

INFLUENCE OF ENVIRONMENTAL CONDITIONS ON GROUNDSEL AND WINTER WEED CONTROL IN ALFALFA

Mick Canevari, Don Colbert, Randall Whitte and Fred Marmor; Weed Science and Agronomy advisor, Research Associate, University of California Cooperative Extension, Stockton Calif, 95205, and Research and Development, Dupont Corporation, Sacramento Calif.

Abstract:

Common groundsel *Senecio vulgaris* is a weed problem in alfalfa throughout much of California. Groundsel is a major problem in newly planted and established fields because of toxic alkaloids that are poisonous to livestock, especially horses. In recent years, erratic groundsel control has been reported with hexazinone herbicide. Hexazinone is the main herbicide for winter weed control in alfalfa and is one of the few options for controlling common groundsel.

To help understand this erratic groundsel control with hexazinone, a two-year study was conducted under both field and greenhouse conditions. Results from a field study in February 2003 with postemergence and preemergence hexazinone applications indicated possible hexazinone resistant groundsel. Groundsel seeds were collected from the above field and in November 2003 a greenhouse study was initiated at U.C. Davis. Results showed that there was no evidence of herbicide resistance. However, groundsel control from a postemergence hexazinone application varied depending upon plant size.

A second field study was initiated in November of 2003 looking at various treatments and timings of postemergence hexazinone applications. The same treatments were applied in November, December and January, approximately 30 days apart. Results showed 100% control groundsel from the November and January applications but only 30% control when applied in December. The poor results from December suggested possible environmental interactions occurring.

In March 2004 a third field experiment was initiated to evaluate the influence of limited sunlight on groundsel control from cloudy or foggy conditions. The treatments included full, partial and no sunlight. The groundsel plants were covered for six days after a postemergence herbicide application. Treatments included were; three rates of hexazinone, one rate of paraquat and an untreated check.. Groundsel control with hexazinone was affected by the amount of light intensity by as much as 50%. Herbicide rates were also a factor; the higher rates were less impacted by the low light intensity treatments. Light intensity had less impact on groundsel control with paraquat.

Introduction

Weeds are a major pest in alfalfa because they can reduce forage quality by competing for light, water, space and nutrients. Some weeds can contribute toxic alkaloids in feeds. Common groundsel *Senecio vulgaris* is such a weed and is found throughout the alfalfa growing regions in the central valleys of California. Since groundsel germination occurs between October through March, it is a major problem in the winter months in newly seeded and established alfalfa fields. The Northern San Joaquin and Sacramento Valleys of California have reported erratic groundsel control with winter postemergence hexazinone applications. Velpar is one of the major herbicides used in California's alfalfa production system. Therefore, understanding and investigating this groundsel problem would be very important economically

to our growers. Research was initiated in 2003/2004 to study several variables that may have contributed to this erratic groundsel control with hexazinone.

Materials and Methods

Herbicide Timing Field Experiment. A field study was initiated in 2003/04 to evaluate hexazinone rates and tank mix combinations applied postemergence on three timings. The applications were made November 11, 2003, December 12, 2003 and January 16, 2004. Plot size were 10 by 15 feet, four replication and arranged in a randomized complete block design for monthly timings. The three timings trials were stacked adjacently in an area of the field where poor groundsel control had been previously reported. Groundsel population was heavy and evenly distributed throughout the trial area. Treatments were applied with a CO₂ pressurized sprayer, 35 PSI in 40 G/A of water (Table 1). Visual weed control data on groundsel and other weed species were made 30 and 60 DAT.

Solar Radiation/Light Intensity. In the above field, a follow up experiment was conducted in March 2004 to evaluate hexazinone performance given different intensities of sunlight reaching the plants. During the winter months, it's not unusual to have consecutive days of fog or cloudy conditions that can result in the reduction of photosynthesis in plants. A reduction in sunlight intensity may have a negative affect on weed control; particularly with herbicides that are photosynthetic inhibitors.

The following treatments were applied postemergence and were exposed to three light intensities; (1) hexazinone 0.25, 0.50 and 1.0 lb ai/A, (2) paraquat 0.47 lb ai/A and (3) Untreated Check. The treatments were exposed to full sunlight, no sunlight (black plastic) and partial sunlight using a 40% shade cloth that covered the plots. They remained covered for six days after application before removing. See Table 1 for application data. Evaluations were made at 6, 21 & 29 days after treatment. Solar radiation measurements were calculated using a nearby electronic weather station (Page 3).

Greenhouse Experiment. A greenhouse observation study was initiated on the U.C. Davis campus on 11/1/03 by Dr. Tom Lanini to investigate efficacy and possible resistance to hexazinone. Groundsel seeds were collected from the Hasting Island alfalfa field where a previous hexazinone application resulted in poor groundsel control. Seeds were planted into nine flats which were approximately 30 cm x 25cm in size, 8 cm deep and filled with a Yolo fine sandy loam soil. Postemergence applications were made using a greenhouse track-sprayer, 8002 flat fan nozzles in 25 G/A of water. On 11/7/03, three flats were selected based on the uniform growth stage of the groundsel (seedling-cotyledon). One half of each flat was covered with saran wrap to create a untreated check. Hexazinone was applied at 0.75 lb ai/A. Using the above procedure, on 11/14/03 three more flats were treated with 0.75 lb ai/A of hexazinone. Groundsel plants were in the 1-2 true leaf growth stage. A third application was made on 11/30/03 to groundsel in the 508 true leaf stage. Hexazinone rate was increase to 1.0 lb ai/A. Following treatment, the saran wrap was removed and periodic visual evaluations were made on groundsel growth and % control.

Results and Discussion

Herbicide Timing Field Experiment. Thirty days after treatment, November and January applications of hexazinone at 1.0 lb ai/A gave 92 and 100% groundsel control, respectively. The December application resulted in only 46% groundsel control (Table 2). Visual evaluations taken 60 DAT gave similar results; November, January and December applications 98, 100 and 47% groundsel control, respectively (Table 3). On all applications dates, treatments which included either hexazinone or diuron gave excellent control of *stellaria media*, *capsella bursa-pastoris* and *lamium amplexicaule*. Since all treatments were included in the same field, other variables had to be considered which may have contributed to the poor

results from the hexazinone December application. Weather data was obtained from a remote weather station located near the test site which furnished hourly updated information. The weather information listed below is data summarized by month and was accessed from the UC IPM website @ <http://www.ipm.ucdavis.edu/> for the Thornton weather station site.

November Application.

Rainfall= 0.14" 10 DAA
Ave Temperature = High 60°F & Low 44°F
Solar Radiation units= 5012 for 30 DAA

December Application

Rainfall= 0.36" 18 Hrs AA
Ave Temperature= High 55°F & Low 42°F
Solar Radiation units= 3595 for 30DAA

January Application

Rainfall= 0.13" 7 DAA
Ave Temperature – High 51°F & Low 42°F
Solar Radiation Units 5873 for 30 DAA

March Application – Light Intensity Study

Rainfall= 0.40" 23 DAA
Avg Temperature= High 74 F & Low 45 F
Solar Radiation Units 13,990 for 30 DAA

Two factors noticeably different on the December timing was rainfall occurrence within 18 hours following application totaling .58" over a 48 hour period. Generally, 18 hours is usually enough time for herbicides to be absorbed by the plant without affecting efficacy. A surfactant was added to the herbicide treatments, which also enhances penetration and uptake in cool wet conditions. For these reasons rainfall was not considered a primary factor.

The other variable was cloud cover and fog, which was present and often occurs in winter months in the Central valley and Delta region. There are periods in which the sun may not break through for days or weeks at a time seriously impeding the plants ability to photosynthesize. Therefore, solar radiation measurements were calculated for a 30-day period after each application. A Pyranometer instrument was used for measuring total solar radiation units.

The December application 30-day period accumulated approximately 1500 units less of solar energy, which amounted to a 30% reduction compared to November and January dates. This posed a strong possibility that lack of sunlight was a principal contributor to the reduced groundsel control.

Solar Radiation/Light Intensity. Results for the simulated light interaction study are in Table 4. Under the three light intensity scenarios, it was clear that the dark treatment with no sunlight and the partial sunlight treatment reduced hexazinone effectiveness by 50% on groundsel (Table 5). Even after the covers were removed, control did improve over time but the lower rate never equaled the control in the full sunlight treatment. This experiment did show an interaction between herbicide rate and light intensity. The lowest rate of 0.25 lb ai/A never did reach acceptable control levels at any light intensity. A final rating 29DAA showed that eventually, the higher rates of hexazinone under partial sunlight intensity gave results equal to the full sunlight treatments (80-95%).

Greenhouse Experiment. Postemergence applications of hexazinone were very effective in controlling groundsel up the two-leaf stage of growth. When hexazinone was applied to groundsel in the cotyledon growth stage, complete death occurred within 3 DAA. Groundsel treated in the 1-2 leaf stage, complete death occurred by 7 DAA. The 5-8 leaf groundsel plants were injured and most died, but a couple of the larger plants survived, although stunted. Some new groundsel emergence was observed 38 DAT. These plants were obviously suppressed and seeds were not produced before the experiment was terminated. Since daily overhead irrigation was used, the hexazinone may have leached out of the germination zone therefore allowing some groundsel to emerge. It was observed that growth was greatest around the edges of the flats, perhaps indicating preferential water flow and thus leaching.

In conclusion, plant size influenced control but the groundsel did not show resistance to hexazinone.

Summary

Field and laboratory research experiments indicated that postemergence and preemergence activity of hexazinone applied alone at 0.5 lb ai/A can be effective in controlling common groundsel and other weed species in alfalfa providing sunlight conditions exist during and for a several days after application. Low rates applied to groundsel beyond the 4-leaf stage may give unsatisfactory results. When overcast, foggy conditions exist during and following application for several days, weed control was greatly reduced and hexazinone should be tank mixed with paraquat under those conditions. The tank mix combination of hexazinone + paraquat provided the best overall weed control under all weather conditions and weed size.

Table 1. Herbicide timing and light intensity application information.

	November	December	January	March - Light Intensity Trial
Application	11/20/03	12/22/03	1/16/04	3/2/04
Air temp	63°F	53°F	54°F	52 F
RH	70%	97%	74%	72%
Wind	3 mph	4 mph	0	5 mph
Cloud cover	100%	100%	100%	0%
Alfalfa	3"	5"	6"	7-8'
Groundsel	Coty – 4 leaf	3-8 leaf	3-8 leaf	9" flowering
Henbit	Coty-4 leaf	2-8 leaf	3-10 leaf	
Shepherdspurse	2-8 leaf	6-14 leaf	6-18 leaf	
Chickweed	Coty-4 leaf	4-10 leaf	6-12 leaf	
Spray volume	40 GPA	40 GPA	40 GPA	40 GPA

Crop oil concentrate = herbimax @ 1% VV

Non ionic surfactant = Unifilm 707 @ 0.25% VV

Table 2. Response of groundsel (SENVU) 30 DAT to postemergence herbicides applied on three dates of application.

Treatment	Rate	SENVU Control at 30 DAT		
		%		
		Nov	Dec	Jan
Hexazinone + diuron	0.5 + 1.6	100	30	98
Hexazinone + diuron	1.0 + 1.6	100	47	100
Hexazinone + diuron	1.5 + 1.6	98	73	100
Hexazinone + diuron + Paraquat	0.5 + 1.6 + 0.47	100	100	100
Hexazinone + diuron + Paraquat	1.0 + 1.6 + 0.47	100	100	100
Diuron	1.6	10	0	33
Paraquat	0.47	100	93	100
Hexazinone	1.0	92	46	100
Paraquat + Hexazinone	0.47 + 0.5	100	100	100
UTC		0	0	0
LSD		5.31	5.73	3.12

Table 3. Response of groundsel (SENVU) 60 DAT to postemergence herbicides applied on three application dates.

Treatment	Rate	SENVU Control at 60 DAT		
		%		
		Nov	Dec	Jan
Hexazinone + diuron	0.5 + 1.6	98	27	100
Hexazinone + diuron	1.0 + 1.6	100	48	100
Hexazinone + diuron	1.5 + 1.6	100	73	100
Hexazinone + diuron + Paraquat	0.5 + 1.6 + 0.47	100	100	100
Hexazinone + diuron + Paraquat	1.0 + 1.6 + 0.47	100	100	100
Diuron	1.6	0	0	30
Paraquat	0.47	92	93	100
Hexazinone	1.0	98	47	100
Paraquat + Hexazinone	0.47 + 0.5	100	100	99
UTC		0	0	0
LSD		2.20	7.37	9.06

Table 5. Groundsel (SENVU) response to postemergence hexazinone and paraquat applications under three light intensity scenarios.

Treatment		Rate Lb/A	SENVU Control		
			%		
			6 DAT	21 DAT	29 DAT
Hexazinone	No light	0.25	0	25	40
Hexazinone	Full light	0.25	0	60	65
Hexazinone	Partial light	0.25	0	30	30
Hexazinone	No light	0.50	0	40	45
Hexazinone	Full light	0.50	0	65	85
Hexazinone	Partial light	0.50	0	40	80
Hexazinone	No light	1.0	0	45	45
Hexazinone	Full light	1.0	0	98	95
Hexazinone	Partial light	1.0	0	70	95
Paraquat	No light	0.47	75	100	100
Paraquat	Full light	0.47	98	100	100
Paraquat	Partial light	0.47	85	100	100
Check	No light	--	0	0	0
Check	Full light	--	0	0	0
Check	Partial light	--	0	0	0