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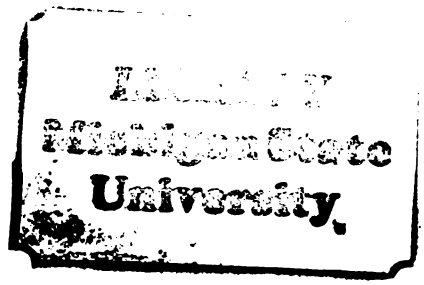

This is to certify that the

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Effects of Weed Control Measures in Established Alfalfa on Yield and and Forage Quality

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Dennis Robert Cosgrove

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EFFECTS OF WEED CONTROL MEASURES IN ESTABLISHED ALFALFA ON YIELD AND FORAGE QUALITY

By

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INTRODUCTION

Hay was Michigans second leading field crop in value of production for the 1981 growing season. Total hay production was 3,894,000 tons of which 3,300,000 tons was alfalfa or alfalfa/grass mixtures. Hay production involved 1,270,000 acres of Michigan farm land in 1981. This hay was either utilized on the farm by livestock producers or sold as a cash crop.

Weeds can reduce the value of alfalfa hay in several ways. Weeds can compete with alfalfa plants for moisture and nutrients, they can slow hay drying in the field and they can reduce hay quality (11). Competition from weeds in established stands of alfalfa can limit alfalfa growth but since the weeds are harvested along with the forage the total forage production may not be effected by the presence of weeds. Weeds, however, are generally of lower quality as an animal feed than alfalfa and, therefore, weeds in established alfalfa have the potential to lower the quality of the forage. In addition, competition from weeds reduces the density and vigor of the alfalfa stand which in turn reduces the alfalfa stand life. This results in the premature need to plow down the stand and rotate to another crop or to re-establish the stand which is an expensive procedure. Controlling weeds can extend the life of the alfalfa stand. This enables the grower to spread the cost of establishing the alfalfa over a greater number of years.

Most weed control measures in alfalfa are concerned with stand establishment and much research was done in this area (21, 23, 26, 30). The benefits of weed control programs in established alfalfa are less clear. Some investigators found weed control measures increased either protein content or digestibility of forage (7, 11, 12). These increases, in at least one case, resulted in a higher animal intake of forage and higher milk production. In addition, feeding a forage with a high protein content could reduce the need to purchase expensive protein supplements. In other cases, however, weed control measures have failed to significantly increase protein content or forage digestibility (31). Before weed control programs in established alfalfa become widely accepted more concrete benefits from their use must be demonstrated. The objectives of this study were: (1) to evaluate metribuzin [4-amino-6-tert-butyl-3-(methylthio)-as-triazine-5(4)+)one], pronamide [3,5-dichloro-N-Cl,1-dimethyl-2-propynyl)benzamide], simazine [2-chloro-4,6-bis(ethylamino)-s-triazine, and terbacil [3-tert-butyl-5-chloro-6-methluracil] for their efficacy as weed control agents in established alfalfa. (2) To determine the effect of stand density and weed pressure on the performance of these herbicides. (3) To determine the effects of these herbicde treatments on forage yield, and (4) To determine the effects of these weed control measures on forage quality.

LITERATURE REVIEW

The effectivenss of chemical weed control in established stands of alfalfa is influenced by several factors. Timing of application effects the spectrum of weeds controlled and also the extent of control. Ilnicki and Hist (18) found no response from curlydock [Rumex crispus (L.)], daisy fleabane (Erigeron strigosus Muhl.) or white cockle (Lychnis alba Mill.) to fall applications of terbacil, simazine or several other herbicides. Yellow rocket (Barbarea vulgaris R. Br.) and chickweed [Stellaria media (L.)] were both controlled with fall or spring applications of the same herbicides. Sheaffer and Wyse (31) found no differences in dandelion (Taraxacum officinale Weber.) control in the first cutting with spring herbicide treatments compared to fall treatments at two of three sites tested. At the remaining site, spring applied metribuzin at 0.80 kg/ha and 1.1 kg/ha significantly reduced common dandelion populations compared to the same treatments fall applied. Arnold and Oneal (3) reported less downy brome [Bromus tectorum (L.)] control from fall applications of metribuzin and terbacil than spring applications of the same materials. Viste and Sanborn (45) found October applications of pronamide to be optimal for quackgrass [Agropyron repens (L.)] control.

Stand density and the size of the weed population are also important factors which affect weed control in established alfalfa. Davis et al.(6) found quackgrass suppression with pronamide increased as alfalfa stand density increased. Pagano et. al. (24) found total forage yields decreased

following a metribuzin application in areas with severe weed infestations. In areas with high alfalfa populations, total forage yields were increased. Fortino (14) observed similar results using metribuzin and determined that benefits were maximized by alfalfa stands containing 4 or more alfalfa plants/ft^2. Triplet et. al. (35) found alfalfa populations as low as 10 to 20 plants/m^2 were able to utilize resources made available as a result of a pronamide treatments.

Longevity of weed control is another factor which must be taken into consideration when discussing weed control programs in established alfalfa. Sheaffer and Wyse (31) observed that, of the treatments applied, only buthidazole (3[5-Cl,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-4-hydroxy-1-methyl-2-imidazoli-dinone) reduced common dandelion populations the year following treatment. Robison et. al. (29) compared several herbicides and observed little residual weed control the year following treatment, although, in some cases there appeared to be enough herbicide residue to cause alfalfa injury if the treatment was reapplied at the original rate. Robison does not specify which treatments caused alfalfa injury. Fawcett et. al. (12) found annual applications of pronamide were necessary for quackgrass control in stands of alfalfa with 10 to 20 crowns/m^2 but that control persisted into the second year in stands with 40 to 50 crowns/m^2. Swan (33) observed that downy brome control from atrazine, (2-chloro-4-ethylamine-6-isopropylamina-5-triazine) simazine, and terbacil decreased to less than half and broadleaf weed control ceased 18 months after applications. Duke (7) reported quackgrass reinfestation of pronamide treated plots occurred in July of the first cropping year following treatment and no difference in quackgrass populations among treatments the second cropping year following treatment.

A fourth factor influencing weed control in established alfalfa is the weed species present. Annual broadleaf weeds such as shepherd's purse [Capsella bursa-pastoris (L.) medic.] and chickweed are generally easily controlled. Kapusta (19) reported excellent common chickweed control with cyanazine (4.5 kg/ha), simazine (1.7 kg/ha) and terbacil (1.1 kg/ha). Pruss (28) found December applications of simazine at 1.12 kg/ha controlled shepherd's purse. Pagano et. al. (24) found shepherd's purse to be controlled by application of metribuzin at 0.56 kg/ha to dormant alfalfa. Peters and O'Leary (27) obtained shepherd's purse control with spring applications of terbacil at 0.56 and 1.12 kg/ha, as well as spring applied simazine at 1.12 and 2.24 kg/ha.

Control of perennial broadleaf weeds such as white cockle and dandelions in established stands of alfalfa has proven somewhat difficult. Pearson and Meggitt (25) observed that simazine at 1.12 and 2.24 kg/ha and terbacil at 1.12 kg/ha applied in early spring gave excellent control of white cockle. Pagano et. al. (24) found 0.84 kg/ha of metribuzin to be necessary for control of white cockle whereas Fortino (14) reported difficulty in white cockle control with metribuzin rates of 1.12 kg/ha. Peters and O'Leary (27) reported severe chlorosis, but not death, with spring treatments of simazine (2.24 kg/ha), terbacil (0.56 kg/ha) and bromacil (5-bromo-3sec-butyl-6-methyluracil) (0.56 and 1.12 kg/ha). Applications of 2,4-DB [4-(2,4-dichlorophenoxy)butanoic acid] had little effect. Currey and Peters (5) reported partial control of white cockle with late summer applications of either terbacil or simazine at 1.12 kg/ha. Duke and Spear (8) observed satisfactory control of white cockle with 2.24 kg/ha of simazine spring applied but poor control with 2.24 or 3.36 kg/ha of

simazine applied in the fall. Good control was also observed with terbacil or bromacil at 2.24 kg/ha, but these rates were injurious to the alfalfa.

Several herbicide treatments have been evaluated for control of dandelion in established alfalfa. Duke and Spear (8) observed dandelion control with spring applications of terbacil at 2.24 kg/ha and bromacil at 1.12 and 2.24 kg/ha. However, these rates were injurious to the alfalfa. No treatment gave good control when applied in the fall. Triplett et. al. (35) found December applications of 2,4-D [(2,4-dichlorophenoxy) acetic acid] reduced the number of seedling dandelions, but did not affect the number of mature dandelions. Pagano et. al. (24) observed only partial control of dandelions with metribuzin at 0.84 kg/ha. Sheaffer and Wyse (31) treated established stands of alfalfa at four separate locations with fall and spring applied buthidazole, metribuzin, simazine and 2,4-DB. They observed that on courser textured soils all treatments, except spring applied simazine at one site and spring applied simazine as well as fall applied metribuzin and 2,4-DB at a second site, reduced dandelion populations at the third cutting. Pearson and Meggitt (25) found spring applications of terbacil at 1.12 kg/ha provided good dandelion control. Duke and Hunt (9) observed that spring applications of metribuzin were more effective for dandelion control than fall applications. Dutt (10) reported excellent and fair control of dandelion with metribuzin and terbacil, respectively, but does not specify the time of application. Waddington (46) obtained control of dandelion in established alfalfa with dichlobenil (2.2 kg/ha), asulam (methylsulfanilycarbamate) (4.45 kg/ha) or terbacil (1.1 kg/ha).

Of the grass species, quackgrass is the most serious problem in alfalfa stands in Michigan. It is a perennial which reproduces both by

seed and by underground rhizomes (32). In addition to its highly competitive nature, there is also evidence which suggests quackgrass has an all allelopathic effect on some crops (20). The best quackgrass control from a herbicide program in established stands of alfalfa was obtained through fall applications of pronamide. Viste and Sanborn (45) observed good quackgrass control with pronamide at both 0.84 and 1.68 kg/ha. Duke (7) obtained excellent quackgrass control with pronamide at 1.68 kg/ha whether applied in the spring or fall. Dutt (11) observed nearly complete suppression of quackgrass with fall applications of pronamide at 1.71 kg/ha. Harvey and Conners (16) found excellent quackgrass control with pronamide at 0.84 and 1.68 kg/ha, although the 0.84 kg/ha rate did not provide season long control. Fortino (14) also observed suppression of quackgrass, but not control, using 1.12 kg/ha metribuzin.

Weed Control and Forage Quality

Weed control measures generally lead to higher crop yield. However, this is not always the case with weed control programs in established alfalfa. Effective weed control measures in existing stands of alfalfa often result in lower or unchanged total forage yields. Fawcett and Harvey (12) observed that fall applications of pronamide decreased total forage yields in fields with low alfalfa densities. However, total alfalfa yields were increased with some pronamide treatments. Total forage yields either remained constant or increased slightly in fields with higher alfalfa stand densities. Dutt (10) observed that herbicides either decreased or had no effect on total forage dry matter yields. However, pronamide applications significantly increased total alfalfa yields. Duke and Spear (8) found total forage yields either remained the same or decreased as a result of herbicide treatments to established alfalfa

infested with several species of broadleaf weeds. Total alfalfa yields were not changed. Sheaffer and Wyse (31) found no increase in either total forage yield or total alfalfa yields as a result of controlling common dandelion in established stands of alfalfa. Although the benefits of weed control in established alfalfa are not apparent in increased forage yields, a potential benefit exists in increased forage quality.

Protein content and forage digestibility are both accepted criterion for forage quality. Cord (4) showed crude protein in alfalfa hay to be negatively correlated with weed content. The digestibility of protein in a forage increases with increasing protein content (13, 15, 17). As alfalfa is higher in crude protein than many weed species (22, 34), increasing the alfalfa component of a forage could increase the protein percentage of that forage.

Forage digestibility is related to the fiber content of the forage. The fiber fraction of a forage is difficult to define (43). Van Soest considers the plant cell walls to represent the total fibre fraction (39), the cell contents being completely digestible by ruminants (40). The plant cell wall constituents include hemicellulose and cellulose fractions which are partly digestible, and a lignin fraction which is completely indigestible. Cell wall constituents may be determined using the neutral detergent method of Van Soest and Wine (44). However, this neutral detergent fiber (NDF) shows little correlation to digestibility (42). The acid detergent method of Van Soest (41) only recovers the cellulose and lignin fractions of the cell wall constituents and shows a better correlation with digestibility (37, 38). The invitro rumen fermentation technique of Tilley and Terry (36), of all methods so far investigated for estimating the dry matter digestibility of a forage, has proven to be the most accurate (1, 42). Several

investigators have used these tests to determine the effects of weed control measures on forage quality. Temme et. al. (34) showed a significant increase in both crude protein and in-vitro digestible dry matter (IVDDM) for treated alfalfa compared to untreated alfalfa infested with several annual broadleaf weeds. Fawcett et. al. (12) found significant protein increases in first cutting hay as a result of pronamide applications to alfalfa infested with quackgrass. IVDDM was also increased in all three cuttings. There was no effect on acid detergent fiber content. Dutt (10) found little difference in crude protein (CP) in treated alfalfa infested with perennial broadleaf weeds. However, significant first cutting protein increases were observed with applications of pronamide to an alfalfa stand heavily infested with quackgrass. In a second study, Dutt (10) found significant increases in both CP and IVDDM as a result of pronamide application to quackgrass infested alfalfa. Duke (7) also reported significant protein increases in the first cutting of pronamide treated alfalfa. Sheaffer and Wyse (31) observed no consistent increases in either CP or IVDDM as a result of controlling common dandelion in established alfalfa.

MATERIALS AND METHODS

Weed control experiments were conducted in established alfalfa at three locations in East Lansing, Michigan.

The soil type at location one was a Riddles-Hillsdale sandy loam (fine-coarse)loamy, mixed typic hapludalfs). A soil test indicated pH of 7.2, 2.41 percent organic matter, 134 kg/ha available P and 102 kg/ha available K. Three hundred pounds K_2O was applied after first cutting in 1981 as recommended by the soil test. Site two was a Capac loam (fine-loamy, mixed mesic Aeric Ochraqualfs). A soil test indicated a pH of 7.2, 3.69 percent organic matter, 92 kg/ha available P and 170 kg/ha available K. One hundred fifty pounds K_2O was applied after first cutting in 1981 as recommended by the soil test. The soil type at site three was also a Capac loam. A soil test indicated a pH of 7.1, 3.88 percent organic matter, 29 kg/ha available P and 349 kg/ha available K. No additional fertilizer was applied. The alfalfa variety was Vernal at all three sites. Site one was a seven year old stand with a stand density of 30 plants/m^2 and severe weed pressure. Site 2 was a 2 year old stand with 56 plants/m^2 and light weed pressure. Site 3 was a 2 year old stand with 58 plants/m^2 and severe weed pressure.

Visual weed control ratings were made using a 0-100 scale, 0 being no control; 100 being complete control. Ratings were done just prior to each cutting date. Botanical composition of the forage at harvest was determined by cutting a square meter sample from each plot and separating

the forage into alfalfa, broadleaf weed and grass weed components. Total forage yields were determined three times a year when 10% of the alfalfa plants had blooms present (1/10 bloom stage). Harvest dates for the three sites are shown in Table 2. Herbicides were applied November 24, 1980 and March 23, 1981, and November 24, 1981 and March 29, 1982. Alfalfa was dormant at all applications. Herbicide combinations are shown in Table 1. All treatments were applied with a tractor mounted sprayer deliverying 261 L/ha at 30 psi.

The experimental design was a randomized complete block with four replications. All data was analyzed using analysis of variance techniques.

Yields were determined by cutting a 4.31 m^2 strip down the middle of each plot with a flail type forage harvester. One thousand gram samples were collected at the time of harvest for dry matter determination. These samples were dried at 65^{o}C, ground to pass through a 40 mesh screen and stored for later analysis.

Yields were determined and hand separations were performed in 1981 on all plots which received herbicide treatments. In 1982, yields and separations were performed only on forage from plots which received the following treatments: metribuzin (0.56 kg/ha) fall applied, metribuzin (1.12 kg/ha) spring applied, pronamide (1.68 kg/ha) fall applied, and pronamide (1.68 kg/ha) fall applied followed by metribuzin (1.12 kg/ha spring applied as well as the untreated control. These four herbicide treatments were chosen due to the fact that they were representative of the spectrum of weed control observed during the course of the study. Metribuzin (0.56) kg/ha represented treatments providing only annual broadleaf weed control, metribuzin (1.12 kg/ha) spring applied was representative of treatments providing both annual and perennial weed

Table 1. Treatments evaluated.

Treatment	Rate (kg/ha)	Appl Time	Treatment	Rate (kg/ha)	Appl Time
1. Pronamide	1.12	Fall	7. Pronamide	1.68	Fall
			Metribuzin	1.12	Spring
2. Pronamide	1.68	Fall			
			8. Simazine	1.40	Fall
3. Pronamide	1.68	Fall			
Simazine	1.40	Fall	9. Metribuzin	0.56	Fall
4. Pronamide	1.68	Fall	10. Terbacil	1.12	Fall
Metribuzin	0.56	Fall			
			11. Metribuzin	1.12	Spring
5. Pronamide	1.68	Fall			
Terbacil	1.12	Fall	12. Terbacil	1.12	Spring
6. Pronamide	1.68	Fall	13. Untreated		
Terbacil	1.12	Spring			

Table 2. Harvest dates for the 1981 and 1982 growing season.[a]

Site	Harvest I		Harvest II		Harvest III	
	1981	1982	1981	1982	1981	1982
I	6/9	6/7	7/17	7/15	9/15	8/20
II	6/9	6/7	7/14	7/12	8/12	8/17
III	6/9	6/7	7/14	7/14	9/1	8/17

[a]All harvests were made when alfalfa was at the 1/10 bloom stage.

control. Pronamide (1.68 kg/ha) fall applied was representative of treatments which provided control of perennial grasses only and pronamide (1.68 kg/ha) fall applied followed by metribuzin (1.12 kg/ha) spring applied was representative of treatments which provided control of both annual and perennial broadleaves and grasses. Determinations were made on plots which received these treatments in 1980/81, 1981/82 or in both 1980/81 and 1981/82. Forage quality analysis was performed in 1981 on plots which received these treatments in 1980/81 and in 1982 on plots which received these treatments only in 1981/82. No analysis was performed in 1982 on forage from plots receiving treatment only in 1980/81 or in both 1980/81 and 1981/82.

Samples were analyzed for crude protein using the Kjeldahl procedure (2). In vitro digestible dry matter (IVDDM) was determined using the Tilley and Terry technique (36) which involves digestion of 0.5 gram forages samples for 48 hours in rumen fluid obtained from fistulated cows followed by the addition of pepsin, acidification and an additional 48 hour digestion. Samples are then filtered, dried and weighed to determine percent dry matter lost. Acid detergent fiber content was determined using the procedure by Van Soest (41) in which 1.0 gram samples are refluxed in 1.0N sulphuric acid solution containing hexaderyl-trimethyl ammonium bromide for 1 hour. These samples are then filtered, dried and weighed to determine percent dry matter lost.

RESULTS AND DISCUSSION

For ease of discussion, the results of this study are arranged by site. Within each site there are three sections: Weed Control, Influence of Herbicides on Forage Composition and Yield, and Influence of Herbicide Treatments on Forage Quality.

SITE I

Weed Control

Orchardgrass (Dactylis glomerata L.) was the most prevalent perennial grass species at the first cutting. Several herbicide treatments provided orchardgrass control in both 1981 and 1982. Pronamide at either 1.12 kg/ha or 1.68 kg/ha (Tables 3 and 4) fall applied gave good orchardgrass control with no significant difference between the two rates. Pronamide (1.68 kg/ha) fall applied in combination with simazine (1.46 kg/ha), metribuzin (0.56 kg/ha), or terbacil (1.12 kg/ha) all provided good orchardgrass control. Metribuzin (0.56 kg/ha) fall applied provided poor control of orchardgrass in both 1981 and 1982. Terbacil (1.12 kg/ha) fall applied provided poor control in 1981 but good control in 1982. Simazine (1.46 kg/ha) fall applied provided fair to good control both years. Ratings for this treatment were 92% in 1981 and 62% in 1982. Spring applied metribuzin (1.12 kg/ha) provided significantly better orchardgrass control than fall applied metribuzin (0.56 kg/ha) in 1981,

Table 3. Orchard grass control ratings at site one for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	% Control Harvest II
Fall Treatments			
Pronamide	1.12	97a	96abc
Pronamide	1.68	99a	80bcd
Simazine	1.46	92a	98ab
Metribuzin	0.56	29b	69d
Terbacil	1.12	28b	77cd
Pronamide + Simazine	1.68 + 1.46	100a	94abc
Pronamide + Metribuzin	1.68 + 0.56	99a	94abc
Pronamide + Terbacil	1.68 + 1.12	99a	95abc
Spring Treatments			
Metribuzin	1.12	95a	76cd
Terbacil	1.12	100a	97abc
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68 + 1.12	99a	96abc
Pronamide/Terbacil	1.68 + 1.12	100a	100a
Control		0b	0b

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 4. Perennial grass[a] control ratings at site one for the 1982 growing season. Treatments applied in 1981/82[b].

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	82cdef	72cde	82bcde
Pronamide	1.68	94ef	72cde	67bcd
Simazine	1.46	62bc	20ab	62bc
Metribuzin	0.56	40ab	20ab	52b
Terbacil	1.12	85cdef	55bc	57bc
Pronamide + Simazine	1.68 + 1.46	94ef	82cde	62bc
Pronamide + Metribuzin	1.68 + 0.56	97ef	87de	82bcde
Pronamide + Terbacil	1.68 + 1.12	92cdef	92e	57bc
Spring Treatments				
Metribuzin	1.12	72bcd	62cd	65bcd
Terbacil	1.12	82cdef	75cde	67bcd
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	77bcde	82cde	94de
Pronamide/Terbacil	1.68 + 1.12	100f	92e	82bcde
Control		0a	0a	0a

[a]The perennial grass at the first harvest is orchardgrass. At harvest two and three is quackgrass.

[b]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

although there was no significant difference between the two treatments in 1982. Both metribuzin rates only provided fair control (40% and 72% respectively) in 1982. Similar results were obtained with terbacil (1.12 kg/ha) spring applied. Spring treatment in 1981 provided significantly better control than fall application. However, there was no significant difference between the two application times in 1982. These results may be partly attributed to a dry spring in 1982. The herbicide did not move into the active root zone of the orchardgrass until a significant amount of growth had taken place. Ratings for metribuzin and terbacil spring applied at 1.12 kg/ha in 1981 were 95% and 100% respectively compared to 72% and 82% in 1982. Fall applied pronamide (1.68 kg/ha), followed by metribuzin (1.12 kg/ha) spring applied, provided excellent orchardgrass control in 1981 although the combination did not improve control over either herbicide alone. The same was true with pronamide (1.68 kg/ha) fall applied followed by terbacil (1.12 kg/ha) spring applied. Similar results were obtained in 1982, although pronamide (1.68 kg/ha) fall applied followed by terbacil (1.12 kg/ha) spring applied provided significantly better control than when followed by metribuzin (1.12 kg/ha).

Quackgrass was the most prevalent perennial grass species at the second and third cuttings. Several investigators found pronamide provided very good quackgrass control (7, 11, 45). Similar results were observed in this study. Pronamide at 1.12 and 1.68 kg/ha fall applied provided good quackgrass control in 1981 with no significant difference between the two treatments (Table 5). Pronamide (1.68 kg/ha) fall applied in combination with simazine (1.46 kg/ha), metribuzin (0.56 kg/ha) or terbacil (1.12 kg/ha) provided excellent quackgrass control,

Table 5. Quackgrass control ratings at site one for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	100a	96ab	77ab
Pronamide	1.68	100a	99a	76ab
Simazine	1.46	70c	87bc	52bcd
Metribuzin	0.56	0d	30ef	40bcde
Terbacil	1.12	15d	44de	20de
Pronamide + Simazine	1.68 + 1.46	100a	99a	64abc
Pronamide + Metribuzin	1.68 + 0.56	100d	94ab	77ab
Pronamide + Terbacil	1.68 + 1.12	87bc	88abc	41bcde
Spring Treatments				
Metribuzin	1.12	87bc	68cd	32cde
Terbacil	1.12	94ab	97ab	73ab
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100a	99a	74ab
Pronamide/Terbacil	1.68 + 1.12	100a	96ab	89a
Control		0d	0f	0e

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

however, metribuzin or terbacil alone at these rates provided poor control. Similar results were obtained with these treatments in 1982 although the degree of control was generally less (Table 4). Pronamide at 1.12 and 1.68 kg/ha gave greater than 90% quackgrass control in 1981 but only 72% control in 1982. Pronamide (1.68 kg/ha) in combination with simazine or metribuzin at the rates mentioned above gave 99% and 44% control respectively in 1981 and 82 and 87% control in 1982. Metribuzin (1.12 kg/ha) spring applied provided significantly better quackgrass control than fall applied metribuzin at 0.56 kg/ha in both 1981 and 1982. Metribuzin (1.12 kg/ha) spring applied in combination with a fall application of pronamide (1.68 kg/ha) provided significantly better quackgrass control than metribuzin alone in 1981. In 1982 there was no difference in the two treatments. Control with this treatment was no better than pronamide (1.68 kg/ha) applied alone in the fall in either year. Pronamide (1.68 kg/ha) fall applied followed by terbacil (1.12 kg/ha) spring applied provided excellent quackgrass control, although control with this combination was no better than either treatment alone in 1981 and 1982. Terbacil (1.12 kg/ha) spring applied provided significantly better quackgrass control than did the same treatment fall applied in 1981 but not 1982. There were few differences in quackgrass control between treatments at the third cutting in either year. Pronamide (1.68 kg/ha) fall applied followed by terbacil (1.12 kg/ha) spring applied provided greater than 80% quackgrass control at the third cutting in both years. The same rate of pronamide followed by a spring treatment of metribuzin at 1.12 kg/ha provided 92% quackgrass control in 1982.

All treatments which were applied in both 1980/81 and 1981/82 gave excellent quackgrass control thoughout the season in 1982 with the

exception of simazine (1.46 kg/ha) fall applied (Table 6). Orchardgrass control with this treatment at the first cutting was not significantly different from the untreated check. Quackgrass control at the second and third cuttings was also poor with this treatment.

Herbicides applied to established stands of alfalfa have been found, in some cases, to provide poor weed control the year following treatment (7, 12, 31). In this study treatments applied in 1980/81 showed reduced perennial grass control in 1982 when compared to treatments applied in 1981/82 or 1980/81 and 1981/82 (Table 7). There were very few significant differences between treatments, although a number of treatments reduced quackgrass populations compared to the untreated control. There was no difference between pronamide 1.12 kg/ha and 1.68 kg/ha fall applied. There were also no significant differences in pronamide applied in the fall with simazine (1.46 kg/ha), metribuzin (0.56 kg/ha), or terbacil (1.12 kg/ha) or with simazine (1.46 kg/ha), metribuzin (0.56 kg/ha) or terbacil (1.12 kg/ha) applied alone. Pronamide (1.68 kg/ha) + metribuzin (0.56 kg/ha) fall applied did give control than metribuzin (0.56 kg/ha) fall applied alone. None of these treatments gave better than 62% control. Metribuzin (1.12 kg/ha) spring applied gave no better control than metribuzin (0.56 kg/ha) fall applied. Neither treatment was significantly better than the untreated check. Terbacil (1.12 kg/ha) spring applied gave better control than the same treatment applied in the fall. Pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied was no better than either treatment alone or than metribuzin (0.56 kg/ha) fall applied.

Similar results were observed with quackgrass control at the second and third cuttings, although slightly better quackgrass control was

Table 6. Perennial grass[a] control ratings at site one for the 1982 growing season. Treatments applied 1980/81 and 1981/82.[b]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	84c	85c	85bc
Pronamide	1.68	100c	94c	87bc
Simazine	1.46	45ab	42b	77b
Pronamide + Simazine	1.68 + 1.46	100c	100c	90bc
Pronamide + Metribuzin	1.68 + 0.56	97c	92c	89bc
Spring Treatments				
Metribuzin	1.12	85cdef	85c	80bc
Terbacil	1.12	97c	89c	77b
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100c	90c	90bc
Pronamide/Terbacil	1.68 + 1.12	100c	94c	100c
Control		0a	0a	0a

[a]The perennial grass at the first harvest is orchardgrass. At harvest two and three is quackgrass.

[b]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 7. Perennial grass[a] control ratings at site one for the 1982 growing season. Treatments applied in 1980/81.[b]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	50bcd	67cd	85cd
Pronamide	1.68	55bcde	42bcd	82bcd
Simazine	1.46	52bcde	40abcd	72bcd
Metribuzin	0.56	15ab	35abc	62bc
Terbacil	1.12	17abc	12ab	57bc
Pronamide + Simazine	1.68 + 1.46	47abcd	47bcd	90cd
Pronamide + Metribuzin	1.68 + 0.56	62cde	45bcd	55bc
Pronamide + Terbacil	1.68 + 1.12	70dc	57cd	70bcd
Spring Treatments				
Metribuzin	1.12	17abc	35abc	42ab
Terbacil	1.12	75de	72d	67bcd
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	52bcde	70cd	80bcd
Pronamide/Terbacil	1.68 + 1.12	87e	72d	60bc
Control		0a	0a	0a

[a]The perennial grass at the first harvest is orchardgrass. At harvest two and three is quackgrass.

[b]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

observed at the third cutting than the second. The better control was probably a result of less quackgrass regrowth in the third cutting.

Spring applications of metribuzin and terbacil were previously found to provide good control of dandelion (8, 10, 35). In this study metribuzin or terbacil spring applied at 1.12 kg/ha alone or in combination with fall applied pronamide (1.68 kg/ha) gave better than 90% dandelion control at the first cutting in 1981 (Table 8). These same treatments provided only fair dandelion control at the first cutting in 1982 with control ranging from 77 to 82% (Table 9). There was no difference in control between treatments with or without pronamide either year. Dandelion control with pronamide alone was not significantly different than the untreated check. Metribuzin (1.12 kg/ha) spring applied provided significantly better dandelion control at the first cutting in both years than did metribuzin (0.56 kg/ha) fall applied. Control at the second cutting was significantly better at the 1.12 kg/ha rate spring applied than the 0.56 kg/ha rate fall applied in 1981. There was no difference between the two treatments at the second cutting in 1982 or at the third cutting in either year. There were no significant differences between fall applications of simazine (1.46 kg/ha), metribuzin (0.68 kg/ha) or terbacil (1.12 kg/ha) at any cutting in 1981 with all treatments providing poor dandelion control. Control ratings with these treatments ranged from 45% to 75% at the first cutting with control decreasing at the subsequent cuttings. Terbacil (1.12 kg/ha) fall applied provided significantly better dandelion control than either fall applied metribuzin (0.56 kg/ha) or simazine (1.46 kg/ha) at the first cutting in 1982. Control with this treatment was poor. There were no significant differences between these treatments at the subsequent cuttings. Duke

Table 8. Dandelion control ratings at site one for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0e	0f	23cd
Pronamide	1.68	38de	15ef	13cd
Simazine	1.46	67cd	68bcd	47bc
Metribuzin	0.56	42de	60cd	40bcd
Terbacil	1.12	42de	54cd	43bc
Pronamide + Simazine	1.68 + 1.46	75bcd	50cd	35bcd
Pronamide + Metribuzin	1.68 + 0.56	66cd	45de	32cd
Pronamide + Terbacil	1.68 + 1.12	72bcd	69bcd	28cd
Spring Treatments				
Metribuzin	1.12	93abc	88ab	69ab
Terbacil	1.12	91abc	79bc	42bc
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	94ab	68bcd	26cd
Pronamice/Terbacil	1.68 + 1.12	99a	98a	91a
Control		0e	0f	0d

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 9. Dandelion control ratings at site one for the 1982 growing season. Treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0a	0a	10ab
Pronamide	1.68	0a	0a	0a
Simazine	1.46	30abc	52bcdef	27abcd
Metribuzin	0.56	35bc	50bcde	32bcde
Terbacil	1.12	65def	40bcd	35bcdef
Pronamide + Simazine	1.68 + 1.46	45bcd	55cdefg	50defg
Pronamide + Metribuzin	1.68 + 0.56	17ab	20ab	17abc
Pronamide + Terbacil	1.68 + 1.12	57cde	37bc	50defg
Spring Treatments				
Metribuzin	1.12	77efg	65cdefgh	62fgh
Terbacil	1.12	77efg	77fgh	72gh
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	82fgh	67defgh	72gh
Pronamide/Terbacil	1.68 + 1.12	77efg	65cdefgh	60efgh
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

and Spear (8) also observed poor dandelion control from fall applications of terbacil. None of the fall applied treatments provided better dandelion control in combination with pronamide than alone.

Dandelion control generally decreased as the season progressed. Control was very poor at the third cutting in both years with few treatments providing great than 60% control.

Treatments applied in both 1980/81 and 1981/82 provided slightly better dandelion control than one year applications in some cases in 1982 (Table 10). Metribuzin (1.12 kg/ha) and terbacil at the same rate spring applied provided very good dandelion control in the first cutting although control decreased as the season progressed. The addition of pronamide (1.68 kg/ha) fall applied did not improve dandelion control. Pronamide (1.68 kg/ha) + metribuzin (1.12 kg/ha) spring applied provided significantly better dandelion control than pronamide (1.68 kg/ha) + metribuzin (0.56 kg/ha) fall applied in all three cuttings.

Dandelion control was reduced in 1982 in plots treated in 1980/81 (Table 11) compared to those treated in 1981/82 (Table 9) or in both 1980/81 and 1981/82 (Table 10). There were no significant differences in dandelion control between any of the broadleaf materials tested at any cuttings with the exception of terbacil (1.12 kg/ha) spring applied in combination with pronamide (1.68 kg/ha) fall applied. This treatment showed significantly better control than any other treatment at the first cutting and several other treatments at the second and third cuttings.

Influence of Herbicides on Forage Composition and Yield

Site one was located in a poor stand of alfalfa (30 plants/m^2) with severe weed pressure. Fawcett and Harvey (12) found applications

Table 10. Dandelion control ratings at site one for the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0a	0a	0a
Pronamide	1.68	0a	22ab	0a
Simazine	1.46	70cd	55bcd	45bc
Pronamide + Simazine	1.68 + 1.46	50bc	42bc	60cd
Pronamide + Metribuzin	1.68 + 0.56	40b	27ab	27ab
Spring Treatments				
Metribuzin	1.12	89de	72de	57cd
Terabcil	1.12	87de	77de	70cd
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	92e	80de	75d
Pronamide/Terbacil	1.68 + 1.12	94e	85e	90e
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 11. Dandelion control ratings at site one for the 1982 growing season. Treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0a	0a	0a
Pronamide	1.68	5ab	0a	0a
Simazine	1.46	15abc	47bcde	27ab
Metribuzin	0.56	37bcdef	45bcde	35bcd
Terbacil	1.12	25abcd	30abc	32bc
Pronamide + Simazine	1.68 + 1.46	15abc	27ab	20ab
Pronamide + Metribuzin	1.68 + 0.56	25abcd	25ab	22ab
Pronamide + Terbacil	1.68 + 1.12	45cdefg	30abc	37bcd
Spring Treatments				
Metribuzin	1.12	37bcdef	55bcdef	35bcd
Terbacil	1.12	27abcde	35abcd	37bcd
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	20abcd	30abc	22ab
Pronamide/Terbacil	1.68 + 1.12	77h	60cdef	57cde
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

of pronamide to stands with low alfalfa densities to decrease total forage yields, with some increases in alfalfa yield. Pagano et al (24) also found that metribuzin applied to alfalfa stands with severe weed pressure reduced total forage yield. Similar results were observed in this study.

In the 1981 growing season forage yield was either decreased or unchanged by herbicide treatments at the first cutting (Table 12). Herbicide treatments either increased or had no effect on alfalfa yield. Treatments causing reductions in forage yield at the first cutting were terbacil (1.12 kg/ha) spring applied, pronamide (1.68 kg/ha) fall applied followed by a spring application of metribuzin (1.12 kg/ha), and pronamide (1.68 kg/ha) fall applied followed by a spring application of terbacil (1.12 kg/ha). Treatments causing increases in alfalfa yield at the first cutting were simazine (1.46 kg/ha) fall applied, pronamide (1.68 kg/ha) + terbacil (1.12 kg/ha) fall applied, metribuzin (1.12 kg/ha) spring applied, and terbacil (1.12 kg/ha) spring applied.

In the second and third cuttings there were no significant differences in either total forage yield or alfalfa yield with any treatments (Tables 13 & 14).

Season total forage yield was decreased by one treatment, but unaffected by all the others (Table 15). Season total alfalfa yields for the treated plots were not significantly different from that of the untreated check.

The treatments which caused a reduction in season total forage yield were pronamide (1.68 kg/ha) fall applied followed by terbacil (1.12 kg/ha) spring applied.

Table 12. First harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	3875abc	2058bc	294bc	1523a
Pronamide	1.68	4217abc	2579abc	114c	1522a
Simazine	1.46	4446abc	3616a	296bc	534bcd
Metribuzin	0.56	5028a	1995bc	2528a	505bcd
Terbacil	1.12	5034a	2405abc	1740ab	891abc
Pronamide + Simazine	1.68 + 1.46	3444bc	2716abc	129c	599bcd
Pronamide + Metribuzin	1.68 + 0.56	4301abc	3079ab	264bc	958ab
Pronamide + Terbacil	1.68 + 1.12	4273abc	3450a	365bc	458bcd
Spring Treatments					
Metribuzin	1.12	4233abc	2948ab	1235abc	50d
Terbacil	1.12	3276c	3214ab	0c	61d
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	3024c	2561abc	259bc	235cd
Pronamide/Terbacil	1.68 + 1.12	1462d	1421c	0c	40d
None		4866ab	1544c	2216a	1106ab

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 13. Second harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	1507a	1070a	161a	275a
Pronamide	1.68	1444a	1134a	89a	221a
Simazine	1.46	1657a	1289a	50a	92a
Metribuzin	0.56	2498a	1310a	1014a	169a
Terbacil	1.12	1764a	1293a	186a	135a
Pronamide + Simazine	1.68 + 1.46	1484a	1673a	107a	126a
Pronamide + Metribuzin	1.68 + 0.56	1887a	1251a	79a	135a
Pronamide + Terbacil	1.68 + 1.12	1837a	1209a	511a	117a
Spring Treatments					
Metribuzin	1.12	1993a	1651a	283a	59a
Terbacil	1.12	1540a	1439a	26a	74a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	1769a	1450a	254a	65a
Pronamide/Terbacil	1.68 + 1.12	1585a	1300a	82a	64a
None		1562a	909a	449a	203a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 14. Third harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	1344a	793a	218a	332a
Pronamide	1.68	1960a	1194a	392a	373a
Simazine	1.46	1394a	921a	257a	216a
Metribuzin	0.56	1573a	828a	508a	236a
Terbacil	1.12	1590a	806a	578a	206a
Pronamide + Simazine	1.68 + 1.46	1344a	879a	192a	273a
Pronamide + Metribuzin	1.68 + 0.56	1388a	803a	378a	207a
Pronamide + Terbacil	1.68 + 1.12	1377a	824a	389a	163a
Spring Treatments					
Metribuzin	1.12	1814a	1183a	518a	113a
Terbacil	1.12	1333a	1047a	165a	120a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	1293a	771a	347a	174a
Pronamide/Terbacil	1.68 + 1.12	1574a	1345a	86b	142a
None		1336a	561a	568a	207a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 15. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site one in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Yield (kg/ha) Alfalfa
Fall Treatments			
Pronamide	1.12	6726ab	4102a
Pronamide	1.68	7622ab	4900a
Simazine	1.46	7112ab	5834a
Metribuzin	0.56	8512a	4137a
Terbacil	1.12	7045ab	4503a
Pronamide + Simazine	1.68 + 1.46	6272bc	4795a
Pronamide + Metribuzin	1.68 + 0.56	6795ab	5707a
Pronamide + Terbacil	1.68 + 1.12	7487ab	5742a
Spring Treatments			
Metribuzin	1.12	7474ab	5514a
Terbacil	1.12	6148bc	5702a
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68 + 1.12	5869bc	4489a
Pronamide/Terbacil	1.68 + 1.12	4667c	4253a
None		7414ab	3131a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Several treatments significantly reduced grass yield at the first cutting (Table 12). The most effective were pronamide (1.68 kg/ha) fall applied, pronamide (1.68 kg/ha) + simazine (1.46 kg/ha) fall applied, terbacil (1.12 kg/ha) spring applied, and pronamide (1.68 kg/ha) fall applied + terbacil (1.12 kg/ha) spring applied. Broadleaf weed yield was also reduced by several treatments at the first cutting, including metribuzin (1.12 kg/ha) spring applied, terbacil (1.12 kg/ha) spring applied, pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied and pronamide (1.68 kg/ha) fall applied + terbacil (1.12 kg/ha) spring applied. There were no significant reductions in grass or broadleaf yields from any treatments at the second or third cuttings.

In the 1982 growing season for plots on which separations were performed, total forage yields at the first harvest were decreased by all treatments applied in 1981/82 (Table 16). Alfalfa yield was increased by all treatments except metribuzin (0.56 kg/ha) fall applied. This treatment also showed poor perennial grass and broadleaf control. For plots which received treatment in 1980/81 and 1981/82, all treatments caused a reduction in total forage yield at the first cutting (Table 17), however, only pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied caused a significant increase in alfalfa yield at the first cutting (Table 17). This treatment provided good perennial grass and broadleaf control at the first cutting. In plots which received treatment in 1980/81, all treatments except metribuzin (0.56 kg/ha) fall applied caused a decrease in total forage yield at the first cutting (Table 18). No treatments resulted in an increase in alfalfa yield. Although there were reductions in total forage yield, the weed control obtained from these treatments was not great enough to allow the

Table 16. First harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one in the 1982 growing season for treatments applied in 1981/82[a].

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	3019ab	2250b	106a	664a
Metribuzin	0.56	3742c	1474a	2161c	106a
Spring Treatments					
Metribuzin	1.12	3043ab	2218b	609ab	106a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2694a	2411b	228a	85a
None		4537d	1376a	2498c	663a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 17. First harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one in the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2928a	2250a	193ab	898a
Metribuzin	0.56	--	--	--	--
Spring Treatments					
Metribuzin	1.12	2474a	2106a	361ab	7a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	3221a	3201b	2.25a	18a
None		4537b	1376a	2498c	663a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 18. First harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	3185ab	1078a	1369ab	651a
Metribuzin	0.56	4117cd	973a	2832c	265a
Spring Treatments					
Metribuzin	1.12	3615bc	1189a	2169bc	258a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2773a	689a	1082a	1002a
None		4537d	1376a	2498c	663a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

alfalfa to respond by an increase in growth. At the second and third cuttings, treatment responses were varied. Total forage yield was either increased or remained the same. This applied whether results of treatments in 1981/1982 (Tables 19 and 20), 1980/1981 (Tables 21 and 22) or both years (Tables 23 and 24) are examined. Alfalfa yield either increased or was unchanged. In most cases, a decrease in total forage yield corresponded with an increase in alfalfa yield. For this reason, in the first experiment there were no significant differences in season total forage yield from any treatments on which separations were performed. Season total alfalfa yield was increased by several treatments. For treatments which were applied in 1981/82 only pronamide (1.68 kg/ha) caused an increase in season total alfalfa yield (Table 25). For treatments which were applied in 1980/81 and 1981/82, metribuzin (1.12 kg/ha) spring applied and pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied both resulted in an increase in season total alfalfa yield (Table 27). There were no significant differences in alfalfa yield at any cutting or in season total alfalfa yields in 1982 for any treatments which were applied in 1980/81 (Table 26). This is indicative of the poor weed control observed in 1982 from treatments which were applied in 1980/81.

Influence of Herbicide Treatments on Forage Quality

Dutt (10) found the removal of perennial broadleaf weeds from established alfalfa had little effect on protein content of the forage. However, the removal of quackgrass from a severely infested stand significantly increased forage protein content. First cutting forage at site one was infested primarily with orchardgrass and protein content of first

Table 19. Second harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2386ab	1727b	136a	522b
Metribuzin	0.56	1855a	835a	142b	178a
Spring Treatments					
Metribuzin	1.12	2516b	1450b	877b	189a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2350ab	1411b	800b	139a
None		1913a	954a	803b	156a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 20. Third harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	1356a	797a	311a	248a
Metribuzin	0.56	1115a	526a	431ab	158a
Spring Treatments					
Metribuzin	1.12	1706ab	954a	543ab	209a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2256b	715a	1459c	89a
None		1223a	514a	521ab	187a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 21. Second harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2119a	788a	941b	390ab
Metribuzin	0.56	2061a	867a	1008b	185a
Spring Treatments					
Metribuzin	1.12	2094a	1083a	773ab	237a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	1825a	855a	372a	598b
None		1913a	954a	803ab	156a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 22. Third harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	1359a	423a	739a	196a
Metribuzin	0.56	1043a	390a	471a	182a
Spring Treatments					
Metribuzin	1.12	1584a	527a	917a	140a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	1182a	306a	678a	197a
None		1223a	514a	521a	187a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 23. Second harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2250ab	1401ab	262a	587c
Metribuzin	0.56	--	--	--	--
Spring Treatments					
Metribuzin	1.12	2468ab	2115bc	336ab	17a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2857b	2695c	137a	29a
None		1913a	954a	803b	156ab

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 24. Third harvest dry matter yields of total forage, alfalfa, grass, and broadleaf weeds as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	1113a	645a	144a	344a
Metribuzin	0.56	--	--	--	--
Spring Treatments					
Metribuzin	1.12	1633a	849a	630b	125a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2500b	1612b	677b	218a
None		1223a	514a	521b	187a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 25. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site one in the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Yield (kg/ha) Alfalfa
Fall Treatments			
Pronamide	1.68	6750a	4774b
Metribuzin	0.56	6712a	2836a
Spring Treatments			
Metribuzin	1.12	7155a	4622ab
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	7318a	4521ab
None		7943a	2842a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 26. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Yield (kg/ha) Alfalfa
Fall Treatments			
Pronamide	1.68	6576a	2289a
Metribuzin	0.56	7206a	2230a
Spring Treatments			
Metribuzin	1.12	7293a	2800a
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	6354a	1866a
None		2943a	2842a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 27. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site one for the 1982 growing season for treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Yield (kg/ha) Alfalfa
Fall Treatments			
Pronamide	1.68	6261a	3832ab
Metribuzin	0.56	--	--
Spring Treatments			
Metribuzin	1.12	6576a	5070b
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	8589a	7508c
None		7943a	2842a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

cutting forage was found to be significantly higher than the untreated check for all treatments on which protein analysis was performed in 1981 (Table 28). Of these treatments, metribuzin (1.12 kg/ha) alone or pronamide (1.68 kg/ha) fall applied followed by a spring application of metribuzin (1.12 kg/ha) both contained a higher percentage of alfalfa in the forage (Table 29). The remaining treatments, while not resulting in an increase in alfalfa yield, did result in a reduction in grass or broadleaf percentages in the forage, although, these reductions were not statistically significant. The greatest increase in protein content was found with pronamide (1.68 kg/ha) fall applied followed by a spring application of metribuzin (1.12 kg/ha). This treatment resulted in a forage containing 85.80% alfalfa and 17.11% protein compared to 32.67% alfalfa and 10.30% protein in the untreated check. The smallest protein increase resulted from metribuzin (0.56 kg/ha). Forage receiving this treatment contained 42.28% alfalfa and 13.07% protein. In 1982, all treatments which resulted in a significant increase in alfalfa percentage in the forage also resulted in a significant increase in protein content at the first cutting (Tables 30 and 31). These were all treatments except metribuzin (0.56 kg/ha) fall applied. There were no differences between any treatments showing significant protein increases over the untreated check. The greatest increase in protein content was observed with pronamide (1.68 kg/ha) fall applied. This treatment resulted in forage containing 72.99% alfalfa and 17.20% protein compared to 30.21% alfalfa and 12.78% protein for the untreated check.

Dutt (10) and Fawcett et. al. (12) both observed increases in IVDDM as a result of pronamide applications to quackgrass infested alfalfa, however, there were no significant differences in the IVDMD

Table 28. First harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site one in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	%P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	16.30a	56.16a	43.77b
Metribuzin	0.56	13.07b	55.79a	43.91b
Spring Treatments				
Metribuzin	1.12	14.97ab	56.35a	43.24b
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	17.11a	55.05a	41.24b
None		10.30c	52.49a	46.68a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 29. Percent alfalfa, grass and broadleaf weeds present in first harvest forage as influenced by herbicide treatment at site one in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Alfalfa	% Grass	% Broadleaf Weeds
Fall Treatments				
Pronamide	1.68	57.86abc	3.23a	38.91cd
Metribuzin	0.56	42.28ab	47.37b	10.35ab
Spring Treatments				
Metribuzin	1.12	79.33c	19.55ab	1.12a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	85.80cd	5.73a	8.47ab
None		32.67a	42.55ab	24.78bc

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 30. First harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site one in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	%P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	17.20a	69.01a	37.23a
Metribuzin	0.56	11.99b	64.25a	40.57a
Spring Treatments				
Metribuzin	1.12	17.04a	65.50a	36.65a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	17.18a	65.23a	36.94a
None		12.78b	61.70a	40.25a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 31. Percent alfalfa, grass and broadleaf weeds present in first harvest forage as influenced by herbicide treatment at site one in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	% Alfalfa	% Grass	% Broadleaf Weeds
Fall Treatments				
Pronamide	1.68	72.99a	3.41a	23.60b
Metribuzin	0.56	37.13b	60.17c	2.70a
Spring Treatments				
Metribuzin	1.12	74.12a	19.45ab	6.43ab
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	86.58a	11.50ab	1.92a
None		30.21b	53.74c	16.05ab

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

with any treatment at the first cut at site one in either year (Tables 28 and 30).

ADF was significantly decreased by all treatments in 1981 (Table 28) but there were no significant differences in 1982 (Table 30).

There were no significant differences in a protein content, IVDMD, or ADF at either the second or third cutting at site one in 1981 (Tables 32 and 33) or 1982 (Tables 34 and 35).

Table 32. Second harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site one in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	%P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	19.46a	57.22a	34.18a
Metribuzin	0.56	17.96a	51.91b	40.40a
Spring Treatments				
Metribuzin	1.12	19.61a	57.29a	34.83a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	18.96a	56.26a	36.64a
None		18.69a	54.18ab	35.12a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 33. Third harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site one in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	21.27a	61.99a	31.05a
Metribuzin	0.56	20.75a	66.24a	31.69a
Spring Treatments				
Metribuzin	1.12	21.19a	62.09a	30.74a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	21.13a	61.64a	30.51a
None		21.39a	61.31a	29.63a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 34. Second harvest, in vitro digestible dry matter and acid detergent fiber content of forage at site one in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	17.40a	63.69a	32.74a
Metribuzin	0.56	17.22a	64.59a	32.93a
Spring Treatments				
Metribuzin	1.12	17.22a	64.20a	34.05a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	15.87a	63.41a	34.44a
None		16.82a	63.89a	33.07a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 35. Third harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site one in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	%P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	18.59a	62.48a	26.77a
Metribuzin	0.56	17.33a	58.93a	28.98a
Spring Treatments				
Metribuzin	1.12	16.82a	57.80a	30.27a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	15.27a	59.82a	31.47a
None		17.33a	53.39a	27.88a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

SITE II

Weed Control

Site 2 was a good stand of alfalfa (56 plants/m^2) with relatively light weed pressure. Weeds present in the stand were dandelion, quackgrass, white cockle and shepherd's purse. As a result of the good stand and lower weed pressure, weed control ratings were generally higher at site 2 than site 1. Quackgrass control at the first cutting was very good for all treatments except metribuzin (0.56 kg/ha) fall applied and simazine (1.46 kg/ha) fall applied in 1981 as well as simazine (1.46 kg/ha) fall applied in 1982 (Tables 36 & 37). Metribuzin (1.12 kg/ha) spring applied was significantly better than metribuzin (0.56 kg/ha) fall applied at controlling quackgrass. Quackgrass control at the second and third cuttings was also very good, although simazine (1.46 kg/ha) fall applied and metribuzin (0.56 kg/ha) fall applied showed poor control at the second cutting in 1982. All other treatments provided good control.

For treatments which were applied in both 1980/81 and 1981/82, all treatments provided good season long quackgrass control in 1982 with the exception of simazine (1.46 kg/ha) fall applied (Table 38). In experiment 1 perennial grass control was greatly reduced in 1982 in plots which were treated only in 1980/81, however, in experiment 2 this was not the case. All treatments showed good to excellent quackgrass control throughout the season except metribuzin (0.56 kg/ha) fall applied (Table 39). These results are in agreement with Fawcett (12) who observed quackgrass control from pronamide applications to persist into the second year if applied to stands with high alfalfa populations (40-50 plants/m^2).

Table 36. Quackgrass control ratings at site two for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	100c	99a	99a
Pronamide	1.68	100c	99a	100a
Simazine	1.46	77b	99a	99a
Metribuzin	0.56	71b	63b	68b
Terbacil	1.12	100c	100a	100a
Pronamide + Simazine	1.68 + 1.46	100c	100a	100a
Pronamide + Metribuzin	1.68 + 0.56	92bc	100a	100a
Pronamide + Terbacil	1.68 + 1.12	100c	100a	100a
Spring Treatments				
Metribuzin	1.12	100c	100a	100a
Terbacil	1.12	100c	100a	100a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100c	100a	100a
Pronamide/Terbacil	1.68 + 1.12	100c	100a	100a
Control		0a	0c	0c

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 37. Quackgrass control ratings at site two for the 1982 growing season. Treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	96cd	73bc	93bcd
Pronamide	1.68	100d	93cde	63b
Simazine	1.46	40ab	47b	73bc
Metribuzin	0.56	76c	50b	70bc
Terbacil	1.12	93cd	100e	100d
Pronamide + Simazine	1.68 + 1.46	100d	93cde	96cd
Pronamide + Metribuzin	1.68 + 0.56	100d	80cd	93bcd
Pronamide + Terbacil	1.68 + 1.12	96cd	100e	100d
Spring Treatments				
Metribuzin	1.12	100d	87cde	76bcd
Terbacil	1.12	100d	93cde	100d
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	96cd	96de	93bcd
Pronamide/Terbacil	1.68 + 1.12	96cd	100e	100d
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 38. Quackgrass control ratings at site two for the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	100c	93c	96c
Pronamide	1.68	100c	100c	63b
Simazine	1.46	60b	57b	76bc
Pronamide + Simazine	1.68 + 1.46	100c	93c	90bc
Pronamide + Metribuzin	1.68 + 0.56	100c	100c	100c
Spring Treatments				
Metribuzin	1.12	100c	100c	100c
Terbacil	1.12	100c	100c	100c
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100c	100c	96c
Pronamide/Terbacil	1.68 + 1.12	100c	100c	100c
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 39. Quackgrass control ratings at site two for the 1982 growing season. Treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	93cd	60bc	73bc
Pronamide	1.68	100d	76cde	90bcd
Simazine	1.46	83bcd	60bc	83bcd
Metribuzin	0.56	53b	37b	53b
Terbacil	1.12	100d	90def	96cd
Pronamide + Simazine	1.68 + 1.46	60b	90def	87bcd
Pronamide + Metribuzin	1.68 + 0.56	73bc	83cde	100d
Pronamide + Terbacil	1.68 + 1.12	100d	93def	86bcd
Spring Treatments				
Metribuzin	1.12	93cd	73cd	86bcd
Terbacil	1.12	100d	90def	100d
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100d	83cde	80bcd
Pronamide/Terbacil	1.68 + 1.12	100d	96ef	93cd
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Dandelion control at the first cutting in 1981 was very good with terbacil (1.12 kg/ha) fall or spring applied or with metribuzin (1.12 kg/ha) spring applied (Table 40). Control was also good with these treatments in combination with pronamide (1.68 kg/ha) fall applied, however, there were no significant differences between treatments with or without pronamide. Dandelion control at the second and third cuttings was similar to the first cutting. Treatments applied in 1981/82 which gave good dandelion control in 1982 were terbacil (1.12 kg/ha) fall applied, metribuzin (1.12 kg/ha) spring applied, terbacil (1.12 kg/ha) spring applied and these treatments in combination with fall applied pronamide at 1.68 kg/ha (Table 41). All other treatments gave poor dandelion control.

For treatments which were applied in both 1980/81 and 1981/82, similar levels of dandelion control were obtained in 1982 (Table 42) as with the treatments applied in 1981/82 alone (Table 41).

Unlike results observed with quackgrass control at this site, treatments applied in the fall of 1980 with no subsequent application showed no better dandelion control than the untreated check in 1982, with the exception of terbacil (1.12 kg/ha) (Table 43). Treatments applied in the spring of 1981 were significantly better than the untreated check at first cutting, but still showed poor dandelion control.

White cockle control was good at the first cutting in 1981 (Table 44) with all treatments except pronamide treatments and simazine (1.46 kg/ha) fall applied and in 1982 with all treatments except pronamide treatments and metribuzin (0.56 kg/ha) fall applied (Table 45).

Treatments applied in 1980/81 provided poor control in 1982 (Table 46) while treatments applied in both 1980/81 and 1981/82 provided

Table 40. Dandelion control ratings at site two for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	29de	66de	13ef
Pronamide	1.68	0e	69de	13ef
Simazine	1.46	55d	83cd	45cdef
Metribuzin	0.56	51d	66de	49cdef
Terbacil	1.12	89bc	99ab	91ab
Pronamide + Simazine	1.68 + 1.46	50d	61e	35def
Pronamide + Metribuzin	1.68 + 0.56	35de	80de	58cde
Pronamide + Terbacil	1.68 + 1.12	87c	97ab	70bcd
Spring Treatments				
Metribuzin	1.12	100a	100a	95ab
Terbacil	1.12	97abc	99a	83abc
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	99ab	94bc	80abc
Pronamide/Terbacil	1.68 + 1.12	100a	100a	98a
Control		0e	0f	0f

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 41. Dandelion control ratings at site two for the 1982 growing season. Treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0a	0a	0a
Pronamide	1.68	0a	0a	30ab
Simazine	1.46	43ab	57bc	63bc
Metribuzin	0.56	53bc	47b	70bcd
Terbacil	1.12	90de	93f	87cde
Pronamide + Simazine	1.68 + 1.46	57bc	60bcd	67bcd
Pronamide + Metribuzin	1.68 + 0.56	67bcd	60bcd	70bcd
Pronamide + Terbacil	1.68 + 1.12	93dc	86def	83cde
Spring Treatments				
Metribuzin	1.12	100e	90f	70bcd
Terbacil	1.12	86cde	87def	77cd
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	96e	63bcd	93de
Pronamide/Terbacil	1.68 + 1.12	93de	80cde	87cde
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 42. Dandelion control ratings at site two for the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0a	0a	0a
Pronamide	1.68	0a	0a	46b
Simazine	1.46	77bcd	70b	67bcd
Metribuzin	0.56	--	--	--
Terbacil	1.12	--	--	--
Pronamide + Simazine	1.68 + 1.46	77bcd	77bc	76bcd
Pronamide + Metribuzin	1.68 + 0.56	63b	70b	50bc
Pronamide + Terbacil	1.68 + 1.12	--	--	--
Spring Treatments				
Metribuzin	1.12	100e	83bcd	77bcd
Terbacil	1.12	100e	100c	93e
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100e	96dc	87e
Pronamide/Terbacil	1.68 + 1.12	66bc	96dc	100e
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 43. Dandelion control ratings at site two for the 1982 growing season. Treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0a	0a	0a
Pronamide	1.68	0a	0a	0a
Simazine	1.46	37abcde	30abcd	57bcd
Metribuzin	0.56	40abcde	23abc	40abc
Terbacil	1.12	33abcd	23abc	57bcd
Pronamide + Simazine	1.68 + 1.46	23abc	43bcde	33ab
Pronamide + Metribuzin	1.68 + 0.56	7ab	30abcd	43abc
Pronamide + Terbacil	1.68 + 1.12	27abc	30abcd	57bcd
Spring Treatments				
Metribuzin	1.12	67cdef	40abcde	60bcd
Terbacil	1.12	70def	50bcdef	73bcde
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	50bcde	20ab	47bc
Pronamide/Terbacil	1.68 + 1.12	70def	77fg	73bcde
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 44. White cockle control ratings at site two for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	23de	77bc	66b
Pronamide	1.68	0e	76bc	79ab
Simazine	1.46	40cde	95ab	84ab
Metribuzin	0.56	99a	55c	79ab
Terbacil	1.12	85abc	95ab	97ab
Pronamide + Simazine	1.68 + 1.46	87abc	88ab	86ab
Pronamide + Metribuzin	1.68 + 0.56	81abc	86abc	97ab
Pronamide + Terbacil	1.68 + 1.12	91ab	94ab	71ab
Spring Treatments				
Metribuzin	1.12	97ab	100a	100a
Terbacil	1.12	71bcd	100a	100a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	80abc	93ab	100a
Pronamide/Terbacil	1.68 + 1.12	66bcd	100a	95ab
Control		0e	0d	0c

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 45. First harvest white cockle control ratings at site two for the 1982 growing season. Treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control
Fall Treatments		
Pronamide	1.12	83bcd
Pronamide	1.68	83bcd
Simazine	1.46	73bcd
Metribuzin	0.56	63abc
Terbacil	1.12	96cd
Pronamide + Simazine	1.68 + 1.46	80bcd
Pronamide + Metribuzin	1.68 + 0.56	50ab
Pronamide + Terbacil	1.68 + 1.12	80bcd
Spring Treatments		
Metribuzin	1.12	100d
Terbacil	1.12	96cd
Fall/Spring Treatments		
Pronamide/Metribuzin	1.68 + 1.12	89bcd
Pronamide/Terbacil	1.68 + 1.12	83bcd
Control		0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 46. First harvest white cockle control ratings at site two for the 1982 growing season. Treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	% Control
Fall Treatments		
Pronamide	1.12	43abc
Pronamide	1.68	83bcdef
Simazine	1.46	73bcdef
Metribuzin	0.56	33ab
Terbacil	1.12	56abcde
Pornamide + Simazine	1.68 + 1.46	83bcdef
Pronamide + Metribuzin	1.68 + 0.56	66bcdef
Pronamide + Terbacil	1.68 + 1.12	66bcdef
Spring Treatments		
Metribuzin	1.12	56abcde
Terbacil	1.12	50abcd
Fall/Spring Treatments		
Pronamide/Metribuzin	1.68 + 1.12	57abcde
Pronamide/Terbacil	1.68 + 1.12	76bcdef
Control		0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

good control (Table 47). White cockle ratings were not made at the second and third cuttings in 1982 due to sparse populations.

Shepherd's purse control was very good in 1981 with all treatments except pronamide at 1.12 and 1.68 kg/ha (Table 43). Shepherd's purse was not rated in 1982 as the infestation was very light.

Influence of Herbicides on Forage Composition and Yield

Pagano (24) and Fortino (14) both observed total forage dry matter increases as a result of herbicide applications to established stands with high alfalfa populations. Site two was located in a stand with high alfalfa populations (40 plants/m^2), however, neither forage yield, alfalfa, or broadleaf yield components were affected by any treatments at the first cutting in 1981 with the exception of pronamide (1.68 kg/ha) fall applied and metribuzin (1.12 kg/ha) spring applied which significantly reduced forage yield (Table 49). However, all treatments except simazine (1.46) kg/ha) fall applied and metribuzin (0.56 kg/ha) fall applied caused a significant decrease in grass yield at the first cutting. Few treatments caused significant yield differences in any component at the second and third cuttings although grass yields were reduced by several treatments (Tables 50 & 51). Of the treatments applied in 1981/82 on which botanical separations were performed, only pronamide (1.68 kg/ha) fall applied caused a significant decrease in total yield at the first cutting in 1982 (Table 52). There were no significant differences in alfalfa yield at the first cutting in 1982. All treatments except metribuzin (0.56 kg/ha) fall applied caused a significant decrease in grass yield at the first cutting in 1982. There were no differences in broadleaf yield. Total forage yield was not affected by any treatments at the second cutting (Table 53). Alfalfa

Table 47. First harvest white cockle control ratings at site two for the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control
Fall Treatments		
Pronamide	1.12	66b
Pronamide	1.68	83b
Simazine	1.46	93b
Metribuzin	0.56	-
Terbacil	1.12	-
Pronamide + Simazine	1.68 + 1.46	79b
Pronamide + Metribuzin	1.68 + 0.56	83b
Pronamide + Terbacil	1.68 + 1.12	-
Spring Treatments		
Metribuzin	1.12	100b
Terbacil	1.12	100b
Fall/Spring Treatments		
Pronamide/Metribuzin	1.68 + 1.12	100b
Pronamide/Terbacil	1.68 + 1.12	100b
Control		0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 48. First harvest shepherd's purse control ratings at site two for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control
Fall Treatments		
Pronamide	1.12	40c
Pronamide	1.68	32cd
Simazine	1.46	99ab
Metribuzin	0.56	100a
Terbacil	1.12	100a
Pronamide + Simazine	1.68 + 1.46	95ab
Pronamide + Metribuzin	1.68 + 0.56	90b
Pronamide + Terbacil	1.68 + 1.12	100a
Spring Treatments		
Metribuzin	1.12	100a
Terbacil	1.12	100a
Fall/Spring Treatments		
Pronamide/Metribuzin	1.68 + 1.12	100a
Pronamide/Terbacil	1.68 + 1.12	100a
Control		0d

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 49. First harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	5297a	4309a	0b	1755a
Pronamide	1.68	4547ab	3520a	0b	1027a
Simazine	1.46	6485a	3177a	322ab	2986a
Metribuzin	0.56	6555ab	3999a	231ab	1324a
Terbacil	1.12	4872ab	4214a	0b	657a
Pronamide + Simazine	1.68 + 1.46	4356ab	3680a	0b	677a
Pronamide + Metribuzin	1.68 + 0.56	5398ab	4598a	171b	629a
Pronamide + Terbacil	1.68 + 1.12	4250ab	3823a	0b	427a
Spring Treatments					
Metribuzin	1.12	4401ab	4178a	0b	223a
Terbacil	1.12	4273ab	4130a	0b	142a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	4216ab	4217a	0b	0a
Pronamide/Terbacil	1.68 + 1.12	2789b	2654a	0b	134a
None		5841a	3754a	506a	1580a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 50. Second harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	3909a	3672ab	725b	229a
Pronamide	1.68	3590a	3442abc	0b	148a
Simazine	1.46	3757a	3574abc	24b	159a
Metribuzin	0.56	3870a	3067abc	303a	499a
Terbacil	1.12	4401a	4334a	27b	40a
Pronamide + Simazine	1.68 + 1.46	2587a	2305c	11b	272a
Pronamide + Metribuzin	1.68 + 0.56	3898a	3720a	0b	177a
Pronamide + Terbacil	1.68 + 1.12	3259a	3156abc	0b	103a
Spring Treatments					
Metribuzin	1.12	4205a	4174a	0b	31a
Terbacil	1.12	3394a	3383abc	0b	11a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	3489a	3398abc	0b	90a
Pronamide/Terbacil	1.68 + 1.12	3461a	3290abc	0b	172a
None		3662a	2363bc	265a	1033a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 51. Third harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	2218a	2105a	5b	107a
Pronamide	1.68	1719cd	1668bc	1b	50a
Simazine	1.46	2100abc	2061ab	8b	30a
Metribuzin	0.56	2162ab	2065ab	31b	65a
Terbacil	1.12	1831abcd	1775abc	15b	38a
Pronamide + Simazine	1.68 + 1.46	1685d	1641c	0b	66a
Pronamide + Metribuzin	1.68 + 0.56	1848abcd	1833abc	1b	15a
Pronamide + Terbacil	1.68 + 1.12	2049abcd	2023abc	1b	26a
Spring Treatments					
Metribuzin	1.12	2083abc	2056ab	1b	25a
Terbacil	1.12	2162ab	2153a	0b	9a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	1825abcd	1795abc	1b	29a
Pronamide/Terbacil	1.68 + 1.12	1881abcd	1849abc	1b	31a
None		1809bcd	1675bc	63a	70a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 52. First harvest yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	3768a	3609a	10a	149a
Metribuzin	0.56	4378ab	4000a	574ab	58a
Spring Treatments					
Metribuzin	1.12	3785ab	3784a	0a	0a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	4320ab	4295a	6a	19a
None		5021b	3930a	971b	121a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 53. Second harvest yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	3256a	2979ab	14a	263a
Metribuzin	0.56	2964a	2741ab	206a	16a
Spring Treatments					
Metribuzin	1.12	2982a	2913ab	55a	0a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	3325a	3308b	0a	17a
None		3192a	2558a	548b	85a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 54. Third harvest yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2336a	1744a	35a	510a
Metribuzin	0.56	2604a	1492a	635cd	477a
Spring Treatments					
Metribuzin	1.12	2532a	1904a	305abc	323a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2905a	2585a	112ab	209a
None		2751a	1759a	795d	197a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

yield was increased by pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied. Results were similar at the third cutting (Table 54).

For treatments applied in both 1980/81 and 1981/82 (Table 55), both metribuzin (1.12 kg/ha) spring applied and this treatment in combination with pronamide (1.68 kg/ha) fall applied caused significant decreases in total forage yield in 1982. There were no differences in total alfalfa yield. Total forage or alfalfa yield was not affected at the second or third cuttings by any treatments except pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied which caused a significant increase in alfalfa yield at the second cutting (Table 56 & 57). For treatments applied in 1980/81 there were no significant differences in either total forage yield or alfalfa yield at any cutting in 1982 (Tables 58, 59, 60).

There were no significant differences in either season total forage yield or season total alfalfa yield from any treatments regardless of application time in 1981 or 1982 (Tables 61, 62, 63, 64). Before weeds can cause a reduction in total alfalfa yield they must be dense enough to compete with the alfalfa for nutrients, water and light. If the weed pressure is such that this is not occurring, total alfalfa yield will not increase as a result of weed removal. This appears to have occurred at the second site.

Influence of Herbicide Treatments on Forage Quality

Protein content was increased at the first harvest by all analyzed treatments in 1981, except metribuzin (0.56 kg/ha) fall applied (Table 65). All treatments which increased forage protein percentage also increased alfalfa percentage, except pronamide (1.68 kg/ha) fall applied (Table 66).

Table 55. First harvest yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1980/81 and 1981/82.

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	3997abc	3319a	21a	614bc
Spring Treatments					
Metribuzin	1.12	3785ab	3785a	0a	0a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	3041a	3038a	0a	3a
None		5021c	3930a	971b	121ab

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 56. Second harvest yield of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1980/81 and 1981/82.

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2820a	2494a	7a	320a
Metribuzin	0.56	--	--	--	--
Spring Treatments					
Metribuzin	1.12	3089a	3089abc	0a	0a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	3301a	3217bc	22a	61a
None		3192a	2558a	548b	85a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 57. Third harvest yield of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2729a	1487a	83ab	1158b
Metribuzin	0.56	--	--	--	--
Spring Treatments					
Metribuzin	1.12	2693a	1882a	165ab	647ab
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2682a	1973a	32a	676ab
None		2751a	1759a	795c	197a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 58. First harvest yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	4056a	3638a	10a	408ab
Metribuzin	0.56	4551a	3507a	780b	267a
Spring Treatments					
Metribuzin	1.12	4254a	3434a	21a	488ab
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	4570a	3701a	38a	831b
None		5021a	3930a	971b	121a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 59. Second harvest yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	3072a	2596ab	0a	475b
Metribuzin	0.56	3219a	2148a	565b	506b
Spring Treatments					
Metribuzin	1.12	3200a	2901b	0a	298ab
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2936a	2546ab	5a	385ab
None		3192a	2558ab	565b	85a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 60. Third harvest yield of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site two for the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2523a	1864a	266ab	392ab
Metribuzin	0.56	2736a	1615a	523bc	599abc
Spring Treatments					
Metribuzin	1.12	2828a	1603a	239ab	985bc
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2657a	1677a	53a	927bc
None		2751a	1759a	795c	197a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 61. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site two in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa
Fall Treatments			
Pronamide	1.12	11492a	10087a
Pronamide	1.68	9856a	8991a
Simazine	1.46	12343a	8996a
Metribuzin	0.56	11586a	9135a
Terbacil	1.12	11105a	10549a
Pronamide + Simazine	1.68 + 1.46	8651a	8064a
Pronamide + Metribuzin	1.68 + 0.56	11144a	10151a
Pronamide + Terbacil	1.68 + 1.12	9684a	9280a
Spring Treatments			
Metribuzin	1.12	10690a	10445a
Terbacil	1.12	9828a	10055a
Fall/Spring T tments			
Pronamide/Metribuzin	1.68 + 1.12	9506a	9421a
Pronamide/Terbacil	1.68 + 1.12	8116a	7861a
None		11312a	8694a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 62. Season total dry matter yields of total forage and alfalfa as influenced by herbicide treatments at site two in the 1982 growing season. Treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Yield (kg/ha) Alfalfa
Fall Treatments			
Pronamide	1.68	9313a	8333a
Metribuzin	0.56	10199a	8232a
Spring Treatments			
Metribuzin	1.12	9284a	8601a
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	10550a	10187a
None		10964a	8247a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 63. Season total dry matter yields of total forage and alfalfa as influenced by herbicide treatments at site two in the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha)	
		Total Forage	Alfalfa
Fall Treatments			
Pronamide	1.68	9486a	7104a
Metribuzin	0.56	--	--
Spring Treatments			
Metribuzin	1.12	9546a	8735a
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	8854a	8062a
None		10964a	8247a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 64. Season total dry matter yields of total forage and alfalfa as influenced by herbicide treatments at site two in the 1982 growing season. Treatments appplied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa
Fall Treatments			
Pronamide	1.68	9650a	8098a
Metribuzin	0.56	10503a	7269a
Spring Treatments			
Metribuzin	1.12	9969a	7939a
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	10163a	7924a
None		10964a	8247a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 65. First harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site two in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	16.48a	55.19a	45.93a
Metribuzin	0.56	14.21b	51.81a	51.37a
Spring Treatments				
Metribuzin	1.12	16.59a	52.88a	47.60a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	16.78a	53.47a	46.03a
None		13.34b	53.32a	46.83a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 66. Percent alfalfa, grass and broadleaf weeds present in first harvest forage as influenced by herbicide treatment at site two in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Alfalfa	% Grass	% Broadleaf Weeds
Fall Treatments				
Pronamide	1.68	84.81abc	0b	15.19ab
Metribuzin	0.56	71.82ab	2.79b	25.39a
Spring Treatments				
Metribuzin	1.12	96.30cd	0b	3.70b
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	100d	0b	0b
None		64.66a	8.37a	26.97a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Between treatments which provided a protein increase over the untreated check, there was no significant difference in protein content. Forage treated with pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied contained 100% alfalfa and 16.78% protein. Forage from the untreated check contained 64.66% alfalfa and 13.34% protein. There were no significant differences in protein content between treated plots and the untreated check at the second and third harvest (Tables 67 and 68). There was no difference in IVDDM or ADF at any cutting in 1981 (Tables 65, 67, 68).

There were no significant differences in percent protein, IVDDM or ADF with any treatment at any cutting in 1982 (Tables 69, 70, 71). Although all treatments resulted in forage containing a high percentage of alfalfa, the forage from the untreated check contained 79.52% alfalfa and 18.11% protein (Table 72). This high alfalfa percentage and protein content in the untreated forage resulted in no significant increases in protein content when weeds were removed by herbicide treatment.

Table 67. Second harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site two in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	18.07a	57.33a	40.87a
Metribuzin	0.56	18.92a	54.34a	40.67a
Spring Treatments				
Metribuzin	1.12	18.40a	58.75a	40.47a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	17.70a	52.85a	41.13a
None		17.68a	56.39a	40.58a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 68. Third harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site two in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	23.28a	61.96a	30.77a
Metribuzin	0.56	22.51a	61.19a	33.06a
Spring Treatments				
Metribuzin	1.12	21.42a	59.12a	33.92a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	22.93a	61.41a	31.75a
None		22.86a	61.53a	31.13a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 69. First harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site two in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	17.81a	68.26a	36.77a
Metribuzin	0.56	18.07a	66.10a	37.90a
Spring Treatments				
Metribuzin	1.12	18.45a	65.99a	38.05a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	17.13a	65.43a	40.12a
None		18.11a	63.40a	35.76a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 70. Second harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site two in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	16.99a	66.18a	34.27a
Metribuzin	0.56	17.50a	67.44a	33.60a
Spring Treatments				
Metribuzin	1.12	18.29a	64.69a	33.51a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	17.67a	66.22a	32.15a
None		18.42a	65.99a	31.78a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 71. Third harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site two in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	17.10a	66.42a	26.80a
Metribuzin	0.56	17.94a	67.01a	26.79a
Spring Treatments				
Metribuzin	1.12	17.15a	65.23a	27.67a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	17.02a	65.34a	28.79a
None		18.83a	66.54a	27.64a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 72. Percent alfalfa, grass and broadleaf weeds present in first harvest forage as influenced by herbicide treatment at site two in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	% Alfalfa	% Grass	% Broadleaf Weeds
Fall Treatments				
Pronamide	1.68	95.62ab	0.23b	4.15a
Metribuzin	0.56	85.21ab	13.19a	1.26a
Spring Treatments				
Metribuzin	1.12	100a	0b	0a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	99.39a	0.16b	0.45a
None		79.52b	18.03a	2.45a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

SITE III

Weed Control

Experiment 3 was located in a good stand of alfalfa (59 plants/m^2) in which there was severe weed pressure. Weeds present were quackgrass, dandelion and white cockle. There were several treatments which provided good quackgrass control in this experiment. Results in 1981 (Table 73) and 1982 (Table 74) were quite similar. At the first cutting, pronamide at 1.12 kg/ha and 1.68 kg/ha both provided good quackgrass control. The two rates were not significantly different. Pronamide (1.68 kg/ha) fall applied in combination with simazine (1.46 kg/ha), metribuzin (0.56 kg/ha) or terbacil (1.12 kg/ha) all exhibited good quackgrass control. However, they were no better than pronmaide alone. Metribuzin (0.56 kg/ha) or simazine (1.46 kg/ha) applied alone in the fall did not provide quackgrass control. Terbacil (1.12 kg/ha) fall applied alone did give good quackgrass control in 1982 (Table 34). This treatment was not applied in 1981. Although metribuzin (1.12 kg/ha) spring applied exhibited fair to good quackgrass control at sites one and two, it did not in this experiment. This is perhaps due to the much heavier quackgrass stand present at site three as well as a very dry spring in 1982. Terbacil (1.12 kg/ha) spring applied did provide good quackgrass control. Pronamide (1.68 kg/ha) fall applied followed by a spring application of either metribuzin (1.12 kg/ha) or terbacil (1.15 kg/ha) provided good quackgrass control, but no better than the pronamide alone. Quackgrass control was less in the second and third cuttings for the majority of the treatments. Pronamide (1.68 kg/ha) fall applied showed poor quackgrass control in both cuttings in 1982 (Table 34). Control was improved with this treatment if it was followed by a spring application

Table 73. Quackgrass control ratings at site three for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	99a	89ab	71abc
Pronamide	1.68	100a	71bcd	80abc
Simazine	1.46	38c	39de	41cd
Metribuzin	0.56	26c	58cd	49bcd
Terbacil	1.12	--	--	--
Pronamide + Simazine	1.68 + 1.46	99a	92ab	66abc
Pronamide + Metribuzin	1.68 + 0.56	100a	93ab	61bcd
Pronamide + Terbacil	1.68 + 1.12	100a	90abc	89abc
Spring Treatments				
Metribuzin	1.12	74b	79bc	73abc
Terbacil	1.12	99a	100a	99a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100a	91a	75abc
Pronamide/Terbacil	1.68 + 1.12	100a	100a	93ab
Control		0d	0e	0d

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 74. Quackgrass control ratings at site three for the 1982 growing season. Treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	94d	70cde	65bcdef
Pronamide	1.68	97d	50bcd	52bcd
Simazine	1.46	32b	22ab	57bcde
Metribuzin	0.56	47bc	42bc	50bc
Terbacil	1.12	87d	75cde	82defgh
Pronamide + Simazine	1.68 + 1.46	100d	85ef	80defgh
Pronamide + Metribuzin	1.68 + 0.56	94d	60bcde	60bcdef
Pronamide + Terbacil	1.68 + 1.12	97d	60bcde	70bcdefg
Spring Treatments				
Metribuzin	1.12	65bc	50bcd	45b
Terbacil	1.12	82d	84ef	85efgh
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100d	77cdef	70bcdefg
Pronamide/Terbacil	1.68 + 1.12	100d	85ef	82defgh
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

of either metribuzin or terbacil at 1.12 kg/ha, although this control was no better than terbacil alone. Metribuzin (1.12 kg/ha) spring applied provided poor quackgrass control throughout the season in 1982 and only fair control in 1981.

For treatments which were applied in both 1980/81 and 1981/82, all provided good quackgrass control throughout the season in 1982 except simazine (1.46 kg/ha) and metribuzin (1.12 kg/ha) spring applied (Table 75). These treatments provided only poor to fair control.

For treatments which were applied in 1980/81, few treatments gave good, season long control in 1982 (Table 76). Terbacil (1.12 kg/ha) spring applied, or this treatment preceded by a fall application of pronamide (1.68 kg/ha), gave good quackgrass control in 1982. All other treatments provided only poor to fair quackgrass control in 1982.

Dandelion control was variable at site 3, but few treatments gave good consistent control. Pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) or terbacil (1.12 kg/ha) in the spring provided the highest levels of dandelion control in 1981 (Table 77) and 1982 (Table 78). All other treatments gave poor to fair control.

Treatments applied in both 1980/81 and 1981/82 appeared to give slightly better dandelion control in 1982 (Table 79). Compared to the 1982 application alone, those treatments which provided good, season long dandelion control when applied in both years were metribuzin (1.12 kg/ha) or terbacil (1.12 kg/ha) applied in the spring. Other treatments provided only fair control.

Of the treatments applied in 1980/81, only pronamide (1.68 kg/ha) + terbacil (1.12 kg/ha) provided good dandelion control in 1982 (Table 80). This control decreased toward the end of the season.

Table 75. Quackgrass control ratings at site three for the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	100c	80cd	75bcd
Pronamide	1.68	84c	82cd	82bcd
Simazine	1.46	17ab	45b	55b
Metribuzin	0.56	--	--	--
Terbacil	1.12	--	--	--
Pronamide + Simazine	1.68 + 1.46	100c	85cd	80bcd
Pronamide + Metribuzin	1.68 + 0.56	74c	85cd	92d
Pronamide + Terbacil	1.68 + 1.12	--	--	--
Spring Treatments				
Metribuzin	1.12	65c	65bc	65bc
Terbacil	1.12	92c	87cd	87cd
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	100c	87cd	85cd
Pronamide/Terbacil	1.68 + 1.12	100c	97d	94d
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 76. Quackgrass control ratings at site three for the 1982 growing season. Treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	60cdef	50bcde	72cdefg
Pronamide	1.68	67cdefg	45bc	57bcde
Simazine	1.46	17ab	17ab	20ab
Metribuzin	0.56	37bc	52bcde	65cdef
Terbacil	1.12	--	--	--
Pronamide + Simazine	1.68 + 1.46	52cde	37abc	57bcde
Pronamide + Metribuzin	1.68 + 0.56	42bcd	47bcd	55bcd
Pronamide + Terbacil	1.68 + 1.12	69cdefg	57bcdef	57bcde
Spring Treatments				
Metribuzin	1.12	42bcd	35abc	40bc
Terbacil	1.12	100g	77defg	85efgh
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	70cdefg	57bcdef	70cdefg
Pronamide/Terbacil	1.68 + 1.12	97g	87fg	85efgh
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 77. Dandelion control ratings at site three for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0g	25f	29cd
Pronamide	1.68	0g	33ef	5d
Simazine	1.46	28f	48de	25cd
Metribuzin	0.56	51de	69bc	67ab
Terbacil	1.12	--	--	--
Pronamide + Simazine	1.68 + 1.46	42e	56cd	48bc
Pronamide + Metribuzin	1.68 + 0.56	0g	48de	20cd
Pronamide + Terbacil	1.68 + 1.12	58d	75ab	74a
Spring Treatments				
Metribuzin	1.12	70c	71bc	48bc
Terbacil	1.12	81b	75ab	61ab
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	80b	81ab	62ab
Pronamide/Terbacil	1.68 + 1.12	90a	85a	76a
Control		0g	0g	0d

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 78. Dandelion control ratings at site three for the 1982 growing season. Treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0a	0a	0a
Pronamide	1.68	0a	5a	0a
Simazine	1.46	57bcd	60bcde	57b
Metribuzin	0.56	50bc	47bc	70bcd
Terbacil	1.12	65cde	60bcde	70bcd
Pronamide + Simazine	1.68 + 1.46	42bc	62bcde	65bc
Pronamide + Metribuzin	1.68 + 0.56	27ab	37b	65bc
Pronamide + Terbacil	1.68 + 1.12	65cde	70cdef	72bcd
Spring Treatments				
Metribuzin	1.12	70cde	52bcd	62bc
Terbacil	1.12	67cde	57bcd	67bcd
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	87ef	87fg	72bcd
Pronamide/Terbacil	1.68 + 1.12	85def	87fg	82de
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 79. Dandelion control ratings at site three for the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	17ab	20ab	0a
Pronamide	1.68	0a	0a	0a
Simazine	1.46	62cd	70c	67b
Metribuzin	0.56	--	--	--
Terbacil	1.12	--	--	--
Pronamide + Simazine	1.68 + 1.46	67cde	75c	72b
Pronamide + Metribuzin	1.68 + 0.56	47bc	75c	70b
Pronamide + Terbacil	1.68 + 1.12	--	--	--
Spring Treatments				
Metribuzin	1.12	94f	87d	77c
Terbacil	1.12	62cd	80c	77c
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	89ef	72c	77c
Pronamide/Terbacil	1.68 + 1.12	94f	94d	87c
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 80. Dandelion control ratings at site three for the 1982 growing season. Treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0a	0a	0a
Pronamide	1.68	15abc	0a	0a
Simazine	1.46	10ab	20ab	40bc
Metribuzin	0.56	47bcd	42bcde	47bcdef
Terbacil	1.12	--	--	--
Pronamide + Simazine	1.68 + 1.46	57de	40bcde	45bcde
Pronamide + Metribuzin	1.68 + 0.56	15abc	22ab	32b
Pronamide + Terbacil	1.68 + 1.12	45bcd	40bcde	45bcde
Spring Treatments				
Metribuzin	1.12	57de	25abc	42bcd
Terbacil	1.12	47bcd	50cdef	50bcdefg
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	47bcd	35bcd	47bcdef
Pronamide/Terbacil	1.68 + 1.12	85ef	72fg	57cdefgh
Control		0a	0a	0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

White cockle control was good in 1981 (Table 81) and 1982 (Table 82) with metribuzin or terbacil spring applied at 1.12 kg/ha or these treatments in combination with fall applied pronamide. Although, control with the treatments including pronamide was no better than those without. No other treatments provided good control in both 1981 and 1982. Results were similar in 1982 for treatments which were applied in both 1980/81 and 1981/82 (Table 83) and treatments applied in 1980/81 (Table 84). The 1980/81 treatments provided somewhat less control. The reduction in white cockle control with these treatments was not as severe as that observed with quackgrass or dandelion.

Influence of Herbicides on Forage Composition and Yield

Pronamide (1.68 kg/ha) fall applied + terbacil (1.12 kg/ha) spring applied significantly reduced total forage yield at the first cutting in 1981 at site 3 (Table 85). None of the other treatments effected forage yield. Alfalfa yield at the first cutting was significantly increased by several treatments including: metribuzin (0.56 kg/ha) fall applied; pronamide (1.68 kg/ha) + terbacil (1.12 kg/ha) fall applied; metribuzin (1.12 kg/ha) spring applied; terbacil (1.12 kg/ha) spring applied; and pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied. Only metribuzin (0.56 kg/ha) fall applied affected grass yield. This treatment had higher grass yield compared to the untreated check. This could be caused by a reduction in broadleaf weed competition provided by the treatment combined with very little grass control at this low rate. This would allow the grass yield to increase.

Several treatments caused signifcant reductions in broadleaf weed yield at the first cutting. The most effective were pronamide (1.68 kg/ha)

Table 81. White cockle control ratings at site three for the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Control Harvest I	Harvest II	Harvest III
Fall Treatments				
Pronamide	1.12	0d	73cd	99a
Pronamide	1.68	0d	65cd	87a
Simazine	1.46	85ab	82bcd	100a
Metribuzin	0.56	62bc	83bcd	88a
Terbacil	1.12	--	--	--
Pronamide + Simazine	1.68 + 1.46	50c	87abc	97a
Pronamide + Metribuzin	1.68 + 0.56	0d	55d	92a
Pronamide + Terbacil	1.68 + 1.12	82ab	86abcd	91a
Spring Treatments				
Metribuzin	1.12	91a	99a	87a
Terbacil	1.12	86ab	97ab	93a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68 + 1.12	85ab	91abc	97a
Pronamide/Terbacil	1.68 + 1.12	73abc	97ab	95a
Control		0d	0e	0b

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 82. First harvest white cockle control ratings at site three for the 1982 growing season. Treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control
Fall Treatments		
Pronamide	1.12	75bcde
Pronamide	1.68	46bc
Simazine	1.46	72bcde
Metribuzin	0.56	57bcde
Terbacil	1.12	52bcd
Pronamide + Simazine	1.68 + 1.46	42b
Pronamide + Metribuzin	1.68 + 0.56	65bcde
Pronamide + Terbacil	1.68 + 1.12	80bcde
Spring Treatments		
Metribuzin	1.12	92de
Terbacil	1.12	65bcde
Fall/Spring Treatments		
Pronamide/Metribuzin	1.68 + 1.12	92de
Pronamide/Terbacil	1.68 + 1.12	84bcde
Control		0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 83. First harvest white cockle control ratings at site three for the 1982 growing season. Treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	% Control
Fall Treatments		
Pronamide	1.12	60bc
Pronamide	1.68	65bc
Simazine	1.46	77bc
Metribuzin	0.56	--
Terbacil	1.12	--
Pronamide + Simazine	1.68 + 1.46	75bc
Pronamide + Metribuzin	1.68 + 0.56	50b
Pronamide + Terbacil	1.68 + 1.12	--
Spring Treatments		
Metribuzin	1.12	97c
Terbacil	1.12	100c
Fall/Spring Treatments		
Pronamide/Metribuzin	1.68 + 1.12	97c
Pronamide/Terbacil	1.68 + 1.12	97c
Control		0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 84. First harvest white cockle control ratings at site three for the 1982 growing season. Treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	% Control
Fall Treatments		
Pronamide	1.12	55bcde
Pronamide	1.68	57bcde
Simazine	1.46	27ab
Metribuzin	0.56	64bcde
Terbacil	1.12	--
Pronamide + Simazine	1.68 + 1.46	62bcde
Pronamide + Metribuzin	1.68 + 0.56	37abc
Pronamide + Terbacil	1.68 + 1.12	50bcd
Spring Treatments		
Metribuzin	1.12	80cde
Terbacil	1.12	84de
Fall/Spring Treatments		
Pronamide/Metribuzin	1.68 + 1.12	70bcde
Pronamide/Terbacil	1.68 + 1.12	89de
Control		0a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 85. First harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	5365a	2801abc	36c	2528ab
Pronamide	1.68	4654a	2332bc	535ab	1786abc
Simazine	1.46	5040a	2850abc	581ab	1608bc
Metribuzin	0.56	5185a	3763ab	806a	617de
Terbacil	1.12	--	--	--	--
Pronamide + Simazine	1.68 + 1.46	4457a	3247abc	26c	1185cd
Pronamide + Metribuzin	1.68 + 0.56	4771a	2984abc	20c	1815abc
Pronamide + Terbacil	1.68 + 1.12	4833a	3941ab	0c	892cde
Spring Treatments					
Metribuzin	1.12	5185a	3471ab	361bc	260de
Terbacil	1.12	4513a	4209a	0c	304de
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	4530a	4409a	0c	121e
Pronamide/Terbacil	1.68 + 1.12	2940b	2868abc	14c	57e
None		4754a	1804c	266bc	2684a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

fall applied + metribuzin (1.12 kg/ha) spring applied and pronamide (1.68 kg/ha) fall applied + terbacil (1.12 kg/ha) spring applied. Treatments with no reduction in broadleaf weed yields were pronamide (1.12 kg/ha or 1.68 kg/ha) fall applied and pronamide (1.68 kg/ha) + metribuzin (0.56 kg/ha) fall applied.

Total forage, grass, and broadleaf weed yields were not affected by any treatments at the second cutting (Table 86). No treatments produced significant alfalfa yield increases over the untreated check, but there were differences between some treatments. At the third cutting, no treatments effected total forage, alfalfa, grass, or broadleaf weed yield (Table 87).

There were no significant effects on season total forage yields from any treatments compared to the untreated check in 1981, but several treatments showed significant increases in season total alfalfa yield (Table 88).

Unlike 1981, in 1982 none of the treatments applied only in 1981/82 significantly affected total forage yield or alfalfa yield at the first (Table 89), second (Table 90), or third harvests (Table 91). Similarly, season total forage or season total alfalfa yield was not significantly changed by any herbicide treatment in 1982 except spring applied metribuzin (Table 92). Season total alfalfa yield was significantly increased by a spring application of metribuzin (1.12 kg/ha).

Treatments applied in 1980/81 also did not affect total forage yield or alfalfa at any of the three harvests (Tables 93, 94, and 95). Season total forage yield and season total alfalfa yield also were not altered in 1982 by the treatments in 1980/81 (Table 96).

Metribuzin (1.12 kg/ha) spring applied and pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied both caused

Table 86. Second harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	1803a	1004e	73a	726a
Pronamide	1.68	2001a	1476abcde	20a	505a
Simazine	1.46	1770a	1118de	291a	360a
Metribuzin	0.56	3270a	2560a	188a	521a
Terbacil	1.12	--	--	--	--
Pronamide + Simazine	1.68 + 1.46	2744a	2175abc	8a	561a
Pronamide + Metribuzin	1.68 + 0.56	2576a	1816abcde	27a	732a
Pronamide + Terbacil	1.68 + 1.12	2391a	1899abcde	12a	480a
Spring Treatments					
Metribuzin	1.12	3080a	2741a	79a	259a
Terbacil	1.12	2687a	2341ab	0a	347a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	2655a	2092abcd	25a	537a
Pronamide/Terbacil	1.68 + 1.12	2262a	1271cde	946a	44a
None		2139a	1364abcde	33a	741a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 87. Third harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.12	1798a	1213a	360a	224a
Pronamide	1.68	2094a	1687a	141a	266a
Simazine	1.46	2156a	1759a	95a	302a
Metribuzin	0.56	1853a	1162a	69a	615a
Terbacil	1.12	--	--	--	--
Pronamide + Simazine	1.68 + 1.46	2946a	2513a	10a	422a
Pronamide + Metribuzin	1.68 + 0.56	2046a	1709a	5a	331a
Pronamide + Terbacil	1.68 + 1.12	1898a	1681a	2a	215a
Spring Treatments					
Metribuzin	1.12	2385a	2068a	133a	184a
Terbacil	1.12	2162a	2009a	9a	143a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68 + 1.12	2385a	2068a	83a	273a
Pronamide/Terbacil	1.68 + 1.12	1792a	1664a	7a	133a
None		1657a	1441a	46a	170a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 88. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site three in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Yield (kg/ha) Alfalfa
Fall Treatments			
Pronamide	1.12	8966ab	4917f
Pronamide	1.68	8749ab	5580ef
Simazine	1.46	8966ab	5751def
Metribuzin	0.56	10309a	7988abc
Terbacil	1.12	--	--
Pronamide + Simazine	1.68 + 1.46	10147a	7855abc
Pronamide + Metribuzin	1.68 + 0.56	9393a	6530cdef
Pronamide + Terbacil	1.68 + 1.12	8966ab	7590abcd
Spring Treatments			
Metribuzin	1.12	10651a	9211a
Terbacil	1.12	9363a	8427abc
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68 + 1.12	9571a	8789ab
Pronamide/Terbacil	1.68 + 1.12	6994b	6967bcde
None		8551ab	5262ef

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 89. First harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	4204a	3645a	33a	526a
Metribuzin	0.56	4210a	2849a	704a	656a
Spring Treatments					
Metribuzin	1.12	4183a	3687a	225a	257a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	3274a	3128a	23a	122a
None		4215a	2452a	388a	1374a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 90. Second harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2975ab	2169ab	1067a	374ab
Metribuzin	0.56	2577a	1770a	548a	259a
Spring Treatments					
Metribuzin	1.12	3033ab	2393ab	309a	330ab
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	3371b	2681bc	464a	228a
None		2890ab	1896ab	344a	599b

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 91. Third harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1981/82.

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2291a	1636a	211a	444a
Metribuzin	0.56	2374a	1777a	245a	351a
Spring Treatments					
Metribuzin	1.12	2583a	2131a	165a	287a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2369a	1918a	111a	339a
None		2600a	1789a	156a	655a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 92. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Yield (kg/ha) Alfalfa
Fall Treatments			
Pronamide	1.68	10223a	7453ab
Metribuzin	0.56	9056a	6391ab
Spring Treatments			
Metribuzin	1.12	9761a	8211b
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	9067a	7728ab
None		9448a	5916a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 93. First harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	4088a	2127a	983ab	978a
Metribuzin	0.56	3613a	1912a	1218b	483a
Spring Treatments					
Metribuzin	1.12	4026a	2615a	841ab	570a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	3974a	2917a	532ab	524a
None		4215a	2452a	388a	1374a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 94. Second harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2528a	1678a	372a	478a
Metribuzin	0.56	2653a	1971a	375a	307a
Spring Treatments					
Metribuzin	1.12	2748a	1762a	502a	444a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2802a	2189a	177a	435a
None		2890a	1896a	344a	599a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 95. Third harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2143a	1222a	438a	483a
Metribuzin	0.56	2652a	1700a	275a	676a
Spring Treatments					
Metribuzin	1.12	2433a	1640a	288a	505a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2431a	1776a	282a	380a
None		2600a	1789a	156a	655a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 96. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1980/81.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Yield (kg/ha) Alfalfa
Fall Treatments			
Pronamide	1.68	8760a	5027a
Metribuzin	0.56	8926a	5591a
Spring Treatments			
Metribuzin	1.12	9029a	6004a
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	9213a	6883a
None		9448a	5916a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

significant alfalfa yield increases when applied in both 1980/81 and 1981/82 (Table 97). This effect did not persist into the second harvest (Table 98). At the second cutting, there were no effects on total forage yield or alfalfa yield for any treatments except pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied which caused a significant increase in alfalfa yield. The same was true at the third cutting (Table 99). Season total alfalfa yield was significantly increased by pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied in both 1980/81 and 1981/82 and by metribuzin (1.12 kg/ha) applied in the spring of 1981 and again in the spring of 1982 (Table 100).

Influence of Herbicide Treatments on Forage Quality

Only pronamide (1.68 kg/ha) fall applied + metribuzin (1.12 kg/ha) spring applied resulted in a significant protein increase in the forage at the first cutting in 1981 (Table 101). This treatment also resulted in the largest increase in forage alfalfa content (Table 102). Forage receiving this treatment contained 97.10% alfalfa and 19.46% protein. Forage from the untreated check contained 37.39% alfalfa and 16.29% protein. There were no significant differences in protein content at either the second (Table 103) or third (Table 104) harvests in 1981. There also were no differences in IVDMD or ADF content at any cutting at this site in 1981 (Tables 101, 103, 104).

In 1982, pronamide (1.68 kg/ha) fall applied and this treatment followed by a spring application of metribuzin (1.12 kg/ha) both resulted in a significant increase in forage protein content (Table 105). Both treatments also resulted in an increase in alfalfa percentage in the forage (Table 106). Metribuzin (1.12 kg/ha) spring applied also resulted

Table 97. First harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1980/81 and 1981/82.[a]

Rate	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	4329a	3234ab	8a	847a
Metribuzin	0.56	--	--	--	--
Spring Treatments					
Metribuzin	1.12	4749a	4201b	511a	36a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	4109a	4043b	3a	62a
None		4215a	2452a	388a	1374a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 98. Second harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2885a	2228a	5a	652b
Metribuzin	0.56	--	--	--	--
Spring Treatments					
Metribuzin	1.12	3074a	2531ab	531a	11a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	3326a	3299b	5a	20a
None		2890a	1896a	534a	599b

[a]Values in each column followed by the same letter are not signficantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 99. Third harvest dry matter yields of total forage, alfalfa, grass and broadleaf weeds as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha) Total Forage	Alfalfa	Grass	Broadleaf Weeds
Fall Treatments					
Pronamide	1.68	2733a	2180ab	14a	539a
Metribuzin	0.56	--	--	--	--
Spring Treatments					
Metribuzin	1.12	2774a	2302ab	339a	132a
Fall/Spring Treatments					
Pronamide/Metribuzin	1.68/1.12	2765a	2591b	11a	163a
None		2600a	1789a	156a	655a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 100. Season total dry matter yields of forage and alfalfa as influenced by herbicide treatments at site three in the 1982 growing season for treatments applied in 1980/81 and 1981/82.[a]

Herbicide	Rate (kg/ha)	Yield (kg/ha)	
		Total Forage	Alfalfa
Fall Treatments			
Pronamide	1.68	9947a	7642ab
Metribuzin	0.56	--	--
Spring Treatments			
Metribuzin	1.12	10596a	9035bc
Fall/Spring Treatments			
Pronamide/Metribuzin	1.68/1.12	10199a	9933c
None		9448a	5916a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 101. First harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site three in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	15.80c	59.73a	43.60a
Metribuzin	0.56	16.00c	57.64a	43.00a
Spring Treatments				
Metribuzin	1.12	18.55ab	58.12a	43.29a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	19.46a	59.30a	41.04a
None		16.29bc	61.09a	41.79a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 102. Percent alfalfa, grass and broadleaf weeds present in first harvest forage as influenced by herbicide treatment at site three in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	% Alfalfa	% Grass	% Broadleaf Weeds
Fall Treatments				
Pronamide	1.68	50.95ab	10.85ab	38.20b
Metribuzin	0.56	71.74bc	15.50a	12.76bc
Spring Treatments				
Metribuzin	1.12	85.18cd	7.08bc	7.74bc
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	97.10e	0c	2.90c
None		37.39a	5.65bc	56.96a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 103. Second harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site three in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	17.08a	58.07a	36.65a
Metribuzin	0.56	16.34a	55.83a	39.99a
Spring Treatments				
Metribuzin	1.12	17.47a	56.30a	37.31a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	18.36a	54.78a	38.51a
None		15.95a	55.37a	40.53a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 104. Third harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site three in the 1981 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	20.32a	60.71a	35.77a
Metribuzin	0.56	22.00a	64.85a	32.99a
Spring Treatments				
Metribuzin	1.12	21.75a	62.46a	35.94a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	21.80a	61.20a	34.33a
None		21.57a	66.31a	35.14a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 105. First harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site three in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	18.45ab	70.26a	34.61abc
Metribuzin	0.56	16.67c	67.37a	36.39ab
Spring Treatments				
Metribuzin	1.12	17.17bc	67.02a	36.63a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	19.01a	67.15a	34.27bc
None		16.22c	68.38a	33.64c

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 106. Percent alfalfa, grass and broadleaf weeds present in first harvest forage as influenced by herbicide treatment at site three in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	% Alfalfa	% Grass	% Broadleaf Weeds
Fall Treatments				
Pronamide	1.68	87.31bc	0.75a	11.94a
Metribuzin	0.56	68.30ab	15.87a	15.83a
Spring Treatments				
Metribuzin	1.12	87.83bc	5.96a	6.21a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	95.85c	0.69a	3.46a
None		59.95a	9.61a	30.44a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

in an increase in forage alfalfa content. This resulted in an increase in a forage protein increase, but this increase was not significant. Forage treated with metribuzin (0.56 kg/ha) fall applied did not contain significantly more alfalfa or protein than the untreated check. Protein content of forage at the second (Table 107) and third (Table 108) cutting was not affected by herbicide treatments.

IVDMD was not affected at site 3 in 1982 by any treatments at any of the three cuttings (Tables 105, 107, 108). ADF content of first cutting forage in 1982 was significantly increased by applications of metribuzin at 0.56 kg/ha fall applied and 1.12 kg/ha spring applied. No other treatments at any cutting had an effect on ADF content.

Table 107. Second harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site three in the 1982 growing season.[a]

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	19.36a	62.76a	31.83b
Metribuzin	0.56	17.90a	63.23a	32.50b
Spring Treatments				
Metribuzin	1.12	18.43a	61.30a	35.36ab
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	18.67a	59.35a	37.39a
None		18.78a	61.08a	34.20ab

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

Table 103. Third harvest protein, in vitro digestible dry matter and acid detergent fiber content of forage at site three in the 1982 growing season.

Herbicide	Rate (kg/ha)	P	IVDDM	ADF
			%DM	
Fall Treatments				
Pronamide	1.68	19.20a	63.38a	30.62a
Metribuzin	0.56	18.65a	52.06a	31.37a
Spring Treatments				
Metribuzin	1.12	18.62a	45.47a	31.75a
Fall/Spring Treatments				
Pronamide/Metribuzin	1.68/1.12	19.20a	46.81a	30.94a
None		18.89a	53.24a	30.38a

[a]Values in each column followed by the same letter are not significantly different at the 0.05 level of probability according to Duncans Multiple Range Test.

GENERAL DISCUSSION

Several general conclusions can be drawn from this research. In terms of weed control efficacy, the herbicide treatments can be grouped into four categories. Metribuzin (0.56 kg/ha) fall applied, terbacil (1.12 kg/ha) fall applied, and simazine (1.40 kg/ha) fall applied all provided control of annual broadleaf weeds, but little control of perennial broadleaves or grasses. Pronamide (1.68 kg/ha) fall applied effectively controlled perennial grasses, but had little or no effect on broadleaf weeds. Spring applications of metribuzin or terbacil at 1.12 kg/ha controlled both annual and perennial broadleaf weed species and had a significant effect on perennial grasses. A combination of fall applied pronamide (1.68 kg/ha), followed by a spring application of either metribuzin or terbacil at 1.12 kg/ha, provided nearly 100% control of both perennial and annual broadleaf and grass species.

Longevity of control from all treatments was poor. Plots which received treatment in 1980/81 with no subsequent application in 1981/82 showed poor weed control in the 1982 growing season. Plots which received treatments in 1980/81 and a second application in 1981/82 showed control in 1982 similar to, but no better than, control in 1981.

Weed control measures were most effective at site II which consisted of a good stand of alfalfa with light weed pressure. At this site, the dense stand of alfalfa was very competitive with the weeds

present which aided in weed control. Also, the alfalfa was better able to compete with weeds for open spaces created by the weed control measures. Weed pressure at sites one and three was severe. Weed control at these two sites was similar, although site one was located in a very sparse stand of alfalfa. Weed control at this site resulted in empty spaces which were filled in by weeds not controlled by the application treatment. Controlling perennial grasses resulted in an increase in broadleaf weeds and vis a verse.

Yield effects from herbicide treatments were observed most dramatically at the first cutting. First cutting forage yields were either reduced or not affected by herbicide treatments. Reductions in forage yield were due to herbicide treatments which removed the weedy component of the forage. Alfalfa yield either increased or remained the same at the first cutting. The effects of herbicide treatments on season total yields were similar to first cutting results. Season total forage yields either decreased or remained the same while season total alfalfa yields either increased or remained the same. As at the first cutting, treatments which caused decreases in total forage yield did so by removing the weed component from the forage. Treatments which provided poor weed control resulted in total forage yields which were not significantly lower than the untreated check due to little or no reduction in the weed component of the forage. Treatments which provided excellent weed control could also result in total forage yields which were not significantly lower than the untreated check due to increases in the alfalfa component of the forage. This was brought about by reduced weed competition with the alfalfa. In some cases, first cutting forage yields were significantly reduced due to removal of the weed component,

but season total forage yields were not significantly different due to the increase alfalfa growth.

Alfalfa yield increases were observed at all three sites, but were observed most often at site three. Site one was a sparse stand of alfalfa which was unable to compete for the additional water and nutrients made available by the weed control measures. Site two was an excellent stand in which the weed pressure present was not a significant yield reducing factor, therefore, the removal of these weeds did not result in significant yield effects. Site three was a good stand of alfalfa with severe weed pressure. The weeds present at this site were a significant factor in limiting alfalfa yield. The stand was also dense enough to respond to the reduced weed pressure. Therefore, of the three sites, treatments at site three resulted in the greatest number of alfalfa yield increases. Alfalfa yield increases were observed in both 1981 and 1982, however, no treatments applied in 1980/81 resulted in alfalfa yield increases in 1982 due to the poor weed control provided by these treatments in 1982.

Of the three parameters chosen to investigate forage quality protein content was the one most affected. In vitro digestible dry matter was not significantly different at any cutting, at any site in either year. Acid detergent fiber content was affected only at the first cutting, at site one in 1981 and site three in 1982. Forage protein content was increased by at least one treatment at the first cutting at all three sites in both years of the study, except the first cutting at site two in 1982. In most, but not all cases, protein increases were observed with treatments which increased alfalfa yield.

If weed control programs in established alfalfa are to be recommended they must represent an economic advantage for the grower

using them. As previously mentioned, of the quality parameters investigated, protein content was the one most affected. Protein increases were observed in at least one case with all treatments tested. In many cases these increases in protein content were accompanied by decreases in total forage yield at the first cutting. When this occurred, the actual increase in total protein harvested/hectare was very small. For this reason calculation of the economic benefits of a treatment should be based on data from treatments which resulted in an increase in forage protein content without decreasing total forage yields. These calculations were performed on treatments meeting this criteria and the results are shown in Table 109. The values in this table are based on the cost of protein as soybean meal. In no case did the savings resulting from protein increases exceed the cost of treatment, indicating these treatments cannot be justified on an economic basis based on increases in protein content.

Increasing stand longevity has been suggested as a potential benefit of weed control programs in established alfalfa. Certainly removing weed competition from an alfalfa stand has this potential, however based upon the results of this study, in order to maintain adequate weed control, annual herbicide applications are necessary. If this is the case, the cost of such a program becomes prohibitive. A more economically feasible approach to the problem of increasing stand longevity, or simply maintaining a relatively weed free stand of alfalfa, seems to be an annual application of simazine (1.46 kg/ha) in the fall. Although this treatment provides only fair control of perennial grasses and broadleaf weeds it is sufficiently inexpensive ($10.00/ha) to be used on an annual basis. Protein analysis was not

Table 109. Savings vs. cost of some herbicide treatments causing significant increases in first harvest forage protein content.

Treatment	Rate kg/ha	Application time	Savings $/ha	Cost
		SITE I 1981		
Pronamide	1.68	Fall	55.47	95.55
Metribuzin	0.56	Fall	25.61	26.43
Metribuzin	1.12	Spring	43.18	52.85
		SITE II 1981		
Pronamide	1.68	Fall	34.85	95.55
Metribuzin	1.12	Spring	36.07	52.85
Pronamide	1.68	Fall +		
Metribuzin	1.12	Spring	38.18	148.40
		SITE III 1981		
Pronamide	1.68	Fall +		
Metribuzin	1.12	Spring	28.63	148.40
		SITE III 1982		
Pronamide	1.68	Fall	17.86	95.55

performed on any forage receiving this treatment, however, metribuzin (0.56 kg/ha) fall applied provides similar control. This treatment provided a significant protein increase only at the first cutting at site one in 1981. Although increases in forage quality may not be realized from the use of simazine, the suppression in weed growth provided by annual applications along with high fertility and timely cutting could prevent weeds from competing too vigorously with the alfalfa and possibly lengthen the life of the stand. There is a need for more work to be done in this area.

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