Eptam for Weed Control in Potatoes

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Eptam, a thiocarbamate herbicide, controls many common grassy weeds and certain broadleaf weeds (table 1). In Idaho, Eptam is particularly useful for controlling wild oat (*Avena fatua*), quackgrass (*Elytrigia repens*), and cutleaf and hairy nightshade (*Solanum triflorum* and *S. sarrachoides*, respectively) in potatoes. Eptam also controls common weeds such as green and yellow foxtail (*Setaria viridis* and *S. lutescens*, respectively), barnyardgrass (*Echinochloa crus-galli*), common lambsquarters (*Chenopodium album*), and redroot pigweed (*Amaranthus retroflexus*). Broadleaf weed control can be improved by tank-mixing Eptam with metribuzin (Lexone or Sencor) when metribuzin-tolerant potato varieties are grown.

This publication provides information on how Eptam controls weeds (its mode of action), on how Eptam's volatility affects its performance, and on Eptam persistence in the soil.

Mode of action

Eptam is effective when applied before weeds emerge because it prevents weed seedling establishment. It does not control emerged weeds nor does it kill ungerminated weed seeds.

Eptam kills susceptible weeds by inhibiting cell elongation and cell division. In grasses, leaves may fail to emerge from the coleoptile. If leaves do emerge, they often do not unroll completely, trapping the tip of the next developing leaf and causing it to form a loop. In broadleaf weeds, leaves are crinkled or cupped, and the hypocotyl is swollen.

Shoot growth is generally more inhibited than root growth, and weeds are generally more susceptible when the herbicide is absorbed by the emerging shoot than when absorbed by the roots. Potatoes are tolerant to Eptam because they rapidly detoxify the herbicide.

Table 1. Eptam effectiveness on weeds in potatoes.

Weed	Eptam effectiveness
Barnyardgrass	G
Black nightshade	F-P
Buckwheat	F
Canada thistle	P
Cocklebur	P
Crabgrass	G
Dodder	P
Field bindweed	P
Foxtail	G
Hairy nightshade	G
Knotweed	G
Kochia	F
Lambsquarters	G
Mallow	P
Mustard	P
Pigweed	G-F
Purslane	G
Quackgrass	G-F
Russian knapweed	P
Russian thistle	P
Sandbur	G
Smartweed	P
Sowthistle	F
Sunflower	P
Sweet clover	P
Volunteer barley	G-F
Volunteer oat	G-F
Volunteer wheat	G-F
Wild oat	G-F
Yellow nutsedge	F

Note: G=good, F=fair, P=poor. Response of weeds to Eptam may be altered by growing conditions, weed populations, type of irrigation, genetic variations, soil type, pH, organic matter, time of application, and application rate. Ratings may vary from season to season and from site to site. Weed control generally decreases as the season progresses.

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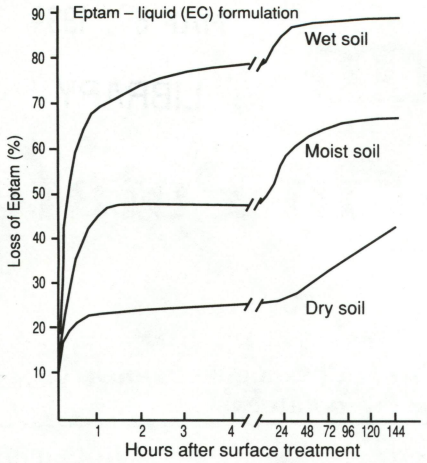

Figure 1. Loss of Eptam from dry, moist, and wet soils after application to the soil surface as a spray at 3 lb per acre. (Adapted from Gray, R. A., and A. J. Weierich. 1965. Factors affecting the vapor loss of EPTC from soils. Weed Science 13:141-147.)

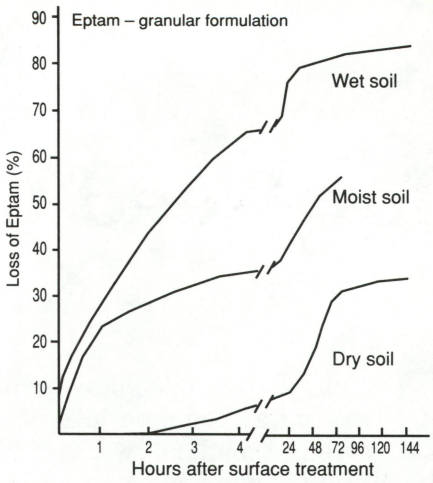

Figure 2. Loss of Eptam from dry, moist, and wet soils after application to the soil surface as a granular formulation at 3 lb per acre. (Adapted from Gray, R. A., and A. J. Weierich. 1965. Factors affecting the vapor loss of EPTC from soils. Weed Science 13:141-147.)

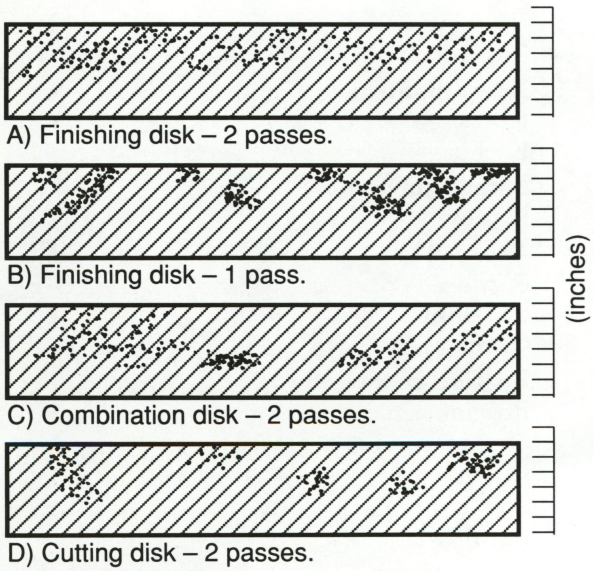

Figure 3. Distribution of surface-applied herbicide following incorporation by various tillage implements. The dark spots indicate where the herbicide is located after tillage. (A) Two perpendicular passes with a finishing disk provide fairly uniform incorporation and leave little herbicide on the soil surface. (B) One pass with a finishing disk leaves streaks where disk blades passed through the soil and leaves herbicide on the soil surface. (C) Two passes with a combination disk leave some "hot spots" (areas of high herbicide concentration) and some areas with little or no herbicide. (D) Two passes with a cutting disk leave hot spots and areas with no herbicides and bury the herbicide too deeply. (Adapted from Thompson, L., Skroch, W. A., and E. O. Beasley. 1981. Pesticide Incorporation: Distribution of Dye by Tillage Implements. North Carolina Agricultural Extension Service.)

Application timing

Because Eptam does not control established weeds, apply it before weeds emerge. Eptam can be applied

1. before planting potatoes (preplant incorporated),
2. after planting but before weeds and potatoes emerge, or
3. after potatoes have emerged as long as emerged weeds have been controlled by cultivation before the Eptam application.

Eptam application timing depends on the weed species to be controlled and other management practices.

Eptam volatility

Eptam is highly volatile and must be used properly to prevent substantial vapor loss. To reduce Eptam vapor loss, which results in poor weed control, mechanically incorporate the herbicide immediately after application or apply it in irrigation water.

Factors that affect the amount of Eptam vapor loss include (1) surface soil moisture, (2) time between application and incorporation, (3) depth and uniformity of incorporation, (4) temperature, and (5) wind.

Vapor loss is much greater when Eptam is applied to a wet or moist soil surface than when it is applied to a dry surface. In one study, when incorporation of the emulsifiable concentrate (EC, liquid) formulation was delayed for 30 minutes, about 22 percent of the applied Eptam was lost from dry soil, 37 percent was lost from

moist soil, and 60 percent was lost from wet soil (fig. 1).

Most of the loss from dry soil occurred during the first 15 minutes after application, while spray droplets were drying. After the spray had dried, Eptam was adsorbed strongly to the dry soil. Adsorbed Eptam does not volatilize as readily as Eptam in the soil solution. Because less Eptam is adsorbed to soil particles in moist or wet soils than in dry soils, Eptam vapor losses increase as soil moisture increases.

In the same study, when Eptam granules were applied to dry, moist, and wet soil surfaces, vapor losses from moist or wet soils also exceeded losses from dry soil surfaces. However, during the first few hours after application, vapor losses were lower than losses from the more commonly used EC formulation (fig. 2). Presumably, vapor loss of Eptam impregnated on fertilizer would be similar to vapor loss from Eptam granules.

For both liquid and granular Eptam formulations, vapor loss from moist or wet soil increases as air temperature and wind speed increase.

Incorporation practices

Mechanical incorporation

Because of its volatility, Eptam must be thoroughly incorporated into the top 2 to 3 inches of soil immediately after application. In Idaho studies, cross disking (two passes, at angles) with a finishing disk[1] set to cut 4 to 6 inches deep and operated at 5 to 7 miles per hour provided fairly uniform herbicide incorporation, leaving little Eptam on the soil surface where it could be lost by volatilization (fig. 3).

One pass with a finishing disk left the herbicide concentrated in streaks, and left too much on the soil surface where it could be lost by volatilization (fig. 3). Combination[2] or cutting[3] disks did not incorporate herbicides as uniformly as finishing disks. A combination disk often produced streaks. A cutting disk usually buried the herbicide too deep and did not adequately mix the herbicide in the soil.

Herbigation

When applying Eptam by sprinkler irrigation (herbigation), meter it into sufficient water so that the water penetrates to a depth of 3 to 4 inches. Because Eptam is volatile, changes in environmental and application factors may affect the amount of herbicide lost during herbigation.

Studies in Washington have shown a 17 percent loss of Eptam during sprinkler application when air temperature was 68°F, water temperature was 70°F, wind speed was 0 miles per hour, water pressure was 45 pounds per square inch, and nozzle diameter was 3/16 inch. This loss is similar to the evaporation loss of water from a center pivot sprinkler under field conditions.

Tips for successful Eptam use

- Apply Eptam before weeds emerge or after a clean cultivation.
- Apply Eptam to a dry soil surface whenever possible.
- Incorporate Eptam thoroughly and uniformly immediately after application.
- When using a disk to mechanically incorporate Eptam, cross disk with a finishing disk to ensure uniform incorporation.
- When applying Eptam via sprinkler irrigation, try to avoid application during hot and/or windy weather to reduce Eptam volatilization losses.
- Whenever possible, avoid repeated Eptam applications within the same cropping season to prevent buildup of microbial populations that rapidly break down Eptam.
- Avoid applications of Eradicane or Sutan for 2 to 3 years before and after applying Eptam.
- When applying Eptam before planting potatoes, minimize the time between application and planting to make the best use of Eptam's relatively short soil persistence.
- When hairy or cutleaf nightshade populations are light to moderate, consider using Eptam after hilling, rather than preplant incorporated, to make best use of Eptam's relatively short soil persistence. If nightshade populations are heavy, and you are growing a metribuzin-tolerant variety, use Eptam preplant incorporated followed by Dual + metribuzin or Prowl + metribuzin applied after hilling but before weeds emerge.
- Always study the label directions before using Eptam or any other herbicide. *The label is the law; follow its directions.*

[1] A *finishing disk* has individual disk blades spaced less than 8 inches apart, blades 20 inches or less in diameter, and spherical rather than conical blades.

[2] A *combination disk* has blade spacings of 8 to 9 inches, blade diameter 20 to 24 inches, and spherical or conical blades.

[3] A *cutting disk* has blade spacings greater than 9 inches and a blade diameter of at least 24 inches.

Table 2. Effect of climatic and operating conditions on Eptam loss during sprinkler irrigation.

Treatment	Temperature		Wind velocity (mph)	Water pressure (psi)	Nozzle size (inches)	Average Eptam loss (%)
	Air (°F)	Water (°F)				
Standard	68	70	0	45	3/16	17
Warm air	90	70	0	45	3/16	22
Warm air + wind	90	70	4 to 6	45	3/16	38
Cold water	68	50	0	45	3/16	10
Warm water	68	86	0	45	3/16	30
Reduced water pressure	68	70	0	30	3/16	14
Reduced nozzle size	68	70	0	45	1/8	19
High Eptam concentration	68	70	0	45	3/16	17

Source: Adapted from Ogg, A.G., Jr. 1987. Factors affecting the loss of EPTC applied through a sprinkler. Weed Technol. 1:162-164.

Also in Washington studies, applying Eptam when air or water temperatures were greater than 70°F or when the wind was blowing increased Eptam losses (table 2). Using cooler irrigation water (50°F) decreased losses to 10 percent. Decreasing the water pressure or nozzle size by 33 percent did not affect Eptam loss.

Additional Eptam may be lost when it is applied to a wet soil surface. The combined losses from sprinkler application and from wet soil could account for the poorer weed control sometimes observed with Eptam applied through sprinklers.

Eptam persistence in soil

Eptam is degraded by soil microorganisms and usually persists 3 to 5 weeks, depending on soil microbial activity. Soil microbial activity is higher under warm than cool temperatures, and Eptam persists longer when soils are cool (41°F) than when soils are warm (59° to 77°F).

Some areas of the United States have had problems with buildup of microbial populations that rapidly break down Eptam. In a Nebraska study, Eptam persisted 3 weeks in a field with no previous Eptam use but only 9 days in a field where Eptam had been used the previous year.

The phenomenon of rapid Eptam breakdown is called "enhanced biodegradation." Rapid Eptam biodegradation may not result in complete weed control failure, but it may result in poor control of weeds with prolonged germination periods, such as hairy nightshade and wild proso millet. Eptam would not persist long enough to control later-germinating weeds.

Although enhanced biodegradation is a common problem in the midwestern United States, only a few cases of enhanced biodegradation have been reported in Idaho. Enhanced biodegradation most commonly occurs when Eptam is used on the same field year after year, but it can occur even when Eptam has been used only in the previous cropping season.

Rotation to Eptam-sensitive crops is common in Idaho, so most acreage does not receive yearly Eptam applications. However, other thiocarbamate herbicides, such as RoNeet, Eradicane (Eptam + safener), and Sutan may be used in rotational crops. While previous use of RoNeet does not enhance biodegradation of Eptam, previous use of Eradicane or Sutan can enhance biodegradation of Eptam. By the same token, Eptam use can enhance Eradicane or Sutan biodegradation, but not RoNeet biodegradation.

Some Idaho potato fields may receive more than one Eptam application per year, which may increase the potential for buildup of Eptam-degrading microbial populations that could reduce performance of later Eptam applications. In North Dakota, microbial populations that rapidly degrade Eptam persisted for 2 to 3 years.

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Pesticide residues — Recommendations for use are based on currently available labels for each pesticide listed. If followed carefully, residues should not exceed the established tolerances. To avoid excessive residues, follow label directions carefully with respect to rate, number of applications, and minimum interval between application and reentry or harvest.

Groundwater — To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.

Trade names—To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

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