

## RESIDUAL PROPERTIES OF HERBICIDES AND ALFALFA HAY PRODUCTION

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Selective herbicides are used extensively for the control of unwanted vegetation in the production of alfalfa hay as well as in the production of many other crops grown in rotation with alfalfa. In alfalfa production, some herbicides are applied preplant, others are used postemergence, and still others are used in established alfalfa during the winter months after it has been cut several times during the summer.

The herbicides used in alfalfa hay production and in the production of crops grown in rotation with alfalfa vary greatly in their modes of action, their selectivities, the spectrum of weeds they control, and, most importantly, they vary in their residual properties.

My primary concern at present is to discuss the residual properties of herbicides that may be used in crops planted in the field preceding alfalfa. I also wish to elaborate on the residual properties of herbicides that are used in established alfalfa, especially those that may be used during the last year of the stand, prior to its removal.

### An Ideal Herbicide

It is desirable to have herbicides that provide effective, long-lasting weed control. An ideal herbicide would be a chemical compound, a mechanical device or a biological agent that could be used in a crop at any time during its growth that would control all the unwanted vegetation and would disappear from the field at the time of harvest. In the case of alfalfa, it would disappear when the last cutting is made prior to the removal of the stand. Such an herbicide has not been manufactured as yet, and I doubt that one will be submitted to the EPA or CDFA for registration in the foreseeable future. Therefore, to use those herbicides that are available to us at the present, and to use them safely and effectively, we need to select them carefully, apply them accurately and be familiar with their residual properties.

We have been and are conducting applied research at the University of California West Side Field Station studying the residual properties of herbicides. In these studies we endeavor to learn also what crops can be planted safely in rotation following the use of specific herbicides.

We have learned that very small quantities of certain herbicides may remain in the soil following the harvest of a crop in which it was used and adversely affect the growth of the seedlings of the crops planted sequentially.

### Herbicide Disappearance

A large percentage of the selective herbicide used in crop production are organic compounds. The conditions and processes that influence their disappearance are fairly well known. The most important ones are:

- a. photodecomposition
- b. chemical degradation, including hydrolysis
- c. microbiological degradation
- d. metabolism within plants
- e. volatilization
- f. leaching
- g. removal with plants at harvest.

With the commonly used soil-applied herbicides, we are most concerned with microbiological degradation, chemical degradation and leaching. Therefore, cultural practices that favor these processes will greatly influence the disappearance of these chemicals from the soil.

Rarely do we encounter injury to newly planted alfalfa from herbicides used in crops preceding the establishment of alfalfa. However, it may be useful to cite one or two examples where growers have encountered problems; herpachs being aware of them can prevent or minimize their reoccurrence.

In sugarbeet and tomato production, Treflan® (trifluralin) is used post-thinning or lay-by. Problems from excessive residue was encountered in saline and/or alkaline soils where two rows of beets were planted on 40-inch beds, or tomatoes on 60 to 66-inch beds. Apparently, the soil in the center of the beds was not wetted thoroughly during irrigations.

Following the sugarbeet and tomato harvest, alfalfa was planted in the field. The alfalfa seedlings were retarded in growth. The pattern of retardation reflected the bed spacings and subsequent analyses confirmed that it was caused by Treflan® residue.

A more common occurrence of retarded growth from Treflan® residue is found in fields planted following cotton. The retarded growth is generally observed at the ends of the field extending 60 to 80 feet into the field. Upon investigation, it is generally learned that Treflan® was applied with a spray-truck traveling at 9 to 10 miles per hour. While slowing down to turn at the ends of the fields, the sprayer was not shut off; hence, applying large quantities of herbicides.

In areas where Aatrex® (atrazine) or Princep® (simazine) are used for weed control in corn or grain sorghum, injury to the seedling alfalfa planted in rotation was observed.

A last example of injury, less frequently observed, occurs when a grower decides to plant alfalfa in an area where an orchard or vineyard was pulled and where yearly applications of herbicides were made to control weeds.

### Injury To Crops Following Alfalfa

Herbicides with relatively long residual properties that are registered for use in established alfalfa are: Karmex® (diuron), Princep® (simazine), Sinbar® (terbacil), Sencor® or Lexone® (metribuzine), Treflan® (trifluralin) and Velpar® (hexazinone). Any one of these herbicides used during the last year of the alfalfa stand could, under certain conditions, retard or injure some crops planted following alfalfa.

In the Central San Joaquin Valley, only two of the above listed herbicides, namely Velpar® and Karmex®, are used extensively in established alfalfa hay fields. Therefore I will limit my discussion to the residual properties of these two herbicides.

In addition to the chemical and biological processes affecting the disappearance of herbicides enumerated earlier, the rate of their application is of significant influence. Being cognizant of this fact, alfalfa hay growers can minimize and prevent harmful residue by:

- a. manipulating the amount of herbicide they apply
- b. carefully calibrating the sprayrig
- c. carefully monitoring the application
- d. preventing overlap (doubling the rate) during treatment

Overlapping while "dressing up" the field, especially with air application, is a common occurrence. This is one reason I caution against the application of Karmex® and Velpar® by airplane during the last year of the stand.

### Residual Properties Of Karmex®

Karmex® was first marketed in the early 50's and, since that time, most of us have had a lot of experience with its use, abuse and misuse.

Crops that are sensitive to small quantities of residual Karmex® and exhibited symptoms when seeded following alfalfa are: tomatoes, sugarbeets, melons, peppers, lettuce and cucumbers. Crops that are somewhat more tolerant are: cotton, alfalfa, safflower, corn, sorghum, small grains, cole crops, and trees and vines.

To prevent residue problems, an alfalfa grower has the following options

1. Do not use Karmex® during the last year of the stand.
2. Use Karmex® at reduced rate the last year of the stand.
3. Do not plant crops very sensitive to Karmex® if it was used at 2.5 to 3.0 lbs (commercial formulation) during the last

- year of the stand.
4. Plant crops that are tolerant to small (residual quantities of Karmex® in the soil.

#### Residual Properties of Velpar®

Velpar® (hexaninone) is a triazine compound. Its water solubility is 32,000 parts per million (25°C). It is more readily leached in all types of soils than Karmex®. Microbiological and chemical degradation and leaching are the primary contributory factors that influence its dissipation from the soil.

Alfalfa is not physiologically tolerant to Velpar®. Newly planted alfalfa can be severely injured by it. Selectivity in established alfalfa, six months old or older, is obtained by using low rates and applying it during the winter months when growth is very slow.

Velpar® controls weeds primarily through root uptake; however, it also has foliar activity. Unfortunately, none of the crops that are commonly grown in rotation with alfalfa exhibit significant tolerance to Velpar®. Therefore, a grower can prevent residue problems from Velpar® by:

- a. not applying it during the last year of the stand, or
- b. reducing the rate of application during the last year of the stand.

In numerous applied research trials, we have demonstrated that Velpar® will provide excellent control of common groundsel (Senecio vulgaris), fiddleneck (Amsinckia intermedia) and many other broadleaf weeds at 0.25 pound active ingredient per acre.

In residue trials conducted at the West Side Field Station on Panoche loam and clay loam soils, we learned that twelve months following the application of Velpar® at 0.5 lb ai/A, a number of crops can be planted safely. We also observed that 2.0 lb ai/A applied March, 1980, persisted in the soil beyond fifteen months in sufficient quantities to cause severe injury to several broadleaf crops (dicots) and some injury to crops in the grass family (monocots).

The following two tables summarize the results obtained in one residue trial. It is essential to emphasize that the results shown are very conservative. The crops were planted approximately at four-month intervals, and they were not grown to maturity. Approximately two months after planting, the area was tilled and layed fallow until the next planting. In an alfalfa field under normal cultural practices, the irrigations would be more frequent and one could assume that the degradation of the herbicide would be somewhat more rapid than observed in the residue trials.

TABLE I. The Residual Effect of Velpar On The Vigor of Selected Crops On Panoche Clay Soil

Velpar® applied at 0.5 lb ai/A - April 15, 1980  
Crops planted: 7/11/80, 12/16/80, 4/21/81, 6/17/81

Crops	Crop Vigor Expressed as Percent of Untreated			
	Dates and Interval Following Velpar® Application			
	8/11/80 3 Months	12/16/80 6 Months	6/21/81 12 Months	7/27/81 16 Months
Cantaloupe	0	--*	89	100
Cotton	24	--*	100	100
Tomato	0	--*	94	100
Sugarbeet	0	77	97	100
Safflower	--*	89	--*	--*
Grain Sorghum	51	--*	--*	100
Millet	7	--*	100	100
Barley	--*	85	--*	--*

\*not planted at these intervals.

**TABLE II.** The Residual Effect Of Velpar® On The Vigor Of Selected Crops On Panoche Clay Soil

Velpar® applied at 2.0 lb ai/A - April 15, 1980  
 Crops planted: 7/11/80, 12/16/80, 4/21/81, 6/17/81

Crops	Crop Vigor Expressed as Percent of Untreated			
	Dates and Interval Following Velpar® Application			
	8/11/80 3 Months	12/16/80 6 Months	6/21/81 12 Months	7/27/81 16 Months
Cantaloupe	0	--*	0	27
Cotton	0	---	41	22
Tomato	0	---	15	23
Sugarbeet	0	0	7	22
Safflower	--*	72	--*	--*
Grain Sorghum	0	--*	--*	78
Millet	0	78	--*	78**
Barley	--*	47	--*	--*

\*not planted at these intervals.

\*\* EC formulation, SP formulation 22%.

It is interesting to note that the residual effect of the soluble powder formulation (SP) was somewhat longer lasting than the liquid formulation, as summarized in Table III.

**TABLE III.** Residual Effects of Two Formulations of Velpar®

Velpar® applied at 2.0 lb ai/A - April 15 1980  
 Crops planted: 4/21/81 and 6/17/81

Crops	Crop Vigor Expressed as Percent of Untreated			
	Soluble Powder Formulation*		Liquid Formulation**	
	6/21/81	7/21/81	6/21/81	7/21/81
Cantaloupe	0	27	7	50
Cotton	41	40	62	37
Tomato	15	23	21	58
Sugarbeet	7	22	30	50
Millet	0	27	7	50

\*Soluble powder formulation 90%.

\*\*Liquid formulation 2.0 lb/gal.

In April, 1982, cotton was planted in the field where Velpar® was applied at 2.0 lb ai/A April, 1980. The cotton grew normally and set bolls; however, in late August, the plants developed severe symptoms and died prematurely. In another field where Velpar® was used at 2.0 lb ai/A and tomatoes were planted, the tomatoes grew normally and the fruit set was good. However, three weeks before harvest the plants developed symptoms and collapsed.

In the areas where 0.5 and 1.0 lb ai/A of Velpar® was applied, the cotton and tomatoes developed and fruited without any evidence of phytotoxicity. These observations suggest that when Velpar® is applied at high rates it leaches into a deeper layer of the soil and sensitive crops planted later in the field can be adversely affected.

### In Conclusion

When alfalfa hay growers use herbicides they must familiarize themselves with their residual properties. They must exercise extreme care during the application of herbicides with long residual properties, and take it into consideration in planning their cropping sequence and rotation.

Velpar® is an excellent herbicide for the control of a large spectrum of weeds in established alfalfa. It provided very effective control at rates as low as 0.25 lb ai/A. Its long residual activity in the soil can benefit alfalfa growers. However, they need to be aware that an excessive amount, applied during the last year of the stand, can cause injury to crops planted following alfalfa.

Karmex® at 1.0 to 1.5 lb ai/A in combination with Velpar® at 0.25 to 0.5 lb ai/A applied during the last year of the stand should provide effective broad-spectrum weed control and not cause symptoms or injury to any crop planted sequentially.