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DRY EDIBLE BEAN HERBICIDE CARRYOVER TO SUGAR BEETS

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INTRODUCTION

Many acres of sugar beets in the North Platte Valley of Wyoming and Nebraska are planted on land that was previously used for dry edible beans. The dinitroaniline herbicides Treflan (trifluralin), Sonalan (ethalfluralin), and Prowl (pendimethalin), alone or in combination with Eptam (EPTC) are the basis of most weed control programs in dry edible beans. These herbicides have the potential to carryover and damage sugar beets the following year. These herbicides are most likely to persist in following years with unusually low precipitation and/or irrigation because microbial activity needed to degrade these herbicides is limited in dry soil. Further, with a preceding crop of dry edible beans there is only minimal amounts of residue present on the soil surface, so many growers choose minimum-tillage for production of sugar beets. Herbicide persistence differs under conventional (plow-based) or minimum-tillage (chisel-based) systems. The objective of this research was to evaluate the effect of several commonly used herbicides in dry edible beans on sugar beets the following season when planted under conventional or minimum-tillage systems.

EXPERIMENTAL PROCEDURE

The research was conducted at the Torrington Research and Extension Center, under sprinkler irrigation in 1991-92 and 1993-94 and under furrow irrigation in 1992-93. Plots were 10 by 70 to 80 feet with three replications arranged in a split block. Dry beans (var. UI-114) were grown with conventional tillage. Herbicide treatments were applied preplant with a knapsack sprayer delivering 20 gallons per acre at 40 pound per square inch and incorporated with a roller harrow. The pinto beans were cultivated as needed and harvested approximately September 1. A timetable of operations is presented in Table 1.

Table 1. Time table for bean and sugar beet operations. Torrington Research and Extension Center, 1991-94.

Operation	1991	1992	1993	1994
Dry bean herbicide applied	5-21	5-27	5-26	
Dry beans seeded	5-21	5-27	5-26	
Dry beans harvested	9-4	8-31	8-31	
Sugar beets planted		4-15	4-23	4-14
Sugar beets replanted		5-15	--	5-9
Postemergence herbicide:				
First application		--	5-18	5-23
Second application		--	5-25	5-31
Third application		--	--	6-7
Layby herbicide application		--	6-23	--
Sugar beets harvested		10-2	10-1	9-30

The entire experimental area was chiseled after bean harvest and one-half of each replication was spring plowed. Secondary tillage was done with a roller harrow. Sugar beets (var. Monohikari) were planted to stand at the rate of 68,000 seeds per acre. Preplant herbicide and insecticide was applied in a 7-inch band and rotary power incorporated during the planting operation. Poor sugar beet stands were obtained due to inadequate water and the sugar beets had to be replanted in 1992 and 1994. Postemergence and layby herbicides were applied and the sugar beets were cultivated as needed. Dates of herbicide application are shown in Table 1 and rates of herbicide and insecticide application are shown in Table 2.

Table 2. Pesticide application and rates applied (oz/A) in sugar beets. Torrington Research and Extension Center, 1992.

Pesticide	1992	1993	1994
Preplant herbicide:			
Nortron	16	21	15
Antor	16	-	-
Insecticide--Temik (oz/1000 ft of row)	8	7	22
Post emergence herbicide:			
First application--Betamix		10	8
Stinger	-	4	-
Poast	-	5	-
Second application--Betamix	-	8	8
Stinger	-	-	3
Third application--Betamix	-	-	8
Poast	-	-	5
Layby herbicide--Treflan	-	8	-
Eptam	-	30	-

RESULTS

Sugar beet response to year produced, tillage, and dry edible bean herbicide carryover is shown in Table 3. A severe *Rhizoctonia solani* infestation in 1992 reduced harvest stand to less than 60 percent of the initial stand and also reduced yields. The rhizoctonia was more severe in reduced tillage compared to conventional tillage plots.

Sugar beet populations and yields were lower with reduced tillage than with conventional tillage. There were no interactions between tillage and herbicide treatment. The seedbed for the reduced tillage sugar beets during all years was loose and fluffy, which probably caused the lower plant populations.

There was a significant difference in initial sugar beet populations due to dry bean herbicide treatment, but these differences did not carry over to sugar beet harvest populations or sugar beet yields. The lowest initial sugar beet populations were in plots that had been treated with high rates of dinitroaniline herbicide, averaging about 80 percent of the initial stands of the Eptam-Dual (standard) treatment. Initial sugar beet stands for plots treated with Eptam plus a half rate of dinitroaniline herbicide averaged approximately 90 percent of the initial population for the check treatment.

This research indicates that sugar beet populations following dry edible beans were better under a plow-based system compared to chisel-based tillage and that dinitro-aniline herbicide carryover from dry edible beans to sugar

Table 3. Sugar beet response to preplant tillage and dry edible bean herbicide carryover. Torrington Research and Extension Center, 1991-1994.

Comparison	Rate (pt/A)	Beets Initial (1000 pl/A)	Beets Harvest (1000 pl/A)	Yield (T/A)	Sucrose (%)
Year:					
1992		35.2	20.0	17.1	13.8
1993		19.6	18.3	23.6	15.2
1994		14.6	13.5	23.6	14.8
LSD (0.05)		2.4	4.1	NS	0.7
Tillage:					
Conventional		28.2	23.2	23.4	15.1
Reduced		18.1	11.4	19.4	14.0
LSD (0.05)		3.2	4.8	3.1	0.5
Dry bean herbicide:					
Treflan	2.0	21.0	16.6	21.6	14.3
Sonalan	4.5	22.3	16.6	20.0	15.1
Prowl	3.7	20.8	15.7	18.4	14.6
Eptam+Treflan	2.3+1.0	23.9	18.2	21.7	14.8
Eptam+Sonalan	2.3+2.2	24.3	18.0	22.3	14.4
Eptam+Prowl	2.3+1.8	23.4	16.7	22.1	14.0
Eptam+Pursuit	2.3+0.2	23.0	16.4	20.8	14.9
Eptam+Dual	2.3+2.0	26.3	20.1	24.5	14.5
LSD (0.05)		2.6	NS	NS	NS
Mean		23.1	17.3	21.4	14.6

beets was influenced by application rate. However, this research further indicated that dinitroaniline herbicide carryover from dry edible beans to sugar beets was possible even at low application rates and under a plow-based tillage system. To minimize sugar beet stand problems following dinitroaniline herbicide application in dry edible beans, it may be desirable to run a soil bioassay.

SOIL BIOASSAY

Dinitroaniline herbicides are mitotic poisons that prevent normal shoot and root development. When present in sufficient amounts, plants will be stunted with twisted, crinkled leaves and some leaves may fail to unroll. Dinitroaniline herbicides also cause swelling of root tissue and prevent branch roots from developing (root pruning). Therefore, growing plants in soil samples may enable detection of potential herbicide carryover problems.

The general procedure for running a bioassay is as follows. Obtain a representative soil sample from the field in question by sampling at numerous places to the depth of the tillage layer. A composite 10 to 20 pound sample should be obtained during the sampling procedure. Also, a sample of soil known to be free of herbicide residues must be obtained to use as the check. The check is necessary so that effects due to herbicide use can be separated from possible non-herbicidal effects associated with conducting the test. The site for obtaining the check soil should be as similar to the treated field as possible. The samples should be dried and the clods broken so that the largest particles are no larger than a wheat kernel. Prepare at least two samples each of the untreated check soil and the test soil. Duplicate samples reduce the risk that one sample will give an erroneous reading due to human error. Containers such as milk cartons, flower pots, or tin cans are suitable, but the same kind of container should be used for all the treatments. Holes should be punched in the bottom of the containers for drainage.

Sugar beets should be used as one bioassay species. Preparing extra pots and testing a more susceptible species such as oats may be helpful in detecting dinitroaniline residues. Plant 20 seeds of both sugar beets and oats in each pot. Water the soil for germination and plant growth as needed, but do not overwater. When the plants are about 2 inches tall, thin to 10 uniform seedlings per container. The containers should be placed in a warm place at about 70 to 75 degrees Farenheit, and in direct sunlight. Observe the plants in the untreated check and test samples for two to three weeks after emergence. Some tangible measurement such as plant height can be taken along with visual observation of abnormalities. The soil should be washed from the roots to observe growth.

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