

Alfalfa Weed Control in the Low Desert Past, Present and Future

Barry R. Tickes, University of Arizona Cooperative Extension

Weeds in Alfalfa

The problems caused by weeds in alfalfa is a subject that has long been debated. In few crops are the weeds sold with the crop. Weeds can contribute substantially not only to the weight and dollar value of baled alfalfa, but it can, in some cases, also increase its nutritional value. On the other hand, buyers commonly demand weed free alfalfa and heavy discounts in price are often levied. The costs and benefits of weed control complicated by a host of changing variables such as supply and demand, crop rotation, modified cultural practices required both when weeds are present or herbicides are used, and other factors. Weeds are generally considered to be potentially serious pests in the early stages of the crop during stand establishment and the later stages of the crop when stand loss has reduced the competitive advantage of the alfalfa. Although the weed spectrum may have changed over the years, weeds have always been a problem in alfalfa and considerable effort and expense has been devoted to controlling them.

Because of the mild climatic conditions in the lower Colorado desert, weeds are a problem year round. During the summer the predominant weeds are grasses including watergrass, barnyardgrass, southwestern cupgrass, prairie cupgrass, red and Mexican sprangletop and sandbur. Bermudagrass is a perennial that becomes increasingly predominant with the life of the stand. Some broadleaf weeds are also present at this time of the year including pigweed, purslane, jimsonweed and groundcherry. Dodder and nutsedge are two of the most difficult to control weeds during the summer months. Broadleaf weeds are predominant during the winter months and include London rocket, shepardspurse, malva, needleleaf goosefoot, lambsquarter and sowthistle. But grasses, such as wild oat and canarygrass can also be a problem. Some changes in the predominance of certain weeds have occurred over the past 40 years. These changes reflect, in most cases, changes in control practices. These changes are the subject of this paper.

1900 to 1960

Cultural Practices

Prior to 1960, cultural practices were the dominant means used to give alfalfa a competitive edge over weeds. Integrated Pest Management (IPM) was touted in the 80's and now, as a new technique in pest management. It is, however, one of the oldest principles used in weed control and prior to the availability of herbicides, the only technique used. The cultural practices used in the 20's and 30's are some of the same practices growers use today. Planting between peak periods for summer and winter annual weed germination, using weed free seed, properly leveled fields to avoid ponding of water, timed cuttings and clippings to enhance alfalfa vigor and reduce weed competition, crop rotation, weed free borders and ditch banks, and other

practices, have always been used to keep weeds in check in alfalfa. Summer fallow and smother crops were used to control weeds more frequently in the early 1900's than they were after herbicides were widely available after 1960. Fallowing during the summer months has always been a viable option on fine textured soils where little, if any, damage is done to the alfalfa stand and summer annual weeds or nutsedge have gotten out of control. Cover crops such as oats or sudan grass have been effective in providing competition against weeds although a good stand of alfalfa has always been considered an effective cover crop by itself during the summer months until August. Sheep grazing during the fall and winter months has long been considered a desirable practice by alfalfa growers particularly where winter annual broadleaf and grass weeds are heavy and widespread.

Chemical Weed Control Prior to the Widespread Availability of Selective Herbicides

Various chemicals were used to control weeds prior to 1960. These were mostly toxic salts, acids and oils, and were largely non-selective 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.

Prior to the jump in petroleum prices, oils were fairly commonly used to control weeds on ditchbanks, levees and other non-crop areas. Early on these were mostly diesel and stove top oils although petroleum companies experimented with, and later made available various other grades of oil for weed control. Crop oils continued to be used for non-selective weed control even after the availability of selective herbicides, but have rarely been used since the increase in petroleum prices in the 1970's. Oils were rarely used in alfalfa fields except as a spot treatment for particularly troublesome weeds such as dodder.

Salts have been over the years some of the most harmful of all substances to agricultural production in the lower Colorado deserts. They were also some of the earliest and most used herbicides. Sodium chlorate and various ammonium salts were some of the earliest herbicides available. These were used mainly around and not in cultivated fields due to non selectivity and soil persistence.

The arsenicals including sodium arsenite, arsenic trichloride, and arsenic acid were commonly used herbicides in the early and mid 1900's. Used often as non-selective soil sterilents, these were sometimes applied to established weeds and translocated to the root system.

Boric, sulfuric and carbolic acids were also used occasionally as non selective herbicides. The rates used of these materials varied considerably depending upon the type and size of vegetation to be controlled.

These early herbicides were used prior to the current emphasis upon worker safety. Worker safety can be over emphasized although these early years were dangerous times to be working on a weedy farm. The chlorates were highly flammable. The arsenicals were some of the most deadly toxicants available to man and animal and the acids were very difficult to handle. These were applied with equipment that by today's standards was extremely primitive.

Low volume precision application equipment was not yet developed and most applications were made in extremely high volumes.

1960 to 1970

Selective weed control with the use of selective herbicides was added to the alfalfa growers cultural practices in this period. Although many of the earliest herbicides were in the developmental stages and tested in the field as early as the 1930's, they were not used commercially on a wide scale until after about 1960. The earliest of these herbicides included 2,4-DB, IPC and CIPC, EPTC, DNBP and Diuron. Only two of these, EPTC and 2,4-DB are used in the lower Colorado desert today. Growers continued to rely on non-chemical control methods although these new herbicides offered them, for the first time, the opportunity to economically remove many weeds from alfalfa fields on a large scale. These were the first of many herbicides that have revolutionized alfalfa production practices and greatly increased the quality of alfalfa produced.

EPTC (Eptam)

This was one of the earliest herbicides used in alfalfa and it is still used today. In 1960, Eptam was used commercially in California as a selective preplant soil incorporated herbicide for the control of annual grasses such as wild oat, volunteer barley, watergrass and some annual broadleaf weeds including pigweed, lambsquarter, purslane and nightshade. Its value in suppressing yellow and purple nutsedge and bermudagrass was already recognized in 1960 and is perhaps its major value today. Only a small acreage of alfalfa was treated with Eptam in the early 1960's and it didn't see widespread use until about 1964. Its early use was preplant incorporated by discing soon after application. It wasn't used widely on established alfalfa until water run application was developed in the mid 1960's. This was the first herbicide ever to be applied by metering into the irrigation water. It was most effective when applied to basin irrigated fields where it could be evenly distributed. Eptam is one of the most volatile of all herbicides and this has reduced its effectiveness over the years. Where alfalfa is irrigated frequently in the summer months, as it is in the lower Colorado deserts, this herbicide will be effective for only two weeks or less. With the continual emergence of summer annual grasses and the rapid reproductive capacity of nutsedge, this herbicide has been less than completely effective. However, Eptam applied in the irrigation water was the most widespread weed control practice in the deserts for the 20 year span from the mid 1960's to the mid 1980's.

Complaints of poor control of summer annual grasses became increasingly frequent in the late 70's and early 80's. Failures were commonly the result of short length of activity, even when applied after every cutting during the summer, and difficulty making even and accurate water-run applications. A granular formulation was introduced in the late 80's and early 90's, first only for preplant use then also for established stands. This formulation allowed the more accurate and even applications as well as spot treatments. Water-run applications of Eptam are still common in some areas, making this one of the longest continually used herbicides in alfalfa.

2,4-DB (Butyrac)

2,4-D was the first of the “phenoxy” or hormone weed killers. In the early and mid 1960's these were found to be selective and effective as translocated herbicides for the control of broadleaf weeds. As one of the earliest selective herbicides, 2,4-D provided the impetus for the discovery and development of other herbicides.

By 1960, 2,4-DB was developed and available for use on alfalfa as butoxone and butyrac 118. 2,4-DB has no effect on broadleaf weeds or alfalfa until it is converted by an internal enzyme system to 2,4-D. Alfalfa and certain other small seeded legumes have a different enzyme structure than many of the broadleaf weeds controlled and do not bring about this change to the same extent and, therefore, remain generally unharmed. In 1960, both amine and ester formulations of 2,4-DB were being tested in the lower Colorado desert. The ester formulation was generally more effective in controlling weeds but could never be used in this region due to its volatility and potential injury to other crops. 2,4-DB was one of the earliest herbicides available in alfalfa and has remained as a standard treatment for postemergence control of many winter annual broadleaf weeds including London rocket, prickly lettuce, goosefoot, lambsquarter and sowthistle. Occasional injury to alfalfa in the form of strapped or thin elongated leaves and weakness in controlling some particularly troublesome weeds such as shepardspurse and malva, have limited its use.

Chem Hoe (IPC) and Furloe (CIPC)

Chem Hoe was one of the earliest selective herbicides and the first carbamate herbicide registered in alfalfa. It was discovered in 1945 but was not used in the lower Colorado deserts until the early to mid 1960's. It was used primarily as a preemergence herbicide for the control of winter annual grasses such as wild oat, canarygrass, and volunteer wheat and barley. It was most active during the cool seasons because of rapid breakdown from high soil temperatures and high volatility. As such, it was weak on summer annual grasses and broadleaves, and had a limited spectrum of weeds controlled. Chem Hoe was used most widely in alfalfa prior to the availability of other herbicides that controlled winter annual grasses and other weeds more effectively. By the mid 1980's, Chem Hoe was no longer used or available. CIPC or Furloe was similar to IPC although Furloe was used effectively to control dodder in alfalfa in cooler regions. It was not as effective for dodder control in the desert regions, again because of high volatility, short residual activity and the continual emergence of new seedling weeds.

DNBP or Dinoseb (Dow General, Sinox, or Contact dinitro)

Dinoseb was one of the earliest and most widely used general contact herbicides used in the lower Colorado deserts. The ammonium salt of dinoseb was used effectively for the control of most annual broadleaf weeds in alfalfa. This was a contact herbicide and was applied in large volumes of water of 40 to 80 gallons per acre to achieve adequate coverage. The tops of weeds are destroyed with this herbicide and small ones were killed. The growing point of grasses is protected and this herbicide was ineffective in controlling them. The most common time of application was after the establishment of new stands, before the first harvest, and when the

weeds were small. This family of herbicides, the Dinitrophenoles, were toxic to humans and Dinoseb registrations were canceled by the EPA in 1987 because of suspected long term health effects. Dinoseb was commonly used after about 1962 and was still widely used when registrations were canceled.

Balan (Benefin)

The dinitroaniline herbicides including Balan, Treflan (trifluralin), Prowl (penimethalin) and Endurance (prodiamine) are some of the most widely used in the lower Colorado deserts. Balan was the first dinitroaniline herbicide registered and used in alfalfa in this region and it continues to be used today. Eptam and Balan have always been the two preplant treatments recommended and used in alfalfa in the lower Colorado deserts. Eptam was used shortly after 1960; Balan was first used five or six years later. Balan is used preplant and incorporated by discing. It has effectively controlled annual grasses and some annual broadleaf weeds, but is ineffective on the mustards, sowthistle and malva. Limiting the widespread use of this herbicide has been the potential for injury to the alfalfa whenever it is stressed from moisture deficit, salt or any other reason. In finer textured soils that crack, weeds also will emerge through the cracks.

1970 to 1980

The decade between 1970 and 1980 was an exciting time for the testing and development of new herbicides. Many were tested and some were registered on alfalfa during this period although the non-dormant varieties that were now grown in the lower Colorado deserts limited what could be effectively used without unacceptable crop injury. Many of the new herbicides registered during this period were difficult to use under the conditions present in the desert and while some of them were very effective, none became the persistent standards that Eptam and 2,4-DB had become. The general movement away from a reliance upon cultural practices to control weeds in alfalfa continued during this decade.

Treflan EC (Trifluralin)

The emulsifiable concentrate formulation of Treflan was registered in the region in the late 60's for use on established alfalfa grown for seed only and was used during the 70's under a special local needs registration that permitted water run applications in alfalfa, bermudagrass and citrus. Water run applications were limited to irrigation runs of 660 feet or less because of problems in achieving good distribution with this technique. Treflan does an excellent job of controlling summer annual grasses and some broadleaves such as pigweed, but application difficulties limited its use during this period and the SLN registration was dropped by the end of the decade.

Tolban (Profluralin)

This dinitroaniline herbicide which was similar to Balan, was available and used briefly from about 1975 to 1980 when it was no longer registered. It was used in the same way as Balan

as a preplant incorporated treatment and controlled annual grasses and some broadleaf weeds such as lambsquarter, goosefoot and pigweed. Crop injury sometimes occurred when the alfalfa was stressed.

Sencor (Metribuzin)

This herbicide was first registered on alfalfa in the lower Colorado desert in the late 1970's and growers are continuing to learn how to use it today. It is very effective, both preemergence and postemergence, on many difficult to control broadleaf weeds such as malva and shepardspurse but is difficult to use with good crop safety on non-dormant alfalfa. It is registered for use after sheep grazing when little alfalfa foliage is present and regrowth is less than two inches. Serious crop injury can occur if applied to alfalfa that is less than one year old or if excessive foliage is present. It is also registered for and used on alfalfa planted on beds for weed control in the non-planted furrows. Although the lack of crop safety on non-dormant alfalfa has limited the use of this herbicide, growers have continued to try to use Sencor because of the broad spectrum of weeds that it controls including broadleaves and grasses.

Gramoxone (Paraquat)

Interest in paraquat as a contact desiccant on small winter annual broadleaf weeds began in the mid 1970's and it continues to be an option used by some alfalfa growers today. Paraquat is a non-selective contact herbicide that will kill very small seedling weeds and allow established alfalfa to recover. Once weeds reach the rosette stage, control becomes erratic. This herbicide has no soil residual activity and weeds that continue to germinate over the season, as most do in the desert, will not be effectively controlled. The alfalfa is desiccated along with weeds and seedling alfalfa can be killed especially if warm sunny conditions prevail. This herbicide should not be used on alfalfa that has more than two inches of regrowth and the alfalfa cannot be grazed or cut for six days following application. All of these restrictions have limited the use of paraquat for alfalfa weed control in the lower Colorado River deserts although some growers, who like a quick kill of small weeds with some temporary injury to established alfalfa, like this product.

Kerb (Pronamide)

There was interest in Kerb for winter annual weed control in the late 1970's and early 1980's primarily by lettuce growers who were willing to pay the relatively high price for this herbicide to control certain weeds in their alfalfa with little problem from drift to lettuce and other high value crops. Kerb has been used in the lower Colorado River desert primarily as a preemergence herbicide in lettuce to control winter annual weeds. It is registered in alfalfa only for use on established stands or new stands having one or more trifoliate leaves. Kerb is active through the soil and not the foliage and will kill weeds both preemergence and postemergence. Although lettuce growers have used this herbicide to control a good spectrum of broadleaf weeds in the past, it has been ineffective in controlling most broadleaf weeds in alfalfa in the desert. It has been very effective in controlling winter annual grasses such as canarygrass, wild oat, annual bluegrass, and volunteer wheat and barley. Failure on many broadleaf weeds has commonly been attributed to the leaching of this herbicide below the germinating broadleaf weeds.

1980 to 1990

The 1980's saw the introduction of a few herbicides that were to have a greater impact upon weed control in alfalfa than any product since the introduction of the selective herbicides in the early 60's. The highly selective foliar applied grass herbicides including Poast, Fusilade, Select and Assure were registered for many crops during this decade and have truly revolutionized grass control in broadleaf crops. Only one of these, Poast, was registered on alfalfa in the lower Colorado desert and gave growers their first opportunity to safely and effectively control most grasses after they had emerged. Trifluralin 10% granules were introduced about the same time as Poast and have brought about a quicker and greater change in weed control practices in alfalfa than any previous herbicide. No herbicide has ever been as widely or effectively used to control annual grasses in alfalfa in the desert. This has demonstrated the effect that a new formulation of an old herbicide can have.

Poast (Sethoxydim)

When registered in the mid 1980's, Poast gave growers their first opportunity to effectively control most annual grasses after emergence with excellent safety to even seedling alfalfa. Poast is weak on sprangletop and will not control annual bluegrass, but is very effective on all other annual grasses in the region. Poast has little, if any, soil activity and it requires at least two applications to achieve season long control of summer annuals because of the continuous emergence of new seedlings from late February through October. Perennial grasses, such as bermudagrass and Johnsongrass, can be controlled but require multiple applications of the highest labeled rate. The cost of this herbicide is relatively high and this has limited its use on alfalfa where trifluralin granules are applied in a timely manner and effective season long. Where trifluralin granules are weakened because of poor drainage and other factors, Poast has been heavily used, such as in the Imperial Valley.

Trifluralin 10G

Treflan TR10 was introduced in the mid 1980's by Elanco Chemical Company and was accepted quickly by growers. By 1990, Wilbur Ellis and Gowan Company were also formulating trifluralin ten percent granules. Trifluralin is a dinitroaniline herbicide similar to Balan and Prowl that has been around for a long time and used heavily on several crops grown in the lower Colorado desert. Both the emulsifiable concentrate and a granular formulation of Treflan were used or tested in this region in the 1970's. Neither performed as effectively as the 10G formulation developed in the 1980's. Like all herbicides, there are conditions under which trifluralin granules are less effective. Where irrigation water is poorly drained, trifluralin will break down anaerobically and be ineffective or effective for a short period of time. In well drained soils, this product has been effective for six months or more at the highest labeled rates. Organic matter will tie this herbicide up. Although this is not a normal condition in the desert, it has occasionally been a factor in reducing the efficacy of this product. Wheel traffic and other factors that weaken or kill the stand of alfalfa will reduce the performance of trifluralin granules. On well drained soils, one application of the highest labeled rate has given season long control and is preferable to split applications at lower rates. This product is normally applied by aircraft.

Where aerial application is not possible, or growers prefer to make applications by ground, specialized equipment is required to apply these very small granules. Growers have been successful in modifying existing equipment or have purchased specialized equipment for ground application. There are two different size granules now manufactured; a 30-60 and a 24-48 granule and there can be more than a 30 percent difference in application rate if growers do not calibrate equipment for both.

Buctril (Bromoxynil)

This herbicide was registered in parts of the lower Colorado desert in the mid 1980's and is for use on seedling alfalfa. As a contact herbicide for broadleaf weed control, this treatment will cause severe injury and death to alfalfa when temperatures reach 70° F. or higher at or soon after application. It will kill small weeds and only temporarily burn back larger ones. Because of the lack of crop safety, this herbicide has seen limited use in the desert.

1990 to Present

This period saw the increase in selective broadleaf weed control with the introduction of Pursuit. This herbicide had the same impact on broadleaf weed control that Poast and trifluralin granules had on grasses in the 1980's. Grass control continued to improve with the registration of Select/Prism which controlled some grasses that Poast and trifluralin did not. Zorial, an older herbicide, was expanded to alfalfa but was difficult to use in diverse cropping systems.

Pursuit (Imazethyphyr)

In the 1980's, American Cyanamid Company developed a new class of herbicides known as the imadazolinones which are useful in a variety of crop and non-crop situations. One of these, Pursuit, was registered on alfalfa in the early 1990's. Pursuit was first registered for use in soybeans and peanuts and was used, on a very limited scale, on peanuts in Arizona. Pursuit does an excellent job of controlling a broad spectrum of broadleaf weeds in alfalfa, especially some that have been very difficult to control in the region such as shepardspurse, malva and swinecress. Pursuit will not control the composites including sowthistle and prickly lettuce, and will suppress, but not kill, many grasses such as canarygrass, wildoat and the summer annuals. It will also suppress, but not kill, nutsedge. Temporary stunting, as shortened internodes, will be evident to treated alfalfa for one cutting after application. Pursuit has long soil activity and this is both an advantage and disadvantage in the lower Colorado desert. This is an advantage because of the long preemergent activity in a region where weeds continue to germinate over the entire season. It is a disadvantage because of carryover damage to crops grown in rotation with alfalfa. A single application of Pursuit will cause injury to many crops grown in rotation with treated alfalfa such as vegetables, cotton, sugarbeets, grain and others, as long as two years after application. Two or more applications of Pursuit would make it difficult to rotate to many crops for perhaps three years after application. Because of soil persistence, Pursuit will likely be restricted to use only during stand establishment or the first year of an alfalfa crop.

Select/Prism (Clethodim)

This herbicide was first registered in the early 1990's on cotton and soybeans. The label was expanded in the late 1990's to include alfalfa, tomatoes, dry beans and peanuts. It was registered as a 0.94 EC called Prism in some states, including California. It was also registered as a 2 EC formulation called Select in Arizona. This herbicide has the same mode of action as Poast, Fusilade and other grass specific lipid biosynthesis inhibitors. Clethodim is effective in controlling almost all annual and many perennial grasses including two that are not controlled by Poast; annual bluegrass and sprangletop.

Zorial (Norflurazon)

This is an older herbicide that was first introduced by Sandoz in 1968 primarily for use in tree, nut and vine crops. It was registered on some field crops in the low desert in the mid 1990's, including cotton and alfalfa. Norflurazon has attracted the attention of many growers and pest control advisors primarily because of its activity on nutsedge. This herbicide has always been difficult to use in double cropped areas because of its soil persistence and is probably known more for the distinctive white foliage and crop injury it produces than for weed control. Zorial is registered as a 80% DF although a 20 % granular formulation was registered in the late 1990's and available in small quantities.

Future

The arsenal of herbicides for use on alfalfa in the low desert was fairly complete with products available to control most weeds. The testing and registration of new herbicides was slower but continuing with compounds such as Visor. The search continued for effective and selective nutsedge control herbicides.

Visor (Thiazopyr)

Visor was developed by Monsanto and sold to Rohm and Haas in 1994. The 2E formulation is currently registered in citrus although it has been tested in alfalfa and other crops for the past several years. Registration on alfalfa is expected around 2000. Thiazopyr has a mode of action similar to the dinitroaniline herbicides such as trifluralin (Treflan) and Prowl. It inhibits cell division and is used preemergence to restrict root growth in developing seedlings. It has no activity on emerged weeds. Thiazopyr is in the pyridine chemical family. Visor has excellent activity on annual grasses and has produced preemergence grass control in our tests that is as good, and often better, than other available herbicides. The control of many broadleaf weeds including mustards, sowthistle, goosefoot, pigweed, and purslane is less consistent and ranges from partial suppression to good. Both a sprayable and granular formulation are being tested.