rate response study indicated that barley showed similar sensitivity to Eptam in the greenhouse and field. Eptam rates as low as 1 pt/ac provided 100% control, and significant biomass reduction.

Chemigating Eptam may not be the most efficient way to use this product. When possible, ground applications with sprinkler incorporation may be more desirable and more efficient compared to chemigation.

In addition, three exposures to Eptam completely changed the rate of Eptam dissipation, reducing the half-life from 7 days to less than 3 days. This indicates that soils in the SLV are just as susceptible to enhanced biodegradation as soils in the mid-west. Growing

potatoes in consecutive years and using split-Eptam applications in both growing seasons could create situations where enhanced degradation may occur, and these practices should be avoided if possible.

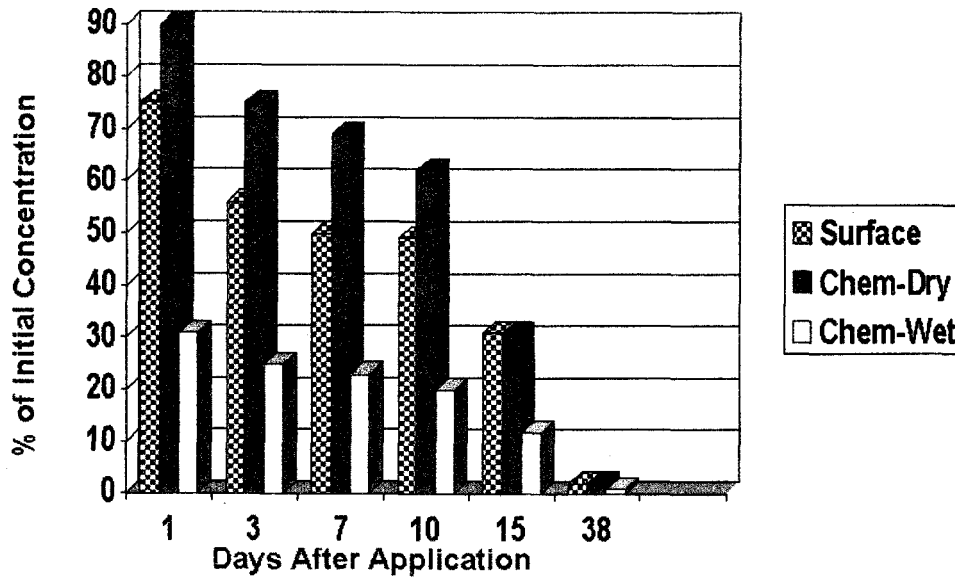


Figure 1. Eptam losses after a surface applied/sprinkler incorporated application, and chemigation to dry or wet soil.

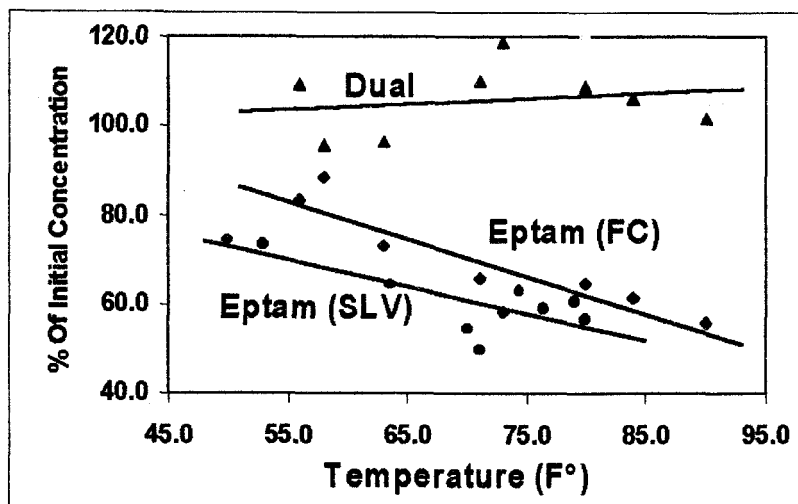


Figure 2. Effect of temperature on volatility of Dual, Frontier, and Eptam. FC location is the Agriculture Research Development and Education Center (ARDEC) near Fort Collins, CO, and SLV location is the Agricultural Experiment Station in Center, CO. (San Luis Valley). The study was conducted in 1997 and 1998.

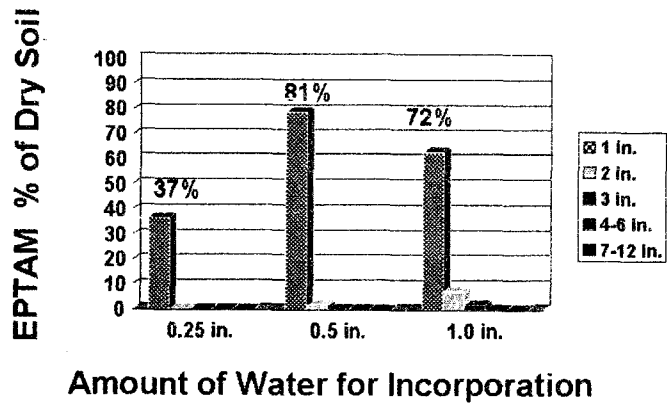


Figure 3. Eptam concentration after incorporation with varying amounts of water.