

# WEED SHIFTS AS A RESULT OF HERBICIDE USE PATTERNS IN ALFALFA

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## ABSTRACT

Weed control in alfalfa always has been and continues to be a challenge. Proper cultural practices are a critical component of effective weed-management systems. However, good cultural practices alone are rarely sufficient for complete weed control—herbicides are usually needed. Herbicides have evolved and improved over the decades but weeds are resilient. A single herbicide does not control all weeds and this has resulted in weed shifts. Weeds that are not controlled by a specific herbicide proliferate if that herbicide is used continuously. Even herbicide-resistant weeds have been documented in alfalfa recently. To minimize these problems, proper weed species identification and herbicide selection are important as well as tank mixing complimentary herbicides and rotating herbicides.

**Key Words:** Weed control, herbicides, herbicide tolerance and resistance, selection

## INTRODUCTION

Despite the development and registration of highly effective herbicides in alfalfa, weeds remain a significant problem in alfalfa fields today. The fall dormancy of alfalfa varies significantly depending on the production region and this can have a profound effect on weed pressure and weed management. Alfalfa grown in the low deserts is non-dormant, whereas, growers produce dormant varieties in the intermountain areas. Even though the areas differ greatly in their growing season and the number of cuttings per year, winter annual, summer annual and perennial weeds are problems in both production zones.

## WEED SHIFTS

No single herbicide controls all of the potential weed problems in either the low desert or intermountain environment. Highly effective and selective herbicides have been extremely valuable weed management tools for alfalfa growers. However, through the use of these herbicides growers have continually selected for the weeds that escape current control practices. We have not been successful at eliminating all weeds and over time have tended to select those weeds that are most difficult to control.

Table 1 illustrates how weeds have been selected with the use of herbicides from the 1950s to present. This table contains eight common broadleaf weeds and ten common grasses.

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## HISTORICAL DEVELOPMENTS

### 1950-1960

Various chemicals were used to control weeds in the 1950s. These were mostly toxic salts, acids, and oils and were largely nonselective vegetation killers used around crop fields rather than in them. They were occasionally used for spot weed control in fields where particularly undesirable weeds were present. The best weed control in alfalfa has always been a thick healthy crop and cultural practices that favored the alfalfa crop over the weeds. These techniques were heavily relied on to control weeds during this period. A variety of weeds were still prevalent in most fields. Weeds that predominated were those that were most competitive and prolific. These included the mustards, mostly London rocket, wild mustard, shepherd's purse, and tansy mustard (in the intermountain area) and the summer annual grasses such as watergrass (*Echinochloa colonum*) and barnyardgrass (*Echinochloa crusgali*).

### 1960-1970

Selective herbicides were registered during this period and became widely used. The use of these herbicides, especially Eptam (EPTC) and 2,4-DB, caused some major shifts in the weeds present in alfalfa fields. Chemhox (propham), Furox (chlorpropham) and Balan (benfen) were used for preemergence weed control and DNBP or Dinoseb was used as a postemergence contact herbicide for control of broadleaf weeds. The most commonly used products at that time, however, were still Eptam and 2,4-DB. Eptam was the first herbicide registered for water-run applications and it was the most commonly used herbicide in alfalfa for the 20-year span from the mid 1960s to mid 1980s in the low desert. Eptam was inconsistent for grass control because of its volatility, short residual activity and the continuous emergence of summer annual grasses. Many summer grasses could be found in alfalfa fields in the low desert during this period. Eptam did, however, suppress perennial weeds such as nutsedge and bermudagrass, which became more serious problems once Eptam use declined.

2,4-DB was the other herbicide that was widely used in the 1960s. This herbicide was effective on many broadleaf weeds in the low deserts with the exception of malva and sheperdspurse. Sheperdspurse was controlled in the intermountain region at this time with 2, 4DB ester (which could not be used in the low deserts) and the dormant season soil-active herbicides such as diuron, simazine and hexazinone (Velpar). Consequently, many weeds such as London rocket, goosefoot and lambsquarters declined in prevalence during this period while malva and sheperdspurse (in the low deserts) proliferated.

The soil residual herbicide diuron (Direx, Karmex) was also registered during this time period. It could not be used in the low desert because it caused excessive alfalfa injury due to the warm temperatures and nondormant alfalfa varieties. Karmex was an effective broad-spectrum herbicide that was used extensively in some area and is still used today. However, when used alone it caused weed shifts. For example it does not control all weeds and continued use of diuron caused a significant increase in the toxic weed common groundsel. Diuron also does not control other less common weeds such as Persian speedwell. Simazine was also used during this time period in dormant alfalfa production areas but has subsequently been removed from the market.

### 1970-1980

Although new herbicides were registered during this period, the weeds that they controlled were not significantly different from those that were controlled with compounds that were already being used. Treflan EC (trifluralin) and Tolban (profluralin) were available for only a short time period and controlled many of the same weeds as Balan and Eptam. Sencor (metribuzin) and Gramoxone (paraquat), which are still registered today, have had limited acceptance in the low desert because of the lack of crop safety, but they are still important herbicides in areas where the alfalfa goes more dormant over the winter such as the intermountain area. No major weed shifts occurred during the period as a result of herbicide use practices.

### 1980-1990

This period saw the introduction of new grass herbicides that caused significant changes in the type of weeds present in alfalfa fields. Treflan 10G (trifluralin) was registered and quickly accepted by growers for the control of annual grasses and a few broadleaf weeds. Trifluralin products replaced much of the use of Eptam for preemergence weed control. As Eptam drums disappeared from the ditch banks in the low desert, nutsedge and bermudagrass appeared in the fields. Trifluralin 10G is highly effective on most annual grasses, removing them as competitors, while perennial weeds (Bermudagrass and nutsedge), which had been suppressed by Eptam, proliferated. Poast (sethoxydim) was also registered during this period and it had an important impact in changing the relative prevalence of weeds in alfalfa fields. As a highly selective postemergence treatment for grasses, Poast, along with the preemergent trifluralin 10G, greatly reduced the presence of many summer annual grasses like watergrass, barnyardgrass, and yellow and green foxtail (*Setaria lutescens* and *viridis*, respectively). In the low desert, there are some summer annual weeds that survive through the winter and come back from established crowns rather than seed. These weeds, including sprangletop and sandbur are not adequately controlled with Poast or trifluralin products. In addition, Poast does not control annual bluegrass. As a result, sprangletop, sandbur and bluegrass became more prevalent during this period. In colder areas, Poast did not adequately control some winter annual grasses such as hare barley (foxtail) and downy brome (cheatgrass).

In addition to these grass herbicides, the soil residual herbicide Velpar (hexazinone) became available and was widely used during this time period. Like Karmex and simazine, Velpar could not be used in the low desert due to unacceptable alfalfa injury. In areas where it can be used, this herbicide is still one of the most popular herbicides for controlling winter annual weeds in alfalfa. It probably controls a broader spectrum of weeds in alfalfa than any other herbicide registered in the crop and it is generally more effective on emerged weeds than the other soil-active herbicides. One of the biggest advantages of Velpar was that it controlled common groundsel, an important toxic weed found in many areas that was not controlled with Karmex. Like all the other herbicides mentioned, Velpar does not control all weeds. It does not have long enough soil residual to control most summer annual weeds. In addition, it does not completely control malva and many perennial weeds. Therefore, in the intermountain region there has been a gradual shift to some of the difficult to control perennial weeds such as dandelion, quackgrass and buckhorn plantain.

### 1990-2000

The registration of new herbicides slowed during this period even though two new registrations occurred that had significant impacts on the spectrum of weeds commonly found in alfalfa fields. Pursuit was registered by American Cyanamide. It was very effective on most broadleaf weeds

including malva and shepherdspurse. It was weak, however, on lambsquarters and many composites including sowthistle and prickly lettuce. As a result, malva and shepherdspurse became scarcer while sowthistle, prickly lettuce and lambsquarters appeared in fields that did not seem to contain them previously. Select/Prism (clethodim) was also registered during this period. This postemergence grass herbicide was similar to Poast but was more effective on bluegrass and sprangletop, which became slightly less prevalent as a result. Prism is also more effective on winter annual grasses such as downy brome and foxtail.

### 2000 to Present

Two events happened during the 2000-2002 period that have already had significant impacts on the prevalence of weeds in alfalfa. One was the registration of Raptor (imazamox), a new imadazolinone herbicide similar to Pursuit. Unlike Pursuit, however, Raptor is more effective on sowthistle, lambsquarters and grasses. This is expected to reduce the prevalence of these weeds. The other major occurrence was the development of herbicide resistance in littleseed canarygrass to the grass herbicides, Poast and Select/Prism. This resistance was documented in the Imperial Valley, California, where canarygrass has started to again become more widespread.

## **SUMMARY**

Complete weed control in alfalfa will always be a challenge. Fortunately, the herbicide tools available for alfalfa producers have improved considerably over the decades. However, no single herbicide will ever be a panacea simply because there is no herbicide that controls all weeds. Biological systems are dynamic and adaptive. Once an herbicide is used, weeds that are tolerant to that herbicide are favored, and over time there is a shift in the weed species present. There is also the possibility of weeds becoming resistant to specific herbicides. Resistance to some herbicides is more likely than it is with others. Herbicides with a specific site of action (like the ALS inhibitor herbicides such as Pursuit and Raptor) are more likely candidates for weed resistance than are other herbicides.

Currently there is research being done on Roundup Ready alfalfa. This technology shows great promise for being an effective weed management tool for alfalfa. However, even with such an effective broad-spectrum herbicide like Roundup, there will still be weeds in alfalfa fields. For example, Roundup is not effective for controlling malva. The key then for a weed control program in alfalfa—now and for the future—is to use an integrated weed management strategy. Cultural practices that maximize alfalfa vigor (i.e., proper variety selection, seedbed preparation, planting date, fertilization, insect control, etc.) are always important to minimize weed infestations. Proper cultural practices give alfalfa the competitive edge over weeds. However, proper cultural practices alone are rarely enough to achieve adequate weed control. Accurate weed identification is essential to select the proper herbicide. Tank mixing complimentary herbicides and rotating herbicides are important weed management strategies to avoid weed shifts and the possibility of herbicide resistant weeds. Using this integrated approach, growers will be able to manage weeds successfully, but it is likely there will always be challenges because of the adaptability of weeds.

Table 1. Weed Shifts as a result of herbicide use patterns in alfalfa.

**Herbicides**  
Date Introduced

	1950	1960	1970	1980	1990	2000
<b>Weeds</b>	Oils, salts, arsenicals, cultural practices	Eptam, 2, 4-DB, Dinoseb, Chemhoe, Balan, Simazine, Karmex	Treflan EC, Tolban, Gramoxone, Sencor	Kerb, Trifluralin 10G, Poast, Buctril, Velpar	Pursuit, Select/Prism, Zorial	Raptor
<b><u>Broadleaves</u></b>						
*Shepherdspurse						
Malva						
Sowthistle						
Lambsquarters						
London Rocket						
Nutsedge						
Common Groundsel						
Dandelion						
<b><u>Grasses</u></b>						
Bluegrass						
Sprangletop						
Watergrass/ Barnyard grass						
Bermudagrass						
Canarygrass						
Sandbur						
Quackgrass						
Green & yellow foxtail						

**Infestation Key:**

HEAVY	
MODERATE	
LIGHT	

\*Shepherdspurse was controlled in the intermountain regions by 2, 4-DB ester when it was available and 2, 4-DB amine plus adjuvant later. It was also controlled by the dormant season soil active herbicides, all of which could not be used in the low deserts where this weed proliferated until Pursuit was registered in the 1990s