

MODE OF ACTION OF SELECTED ALFALFA HERBICIDES

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Abstract: Herbicides have been helpful tools when used in a alfalfa weed management program. As with any tool, in order to use it correctly, it is well to understand how the tool works and what it does. In alfalfa there are both pre and postemergence herbicides available for use. An understanding of how the herbicides work and what they do to alfalfa and weeds should benefit the applicator so that the correct application methods, timing, and placement of herbicides can occur as well as making sure that previous and subsequent field operations concur with herbicide requirements.

INTRODUCTION

The herbicides we will discuss include the foliar herbicides: 2,4-DB amine, Gramoxone (paraquat), Poast (sethoxydim), and Roundup (glyphosate); and the preemergence, soil applied herbicides: Balan (benefin), EPTC, diuron, Kerb (pronamide), trifluralin, and Velpar (hexazinone).

FOLIAR HERBICIDES

2,4-DB amine is a foliar applied systemic herbicide which is often used in seedling alfalfa to control small broadleaved weeds. 2,4-DB in itself is not toxic to plants but when the "B" is cleaved off of the herbicide molecule it becomes 2,4-D which is quite toxic to broadleaved plants. 2,4-D is a "growth regulator herbicide" which moves readily in plants and tends to accumulate at growing points where it interferes with the synthesis of nucleic acid and protein causing abnormal growth and often interfering with the plant's transport system. After absorption most broadleaved plants convert 2,4-DB to 2,4-D readily, but many plants in the pea family like alfalfa and clovers do so very slowly so that a toxic concentration is not reached within the plant. The soil contains enzymes which are capable of converting 2,4-DB to 2,4-D; for this reason if rainfall or irrigation occur within 7-10 days after application and the 2,4-DB is washed into the soil some conversion to 2,4-D is likely and alfalfa injury can occur. For effective control the broadleaved weeds should be no larger than 2 to 3 inches in height or at the small rosette stage. 2,4-DB ester had been registered in alfalfa until 1990. Since its removal, 2,4-DB amine is now used. Under most circumstances, 2,4-DB amine has much less weed control activity than the ester. This makes timing of postemergence herbicide application very critical. If broadleaved weeds are allowed to gain a size beyond 2 to 3 inches, control will often be erratic or poor.

Gramoxone (paraquat) is a foliar applied contact herbicide which is used mainly for the control of winter annual weeds in semi-dormant and dormant alfalfa. It is effective in the control of seedling broadleaf and grass weeds. Paraquat works within the green leaf and stem tissue of plants where it interferes with photosynthesis. It intercepts the energy of photosynthesis to form free radicals which produce compounds which then destroy plant tissue. Paraquat does not move appreciably within the plant and has earned the reputation of a contact herbicide. Light is necessary for its herbicidal activity. Paraquat is a strong cation (positively charged) and is strongly bound to negative plant and soil particles. If leaf surfaces are dusty a reduction of efficacy may occur due to the herbicide "tying up" on the dusty leaf surface.

Poast (sethoxydim) is a "grass specific," foliar applied, systemic herbicide which is used for the control of seedling grass weeds in seedling and established alfalfa. Once .ul

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absorbed it translocates to the growing points where it interferes with the formation of plant membranes; growth of the grass is stopped and the growing points gradually die. Often several days or weeks are required before complete kill is noted. In order to assure best absorption of sethoxydim a crop oil concentrate is utilized. Rainfall may reduce the effectiveness of sethoxydim if it occurs within 24 hours of application. Because sethoxydim works best on seedling grasses, alfalfa fields should be monitored for the development of serious grass infestations and treatment should be made while grasses are small and vigorously growing.

Roundup (glyphosate) is a foliar applied, non-selective, systemic herbicide which is applied prior to crop (alfalfa) emergence for both annual and perennial weed control; it is also effective for non-crop areas in field head and tail ends. Glyphosate is absorbed into plant foliage where it translocates with plant photosynthate to "sinks" (growing points and storage organs) where it inhibits the formation of certain essential amino acids. Without a supply of these amino acids, protein synthesis is stopped, plant growth stops, and most metabolic processes are affected. Because glyphosate is a "polar," or water soluble compound, it is often difficult to get it into the non-polar plant tissue. An adjuvant is mixed with the formulated product (Roundup) to aid in absorption; if high spray volumes are used (50-200 gallons of spray mix per acre) then additional non-ionic surfactant can improve performance. If weeds are stressed or have dust on their leaves performance will also be reduced.

PREEMERGENCE HERBICIDES

Balan (benefin)/trifluralin are preemergence herbicides which are used as a preplant incorporated treatment and as a preemergence treatment for summer annual grasses and dodder in established alfalfa respectively. Both benefin and trifluralin have only preemergence activity; they will not control weeds after they have emerged. Therefore, one must anticipate weed germination in order to have success with these herbicides. They must be present in the soil prior to germination. Both herbicides are dinitroaniline herbicides. Herbicides in this chemical family are known as mitotic disrupters. They disrupt the sequence of cell division in the growing points of plants. When newly developing roots and shoots encounter these herbicides in the soil, cell division stops and growing tips often become stubbed off. These herbicides do not move readily in plants or soil and usually affect plants at the point of absorption (developing root and shoot tips).

Diuron/Velpar(hexazinone). These are preemergence herbicides usually utilized in dormant established alfalfa for winter and spring weed control. Incorporation into the soil is usually done through winter rainfall. Both herbicides can cause some yellowing of alfalfa foliage if they are used after alfalfa has started to regrow or are used at excessive rates. These herbicides are absorbed by the roots of plants and transported to the leaves where they block the photosynthetic mechanism of the plant. As the process is blocked, the energy of photosynthesis cannot be dissipated and destruction of plant tissue results. The green pigments in the leaves and stems are first to be destroyed (yellowing or chlorosis occurs) followed by death of the tissue (necrosis). These herbicides work best when applied in the winter on dormant and semi-dormant alfalfa just prior to the emergence of winter weeds. If applied too late after weed emergence, control will be reduced.

EPTC is utilized as a preemergence herbicide in seedling and established alfalfa and as a preplant incorporated treatment. Incorporation is done mechanically with the preplant treatment and irrigation is used to incorporate it for the preemergence treatments. EPTC causes a distortion of the first foliar leaves of weeds after emergence and is known to affect developing leaves and shoot growing points. EPTC has a fairly broad spectrum of weed control affecting many broadleaved weeds, grasses and nutsedge. It has a short residual activity in the soil lasting but a few weeks in most cases. This often necessitates retreatment particularly when it is used for summer grass control in established alfalfa.

Kerb (pronamide) is usually utilized in seedling alfalfa for control of winter annual grasses and some broadleaf species. Pronamide is applied to the soil surface and irrigation or rainfall is used to incorporate it into the soil. Pronamide is a mitotic disrupter which blocks cell division. This results in a cessation of growth of roots and shoots of germinating and developing plants. Swollen root tips are often seen as a symptom. When pronamide is used to control grasses which have already germinated, it may take several weeks for control to be noticed. This is because pronamide is blocking the formation of new roots and the plant is able to survive for a while on the older established root system. Although pronamide has a similar mode of action as Balan and trifluralin, it is more mobile in the soil. The following chart summarizes many of the basic conc

herbicides. If you anticipate utilizing any of these herbicides thoroughly review the herbicide label for specific requirements.

ALFALFA HERBICIDE SUMMARY

Herbicide	How Applied	How it Works	Surfactant Needed	Needs Water for Incorporation. If so, how soon and how much?	How Long Should Water be Withheld?
Foliar					
2,4-DB amine	Foliar Systemic	Growth Regulator	No	No	+ days
Gramoxone	Foliar Contact	Photosynthesis Inhibitor	Yes	No	+ hour
Poast	Foliar Systemic	Plant Membrane Inhibitor	Yes	No	2 + hours
Roundup (Spot Treatment)	Foliar Systemic	Inhibits Protein Synthesis	At Higher Spray Volumes	No	+ day
Preemergence					
Balan/trifluralin	Soil Applied	Growth Inhibitor	No	3 days/1/2/inch	-
diuron	Soil Applied	Photosynthesis Inhibitor	No	30 + days/1/2/inch	-
Velpar	Soil Applied	Photosynthesis Inhibitor	No	14 days/1/2/inch	-
EPTC	Soil Applied	Inhibits Shoot Growth	No	Mech. or Irrig.	-
Kerb	Soil Applied	Growth Inhibitor	No	1-3 days/1/2/inch	-

- 2,4-DB amine - Disrupts plant hormonal balance causing irregular growth (plant grows itself to death). Selectivity due to the "B." Weeds convert 2,4-DB to 2,4-D; alfalfa does not.
- Gramoxone - Destruction of the green tissue of the plant. Acts within the photosynthesis process to produce toxic compounds which result in the death of leaf tissue. Light is necessary for this reaction.
- Poast - Prevents formation of plant membranes. First indication is death of growing points of plants.
- Roundup - Inhibits formation of proteins used in plant growth processes resulting in stunting, chlorosis and multiple growing points.
- Balan/trifluralin - Affects growing points of plants, mainly root tips. Prevents cell division resulting in swollen root and shoot tips with little or no branching.
- diuron/Velpar - Absorbed by roots and moves to leaves where it destroys photosynthesis.
- EPTC - Inhibits shoot and leaf development.
- Inhibits cell division at plant growth points, principally root tips and weed seedlings as they emerge. Without cell division, root tips swell and become nonfunctional.