

EFFECT OF SOIL TEMPERATURE, PLANTING DEPTH,
AND HERBICIDE RATE ON THE RESPONSE OF RUSSET BURBANK POTATOES
TO PRE-PLANT INCORPORATED TREFLAN

by
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Since its introduction in the 1960's trifluralin, marketed under the Elanco Products Company trade name of Treflan, has become one of the primary herbicides used in potato production throughout the United States. In 1980 approximately 29% of the potato acreage in Washington, Oregon, and Idaho was treated with Treflan. In 1975 the Treflan registration was expanded to include a pre-plant incorporated application to potatoes. During the past few years reports of potatoes injured by pre-plant incorporated Treflan applications have been filed.

Several soil factors are considered capable of influencing the activity of soil applied herbicides and thus altering crop tolerance to the chemical. These factors include:

- Soil Type
- Soil Organic Matter
- Soil pH
- Soil Moisture
- Soil Temperature

The potato producing soils of eastern Washington and Oregon vary from coarse sands to loams. As the clay content of the soil increases, the soils ability to tightly adsorb Treflan increases, making it less available to emerging plants. To compensate for reduced availability increased amounts of Treflan must be applied to soils as clay content increases.

Soil organic matter also tightly adsorbs Treflan and makes it unavailable. However, the potato producing soils of this region are very low in organic matter and it does not significantly contribute to Treflan activity in these soils.

Soil pH has been shown to alter the activity of many herbicides, however, Treflan activity is not altered between soil pH of 4.5 and 7.5. These pH values encompass those of the potato producing soils of eastern Washington and Oregon.

Pre-plant incorporated Treflan treatments delayed stolon initiation with shallow planting or at high rates in 50° soil. No delay occurred in warmer soils. No differences in total stolon number were caused by treatment with Treflan.

Other Treflan injury symptoms included swollen, cracked, and brittle stems. A Witches broom affect, (abnormal branching of the stems) occasionally occurred with high Treflan rates and cold soil temperatures.

At the end of the season there were no significant differences in total yield between treatments within each planting date, except the 2.0 lb/acre treatment which was lower (Figure 7).

This study indicates that if growers are going to apply pre-plant incorporated Treflan early in the season, with soil temperatures of 50° or colder, they can expect some temporary injury to the potatoes. However, no long-term or economic damage resulted in these trials. With cold soil temperatures strict adherence to the labeled rate is essential to prevent injury or to keep it minimal.

Table of Metric Weight and Temperature Conversions

0.38 lbs/acre = 0.44 kg/ha

0.5 lbs/acre = 0.58 kg/ha

0.75 lbs/acre = 0.87 kg/ha

2.00 lbs/acre = 2.31 kg/ha

50°F = 10°C

60°F = 15°C

70°F = 21°C

Treflan caused only a slight emergence delay at soil temperatures of 60° (Figure 3) and 70° (Figure 4). At both temperatures all Treflan treatments, except 2.0 lbs/acre, had attained a plant stand comparable to the untreated checks within a week of initial emergence. Although the 2.0 lbs/acre rate (6 x label rate) greatly delayed emergence, it was not lethal at 70°F. (Figure 4) This extreme overdose was almost 100% lethal at 50°, regardless of planting depth.

The fibrous root system of the potato develops adventitiously from the underground portion of the stem. These roots first grow horizontally for some distance from the young plant before growing downward. As a result most of the roots are located in the upper few inches of soil early in the season. Pre-plant incorporated Treflan resulted in decreased root growth within the layer of treated soil. In 50° and 60° soil total root weight decreased with increasing rates of Treflan. At 70° no overall reduction in weight occurred (Figure 5).

Reduced root weight alone does not adequately depict the severity of root injury caused by Treflan in cold soil or at high rates. At 50° the 0.38 lb/acre treatment severely reduced the growth of fine fibrous roots and root hairs. Although these minute roots do not contribute greatly to total weight they do comprise the majority of the root systems absorption surfaces. Treflan rates of 0.5 and 0.75 lbs/acre at 50° eliminated fine root growth within the treated layer. The larger fibrous roots continued to elongate and once they passed through the layer of treated soil normal growth resumed.

The inhibition of fine roots was not as severe at soil temperatures of 60° and 70°. Root growth was more rapid at the higher temperatures and the roots grew out of the treated layer much more rapidly.

Treflan treated potatoes also exhibited a reduction in early growth with cool soil temperatures. With potatoes planted in 50° soil the 0.38 lb/acre Treflan rate caused only a slight reduction in growth. As Treflan rate increased the reduction in growth became more severe. Potatoes delayed by Treflan eventually outgrew the injury and 72 days after planting no differences in vine growth were present. (Figure 6) As with emergence the deeper planting resulted in less injury.

With soil temperatures of 60° and 70° only the 0.5 and 0.75 lbs/acre treatments reduced early growth. The reduction was slight and the plants rapidly outgrew the injury.

Although Treflan is considered immobile in the soil, small concentrations do move through the liquid phase of the soil. As the soil dries Treflan begins to vaporize and move through the gaseous phase. Although soil moisture greatly affects plant growth and seed germination it does not greatly influence Treflan availability.

Soil temperature influences the accumulation of Treflan in the roots of several crops. As soil temperature decreases Treflan level increases. This increased uptake can also contribute to increased phytotoxicity. Seedlings develop slower under cold soil conditions and slow growth will result in the emerging shoots and developing roots being in contact with the herbicide treated soil for a longer period of time.

Planting depth can also influence the response to Treflan. In some crops planting within the layer of treated soil has resulted in greater injury than planting below the treated soil.

During the 1979 and 1980 growth chamber and field experiments were conducted to determine the influence of soil temperature, planting depth, and herbicide rate on response of potatoes to pre-plant incorporated Treflan. Pre-plant incorporated Treflan was applied at rates of 0.38, 0.5, and 0.75 lbs active ingredient per acre and incorporated to a depth of 3-1/2 inches. The recommended rate for the loam soil used in this study was 0.38 lbs/acre. Russet Burbank potatoes were planted at two depths, 3-1/2 and 7 inches, at each of three soil temperatures, 50, 60, and 70°F.

Since Eptam (EPTC) is often applied in combination with Treflan it was also included, alone and in combination with Treflan. Eptam did not contribute to Treflan phytotoxicity or cause injury by itself in any of the treatments.

Potato emergence was delayed by all Treflan treatments in 50° soil. Only a slight delay occurred with the 0.38 lb/acre treatments while the 0.5 and 0.75 lbs/acre treatments significantly delayed emergence. Treflan caused a greater delay in the 3 inch planting (Figure 1) than in the 7 inch planting (Figure 2). The 3 inch planting also showed a reduced tolerance to over application 0.5 and 0.75 lbs/acre of Treflan. Although emergence was delayed the final potato stand was not reduced, even at the higher rates. Plant counts comparable to the untreated checks were obtained for all treatments 52 days after planting in the 3 inch depth and 38 days for the 7 inch depth.

Figure 1. Influence of pre-plant incorporated Treflan on emergence of Russet Burbank potatoes planted 3 inches deep in 50° soil.

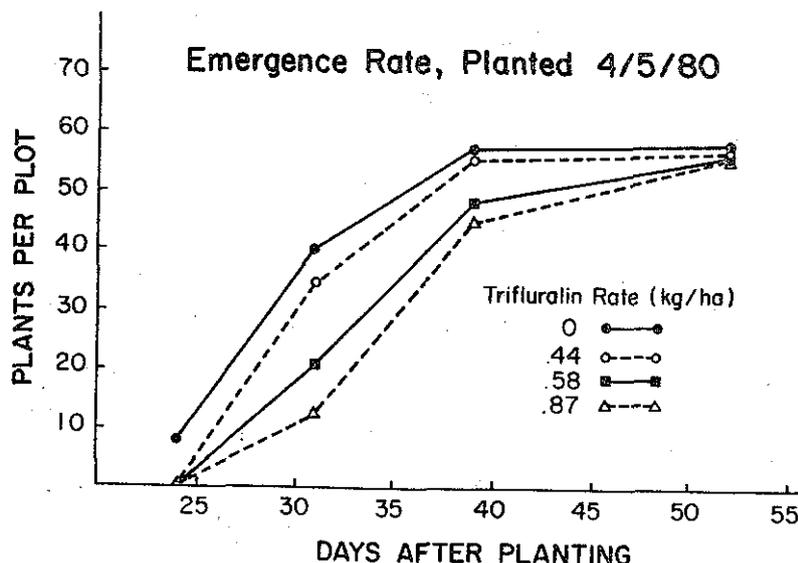


Figure 2. Influence of pre-plant incorporated Treflan on emergence of Russet Burbank potatoes planted 7 inches deep in 50°F soil.

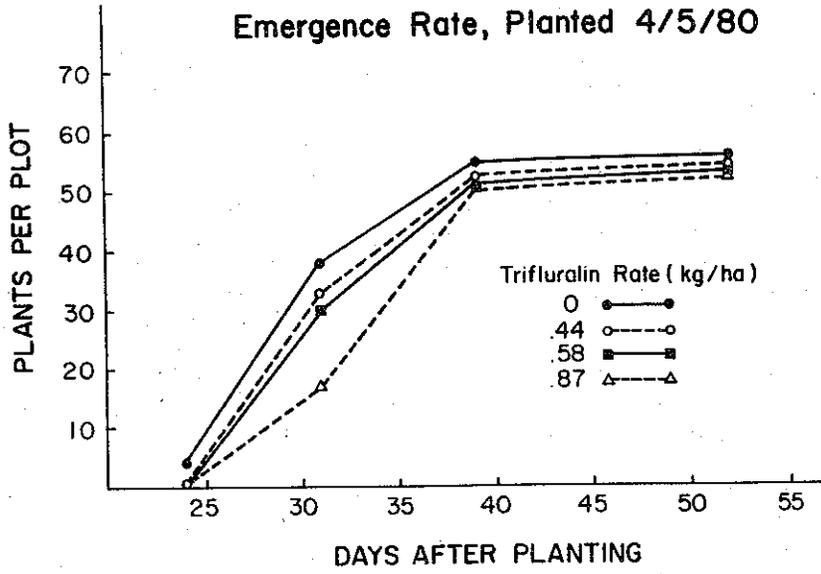


Figure 3. Influence of pre-plant incorporated Treflan on emergence of Russet Burbank potatoes planted 3 inches deep in 60°F soil.

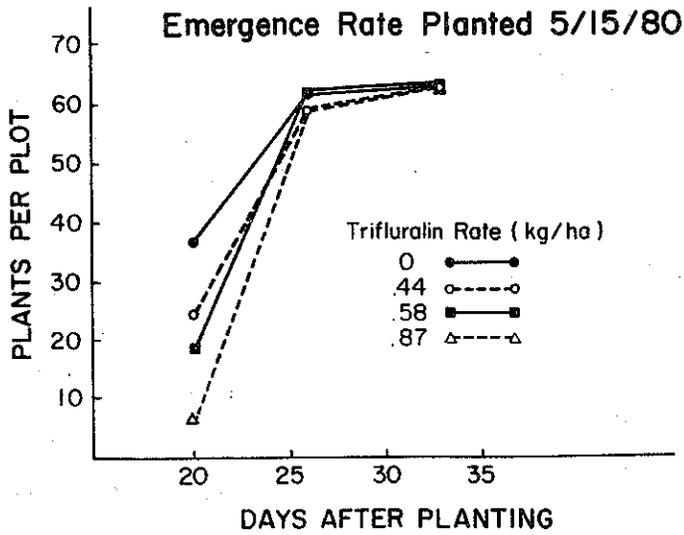


Figure 4. Influence of pre-plant incorporated Treflan on Emergence of Russet Burbank potatoes planted 3 inches deep in 70°F soil.

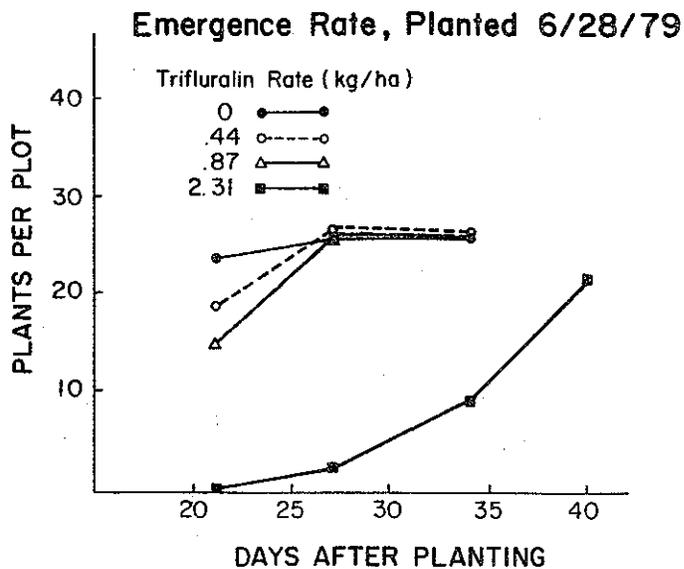


Figure 5. Influence of pre-plant incorporated Treflan and soil temperature on root weight of Russet Burbank potatoes planted 7 inches deep.

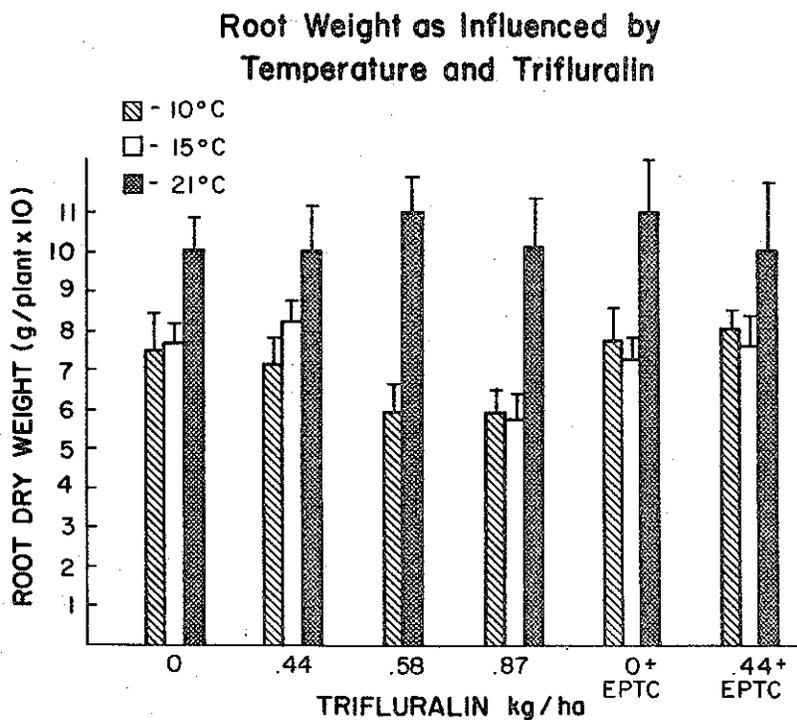


Figure 6. Influence of pre-plant incorporated Treflan on early growth of Russet Burbank potatoes planted 3 inches deep in 50° soil.

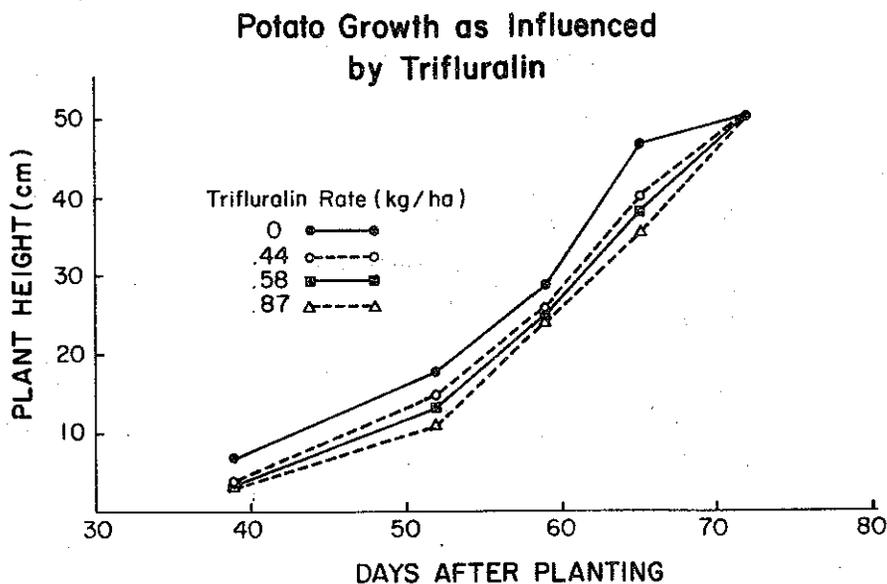


Figure 7. Total yield of Russet Burbank potatoes as influenced by Treflan and soil temperature. Soil temperatures for the field planting dates were, 50°F on 4/5/80, 60°F on 5/18/80, and 70°F on 6/28/79.

