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INTRODUCTION

Members of the Pennsylvania State University College of Agriculture are conducting a research project in cooperation with the Pennsylvania Department of Transportation. A discussion of the various aspects of roadside right-of-way vegetation management under study are present in this report. Specific topics were identified in part by members of a PennDOT Task Force on roadside maintenance. Interviews with roadside specialists helped locate plot sites and design experiments that would examine the following:

1. Chemical Control of Canada Thistle Growing in Crownvetch and in Grass. Plots were established in Centre, Montour and Lancaster counties. One objective was to test various chemical compounds at different application rates and timings for their ability to control Canada thistle. A second objective was to screen all compounds at each rate used in the studies for possible toxic effects to crownvetch ground cover. A third objective was to determine the best timing for a second chemical application during the same growing season. The most successful control will be known when the thistles emerges from dormancy in the spring of 1987. Data collected thus far is discussed in this report.

2. Control of Herbaceous Weeds and Brush. A dense stand of missed herbaceous weeds and brush was located near State College in Centre county. Existing plants were catalogued and treatments of various compounds at different rates were applied to separate plots at two different times. After spring regrowth occurs, the vegetation will again be catalogued and compared to the pre-test list.

3. Brush Control. Four methods of treating brushy of woody growth were tested. They were a) basal bark treatments, in which the lower stem of trunk is thoroughly wetted with herbicide, b) dormant stem treatment, in which the stem is sprayed with herbicide after the foliage has dropped but before spring regrowth appears, c) summer foliar treatments, and d) fall foliar treatments which are timed to coincide with autumn leaf color change to avoid noticeable brownout. Sites are located in Bradford, Perry, Northumberland, Chester and Montour counties.

4. Application of Plant Growth Regulating Compounds (PGR's) to Turf. The number of mowing cycles performed each year on some areas of right-of-way turf can be reduced by suppressing seedhead formation and vertical foliar growth. Greenhouse experiments screened different rates of several products to determine the most promising rates to test for effectiveness in the field. The greenhouse experiments also tested the PGR's for their effects on tillering response and root growth. This information is particularly useful because severe reduction of tillers and roots causes the entire grass stand to become thinned and weakened. Field experiments examined canopy height, seedhead suppression, phytotoxicity, sward density and broadleaf weed control.

The nature of biological research requires an experimental time-frame that considers the life-cycle and growth habits of the species under investigation. Perennial plants are difficult to control because energy stored in their underground root systems enables them to withstand injury to or loss of top growth. Some weeds may five the appearance of being controlled soon after treatment but may eventually regrow as healthy as before. A fair assessment of the effects of a chemical treatment must allow sufficient time for regrowth to appear. Conversely, trees treated with a chemical herbicide may refoliate for several years before finally succumbing to the effects of treatment. Data collected during the first year of treatment reveals important information, bu tin many cases follow up studies are necessary to yield final results.

TASK - I

To assess the botanical composition and distribution of vegetation along Pennsylvania Roadsides, review existing vegetation management programs, and select research sites.

To achieve the first component of this goal, a botanist was hired to catalogue the vegetation composition on selected roadsides throughout the state. Emphasis was placed on identifying the vegetation in the mowed vs. unmowed areas of the roadside. Different types of roads were traveled to investigate the succession of vegetation on different age and different maintenance levels of the roadside environment. The roads that were traveled range from relatively new four lane interstates (I-80,76) to some of the older established state routes (6,30,322). The routes traveled were selected to traverse the different geophysical regions of the state. In traveling these regions, stops were made as the vegetation and geophysical characteristics changed. The vegetation was identified and cataloged at each stop. Plants observed at each location were listed as either dominant species or occasional species. This strategy was implemented in both the mowed and unmowed areas of the roadside. General habitat statements concerning slope and aspect, plant community type, drainage, planted vegetation, and land use bordering the right-of-way were also noted. The vegetation composition survey was completed in late August and is presently being analyzed.

To accomplish the second portion of the task, a visit was made to each district in December and January to gain information about their vegetation management programs. Each district roadside specialist was interviewed and all of the maintenance programs were discussed. The chemical and mechanical aspects of the districts policy were reviewed. These include brush control, herbaceous weed control and the use of plant growth regulators. In the area of brush control, we investigated the criteria for spraying brush, the use of basal bark treatments, and inquired about any hard to control species that should receive special attention. For the weed control information, we reviewed problem species growing in grasses and crownvetch and determined approximate areas planted to crownvetch versus grasses. In the area of plant growth regulators, we requested information regarding individual mowing strategies and costs related to mowing. For all the areas of investigation, we examined information concerning chemical materials utilized, timings, equipment, and types of labor force.

TASK – I
PART I – Vegetation Survey

A vegetation survey was conducted during the summer of 1986 to establish a ground truth evaluation of roadside vegetation between mowed and unmowed areas of the right-of-way that were surveyed rather than to perform an intensive composition survey. The task was accomplished by having one person travel the state covering both 2 and 4 lane roads. The itinerary was arranged so as to cross all physiographic regions of the state, from North to South and from East to West (refer to map on following page). Distance betweenstops averaged 30 to 40 miles, less where vegetation appeard to undergo an obvious shift. Over 1,800 entries were made, a complete printout of which is included in the Appendix to this report. At each stop the following aspects were observed and recorded:

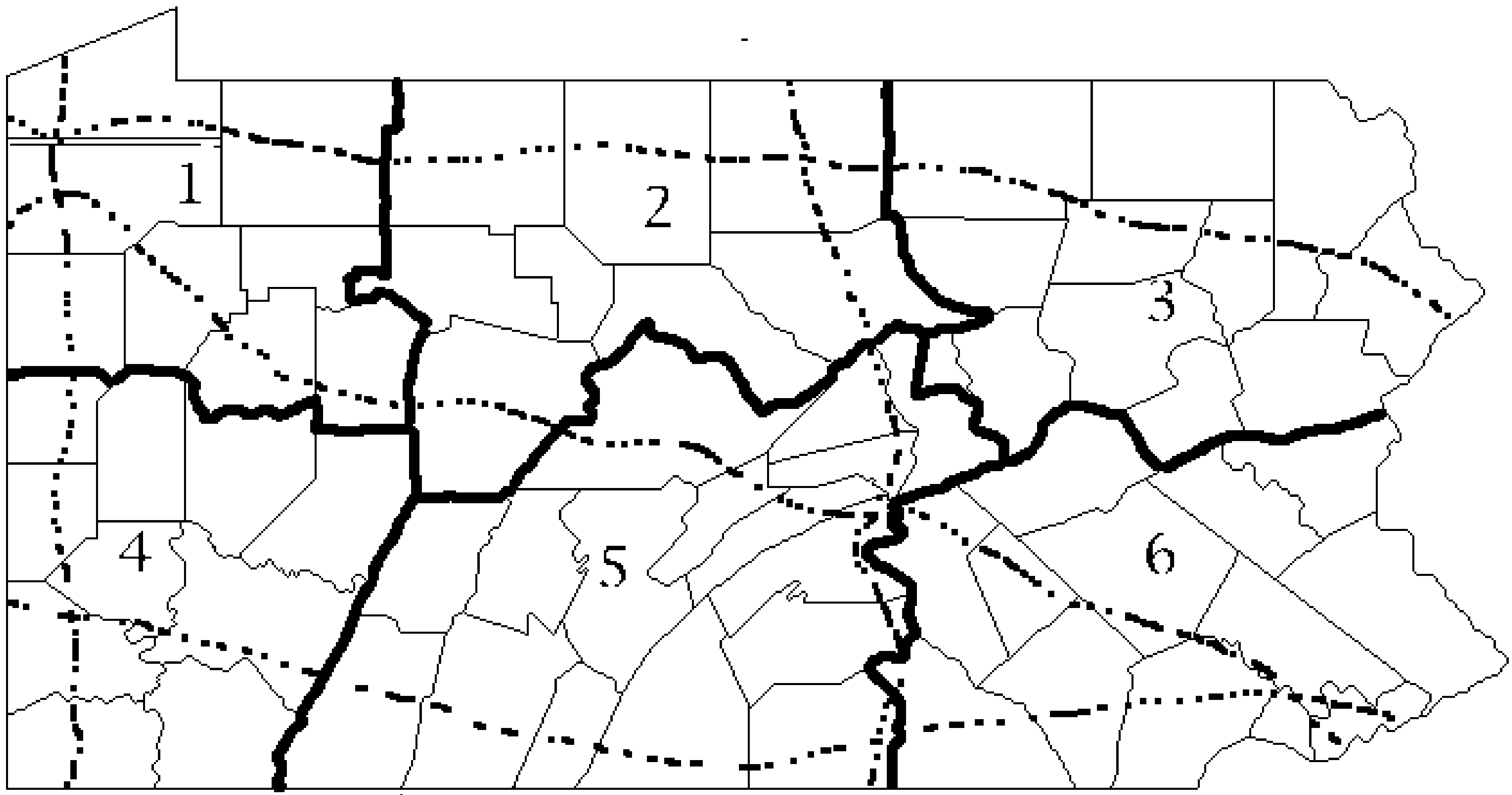
County	(CTE)
Number of lanes	(21, 41)
Slope	(flat, moderate, steep)
dominant plants in mowed areas	(DM)
occasional " " " " ""	(OM)
dominant plants in unmomwed areas	(DU)
occasional " " " " ""	(OU)

Not all the aspects were needed for sorting and interpreting the data at this time (e.g. county, number of lanes and slope), but they were included in the event that a need should arise for them at some future time.

When growth habits among different species within the same genus were similar, it was usually unnecessary to list them separately by species. Therefore, plants are listed by genus only, except when difference among species was considered important. For instance, green, yellow and giant foxtail are so similar that the genus name *Setaria* was sufficient. However, the difference between bull thistle and Canada thistle is significant, so species was noted. When species was included, and abbreviation of the species name was added directly to the end of the genus name to allow the file program to sort by using a single word. Plant names thus treated, with abbreviations and common names following, are:

Acer rubrum	*Acerrub*	red maple
Acer negundo	*Acerneg*	boxelder
Acer saccharum	*Acersac*	sugar maple
Cirsium arvense	*Cirsiumarv*	Canada thistle
Cirsium vulgare	*Cirsiumvul*	bull thistle
Poa pratensis	*Poa*	Kentucky bluegrass
Poa annua	*Poaan*	annual bluegrass

The state was divided into 6 sections (refer to the map on the following page) to help organize the data and to facilitate its entry onto a computer file program. For the purpose of this task, the data was sorted by dominant plants only, according to occurrence in mowed versus unmowed areas are included here. The total count for each plants listed is found directly under the plant name. Referring to the column of numbers above each name, the right-hand number signifies the section in which the plant was found, the left-hand number shows how many times the plant was identifies as a dominant in that section. The following example uses the Dominant – Mowed list to illustrate how the Dominant Plants Lists are to be read:



Pennsylvania Vegetation Survey Districts

------------ itinerary

DOMINANT – MOWED

Dom. Mowed Sec.

1	1
2	2
1	3
2	5

Count for Agropyron
6

2	1
2	2
2	3
2	5

Count for Agrostis
8

"On mowed right-of-way surveyed, Agropyron (quackgrass) was found as a dominant cover 6 times – once in section 1, twice in section 2, once in section 3, and twice in section 5. *Agrostis* (bentgrass) was observed as a dominant cover on mowed right-of-way 8 times, twice in sections 1, 2, 3 and 5. After checking the Dominant-Unmowed list, we see that neither plant was observed as dominant on any unmowed right-of-way, and so on.

By comparing the 2 lists, mowed and unmowed, we observe several trends. The unmowed area surveyed exhibited a greater variety of plants. The total number of different dominant plants found on the unmowed right-of-way was 47, compared with 39 for the level of management. Twenty-eight plants occurred as dominants only in the unmowed area, compared with 21 plants found as dominants only in the mowed area. Grassy species are crowded out by herbaceous and woody growth when mowing is not performed. Grasses accounted for 17 of the mowed area dominants (17/39 = 44%), and only 3 of the unmowed area dominants (3/47 = 40%).

PART 2. MANAGEMENT PROGRAM REVIEW

A visit was made to each district in December and January to gain information about their vegetation management programs. Each district roadside specialist was interviewed and all of the maintenance programs were discussed. The chemical and mechanical aspects of the districts policies were reviewed. These included brush control, herbaceous weed control and the use of plant growth regulators. In the area of brush control, we investigated the criteria for spraying brush, the use of basal bark treatments, and inquired about any hard to control species that should receive special attention. For weed control information, we reviewed problem species growing in grasses and crownvetch and determined approximate areas planted to crownvetch versus grasses. In the area of plant growth regulators, we requested information regarding individual mowing strategies and costs related to mowing. For all the areas of investigation, we examined information concerning chemical materials utilized, timings, equipment and types of labor force.

DOMINANT – MOWED

Dom. Mowed   Sec.
1   1
2   2
1   3
2   5

Count for Agropyron:
6

2   1
2   2
2   3
2   5

Count for Agrostis:
8

1   5
1   6

Count for Ailanthus:
2

1   6

Count for Ambrosia:
1

1   5

Count for Apocynum:
1

1   2

Count for Arrhenather:
1

1   4

Dom. Mowed   Sec
1   5

Count for Asclepias:
2

1   1
1   5

Count for Aster:
2

1   2
1   4

Count for Bare:
2

2   2
1   3
2   5

Count for Bromus:
5

2   5

Count for Centaurea:
2

2   4

Count for Chrysan:
2

1   5

Count for Cichorium:
1

Dom. Mowed   Sec.

1   6

Count for Cirsiumarv:
1

1   4

Count for Circiumvul:
1

1   1
1   2
3   3
5   5
2   6

Count for Coronilla:
12

1   2
2   3
2   5

Count for Dactylis
5

2   1
1   3
3   4
2   5

Count for Dauucus:
8

1   3
1   5

Count for Digitaria:
2

1   3

Count for Echinochola:
1

Count for Juncus:
1

1   2

Count for Leersia:
1

Count for Phleum:
2

1   1
5   2
5   5

Dom. Mowed	Sec.
1	5

Count for Euphorbia:
1

Dom. Mowed	Sec.
7	1
4	2
6	3
4	4
16	5
6	6

Count for Festcua:
43

Dom. Mowed	Sec.
2	1
3	4
1	5
4	6

Count for Grass:
10

Dom. Mowed	Sec.
1	5

Count for Hypericum:
1

Dom. Mowed	Sec.
1	2

Count for Sporobus:
1

Dom. Mowed	Sec
2	5

Count for Linaria:
2

Dom. Mowed	Sec
1	2
1	5

Count for Lotus:
2

Dom. Mowed	Sec
1	1
1	5

Count for Melilotus:
2

Dom. Mowed	Sec
2	5

Count for Nepeta:
2

Dom. Mowed	Sec
1	1
2	2

Count for Phalaris:
3

Dom. Mowed	Sec
1	3
1	5
1	6

Count for Tridens:
3

Dom. Mowed Sec.

Count for Poa:
11

Dom. Mowed	Sec.
1	2
1	5

Count for Poaan:
2

Dom. Mowed	Sec.
1	1

Count for Polygonum:
1

Dom. Mowed	Sec.
1	5

Count for Rubus:
1

Dom. Mowed	Sec.
3	2
2	3
5	5
4	6

Count for Setaria:
14

Dom. Mowed	Sec.
2	2
2	5

Count for Solidago:
4

Dom. Mowed	Sec.
1	4

Count for Tussilago:
1

Dominant-Unmowed

```
Dom. Unmowed    Sec.
     1          2
     1          4
     1          5
--------------------
Count for Acerrub:
     3

     1          4
     1          5
     1          6
--------------------
Count for Ailanthus:
     3

     1          1
     1          6
--------------------
Count for Apocynum:
     2

     1          4
     3          5
--------------------
Count for Asclepias:
     4

     1          3
     1          5
     1          6
--------------------
Count for Aster
     3

     1          6
--------------------
Count for Betula:
     1


     1          1
     1          5
--------------------
Count for Grass:
     2

     1          4
--------------------
Count for Hamamelis:
     1
```

```
Dom. Unmowed    Sec
     1          6
--------------------
Count for Brassica:
     1

     1          1
     1          4
     1          5
--------------------
Count for Bromus:
     3

     1          3
--------------------
Count for Centaurea:
     1

     1          5
--------------------
Count for Cichorium:
     1

     3          6
--------------------
Count for Cirsiumarv:
     3

     1          3
     1          6
--------------------
Count for Conium:
     2

     1          4
     1          5
--------------------
Count for Cornus:
     2


     1          4
     2          5
--------------------
Count for Lotus:
     3

     1          5
--------------------
Count for Nepeta:
     1
```

```
Dom. Unmowed    Sec.

     6          1
     4          2
     4          3
     3          4
     9          5
     7          6
--------------------
Count for Coronilla:
     33

     2          1
     1          3
     1          4
     2          5
--------------------
Count for Daucus:
     6

     1          5
--------------------
Count for Dipsacus:
     1

     1          4
--------------------
Count for Eupatorium:
     1

     2          1
     2          4
     8          5
--------------------
Count for Festuca:
     12

     1          3
--------------------
Count for Fraxinus:
     1

     1          1
     1          2
     2          3
     2          4
     1          5
     1          6
--------------------
Count for Populus:
     8
```

```
Dom. Unmowed   Sec.

     1         6
--------------------
Count for Hemerocallis:
     1

     1         4
--------------------
Count for Lactuca:
     1

     1         5
--------------------
Count for Linaria:
     1

     1         4
--------------------
Count for Liriodendron:
     1

     1         5
--------------------
Count for Lonicera:
     1

     2         2
     1         3
     2         4
     4         5
--------------------
Count for Rubus:
     9

     5         1
     6         2
     6         3
     4         4
     6         5
     4         6
--------------------
Count for Solidago:
     31

     1         5
--------------------
Count for Symphor:
     1
```

```
Dom. Unmowed   Sec
     1         1
     1         4
--------------------
Count for Panicum:
     2

     1         4
     1         5
--------------------
Count for Pastinaca:
     2

     1         5
--------------------
Count for Pinus:
     1

     1         5
     1         6
--------------------
Count for Poa:
     2

     1         1
--------------------
Count for Polygonum:
     1

     1         5
--------------------
Count for Trifolium:
     1

     1         4
     1         5
--------------------
Count for Ulmus:
     2

     1         3
     1         4
--------------------
Count for Vitis:
     2
```

```
Dom. Unmowed   Sec.
     1         4
     2         5
--------------------
Count for Prunus:
     3

     1         5
--------------------
Count for Quercus:
     1

     1         1
     2         2
     2         3
     2         4
     4         5
--------------------
Count for Rhus:
     11

     1         3
     1         4
     1         5
--------------------
Count for Robinia:
     3

     1         4
--------------------
Count for Sassafras:
     1

     1         3
--------------------
Count for Spiraea:
     1

     1         5
     2         6
--------------------
Count for Toxico:
     3
```

TASK II

The overall objectives of this task are to compare several herbicide treatments for their effectiveness in controlling herbaceous and woody perennial weeds along roadsides. Level of control, application timing and technique will receive primary emphasis.

Several studies were set up across the state to accommodate this task. They were:

- PART I - CANADA THISTLE CONTROL STUDY
  - *Experiment 1* - Canada Thistle Herbicide Treatments in Elizabethtown
  - *Experiment 2* - Canada Thistle Herbicide Treatments in State College
  - *Experiment 3* - Crownvetch Herbicide Sensitivity Evaluation in Danville
  - *Experiment 4* - Evaluation of TNC Levels and Herbicide Efficacy on Canada Thistle.

- PART II - HERBACEOUS WEED CONTROL STUDY
  - Herbaceous Weed Control Treatments in Centre County

- PART III - BRUSH CONTROL STUDY
  - *Experiment 1* - Basal Bark Herbicide Treatments
  - *Experiment 2* - Dormant Stem Herbicide Treatments
  - *Experiment 3* - Summer Foliar Herbicide Treatments
  - *Experiment 4* - Fall Foliar Herbicide Treatments

PART I - CANADA THISTLE CONTROL STUDY

The perennial weed Canada thistle (Cirsium arvense L.) growing in crownvetch, (Coronilla varia L.) is a maintenance problem on roadsides throughout the state of Pennsylvania. The objective of this study is to determine the most effective program for controlling Canada thistle in crownvetch along Pennsylvania roadsides. Several experiments were conducted to achieve this goal.

Experiment # 1 was performed near Elizabethtown, Lancaster County where crownvetch was the established groundcover. Several herbicides were evaluated for their ability to control Canada thistle and their effect on crownvetch.

Experiment #2, located at a site near State College, Centre County, evaluated several herbicides for their efficacy in controlling Canada thistle. Groundcover at this site was a mixture of crownvetch and grass. Because the dominant species varied from plot to plot, treatment related activity on the groundcovers could not be evaluated. Therefore, the activity of the treatments on the Canada thistle was the only parameter measured.

The objective of Experiment # 3 is to evaluate the performance of several herbicide treatments when applied to a pure stand of crownvetch. By treating a pure stand of crownvetch with a variety of herbicide treatments, information describing the sensitivity of the crownvetch to those treatments can be obtained. The list of herbicides for this experiment was comprised of all the treatments from experiments 1 and 2 of Part I (Canada Thistle Control Study), and several of the treatments from Part II (Herbaceous Weed Control Study) and Part III (Brush Control Study). The experiment was performed in Danville, Montour County.

The objective of Experiment #4 is to measure the level of total nonstructural carbohydrates (energy reserves) of the Canada thistle plant throughout an entire growing season and determine the best time for herbicide application. Both herbicide treated plants and non-treated plants will be evaluated. The experiment located on I-80 in Centre County, was initiated in the fall of 1986 and will be complete in late 1987.

When working with perennial plants such as Canada thistle that have an extensive root system and high levels of total nonstructural carbohydrates, control ratings for the first season after a control measure has been applied can be misleading. Canada thistle has the ability to produce new shoots from its underground root systems. When a control measure is applied, the thistle plant will use any remaining underground energy reserves not affected by the herbicide to produce new shoots. The plants may look healthy when this initial regrowth occurs, but they are actually in an energy depleted state and may not be able to survive the winter. Therefore, recommendations made during the first year of treatment may be misleading and premature. Many of the treatments appear to be promising, but only when stand counts and ratings can be taken as regrowth appears can a firm conclusion be established. Control ratings the second year are the true test of the efficacy of an herbicide on Canada thistle.

EXPERIMENT # 1

Objective :

To rate several herbicide treatments for their effectiveness in controlling Canada thistle.

Materials and Methods :

Trials were established in Elizabethtown (Lancaster County). District roadside specialists recommended areas where Canada thistle is present in stands large enough and dense enough to fulfill experimental needs as to plot size and plant population density. Plots measure 6 feet by 25 feet. Soil samples were taken at each site to establish existing fertility and pH levels. Treatments were selected from a review of currently available herbicides. These treatments were implemented at three different timings; late winter, late bud, and summer. All treatments were applied broadcast. Canada thistle stem counts were taken to determine the effectiveness of each treatment. The height of the crownvetch was measured, and the density of the crownvetch stand (percentage cover) was visually estimated.

Elizabethtown Area Canada Thistle Treatments

No.	Treatment	Stage	Rate lb ai/A	Replication/Plot No. 1	2	3
1	Atrazine	Dormant	4	110	125	136
2	Velpar	Dormant	2	113	128	134
3	Arsenal	Dormant	1	116	124	135
4	Atrazine + oil	Late bud	4	101	115	127
5	Velpar + NIS	Late bud	2	105	109	123
6	Arsenal	Late bud	1	106	111	129
7	Atrazine + oil	Summer	4	107	117	120
8	Velpar + NIS	Summer	2	102	104	131
9	Arsenal	Summer	1	103	122	126
10	Check	------	---	114	121	133

NIS = "Surfactant WK" non-ionic surfactant @ 0.25%
Oil = Emulsifiable crop oil @ 2 qts/A

Results and Discussion:

Table 1 presents the visual ratings taken over the 1986 season. Canada thistle stem counts were taken in the spring of 1986. This procedure will be repeated in the spring of 1987. Arsenal applied to the crownvetch and thistle during dormancy gave excellent early control, but lost its activity by mid-summer resulting in a dense flush of thistle growth. Velpar applied dormant was slow to cause significant damage to the thistle but produced a high rating for control by late summer. Both Velpar and atrazine applied at the late bud stage gave satisfactory control. The late bud treatments of Velpar and atrazine appeared to cause the least injury to the crownvetch. The values presented in Table 1 for the summer treatments (August 31, 1986) represent a single rating period. It recieved only one rating during 1986 because the growing season ended and dormancy began soon after the first rating period. Therefore, a firm conclusion for the summer treatments cannot be made until growth during the 1987 season is evaluated.

EXPERIMENT #2

Objective :

To rate several herbicide treatments for their effectiveness in controlling Canada thistle.

Materials and Methods :

Trials were established in State College (Centre County). Soil samples were taken to establish existing fertility and pH levels. Treatments were selected from a review of currently available herbicides and from the list of control measures currently used by department personnel. These treatments were implemented at three different timings; late winter, late spring, and summer (during late bud stage). All treatments were applied broadcast. Plots measure 6 feet by 25 feet. To determine the effectiveness of each treatment, control was visually rated and Canada thistle stem counts were taken. Groundcover at this site was a mixture of crownvetch and grass. Because the dominant species varied from plot to plot, treatment related activity on the groundcovers could not be measured. Therefore, the activity of the treatments on the Canada thistle was the only parameter evaluated.

State College Area Canada Thistle Treatment List

No.	Treatment	Stage	RATE lb ai/A	REPLICATION/PLOT NO. 1	2	3
1	Escort + NIS	Late bud	0.0375	101	220	305
2	Velpar + NIS	Late bud	2	102	203	311
3	Roundup	Late bud	4	103	215	320
4	Atrazine + oil	Late bud	4	104	217	312
5	Arsenal	Late bud	1	105	210	316
6	XRM 3972 + NIS	Late bud	0.2	106	202	309
7	Crossbow + NIS	Late bud	1	107	211	318
8	Escort +	Late bud	0.0375	108	213	306
	Roundup + NIS		1			
9	Garlon 4 +	Late bud	0.67	109	219	310
	Banvel 720 + NIS		0.33			
10	Mechanically Cut		---	119	214	317
11	Untreated check	----	---	120	206	301

NIS = "Surfactant WK" non-ionic surfactant @ 0.25%
Oil = Emulsifiable crop oil @ 2 qts/A

Results and Discussion:

Table 2 presents the ratings of percent Canada thistle control for the State College experiment. The means were analyzed using Duncan's New Multiple Range Test. Arsenal, at the rate used, was the most effective in controlling the thistle. The mechanically cut (hand weeded) check produced a high flush of thistle regrowth in the late summer compared to all herbicide treatments. Again, final conclusions must await data gathered after spring regrowth occurs in 1987.

Table 2 Experiment #2 - Canada Thistle Control - 1986-87
Park Ave. - State College, PA

Treatment (applied June 10)	RATE	JUNE 30 Canada Thistle Control	JULY 29 Canada Thistle Control	SEPTEMBER 1 Canada Thistle Control
	lb ai/A	(%)	(%)	(%)
1. Escort [1]	0.0375	25 c [3]	90 ab	17 bc
2. Velpar [1]	2	97 ab	88 ab	13 bc
4. Atrazine [2]	4	73 abc	82 ab	22 bc
5. Arsenal	1	43 bc	95 a	67 a
6. XRM 3972 [1]	0.2	38 c	72 b	28 b
7. Crossbow [1]	1	43 bc	89 ab	25 b
8. Escort + Roundup [1]	.0375 + 1	52 abc	88 ab	23 bc
9. Garlon + Banvel 720 [1]	0.67 + 0.33	38 c	83 ab	27 b
10. Mechanically Cut	---	100 a	90 ab	3 c
11. Untreated Check	---			

1 - Includes non-ionic surfactant at 0.25% .
2 - Includes emulsifiable oil at 2 quarts/acre
3 - Column means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

EXPERIMENT #3

Objective:

To screen several herbicide treatments for their effect on crownvetch.

Materials and Methods :

Chemical applications that were utilized in the Canada thistle control studies, and some from the herbaceous weed control study and brush control study were applied to a pure stand of crownvetch. This approach tested the sensitivity of crownvetch to all of the herbicides that were used. The site selected was in Danville, Montour County.

Crownvetch Sensitivity Treatment List

No.	Treatment	Timing	RATE lb ai/A	REPLICATION/PLOT NO. 1	2	3
1	Atrazine	Dormant	4	102	313	229
2	Velpar	Dormant	2	103	119	321
3	Arsenal	Dormant	1	106	211	325
4	Velpar + NIS	Late spring	2	101	214	328
5	Arsenal	Late spring	1	104	318	222
6	Atrazine + oil	Late spring	4	105	220	121
7	Escort + NIS	Late spring	0.0375	107	115	126
8	Escort +	Late spring	0.0375	108	317	329
	Roundup + NIS		1			
9	Escort +	Late spring	0.0375	109	216	326
	Garlon 4 + NIS		0.67			
10	Garlon 4 +	Late spring	0.67	110	217	122
	Weedone 170 + NIS		7.4			
11	Crossbow + NIS	Late spring	1	201	315	127
12	XRM 3972 + NIS	Late spring	0.2	202	215	223
13	Oust + NIS	Late spring	0.2	204	320	324
14	Garlon 4 +	Late spring	0.67	205	311	331
	Banvel 720 + NIS		0.33			
15	Atrazine + oil	Summer	4	206	213	327
16	Velpar + NIS	Summer	2	207	118	226
17	Arsenal	Summer	1	208	112	330
18	Check	---		310	114	123

NIS = "Surfactant WK" non-ionic surfactant @ 0.25 %
Oil = Emulsifiable crop oil @ 2 qts/A

Results and Discussion:

When controlling unwanted weeds in a crownvetch groundcover along roadsides, a minimum of damage to the crownvetch foliage canopy is desired. The optimum herbicide treatment should display low levels of foliar injury to crownvetch and/or have little or no soil residual to allow for rapid seedling germination and re-establishment of the crownvetch ground cover. This vegetation canopy is essential to inhibit the germination of weed seeds presently in the soil.

Ratings for crownvetch height and canopy cover were tabulated and the means analyzed using Duncan's New Multiple Range Test. Promising herbicides include atrazine applied during dormancy, in late spring, and in summer, Velpar applied in late spring and in summer, and XRM 3972 (Clopyralid) applied in late spring (Table 3). Arsenal applied to crownvetch during dormancy allowed steady regrowth throughout the season, which produced a suitable canopy. Survival of the crownvetch alone is not enough to deem an herbicide desirable. The treatment must also be effective in controlling the problem weed. Although some herbicide treatments reviewed caused significant damage to crownvetch, no treatments will be disregarded until the Canada thistle control trials are conclusive. The growth of all treatments will be compared to the untreated check. When the 1987 season ratings of crownvetch selectivity and Canada thistle control are completed and analyzed, the appropriate choice of a treatment can be made.

Table 3:

Sensitivity of Brush and Non-Cropland Herbicides on Crownvetch - 1986-87 Interstate 80 - Exit 33 W Danville, PA

Treatment	Timing	Rate	-----Height-----				-----Cover-----			
			7/01	7/30	8/25	9/28	7/01	7/30	8/25	9/28
		lb ai/A	(cm)	(cm)	(cm)	(cm)	(%)	(%)	(%)	(%)
1. Atrazine	Dormant	4	7 c	29 b	35 cd	31 c	36 cd	70 a	88 a	81 ab
2. Velpar	Dormant	2	0d	2c	4f	7e	0e	3d	9de	28de
3. Arsenal	Dormant	1	0d	4c	10f	15de	0e	10cd	34c	59abc
4. Velpar 3	Late Spring	2	13bc	30b	32cd	27c	59bc	74a	86a	73ab
5. Arsenal	Late Spring	1	11bc	12bc	7f	5e	30cde	3d	2e	12ef
6. Atrazine 4	Late Spring	4	7c	16bc	29de	26cd	13de	42b	85a	83a
7. Escort 3	Late Spring	0.0375	17b	15bc	4f	6e	84ab	2d	1e	8ef
8. Escort	Late Spring	0.0375	16b	21bc	4f	6e	23de	1d	3e	18ef
+ Roundup 3		+1								
9. Escort	Late Spring	0.0375	17b	1c	5f	6e	30cde	1d	3e	15ef
+ Garlon 4 3		+ 0.67								
10. Garlon 4	Late Spring	0.67	16b	1c	4f	7e	25de	1d	3e	17ef
+ Weedone 170 3		+ 7.4								
11. Crossbow 3	Late Spring	1	17b	20bc	10f	8e	11de	15cd	6e	20ef
12. XRM 3972 3	Late Spring	0.2	17b	27b	28de	24cd	85ab	27bc	32c	52bcd
13. Oust3	Late Spring	0.2	17b	26b	17ef	14de	79ab	6cd	8de	12ef
14. Garlon 4	Late Spring	0.67	16b	22bc	18ef	11e	21de	3d	11de	39cde
+ Banvel 720 3		+ 0.33								
15. Atrazine 4	Summer	4	---	---	43bc	35bc	---	---	41c	55a-d
16. Velpar 3	Summer	2	---	---	40bcd	33bc	---	---	62b	65abc
17. Arsenal	Summer	1	---	---	52ab	43b	---	---	28cd	3f
18. Untreated Check	---	---	27a	64a	63a	55a	95a	77a	87a	61abc

1 - Treatment timing: Dormant - March 25 (trt. 1,2), April 7 (trt. 3); Late spring - May 29 (trt. 4,5,6), June 12 (trt. 7,9,11,12,14,15), June 17 (trt. 8,10); Summer - July 30.

2 - Column means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

3 - Includes non-ionic surfactant at 0.25%.

4 - Includes emulsifiable oil at 2 quarts /Acre.

EXPERIMENT #4

Objective:

To determine proper timing for effective herbicide application in the same season by measuring total nonstructural carbohydrate levels (TNC) in Canada thistle that has been treated with herbicides.

Materials and Methods:

The site for Experiment #4 has been established on Interstate 80 between the Lamar and Bellefonte exits. Herbicide treatments for Canada thistle were selected using the results from Experiments #1 and # 2. Each herbicide will be applied to Canada thistle that is growing in crownvetch. Plot size is approximately 8 feet by 50 feet, which allows for removal of sufficient Canada thistle plant root to obtain a representative sample. Root samples of Canada thistle will be collected, with sampling times being once in late fall of 1986 and at two week intervals beginning in early spring and continuing through September 1987. All root samples will be taken during the same time period of the day at each sampling date, washed thoroughly with water to remove all soil, and oven dried at 70 degrees Centigrade as soon as possible to denature respiratory enzymes thereby reducing respiratory losses. All samples will be ground to a 40 mesh size fineness. A modified Weinman method, which is an enzymatic digestion with acid hydrolysis of polysaccharides, will be used for removing TNC. The amount of TNC will then be determined colorimetrically using the Technicon auto-analyzer.

At present time, visual ratings and stand counts for 1986 have been completed for Experiments #1, # 2, and # 3. Similar ratings will be taken for these plots throughout the 1987 growing season which will allow for a complete analysis to determine a proper herbicide timing.

A sampling of Canada thistle roots has been taken in October, 1986 to determine a baseline for TNC levels as the plants go into winter dormancy. These samplings will resume approximately March 15, 1987.

Results to Date:

Data collection will be complete after the 1987 growing season. Because the experiment was initiated in the fall, only a portion of the data is available at this time and no analysis can be made.

PART II – HERBACEOUS WEED CONTROL STUDY

Objective:

To screen herbicides, rates, and application timings on brush and herbaceous weeds.

Materials & Methods:

A site was established in Centre County to screen herbicides at different rates and application timings for their effectiveness on controlling brush and herbaceous weeds. The site is along a county roadside that has a dense stand of a variety of weeds and brush. Plots measure 11 feet by 100 feet. A botanist cataloged the vegetative composition of each plot. After results of these treatments are evident in the spring of 1987, the composition will again be cataloged and compared to the pre-treatment list. The treatment list and timings are as follows.

HERBACEOUS WEED CONTROL TREATMENT LIST

Applied June 29, 1986

Treatment No.	Herbicide	Rate lb ai/A	Replication/Plot Number 1	2	3	4
1.	Escort*	0.0375	106	206	125	225
2.	Escort + Roundup*	0.0375 + 1	117	216	127	227
3.	Escort + Garlon 4E*	0.0375 + .67	103	203	142	242
4.	Garlon + Banvel 720*	.67 + .33	110	210	137	237
5.	Crossbow*	1	112	212	132	232
6.	Garlon + Weedone 170*	.67 + 7.4	119	219	138	238
7.	Velpar*	2	122	222	133	233
8.	Arsenal	1	121	221	131	231
9.	Oust*	0.1875	113	213	126	226

Applied September 16, 1986

Treatment No.	Herbicide	Rate lb ai/A	Replication/Plot Number 1	2	3	4
10.	Escort*	0.0375	111	211	136	236
11.	Escort + Roundup*	0.0375 + 1	116	217	143	243
12.	Escort + Garlon 4E*	0.0375 + .67	102	202	140	240
13.	Garlon + Banvel 720*	.67 + .33	114	214	123	223
14.	Crossbow*	1	120	220	129	229
15.	Garlon + Weedone 170*	.67 + 7.4	109	209	128	228
16.	Velpar*	2	105	205	144	244
17.	Arsenal	1	118	218	139	239
18.	Oust*	0.1875	101	201	135	235
19.	Krenite*	8	115	215	141	241
20.	Krenite + Escort*	8 + .0375	108	208	130	230
21.	Krenite + Garlon*	8 + .67	104	204	134	234
22.	Krenite + Roundup*	8 + 1	107	207	124	224

* includes surfactant WK @ 1 qt/100 gal of spray

Results & Discussion:

Data for all treatments will be completed when the vegetation emerges in the spring and summer of 1987. At that time, the degree of control can be analyzed based on the degree of emergence of undesirable weeds in each treatment plot.

PART III - BRUSH CONTROL STUDY

The brush control study consists of four experiments, they are:

Experiment 1 - Basal Bark Herbicide Treatments
Experiment 2 - Dormant Stem Herbicide Treatments
Experiment 3 - Summer Foliar Herbicide Treatments
Experiment 4 - Fall Foliar Herbicide Treatments

To control brush using the basal bark technique, herbicides are carefully applied to the lower 8 to 10 inches of individual trunks of trees or large shrubs. This treatment has been effective during the dormant seaso and because of the method of application, is highly selective. It is a very effective tool for right-of-way management in highly sensitive areas because there is no risk of off-target or off right-of-way chemical movement.

The dormant stem treatments also provide several advantages over current practices. By applying in th dormant season, more plants and more of each plant can be contacted by the chemical because there is no folia present to intercept the spray. In addition, there are no crops actively growing that could be injured by spray drift. Both the basal bark and the dormant stem treatments avoid brownout and extend the time period in whic brush can be chemically controlled.

The summer and fall foliar treatments are the traditional methods of applying brush control materials in Pennsylvania. These experiments evaluated some of the newly introduced brush control chemicals and spray additives.

EXPERIMENT # 1 BASAL BARK TREATMENTS

Objective:

To determine the efficacy of several herbicides, rates of application, and penetrants for controlling 5 species of brush.

Materials and Methods:

The treatments listed below were applied to the bottom 8-10 inches of the trunks of 10 trees each of Acer rubrum (red maple), Prunus serotina (black cherry), Quercus rubra (red oak), Robinia pseudoacacia (black locust), and Rhus typhina (staghorn sumac). Most trees were in the range of 1-3 inches in diameter, with a few in the 4-6 inch range. Trees were treated in May and evaluated in August, 1986.

This experiment was performed at the experimental forest plots located at the University Park Airport and along the south side of route 322 at the Mifflintown entrance ramp. The treatments were applied to ten trees of each of the following species; Ash, Cherry, Locust, Maple, Oak and Sumac. An area of 8-10 inches at the bottom of the trunk was treated. The treatment list is as follows:

1. 2,4-D/2,4-DP (Weedone CB) 100%
2. Garlon (5%) + water + Booster E (1%)
3. Garlon (20%) + water + Booster E (1%)
4. Garlon (5%) + water + Booster E (2%)
5. Garlon (5%) + water + Escort 1 oz./100 gal. + Booster E (1%)
6. Garlon (20%) + Arborchem Basal Oil
7. Garlon (5%) + diesel fuel

Results and Discussion:

The injury ratings recorded in August, 1986 are presented in Table 4. They should be considered preliminary results because further symptoms may develop in 1987. It is possible that some treatments killed the cambium and phloem without affecting the xylem in the trees. Trees whose phloem has been destroyed but whose xylem is still functioning will slowly decline over a period of years until all carbohydrate reserves in the roots are exhausted.

At this time, it appears that Garlon alone in oil based carriers provides rapid and almost total control of all the species treated. Garlon at 5% in diesel fuel provided as good a level of control as did Garlon at 20% in Arborchem Basal Oil. Water based treatments including 5% Garlon alone or with Escort provided very little control. Garlon at 20% in water provided excellent control of sumac, black locust, and maple, but poor control of oak and cherry. Weedone CB provided excellent control of sumac and oak, but poor control of black locust, maple, and cherry.

Table 4: The control of 5 brush species provided by 7 herbicide treatments (1 = no injury; 2 = leaf distortion; 3 = moderate defoliation; 4 = severe injury; 5 = dead). These should be considered preliminary results, as further symptoms may develop in 1987.

Treatment	Sumac	Bl. Locust	Maple	Oak	Cherry
1. Weedone CB (100%)	5.0	1.0	2.4	4.3	2.3
2. Garlon (5%) + Booster E (1%)	1.1	1.6	1.7	1.8	1.4
3. Garlon (20%) + Booster E (1%)	5.0	5.0	4.3	2.1	1.7
4. Garlon (5%) + Booster E (2%)	2.1	1.2	2.0	1.1	1.0
5. Garlon (5%) + Escort (1 oz/100 gal) + Booster E (1%)	2.7	1.0	1.8	1.0	1.0
6. Garlon (20%) + Arborchem Oil (80%)	5.0	5.0	5.0	5.0	4.4
7. Garlon (5%) Diesel Fuel (95%)	5.0	4.8	5.0	5.0	4.9

EXPERIMENT # 2 - DORMANT STEM BROADCAST TREATMENTS

Objectives:

1. To determine the efficacy of Garlon alone or in combination with Escort or Roundup for controlling brush when applied as a broadcast spray in the dormant season.
2. To compare the ability of several penetrants to improve the activity of Garlon.

Materials and Methods:

The experiment was performed at three roadside locations; Bradford County, Perry County, and Northumberland County. The Northumberland County site was set up for review at the summer roadside meeting in Danville. The plot areas are100 feet in length and were selected based on density and consistancy of brush species. They were applied in April with a Radiarc sprayer in the equivalent of 110 gallons of water per acre. In Perry County, the understory consisted of a mix of tree and shrub seedlings and tear thumb vine. The primary brush species were maple, ash, cherry, redbud, and viburnum. Most of the trees were less than 3 inches in diameter, but some were larger. At the Northumberland County site the understory was primarily crownvetch, with some other herbaceous perennials mixed in with it. The brush species present were maple, ash, oak, and hawthorn. Plots were evaluated in July.

The treatment list follows.

Dormant Stem Broadcast Treatments

Treatment	Rate
1. Garlon +	1%
Cidekick	2%
2. Garlon +	5%
Cidekick	2%
3. Garlon +	1%
Asplundh Clean Cut + Pine	2%
4. Garlon +	5%
Asplundh Clean Cut + Pine	2%
5. Garlon +	1%
Booster E	2%
6. Garlon +	5%
Booster E	2%
7. Garlon +	1%
Escort +	1oz./100 gallon
Booster E	2%
8. Garlon +	1%
Roundup +	1%
Booster E	2%

Results and Discussion:

The Bradford County test site was inadvertently oversprayed during routine maintenance operations, so results from this site will not be presented. Data from the other sites could not be rated with a simple numeric system because of the variation in types of vegetation treated. Results were as follows:

Treatment 1 - Garlon (1%) + Cidekick (2%)

Perry Co. - 90-95% of the understory was killed. Small branches on the woody plants that were contacted were killed or injured. Large branches and branches that were not contacted were not injured.

Northumberland Co. - The understory was not killed. There was some tip kill and injury to the woody plants, but none were killed.

Treatment 2 - Garlon (5%) + Cidekick (2%)

Perry Co. - 100% of the understory was killed. All contacted branches were killed and several 15-foot-tall maple and ash were killed or severely injured. There was little effect on the unsprayed parts of black locust.

Northumberland Co. - 100% of the understory was killed. All contacted branches were killed.

Treatment 3 - Garlon (1%) = Cleancut + Pine (2%)

Perry Co. - 85% of the understory was killed. Contacted branches of trees and shrubs were killed. The remainder of the plants were unaffected.

Northumberland Co. - Hawthorns were killed. Ash exhibited delayed budbreak and distorted growth. The new growth of oak was slightly distorted. Contacted maple branches were injured but not killed.

Treatment 4 - Garlon (5%) + Cleancut + Pine (2%)

Perry Co. - 100% of the understory was killed. Viburnum and redbud were killed. Maple and cherry (2-3 inch dia.) were dying while oak was severely injured.

Northumberland Co. - 100% of the understory was killed. Young ash trees were killed. Maple was severely injured or killed where contacted. Oak tips were killed, but regrowth occurred on main stems.

Treatment 5 - Garlon (1%) + Booster E (2%)

Perry Co. - 85% of the understory was killed. Contacted branches of trees and shrubs were killed. The remainder of the plants were unaffected except for some small maples (10 feet, 1 inch dia.) which had cupped leaves at the branch tips.

Northumberland Co. - 90% of the understory was killed. Hawthorn was 50-95% defoliated, maple was 10% defoliated, and ash was 5% defoliated.

Treatment 6 - Garlon (5%) + Booster E (2%)

Perry Co. - 100% of the understory was killed. Maple, cherry, and viburnum were killed and oak was severely injured.

Northumberland Co. - 100% of the understory was killed. All contacted branches were killed. Some trees that were only partially covered were killed, while others survived the partial coverage.

Treatment 7 - Garlon (1%) + Escort (1 oz/100 gal) + Booster E (2%)

Perry Co. - 80% of the understory was killed. Contacted branches of trees and shrubs were killed. The upper parts of redbud and sassafras had cupped leaves or dead tips, but other trees were unaffected above the sprayed parts.

Northumberland Co. - 80% of the understory was killed. Trees exhibited delayed budbreak, some dead tips, and some curled leaves.

Treatment 8 - Garlon (5%) + Roundup (1%) + Booster E (2%) (Perry County only)
Garlon (1%) + Booster E (2%) (Northumberland County only)

Perry Co. - 98% of the understory was killed. Trees less than 1 1/2 inches dia. were killed or severely injured.

Northumberland Co. - 90% of the understory was killed. Grey dogwood was killed and hawthorn was almost dead. 50% of the contacted branches of other trees were killed. The other 50% exhibited delayed budbreak or leaf distortion.

Conclusions:

Garlon at 1% did not provide adequate control of brush. At 5%, Garlon provided good control of most species. There did not seem to be much benefit from including Escort or Roundup in the spray solution. No one penetrant provided significantly better control than another.

Test plots should be re-evaluated in 1987 to determine if there is any delayed response. To reduce the cost of the 5% Garlon treatment, the volume in which the material is applied should be reduced from 110 gallons per acre to about 80 gallons per acre. Intermediate concentrations should also be evaluated.

EXPERIMENT # 3 – SUMMER FOLIAR HERBICIDE TREATMENTS

Objective: To test the efficacy of varying rates and combinations of herbicides in controlling brush species.

Materials and Methods:

These experiments were performed at two locations within the state. Plots were located in Perry Count and in Northumberland County for the summer roadside meeting in Danville. A third location was planned in Bradford County, but the area was inadvertently over sprayed prior to treatment during routine maintenance operations. The treatment list follows.

Summer Foliar Brush Control Treatments.

Treatment	Rate
1. Escort +	1 oz./100 gal.
Roundup +	.25%
Surfactant WK	.5%
2. Escort +	1 oz./gal.
Garlon +	.75%
Surfactant WK	.5%
3. Garlon +	.75%
Weedone 170 +	1.5%
Surfactant WK	.5%
4. Garlon +	.75%
2,4-D +	2# AI/A
Surfactant WK	.5%
5. Garlon +	.75%
Banvel 720 +	.75%
Surfactant WK	.5%
6. Banvel 720 +	1%
Surfactant WK	.5%
7. Garlon +	.75%
Surfactant WK	.5%

These treatments were applied in the equivalent of 50 gallons water per acre.

Results and Discussion:

All treatments caused brownout and death of most of the treated foliage. The effectiveness of the treatments in killing entire branches or plants will be known after budbreak in the spring and summer of 1987.

EXPERIMENT #4 - FALL FOLIAR BRUSH CONTROL TREATMENTS

Objective:

To test the efficacy of varying rates of the herbicide Krenite alone and in combination with other herbicides for the control of brush species.

Materials and Methods:

Treatments were applied during the second week of September near Philadelphia in the area selected as the site of next summers roadside meeting. The results will be viewed by all roadside personnel at that time. The treatment list is as follows:

Fall Foliar Brush Control Treatments

Treatment	Rate
1. Krenite	1.5%
2. Krenite +	1.5%
Escort	1 oz./100 gal.
3. Krenite +	1.5%
Garlon	.5%
4. Krenite +	1.5%
Roundup	1%
5. Krenite +	1.5%
Banvel 720	.5%
6. Krenite +	1%
Garlon	.5%
7. Krenite +	1%
Roundup	1%
8. Krenite +	1%
Banvel 720	.5%

Results to Date: Results will be taken after budbreak in the spring and summer of 1987.

TASK III

PLANT GROWTH REGULATOR STUDY

The Plant Growth Regulator Study was performed in both greenhouse and field evaluations. The experiments and sites involved were:

- PART I - GREENHOUSE EVALUATIONS
  - Experiments 1 - 6
- PART II - FIELD EVALUATIONS
  - Danville Site -
    - Experiment 1
  - Tyrone Site -
    - Experiment 2
    - Experiment 3
  - State College Site -
    - Experiment 4
    - Experiment 5

PART I - GREENHOUSE EVALUATIONS

Six experiments were conducted in the greenhouse to screen numerous compounds and combinations for their effects on the growth of tall fescue. The overall objectives of these experiments were:

1. To screen experimental compounds to determine possible rates for use on roadsides.

2. To evaluate specific commercial products and combinations of those products for their growth suppression potential and safety on tall fescue.

3. To evaluate plant growth regulator effects on the morphology of tall fescue, particularly root and foliar growth and tillering responses.

Greenhouse experiments offer an excellent opportunity to rapidly screen growth suppression potential. It is very desirable to obtain a PGR compound that would suppress leaf growth and inhibit seedhead emergence, yet allow the underground growth of roots and development of new tillers to continue. It is difficult to accurately quantify some of these parameters under field conditions. Greenhouse procedures allow for a unique opportunity to evaluate and to quantify the tillering and root development responses of the turf to PGR applications.

The degree to which greenhouse results can be extrapolated to results from field experiments cannot be accurately predicted. There is usually not a one-to-one relationship between the performance of a treatment in the greenhouse and performance of the same application under field conditions. Treatments that perform poorly in the greenhouse may perform better in the field under somewhat different environmental conditions or vice versa.

Suppressing vertical foliar development is only one of several parameters considered when evaluating the efficacy of a plant growth regulator. In some trials, PGR's caused severe yellowing and thinning, near death, or death to the grass. In these cases of severe injury, the desired reduction in foliar growth was achieved at the expense of the health and vigor of the grass. Therefore, the tall fescue plants in these studies were evaluated for foliar injury and discoloration, as well as tillering and rooting response. Seedhead suppression in the greenhouse was not evaluated because of the lack of the proper environment for seedhead induction and initiation.

Foliar height of the grass was determined weekly for 12 weeks following treatment. Periodic visual evaluations of foliar injury were made. The experiments were terminated at the end of 12 weeks at which time the roots in each pot were washed free of soil, dried, and weighed. Tillers were harvested at soil level, counted, and weighed. The weight measurement taken from the fresh harvest of the tillers is considered to be the canopy fresh weight. The tillers were dried and then weighed again to establish the canopy dry weight. The relationship between the fresh and dry weights of the canopy expresses the amount of dead matter or tillers that have low amounts of water present compared with tillers that have a higher amount of moisture, which is usually associated with aggressive growth. A small difference between fresh versus dry weight suggests a high amount of dead matter or tissues with low water content whereas a large difference between fresh and dry weight indicates tissues with high water content and/or a low amount of dead matter.

Each experiment received twelve different treatments. Each treatment was repeated nine times (three pots for each of three replications). Each pot contained seven tall fescue tillers that had been clipped back to 10.2 cm two days prior to treatment. Chemicals were applied in the equivalent of 50 gallons of water per acre with the exception of granular treatments which were applied directly to the soil in the pot.

All products utilized in these evaluations are referred to by their generic chemical names. Below is a table listing the chemicals and their respective product names.

Chemical Name	Product Name
ACP-1900	Experimental-American Cyanamid Co.
Amidochlor	Limit
Chlorsulfuron	Gleen
EPTC	Shortstop
Fluazifop-butyl	Fusilade
Flurprimidol	Cutless
Glyphosate	Roundup
Mefluidide	Embark
Metsulfuron methyl	Escort
Sethoxydim	Poast
Sulfometuron methyl	Oust
XE-1019	Experimental-Chevron Chemical Co.

Throughout the text, Metsulfuron methyl (Escort) will be referred to as MSM and Sulfometuron methyl (Oust) will be referred to as SMM.

GREENHOUSE EXPERIMENT #1:

Objectives:

1. To assess the effects of compounds that inhibit cell division when used alone or in combination with a compounds that reduce cell elongation.

2. To determine the effects of metsulfuron methyl (Escort) alone and in combination with mefluidide (Embark).

Treatment List Applied 1/17/86

Chemical	Formulation	Rate (Lbs. ai/A)	(Kg ai/ha)
EPTC	10 G	9.70	10.8
amidochlor	4 F	1.50	1.68
mefluidide	2 S	0.38	0.42
ACP-1900	50 g/L	50 g	50.0 g
flurprimidol	50 WP	1.50	1.68
EPTC + flurprimidol	10G + 50 WP	3.0 + 0.75	5.40 + 0.84
amidochlor + flurprimidol	4 F + 50 WP	0.75 + 0.75	0.84 + 0.84
mefluidide + flurprimidol	2S + 50 WP	0.187 + 0.75	0.21 + 0.84
ACP-1900 + flurprimidol	50 g/L + 50 WP	25 g + 0.75	25.0 g + 0.84
mefluidide + metsulfuron methyl	2 S + 60 DF	0.063 + .012	0.07 + 13.8
metsulfuron methyl	60 DF	0.019	21.0
check			

Quality Evaluation:

Quality evaluations made10 weeks after treatment revealed that grass treated with MSM alone or in combination with mefluidide was in highly unacceptable condition and very near death (Table 5). ACP-1900 and amidochlor treated grass was also rated as unacceptable. Chemical treatments applied in combination with flurprimidol tended to improve the grass quality compared with treatments of flurprimidol alone.

At 12 weeks after application the quality of grass treated with MSM, MSM + mefluidide, and ACP-1900 were still rated as unacceptable. At 12 weeks after treatment, the check treatment began to decline in foliar quality because soil nutrients were being depleted by non-suppressed foliar growth. For this reason, the quality of the tall fescue treated with amidochlor, mefluidide + flurprimidol, mefluidide alone, and ACP-1900 + flurprimidol tended to be of higher quality than the check.

Table 5: Foliar quality of tall fescue (0 to 9)**.

Treatments	9 WAT*	12 WAT
EPTC	6.3 abc	6.5 b
amidochlor	5.5 cd	8.2 ab
mefluidide	7.3 ab	8.0 ab
flurprimidol	7.0 abc	6.8 ab
EPTC + flurprimidol	6.7 abc	8.3 ab
amidochlor + flurprimidol	6.2 bc	7.0 ab
mefluidide + flurprimidol	7.8 a	8.7 a
ACP-1900 + flurprimidol	6.5 abc	7.7 ab
mefluidide + metsulfuron methyl	2.7 e	2.2 d
metsulfuron methyl	2.8 e	1.5 d
check	7.7 ab	7.5 ab

Means followed by the same letter are not significantly different (P < 0.05; Duncan's New Multiple Range Test).
* Weeks after treatment
** Quality rating 0 = dead grass, 9 = high quality

Height Evaluation:

All treatments significantly reduced the foliar height of tall fescue throughout the 12 week experiment (Table 6). Grass treated with mefluidide was suppressed for approximately 8 weeks after which time it was rated significantly taller than the rest of the treatments. EPTC slowed the growth of grass but never totally inhibited it.

Table 6: Vertical foliar height (cm) of tall fescue at various weeks after treatment.

Treatments	2	3	4	5	6	7	8	9	10	11	12
EPTC	12.1 bcd	12.2 bc	12.2 bc	12.1 cd	12.0 cde	12.0 cdef	12.0 cde	11.9 def	11.8 de	11.7 de	11.9 cd
mefluidide	12.4 bc	12.3 bc	12.4 bc	12.5 bc	12.9 b	13.3 b	13.7 b	14.1 b	14.4 b	14.3 b	14.2 b
ACP-1900	11.9 cd	11.9 bc	11.9 bc	12.0 cd	11.9 de	11.8 def	12.0 cde	12.0 def	11.9 de	12.0 de	12.0 cd
flurprimidol	12.7 b	12.9 b	12.9 b	13.1 b	12.8 bc	12.9 bc	12.8 c	12.6 cd	12.7 cd	12.5 d	12.6 c
EPTC + flurprimidol	11.9 cd	12.0 bc	12.1 bc	11.8 cd	11.9 de	11.8 def	11.8 de	11.8 ef	11.8 de	11.7 de	11.5 d
amidochlor + flurprimidol	12.0 cd	11.9 bc	12.1 bc	11.9 cd	11.9 de	11.9 def	11.9 de	11.8 ef	11.8 de	11.7 de	11.7 cd
mefluidide + flurprimidol	12.4 bc	12.5 bc	12.2 bc	12.4 cd	12.3 bcde	12.5 cde	12.2 cde	12.2 de	12.3 de	12.2 de	12.1 cd
ACP-1900 + flurprimidol	11.5 d	11.5 c	11.7 c	11.7 d	11.6 e	11.6 f	11.4 e	11.4 f	11.4 e	11.4 e	11.4 d
mefluidide + metsulfuron methyl	11.5 d	11.7 c	11.6 c	11.7 d	11.8 de	11.7 ef	11.6 e	11.6 ef	11.5 e	11.6 de	11.6 cd
metsulfuron methyl	11.6 d	11.8 bc	11.9 bc	11.9 cd	11.8 de	11.7 def	11.8 de	11.4 f	11.6 e	11.7 de	11.6 cd
check	13.5 a	14.6 a	16.1 a	16.7 a	16.7 a	16.9 a	17.4 a	17.8 a	18.0 a	17.6 a	17.3 a

Means followed by the same letter are not significantly different (P < 0.05; Duncan's New Multiple Range Test).

Tiller and Root Evaluation:

All treatments caused significantly increased tillering with the exception of MSM alone and in combination with mefluidide, neither of which differed from the check (Table 7). ACP-1900 plus flurprimidol produced an exceptionally high number of tillers.

All treated grass tended to have lower canopy fresh weights than the check. Grass treated with either MSM alone, MSM + mefluidide, or ACP-1900 had significantly lower canopy fresh weights than all other treatments.

Mefluidide and flurprimidol were the only treatments that did not significantly decrease canopy dry weights. ACP-1900 and treatments that included MSM had the lowest total dry weights.

EPTC, mefluidide, flurprimidol, and mefluidide + flurprimidol did not decrease root dry weights when compared with the check. All other treatments significantly decreased root dry weights. Treatments that included MSM and ACP-1900 tended to cause the most severe root inhibition.

Table 7: Tiller and root production of tall fescue.

Treatments	Tiller number	Canopy fresh wt.(g)	Canopy dry wt.(g)	Root dry wt.(g)
EPTC	15.3 b	2.3 a	0.72 bc	1.5 ab
amidochlor	19.0 b	2.3 a	0.65 cd	1.2 bcd
mefluidide	17.7 b	2.5 a	0.86 ab	1.4 abc
ACP-1900	16.7 b	1.5 b	0.48 de	0.6 ef
flurprimidol	18.1 b	2.6 a	0.77 abc	1.4 abc
EPTC + flurprimidol	16.8 b	2.1 ab	0.63 cd	1.2 cd
amidochlor + flurprimidol	18.2 b	2.0 ab	0.59 cd	1.1 cd
mefluidide + flurprimidol	18.4 b	2.4 a	0.73 bc	1.2 abcd
ACP-1900 + flurprimidol	27.5 a	2.3 a	0.65 cd	0.9 de
mefluidide + metsulfuron methyl	8.4 c	0.8 c	0.31 ef	0.5 f
metsulfuron methyl	7.5 c	0.6 c	0.27 f	0.3 f
check	9.8 c	2.7 a	0.96 a	1.6 a

Means followed by the same letter are not significantly different (P < 0.05; Duncan's New Multiple Range Test).

GREENHOUSE EXPERIMENT #2

Objectives:

1. To assess the effects of different rates of EPTC on tillering and vertical growth of tall fescue.

2. To reduce injury caused by metsulfuron methyl/mefluidide combinations found in Experiment 1 by altering the mefluidide rate.

Treatment List Applied 2/3/86

Rate

Chemical	Formulation	(Lbs. ai/A)	(Kg ai/ha)
EPTC	10 G	3.0	3.36
EPTC	10 G	4.0	4.48
EPTC	10 G	5.0	5.60
EPTC	10 G	6.0	6.72
mefluidide + metsulfuron methyl	2 S + 60 DF	0.031 + .012	0.03 + 13.8 g
mefluidide + metsulfuron methyl	2 S + 60 DF	0.063 + .012	0.07 + 13.8 g
mefluidide + metsulfuron methyl	2 S + 60 DF	0.125 + .012	0.14 + 13.8 g
mefluidide + metsulfuron methyl	2 S + 60 DF	0.187 + .012	0.21 + 13.8 g
mefluidide + metsulfuron methyl	2 S + 60 DF	0.250 + .012	0.28 + 13.8 g
mefluidide + metsulfuron methyl	2 S + 60 DF	0.031 + .012	0.35 + 13.8 g
mefluidide + metsulfuron methyl	2 S + 60 DF	0.312 + .012	0.42 + 13.8 g
check			

Quality Evaluation:

Foliar quality of tall fescue was rated acceptable for all rates of EPTC at 7 weeks after treatment (Table 8). All grass treated with mefluidide + MSM was considered unacceptable. Foliar injury increased as the mefluidide rate increased.

By 12 weeks after treatment, all mefluidide + MSM treatments had caused severe phytotoxity to tall fescue. By this time, grass treated with all rates of EPTC continued to maintain acceptable foliar quality.

Table 8: Foliar quality of tall fescue (0 to 9)**.

Treatment	Rate (kg ai/ha)	7 WAT*	12 WAT
EPTC	3.36	7.0 a	7.2 ab
EPTC	4.48	7.2 a	7.7 a
EPTC	5.60	7.3 a	6.7 b
EPTC	6.72	7.3 a	6.8 b
Mef.+ MSM	0.03 + 13.8g	3.0 bc	1.8 c
Mef.+ MSM	0.07 + 13.8g	3.0 bc	1.7 c
Mef.+ MSM	0.14 + 13.8g	2.5 bc	1.5 c
Mef.+ MSM	0.21 + 13.8g	3.7 b	1.5 c
Mef.+ MSM	0.28 + 13.8g	2.3 c	1.5 c
Mef.+ MSM	0.35 + 13.8g	2.3 c	1.5 c
Mef.+ MSM	0.42 + 13.8g	2.2 c	1.2 c
Check	0.00	7.0 a	6.8 b

Means followed by the same letter are not significantly different (P < 0.05; Duncan's New Multiple Range Test).
* Weeks after treatment
** Quality rating 0 = dead grass, 9 = high quality

Height Evaluation:

Height data for this experiment did not reveal significant treatment effects. All turf in this experiment exhibited a much slower growth rate regardless of whether chemically treated or not (Table 9). Extended periods of low light intensity in the greenhouse due to adverse weather patterns and reduced fertility during this experiment were a major factors contributing to the growth reduction.

Table 9: Vertical foliar height (cm) of tall fescue at various weeks after treatment.

Treatment	Rate (kg ai/ha)	1	2	3	4	5	6	7	8	9	10	11
EPTC	3.36	12.0 a	12.6 a	12.4 a	12.3 a	12.8 a	12.8 ab	13.0 a	13.1 a	13.1 a	13.0 a	12.6 a
EPTC	4.48	11.1 bc	11.6 b	11.6 ab	11.9 ab	12.1 ab	12.9 a	13.0 a	12.9 ab	12.9 ab	12.7 ab	12.7 a
EPTC	5.60	11.4 ab	11.6 b	11.4 b	11.3 bc	11.3 bc	11.5 c	11.6 b	11.8 cd	11.7 abc	11.7 bc	11.7 ab
EPTC	6.72	11.7 ab	11.6 b	11.6 ab	11.5 abc	11.1 c	11.5 c	11.5 b	11.5 cd	11.6 bc	11.4 bc	11.6 ab
Mef.+ MSM	0.03 + 13.8g	11.6 ab	11.7 b	11.7 ab	11.7 abc	11.5 bc	11.7 c	11.7 ab	11.5 cd	11.6 bc	11.6 bc	11.7 ab
Mef.+ MSM	0.07 + 13.8g	11.3 bc	11.4 b	11.6 ab	11.5 abc	11.4 bc	11.5 c	11.4 b	11.4 cd	11.6 bc	11.5 bc	11.5 ab
Mef.+ MSM	0.14 + 13.8g	11.3 bc	11.4 b	11.4 b	11.5 abc	11.5 bc	11.4 c	11.2 b	11.3 cd	11.3 c	11.5 bc	11.3b
Mef.+ MSM	0.21 + 13.8g	11.3 bc	11.6 b	11.6 ab	11.5 abc	11.5 bc	11.3 c	11.5 b	11.3 cd	11.4 c	11.5 bc	11.4 ab
Mef.+ MSM	0.28 + 13.8g	11.2 bc	11.3 b	11.2 b	11.2 bc	11.2 bc	11.2 c	11.1 b	11.1 cd	11.1 c	11.1 c	10.9b
Mef.+ MSM	0.35 + 13.8g	11.2 bc	11.1 b	11.2 b	11.2 bc	11.0 c	11.1 c	11.0 b	10.8 d	11.0 c	10.9 c	11.0 b
Mef.+ MSM	0.42 + 13.8g	10.7 c	11.0 b	11.1 b	10.8 c	11.0 c	10.9 c	10.8 b	10.8 d	10.8 c	10.8 c	10.6b
Check	0.00	11.4 ab	11.2 b	11.4 b	11.7 abc	11.5 bc	11.9 bc	11.8 ab	12.0 bc	11.9 abc	11.7 bc	11.5 ab

Means followed by the same letter are not significantly different (P < 0.05; Duncan's New Multiple Range Test).

Tiller and Root Evaluation:

Tiller production of tall fescue was stimulated by all rates of EPTC (Table 10). Conversely, mefluidide + MSM inhibited tiller production when compared with the check.

Both fresh and dry weights of the canopy were significantly reduced by all rates of mefluidide + MSM. EPTC at 4.48 kg ai/ha increased canopy fresh and dry weights when compared with the check. All other rates of EPTC were not significantly different.

Root dry weight was significantly increased by all rates of EPTC. All rates of mefluidide + MSM tended to inhibit root production of tall fescue.

Table 10: Tiller and root production of tall fescue.

Treatment	Rate (kg ai/ha)	Tiller number	Canopy fresh wt.(g)	Canopy dry wt.(g)	Root dry wt.(g)
EPTC	3.36	12.5 bc	1.7 b	0.63 ab	1.11 a
EPTC	4.48	16.4 a	2.2 a	0.80 a	1.25 a
EPTC	5.60	14.9 ab	1.5 b	0.57 b	1.05 a
EPTC	6.72	13.8 ab	1.3 b	0.52 b	1.08 a
Mef.+ MSM	0.03 + 13.8g	7.0 d	0.6 c	0.30 c	0.35 bc
Mef.+ MSM	0.07 + 13.8g	7.3 d	0.7 c	0.25 c	0.31 bc
Mef.+ MSM	0.14 + 13.8g	6.9 d	0.5 c	0.24 c	0.22 c
Mef.+ MSM	0.21 + 13.8g	6.8 d	0.5 c	0.28 c	0.33 bc
Mef.+ MSM	0.28 + 13.8g	7.3 d	0.5 c	0.21 c	0.31 bc
Mef.+ MSM	0.35 + 13.8g	6.9 d	0.5 c	0.23 c	0.32 bc
Mef.+ MSM	0.42 + 13.8g	7.0 d	0.3 c	0.20 c	0.29 bc
Check	0.00	9.7 cd	1.3 b	0.52 b	0.62 b

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).

GREENHOUSE EXPERIMENT #3

Objective: To apply three known sulfonyl urea grass herbicides at reduced rates and evaluate their performance as plant growth regulators on tall fescue.

Treatment List Applied 2/21/86

Chemical	Formulation	Rate (Lbs. ai/A)	Rate (g ai/ha)
sulfometuron methyl	75 DF	0.0059	7.0
sulfometuron methyl	75 DF	0.0118	13.0
sulfometuron methyl	75 DF	0.0236	26.0
sulfometuron methyl	75 DF	0.0354	40.0
chlorsulfuron	75 DF	0.0059	7.0
chlorsulfuron	75 DF	0.0118	13.0
chlorsulfuron	75 DF	0.0236	26.0
chlorsulfuron	75 DF	0.0354	40.0
metsulfuron methyl	60 DF	0.0059	5.3
metsulfuron methyl	60 DF	0.0118	10.5
metsulfuron methyl	60 DF	0.0236	21.0
check			

<u>Quality Evaluation:</u>

Foliar quality was reduced to an unacceptable degree by all chemical treatments at all rates by five weeks after treatment (Table 11). Due to the severe injury to the tall fescue during the initial five weeks of this experiment, the decision was made to terminate data collection at the end of six weeks. SMM and chlorsulfuron at 7.0 g ai/ha tended to cause the least injury, while MSM at 10.5 and 21.0 g ai/ha tended to have the most severe phytotoxic effects.

Table 11: Foliar quality of tall fescue (0 to 9)**.

Treatment	Rate (g ai/ha)	5 WAT*
Sulfometuron methyl	7.0	5.5 ab
Sulfometuron methyl	13.0	3.5 b
Sulfometuron methyl	26.0	3.5 b
Sulfometuron methyl	40.0	2.8 b
Chlorsulfuron	7.0	5.2 ab
Chlorsulfuron	13.0	3.8 b
Chlorsulfuron	26.0	3.3 b
Chlorsulfuron	40.0	4.0 b
Metsulfuron methyl	5.3	3.5 b
Metsulfuron methyl	10.5	2.6 b
Metsulfuron methyl	21.0	2.3 b
Check	0.0	8.3 a

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).
* Weeks after treatment
** Quality rating 0 = dead grass, 9 = high quality

Height Evaluation:

For the six weeks this experiment was conducted, all treatments at all rates effectively suppressed the growth of tall fescue when compared with the untreated grass (Table 12). The height suppression noted here is the result of severe phytotoxic reaction as discussed above in the quality section.

Because severe injury occurred and the study was terminated after 6 weeks, no tiller or root parameters were evaluated.

Table 12: Vertical foliar height (cm) of tall fescue at various weeks after treatment

Treatment	Rate (g ai/ha)	1	2	3	4	6
Sulfometuron methyl	7.0	10.8 a	10.7 bc	10.6 b	10.5 b	10.6 b
Sulfometuron methyl	13.0	10.6 a	10.5 bc	10.6 b	10.6 b	10.6 b
Sulfometuron methyl	26.0	10.9 a	10.9 b	11.0 b	10.9 b	10.9 ab
Sulfometuron methyl	40.0	10.7 a	10.6 bc	10.7 b	10.6 b	10.6 b
Chlorsulfuron	7.0	10.6 a	10.5 c	10.4 b	10.6 b	10.6 b
Chlorsulfuron	13.0	0.8 a	10.8 bc	10.9 b	10.6 b	10.6 b
Chlorsulfuron	26.0	10.6 a	10.4 c	10.7 b	10.6 b	10.6 b
Chlorsulfuron	40.0	10.6 a	10.6 bc	10.6 b	10.6 b	10.5 b
Metsulfuron methyl	5.3	10.5 a	10.6 bc	10.5 b	10.4 b	10.6 b
Metsulfuron methyl	21.0	10.6 a	10.4 c	10.5 b	10.5 b	10.5 b
Check	0.0	10.9 a	11.4 a	11.6 a	11.6 a	11.5 a

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).

GREENHOUSE EXPERIMENT #4

Objective: To evaluate extremely low rates of glyphosate alone and in combination with sulfometuron methyl and chlorsulfuron for potential use as plant growth regulators on tall fescue.

Treatment List   Applied 3/21/86

Chemical	Formulation	Rate (Lbs. ai/A)	Rate (ai/ha)
gyphosate	4 S	0.1250	0.14 kg
glyphosate	4 S	0.1875	0.21 kg
glyphosate + sulfometuron methyl	4 S + 75 DG	0.1250 + 0.0059	0.14 + 7.0 g
glyphosate + sulfometuron methyl	4 S + 75 DG	0.1875 + 0.0118	0.21 kg + 13.0 g
glyphosate + sulfometuron methyl	4 S + 75 DG	0.2500 + 0.0118	0.28 kg + 13.0 g
glyphosate + chlorsulfuron	4 S + 75 DG	0.1250 + 0.0118	0.14 kg + 13.0 g
glyphosate + chlorsulfuron	4 S + 75 DG	0.1875 + 0.0236	0.21 kg + 26.0 g
sulfometuron methyl	75 DG	0.0059	7.0 g
sulfometuron methyl	75 DG	0.0118	13.0 g
chlorsulfuron	75 DG	0.0118	13.0 g
chlorsulfuron	75 DG	0.0236	26.0 g
check			

Quality Evaluation:

The foliar quality of grass treated with either low rate of glyphosate alone was acceptable and tended to improve as the experiment progressed.

SMM and chlorsulfuron alone and in combination with glyphosate caused unacceptable phytotoxicity to tall fescue after six weeks. Damage from these treatments progressed to near death by twelve weeks after treatment (Table 13).

Table 13: Foliar quality of tall fescue (0 to 9)**.

Treatment	Rate (ai/ha)	6 WAT*	7 WAT	10 WAT	12 WAT
Glyphosate	0.14 kg	6.3 a	7.8 a	8.3 a	8.2 a
Glyphosate	0.21 kg	6.3 a	6.7 a	7.3 a	7.3 a
Glyphosate + SMM	0.14 kg + 7.0 g	5.0 ab	4.0 b	3.8 b	3.0 b
Glyphosate + SMM	0.21 kg + 13.0 g	3.8 b	3.0 b	2.5 bc	1.5 bc
Glyphosate + SMM	0.28 kg + 13.0 g	3.3 b	2.3 b	2.5 bc	1.2 bc
Glyphosate + chlorsulfuron	0.14 kg + 13.0 g	3.0 b	2.5 b	1.7 c	0.8 c
Glyphosate + chlorsulfuron	0.21 kg + 26.0 g	3.5 b	2.3 b	2.0 bc	1.2 bc
Chlorsulfuron	13.0 g	4.3 ab	3.7 b	1.7 c	1.2 bc
Check	0.00	6.3 a	6.5 a	7.0 a	6.8 a

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).
* Weeks after treatment
** Quality rating 0 = dead grass, 9 = high quality

Height Evaluation:

Glyphosate alone at either application rate did not suppress the growth of tall fescue (Table 14). The lower rate tended to stimulate the growth of grass at approximately 4 weeks after treatment. This phenomenon of growth stimulation has been demonstrated by other total vegetation control products applied at very low rates to certain turf species. This growth stimulation probably negates the limited growth suppression that is sometimes found.

The growth of grass treated with SMM at 7.0 g ai/ha was not significantly different from the check. At five weeks after treatment, both rates of SMM caused vertical growth suppression.

Chlorsulfuron at 13.0 g ai/ha significantly suppressed the growth of grass after the fifth week of treatment. The 26.0 g ai/ha rate did little to suppress tall fescue throughout the rating period and severely discolored the leaf canopy.

The combination treatments that included glyphosate + SMM effectively suppressed tall fescue for the twelve week period. Glyphosate + chlorsulfuron did not provide significant suppression until four weeks after treatment, at which time the suppression was attributed to the phytotoxicity problems discussed previously in the quality section.

Table 14: Vertical foliar height (cm) of tall fescue at various weeks after treatment.

Treatment	Rate (ai/ha)	1	2	3	4	5	7	8	9	12
Glyphosate	0.14 kg	11.7 ab	12.3 a	12.4 a	12.7 a	12.5 a	12.9 a	13.0 a	12.9 a	13.0 a
Glyphosate	0.21 kg	11.4 abc	11.5 bcd	11.7 bcd	11.8 bcde	11.9 abcd	12.0 bc	12.0 bcd	11.8 bcd	11.6 bcd
Glyphosate + SMM*	0.14 kg + 7.0 g	11.0 c	11.3 cd	11.2 d	11.3 e	11.1 e	11.2 d	11.3 de	11.3 d	10.9 d
Glyphosate + SMM	0.21 kg + 13.0 g	11.2 abc	11.3 cd	11.4 cd	11.3 e	11.3 de	11.3 cd	11.2 e	11.2 d	11.2 cd
Glyphosate + SMM	0.28 kg + 13.0g	11.1 bc	11.0 d	11.3 d	11.4 de	11.4 de	11.5 cd	11.4 cde	11.4 d	11.4 bcd
Glyphosate + chlorsulfuron	0.14 kg + 13.0g	11.5 abc	11.6 bcd	11.6 bcd	11.7 cde	11.7 cde	11.7 cd	11.5 cde	11.5 cd	11.5 bcd
Glyphosate + chlorsulfuron	0.21 kg + 26.0g	11.3 abc	11.3 cd	11.7 bcd	11.7 cde	11.6 cde	11.6 cd	11.7 cde	11.7 cd	11.7 bcd
SMM	7.0 g	11.6 abc	11.8 abc	11.8 abcd	12.1 bc	11.8 bcd	11.9 bcd	11.8 bcde	11.8 bcd	11.8 bcd
SMM	13.0 g	11.5 abc	11.8 abc	11.8 abcd	11.8 bcde	11.7 cde	11.7 cd	11.7 cde	11.7 cd	11.7 bcd
Chlorsulfuron	13.0 g	11.3 abc	11.4 cd	11.7 abcd	11.6 cde	11.6 cde	11.5 cd	11.5 cde	11.5 cd	11.5 bcd
Chlorsulfuron	26.0 g	11.7 a	12.0ab	12.2 abc	12.0 bcd	12.1 abc	11.8 cd	12.1 bc	12.1 bc	12.1abc
Check	0.00	11.7 ab	12.3 a	12.3 ab	12.3 ab	12.4 ab	12.5 ab	12.5 ab	12.4 ab	12.3 ab

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).
* Sulfometuron methyl

Tiller and Root Evaluation:

Glyphosate when applied alone at either rate did not significantly alter the tillering of tall fescue when compared with the check. Treatments that included either of the sulfonyl urea compounds significantly reduced the tiller production of tall fescue. These negative effects on tillering are cause for concern if they carry over into field evaluations. Stand density is critically important for roadbank stabilization, erosion control, and weed competition.

Canopy fresh weight of tall fescue treated with glyphosate alone was not different from the check. Grass treated with glyphosate at 0.14 kg ai/ha had superior canopy dry weights. Grass treated with sulfonyl urea compounds alone or in combination with glyphosate had significantly less fresh and dry canopy weights than the check.

Glyphosate at 0.14 kg ai/ha caused grass to have significantly increased root dry weights. Glyphosate at 0.21 kg ai/ha also increased root production but not to a significantly greater degree than the check. Treatments that included sulfonyl urea compounds caused decreased root dry weights when compared with untreated grass (Table 15).

Table 15: Tiller and root production of tall fescue.

Treatment	Rate (ai/ha)	Tiller number	Canopy fresh wt(g)	Canopy dry wt.(g)	Root dry wt.(g)
Glyphosate	0.14 kg	21.8 a	3.6 a	1.25 a	1.8 a
Glyphosate	0.21 kg	20.7 a	3.1 a	0.99 ab	1.4 ab
Glyphosate + SMM	0.14 kg + 7.0 g	9.5 b	1.3 b	0.41 c	0.6 c
Glyphosate + SMM	0.21 kg + 13.0 g	7.2 b	1.4 b	0.42 c	0.6 c
Glyphosate + chlorsulfuron	0.14 kg + 13.0 g	7.1 b	0.6 b	0.33 c	0.4 c
Glyphosate + chlorsulfuron	0.21 kg + 26.0 g	7.3 b	0.7 b	0.31 c	0.4 c
Sulfometuron methyl	7.0 g 7	.9 b	0.7 b	0.33 c	0.4 c
Sulfometuron methyl	13.0 g	7.3 b	0.9 b	0.43 c	0.4 c
Chlorsulfuron	26.0 g	6.8 b	0.6 b	0.37 c	0.4 c
Check	0.00	20.8 a	2.7 a	0.84 b	1.2 b

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).

GREENHOUSE EXPERIMENT #5

Objective: To test the safety and efficacy of several rates of a metsulfuron methyl/mefluidide combination for use on tall fescue.

Treatment List Applied 4/11/86

Chemical	Formulation	Rate (Lbs. ai/A)	Rate (ai/ha)
metsulfuron methyl	60 DF	.0015	1.68 g
metsulfuron methyl	60 DF	.0031	3.47 g
metsulfuron methyl	60 DF	.0062	6.94 g
mefluidide	2 S	.0312	0.03 kg
mefluidide	2 S	.0625	0.07 kg
mefluidide + metsulfuron methyl	2 S + 60 DF	.0312 + .0015	0.03 kg + 1.68 g
mefluidide + metsulfuron methyl	2 S + 60 DF	.0625 + .0015	0.07 kg + 1.68 g
mefluidide + metsulfuron methyl	2 S + 60 DF	.0312 + .0031	0.03 kg + 3.47 g
mefluidide + metsulfuron methyl	2 S + 60 DF	.0625 + .0031	0.07 kg + 3.47 g
mefluidide + metsulfuron methyl	2 S + 60 DF	.0312 + .0062	0.03 kg + 6.94 g
mefluidide + metsulfuron methyl	2 S + 60 DF	.0625 + .0062	0.07 kg + 6.94 g
check			

Quality Evaluation:

All rates of MSM applied alone had acceptable foliar quality throughout the rating period, but the foliar quality tended to decrease as the rate of MSM increased (Table 16). Grass treated with mefluidide alone had acceptable quality throughout the rating period and was similar in appearance to untreated grass at nine weeks after application. All combination treatments caused grass quality to be rated lower than the check at seven weeks after application. Combinations with the higher rate of mefluidide (0.07 kg ai/ha) caused poor quality and unacceptable injury.

Table 16: Foliar quality of tall fescue (0 to 9)**.

Treatment		3 WAT*	7 WAT	9 WAT
MSM	1.68 g ai/ha	8.0 ab	7.3 abc	7.8 ab
MSM	3.47 g ai/ha	7.7 b	7.2 bcd	7.7 ab
MSM	6.94 g ai/ha	6.7 c	6.8 cd	6.8 ab
Mef	0.03 kg ai/ha	7.7 b	7.7 abc	8.2 a
Mef	0.07 kg ai/ha	7.2 bc	8.2 ab	8.2 a
Mef	0.03 + MSM 1.68	7.3 bc	6.5 cde	6.3 ab
Mef	0.07 + MSM 1.68	7.3 bc	6.0 def	6.5 ab
Mef	0.03 + MSM 3.47	7.2 bc	6.0 def	6.2 b
Mef	0.07 + MSM 3.47	6.7 c	5.3 ef	4.0 c
Mef	0.03 + MSM 6.94	7.3 bc	7.0 bcd	7.0 ab
Mef	0.07 + MSM 6.94	7.3 bc	5.2 f	4.5 c
Check	0.00	8.7 a	8.5 a	8.2 a

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).
* Weeks after treatment
** Quality rating 0 = dead grass, 9 = high quality

<u>Height Evaluation:</u>

All treatments suppressed tall fescue for at least four weeks (Table 17). At approximately seven weeks after application, turf treated with either MSM at 1.68 or 3.47 g ai/ha, or mefluidide 0.07 kg ai/ha + MSM 1.68 g ai/ha were no longer suppressed. By eight weeks after application these plants tended to be of greater height than the check. At ten weeks after application, mefluidide 0.07 kg ai/ha + MSM 6.94 g ai/ha did not suppress the canopy height of the tall fescue. After 12 weeks, grass treated with MSM 6.94 g ai/ha, mefluidide 0.03 or 0.07g kg ai/ha, or mefluidide 0.03 kg ai/ha + MSM 3.47 g ai/ha was no longer suppressed. Mefluidide 0.07 kg ai/ha + MSM 3.47 g ai/ha was the only treatment that significantly suppressed the height of tall fescue for the twelve week rating period.

Table 17: Vertical foliar height (cm) of tall fescue at various weeks after treatment.

Treatment	Rate kg ai/ha	1	2	3	4	6	7	8	9	10	11	12
MSM*	1.68 g ai/ha	9.9 b	10.0 b	10.0 b	10.0 b	10.1 abc	10.9 abc	13.3 ab	13.6 abc	14.1 ab	14.8 ab	14.8 a
MSM	3.47 g ai/ha	10.0 b	0.2 b	10.4 ab	10.1 b	10.5 abc	12.1 a	14.2 a	15.0 a	15.5 a	16.1 a	16.0 a
MSM	6.94 g ai/ha	9.7 b	0.0 b	10.1 b	9.9 b	10.1 abc	10.6 bc	13.2 abc	14.1 ab	14.3 ab	14.9 ab	15.4 a
Mef**	0.03 kg ai/ha	10.3 ab	10.3 b	10.4 ab	10.3 b	10.5 abc	10.6 bc	11.6 bcd	12.3 abcd	13.6 abc	13.9 ab	14.0 ab
Mef	0.07 kg ai/ha	9.9 b	10.0 b	10.0 b	10.0 b	9.9 c	10.7 bc	12.2 abcd	12.6 abcd	12.8 abcd	14.2 ab	14.2 ab
Mef	0.03 + MSM 1.68	10.3 ab	10.5 b	10.4 ab	10.4 b	11.0 a	11.3 abc	12.9 abc	13.4 abc	14.2 ab	15.6 a	15.4 a
Mef	0.07 + MSM 1.68	10.2 ab	10.3 b	10.1 b	9.9 b	10.6 abc	11.0 abc	12.7 abc	13.3 abc	13.4 abc	14.1 ab	15.5 a
Mef	0.03 + MSM 3.47	10.1 b	10.4 b	10.2 b	10.2 b	10.2 abc	10.0 c	10.1 d	10.1 d	10.3 d	10.3 c	10.6 c
Mef	0.03 + MSM 6.94	10.0 b	10.0 b	10.1 b	9.9 b	10.0 bc	10.4 bc	11.0 bcd	11.3 bcd	11.3 cd	11.8 bc	11.7 bc
Mef	0.07 + MSM 6.94	9.9 b	10.1 b	9.9 b	10.1 b	10.0 bc	10.2 bc	10.7 cd	11.1 cd	11.9 bcd	13.3 abc	13.4 abc
Check	0.00	10.9 a	11.1 a	1.0 a	11.0 a	10.9 ab	11.5 ab	12.2 abcd	12.8 abcd	13.2 abc	13.8 ab	14.3 ab

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).
* MSM - Metsulfuron methyl
** Mef - Mefluidide

Tiller and Root Evaluation:

Tillering of the tall fescue was increased by both rates of mefluidide alone and MSM alone at 1.68 and 3.47 g ai/ha. The mefluidide treatments increased tillering more than the untreated check, while the MSM treatments tended to increase tillering only slightly more than the untreated check (Table 18). All other treatments did not statistically increase tillering. Mefluidide 0.07 kg ai/ha + MSM 3.47 g ai/ha was the only treatment to significantly reduce tiller production, though all combination treatments tended to decrease tiller production to some degree. Combinations of MSM and mefluidide need to be field evaluated to determine tillering responses. Apparent synergism occurs and the appropriate ratio of the components of the combination needs further research.

Neither mefluidide nor MSM used alone reduced fresh or dry canopy fresh weights when compared with the check. All other treatments significantly reduced both fresh and dry canopy weights.

Most treatments significantly reduced root dry weights of the tall fescue. The exceptions were MSM alone at 3.47 and 6.94 g product ha, and mefluidide at 0.03 kg/ha, none of which significantly decreased root dry weights when compared with the check.

Table 18: Tiller and root production of tall fescue.

Treatment		Tiller number	Canopy fresh wt.(g)	Canopy dry wt.(g)	Root dry wt.(g)
MSM	1.68 g ai/ha	19.4 abc	4.5 ab	1.6 abc	2.8 abc
MSM	3.47 g ai/ha	19.0 abcd	4.7 a	1.7 ab	2.8 abc
MSM	6.94 g ai/ha	17.3 bcde	4.2 abc	1.5 abc	2.6 bc
Mef.	0.03 kg ai/ha	20.8 ab	4.4 ab	1.6 abc	2.9 ab
Mef.	0.07 kg ai/ha	22.2 a	4.2 abc	1.5 bc	2.5 bcd
Mef.	0.03 + MSM 1.68	13.4 ef	3.4 cde	1.3 cd	1.7 ef
Mef.	0.07 + MSM 1.68	15.8 cdef	3.6 bcd	1.3 cd	2.0 cde
Mef.	0.03 + MSM 3.47	16.7 bcde	3.1 de	1.1 de	1.8 de
Mef.	0.07 + MSM 3.47	11.9 f	1.6 f	.5 f	1.0 f
Mef.	0.03 + MSM 6.94	15.0 def	3.7 bcd	1.3 cd	2.6 bc
Mef.	0.07 + MSM 6.94	13.5 ef	2.5 ef	0.9 e	1.6 ef
Check	0.00	17.5 bcde	4.9 a	1.9 a	3.5 a

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).

GREENHOUSE EXPERIMENT #6

Objectives:

1. To evaluate low rates of selective grass herbicides for acceptability as plant growth regulators on tall fescue.

2. To assess the activity of an experimental cell elongation inhibiting compound (XE-1019) on tall fescue.

Treatment List Applied 6/27/86

Chemical	Formulation	Rate (Lbs. ai/A)	Rate (kg ai/ha)
sethoxydim	1.5 EC	0.01	0.011
sethoxydim	1.5 EC	0.02	0.028
sethoxydim	1.5 EC	0.05	0.056
sethoxydim	1.5 EC	0.10	0.112
fluazifop-butyl	1.0 EC	0.05	0.056
fluazifop-butyl	1.0 EC	0.10	0.112
fluazifop-butyl	1.0 EC	0.20	0.224
XE-1019	10 WP	0.07	0.084
XE-1019	10 WP	0.15	0.168
XE-1019	10 WP	0.20	0.224
XE-1019	10 WP	0.25	0.280
check			

Height Evaluation:

All treatments initially suppressed the growth of tall fescue (Table 19). Sethoxydim 0.011, 0.028, and 0.056 kg ai/ha, and all rates of XE-1019 effectively suppressed height throughout the eleven week rating period. Treatments containing the high rate of sethoxydim and all rates fluazifop-butyl initially caused stand loss which was followed by a tillering response of the tall fescue. At approximately seven weeks after treatment, the growth of these new tillers accounted for an increase in height of the grass canopy. This tillering response is also noted in the following evaluation sections.

Table 19: Vertical foliar height (cm) of tall fescue at various weeks after treatment.

Treatments	Rate (kg ai/ha)	1	2	3	4	5	6	7	8	9	10	11
Sethoxydim	0.011	10.5 b	10.4 e	10.6 cd	10.6 d	10.7 d	11.0 c	12.2 bc	12.1 cd	12.4 de	12.8 bc	12.9 cd
Sethoxydim	0.028	10.6 b	10.6 de	10.6 cd	11.0 bcd	11.4 cd	11.2 c	12.2 bc	12.7 bcd	13.1 bcde	13.4 b	13.6 bc
Sethoxydim	0.056	11.1 b	11.3 bcd	10.9 bcd	11.0 bcd	11.2 cd	11.5 bc	12.3 bc	12.4 cd	12.7 cde	13.4 b	13.6 bc
Sethoxydim	0.112	10.6 b	10.8 cde	10.7 cd	11.2 bcd	11.9 bcd	12.3 bc	14.4 a	14.6 ab	15.0 abc	15.7 a	16.3 a
Fluazifop-butyl	0.056	10.8 b	11.0 bcde	11.2 bcd	11.8 b	12.7 b	12.9 bc	15.1 a	15.2 a	16.3 a	16.9 a	17.7 a
Fluazifop-butyl	0.112	10.6 b	10.5 de	10.5 d	10.9 bcd	11.7 bcd	12.2 bc	13.5 ab	14.0 abc	14.6 abcd	15.7 a	15.9 ab
Fluazifop-butyl	0.224	10.7 b	10.6 de	10.8 bcd	11.0 bcd	11.7 bcd	12.2 bc	13.5 ab	14.0 abc	14.6 abcd	15.7 a	15.9 ab
XE-1019	0.084	10.9 b	11.2 bcde	11.4 bc	11.6 bc	11.6 bcd	11.7 bc	11.7 bc	11.9 cd	12.3 de	12.7 bc	12.8 cd
XE-1019	0.168	11.1 b	11.7 ab	11.7 b	11.6 bcd	11.3 cd	11.5 bc	11.3 c	11.0 d	11.0 e	11.2 bc	11.6 cd
XE-1019	0.224	10.7 b	11.1 bcde	10.8 cd	10.8 cd	10.8 d	11.1 c	11.3 c	11.0 d	11.3 e	11.2 bc	11.4 cd
XE-1019	0.280	11.1 b	11.4 bc	11.3 bcd	11.4 bcd	11.2 cd	11.3 c	11.1 c	11.0 d	10.9 e	10.6 c	10.8 d
Check	0.00	12.0 a	12.4 a	13.2 a	13.9 a	14.3 a	14.6 a	15.2 a	15.5 a	16.2 a	16.9 a	16.7 a

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).

Quality Evaluation:

Treatments containing sethoxydim and fluazifop-butyl initially caused severe injury to the leaves of the treated plants. The grass that was injured by these treatments began to produce tillers from the crown of the plant after the initial leaves were killed. Both the live and senesced tillers were counted and the percentage of live tillers was calculated at eight weeks after treatment. The senesced tillers tended to increase as the rates of these two products increased. All rates of XE-1019 and fluazifop-butyl at the low rate of 0.056 kg ai/ha did not significantly decrease the percentage of live tillers (Table 20).

Tiller and Root Evaluation:

All rates of sethoxydim and fluazifop-butyl significantly increased the number of tillers harvested 13 weeks after treatment (Table 20). As rates of these two products increased, the number of tillers produced also tended to increase. All rates of XE-1019 did not alter tillering of tall fescue when compared with the check.

With the exception of 0.011 kg ai/ha rate, all rates of sethoxydim caused grass canopy fresh weights that were no different from untreated turf, although the fresh weights tended to increase as the rate increased. Canopy dry weights were significantly decreased by all rates of sethoxydim.

Fresh weights for all rates of fluazifop-butyl were statistically similar to untreated grass, although the fresh weights of that grass tended to decrease as rates increased. Canopy dry weight for the 0.056 kg ai/ha rate of fluazifop-butyl was similar to the check, but rates of 0.112 and 0.224 kg ai/ha significantly reduced the canopy dry weights.

Canopy fresh weights of grass treated with XE-1019 were all statistically similar to untreated grass but all canopy dry weights were reduced. Canopy dry weights tended to decrease as XE-1019 rates increased. XE-1019 should be evaluated further at higher rates in combination with mefluidide.

Table 20: Tiller response of tall fescue.

Treatments	Rate (kg ai/ha)	% Live tillers 8 WAT*	Tiller number	Canopy fresh wt.(g)	Canopy dry wt.(g)
Sethoxydim	0.011	89.5 b	21.8 bcd	3.8 d	1.1 e
Sethoxydim	0.028	84.7 bc	22.5 bcd	3.9 cd	1.2 de
Sethoxydim	0.056	76.6 de	21.8 bcd	4.2 bcd	1.3 cd
Sethoxydim	0.112	75.4 e	28.5 a	4.1 bcd	1.4 cd
Fluazifop-butyl	0.056	95.0 a	21.7 bcd	4.8 a	1.6 ab
Fluazifop-butyl	0.112	85.5 bc	23.3 bc	4.3 abcd	1.4 cd
Fluazifop-butyl	0.224	81.9 cd	24.5 ab	4.0 bcd	1.3 cd
XE-1019	0.084	100.0 a	15.2 e	4.5 abc	1.5 bc
XE-1019	0.168	100.0 a	18.2 cde	4.6 ab	1.4 cd
XE-1019	0.224	100.0 a	16.1 e	4.4 abc	1.3 cd
XE-1019	0.280	100.0 a	17.8 de	4.1 bcd	1.3 de
Check	0.00	100.0 a	13.7 e	4.4 abc	1.7 a

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).
* Weeks after treatment

Conclusions of Greenhouse Study

- All treatments that included sulfonyl urea compounds caused undesirable phytoxicity to tall fescue. Lower rates should be evaluated.

- Flurprimidol and XE-1019 provided prolonged foliar growth suppression without undesirable phytotoxicity. Both rates should be further evaluated alone and in combination with mefluidide.

- Combination treatments that included flurprimidol enhanced suppression without increasing injury.

- Low rates of grass herbicides caused canopy loss, but crown bud recovery resulted in increased density after nine weeks.

PLANT GROWTH REGULATOR STUDY

PART II - FIELD EVALUATIONS

Five field experiments were conducted on roadsides in three districts across the state to determine the efficacy of plant growth regulators. The sites selected were on the Tyrone by-pass, Blair County, the State College by-pass, Centre County, and in Danville, Montour County. The experiments and the associated sites are:

Experiment #1 - Danville Site
Experiment #2 - Tyrone Site
Experiment #3 - Tyrone Site
Experiment #4 - State College Site
Experiment #5 - State College Site

Overall objectives of these experiments were:

1. To compare the effects of various growth retarding compounds on the canopy height of roadside grasses.

2. To determine the seedhead suppression resulting from applications of growth regulators to roadside grasses.

3. To evaluate the phytotoxicity associated with applications of growth regulators to roadside grasses.

4. To assess the effects growth regulators have on the density of a roadside sward.

5. To evaluate the response of roadside weed populations to plant growth regulating compounds.

Evaluation Techniques For Field Studies:

Evaluations of foliar height suppression, foliar injury and discoloration, seedhead suppression, change in stand density, weed control, and total grass vegetation reduction were made during the growing season.

Foliar height was measured approximately every 10 days using a graduated device placed at random three times within each plot. Canopy height was determined by measuring the height of the leaf blades directly in front of the measuring device.

Foliar injury and discoloration were visually estimated on May 15 and June 6. A scale of 0-9 was used where 0 = dead grass, 9 = excellent quality, and less than 6 was considered unacceptable for a roadside.

Seedhead suppression was visually estimated on June 6. Ratings were based on a scale from 0% (no suppression) to 100% (total suppression). Control treatments had no seedhead suppression and were rated 0%. A rating of less than 75% seedhead suppression is considered unacceptable for roadside use.

Stand density and tiller weight were evaluated for Experiments 1, 2, and 3 by using a 20 cm x 20 cm quadrant placed three times at random in each plot. At each quadrant drop, all tillers within the quadrant were cut at soil level, counted and then dried. Both total dry weights and average individual tiller weights were calculated.

For experiments 2, 3, 4, and 5, the total vegetation suppression was evaluated by harvesting a portion of each treatment and measuring the fresh weight of the material harvested. The study examined the total vegetative matter growing in the plots including the grass blades, seedheads if present, and broadleaf weeds.

All treatments were applied in the spring just after green-up of the roadside grasses. All spray treatments were applied with flat fan nozzles mounted on a boom. Granular applications were made with a drop spreader. Plots were arranged in a randomized complete block design, and each treatment was replicated 3 times.

The performance of PGR's can vary from site to site and from year to year. Rainfall prior to and after application, environmental conditions during the study, fertility, levels of stress and general health and vigor of the stand, are some of the factors that can contribute to inconsistency.

All products utilized in these evaluations are referred to by their generic chemical names. The table below lists the chemicals and their respective product names.

Chemical Name	Product Name
Amidochlor	Limit
Chlorsulfuron	Gleen
EPTC	Shortstop
EPTC + dicamba	Shortstop/dicamba
Flurprimidol	Cutless
Glyphosate	Roundup
Mefluidide	Embark
Metsulfuron methyl (MSM)	Escort
S-1615	Experimental-O.M. Scotts Co.
Sulfometuron methyl (SMM)	Oust
XE-1019	Experimental-Chevron Chemical Co.

All rates discussed here are referred to in kilograms of active ingredient per hectare (kg ai/ha) unless a gram symbol (g) follows the rate number, which would signify grams of active ingredient per acre. For example, EPTC 6.72 refers to EPTC applied at 6.72 kg ai/ha and MSM 13.8g refers to MSM applied at 13.8 grams ai/ha.

FIELD EXPERIMENT #1 - DANVILLE SITE

Objective: To evaluate the response of a roadside sward to several plant growth regulating compounds.

Treatment List Applied 4/18/86

Chemical	Formulation	Rate (Lbs. ai/A)	Rate (kg ai/ha)
Mefluidide	2 S	0.375	0.42
Mefluidide	2 S	0.25	0.28
EPTC	10 G	3.0	3.36
EPTC	10 G	4.0	4.48
EPTC	10 G	6.0	6.72
EPTC + dicamba	10 G	3.0 + 5.0	3.36 + 0.56
EPTC + dicamba	10 G	6.0 + 1.0	6.72 + 1.12
Amidichlor	4 F	2.5	2.80
Mefluidide + metsulfuron methyl	2 S + 60 DF	0.056 + 0.012	0.062 + 13.8 g
Mefluidide + flurprimidol	2 S + 10 W	0.25 + 1.5	0.28 + 1.68
Mefluidide + flurprimidol	2 S + 10 W	0.125 +1.0	0.14 + 1.12
Check		0.00	0.00

Quality Study:

Three weeks after treatment, the foliar quality of grass treated with mefluidide + MSM and mefluidide 0.28 + flurprimidol 1.68 was rated as unacceptable for roadside turf. Seven weeks after application, grass treated with EPTC 6.72 + dicamba 1.12 was rated unacceptable. At this time, mefluidide 0.28 + flurprimidol 1.68 was still causing undesireable phytotoxicity to tall fescue (Table 21).

Seedhead Suppression Study:

Both rates of mefluidide, both rates of the mefluidide + flurprimidol combination, EPTC 6.72 + dicamba 1.12, amidochlor 2.8, and mefluidide 0.14 + flurprimidol 1.12 all provided excellent seedhead suppression. EPTC at 6.72 and mefluidide 0.07 + MSM 13.8g also provided adequate seedhead suppression. EPTC at 3.36, 4.48 and EPTC 3.36 + dicamba 0.56 provided sufficient seedhead suppression when compared with untreated grass, but was insufficient for roadside application (Table 21).

Table 21: Seedhead suppression and foliar quality of tall fescue

Treatment	Rate (kg ai/ha)	% Seedhead suppression	Quality 3 WAT*	Quality 7 WAT
Mefluidide	0.42	97.0 a	7.2a b	6.7 abcd
Mefluidide	0.28	95.7 a	7.2a b	6.5 bcd
EPTC	3.36	36.7 e	8.0 a	8.0 ab
EPTC	4.48	58.3 d	7.2 ab	6.8 abcd
EPTC	6.72	76.7 bc	7.8 a	7.3 abc
EPTC + dicamba	3.36 + 0.56	61.7 cd	6.8 ab	7.5 abc
EPTC + dicamba	6.72 + 1.12	81.7 ab	6.3 ab	5.3 d
Amidochlor	2.80	86.7 ab	6.0 ab	6.5 bcd
Mefluidide + metsulfuron methyl	0.07 + 13.8g	75.0 bc	5.5 b	6.2 bcd
Mefluidide + flurprimidol	0.28 + 1.68	96.3 a	5.5 b	5.8 cd
Mefluidide + flurprimidol	0.14 + 1.12	80.7 ab	6.7 ab	6.5 bcd
Check	0.00	00.0 f	7.3 ab	8.5 a

* Weeks after treatment Means followed by the same letter are not significantly different
** Quality rating 0 = dead grass, 9 = high quality (P < 0.05; Duncan's New Multiple Range Test).

Tiller Study:

The number of tillers harvested by quadrant samples was not significantly altered by any treatment. However, mefluidide + MSM and mefluidide 0.28 + flurprimidol 1.68 tended to cause reduced tiller production. These same treatments also tended to reduce total tiller dry weights. In addition, the mefluidide + MSM treatment tended to reduce average individual tiller dry weights (Table 22).

Table 22: Tiller production of tall fescue

Treatment	Rate (kg ai/ha)	Tiller number	Total weight(g)	Individual tiller wt.
Mefluidide	0.42	25.9 a	15.4 ab	0.20 ab
Mefluidide	0.28	22.8 a	12.7 abc	0.19 ab
EPTC	3.36	25.1 a	17.9 a	0.24 a
EPTC	4.48	27.4 a	17.0 ab	0.21 a
EPTC	6.72	20.3 a	11.2 abc	0.19 ab
EPTC + dicamba	3.36 + 0.56	26.0 a	13.1 abc	0.17 ab
EPTC + dicamba	6.72 + 1.12	21.1 a	13.6 abc	0.21 a
Amidochlor	2.80	27.3 a	13.6 abc	0.17 ab
Mefluidide + metsulfuron methyl	0.07 + 13.8g	17.3 a	6.5 c	0.13 b
Mefluidide + flurprimidol	0.28 + 1.68	17.3 a	9.5 bc	0.18 ab
Mefluidide + flurprimidol	0.14 + 1.12	24.4 a	13.6 abc	0.19 ab
Check	0.00	21.2 a	14.0 abc	0.22 a

Means followed by the same letter are not significantly different (P < 0.05; Duncan's New Multiple Range Test).

Height Study:

Five and seven weeks after application all treatments tended to suppress the vertical foliar growth of tall fescue (Table 23). Amidochlor and mefluidide + MSM were the only treatments to significantly suppress foliar growth at five to nine weeks after treatment. Grass treated with mefluidide at 0.28, EPTC at 3.32 or EPTC 6.72 + dicamba 1.12 tended to be of greater height than untreated grass by eleven weeks after treatment.

Table 23: Vertical foliar height (cm) of tall fescue at various weeks after treatment.

Treatment	Rate (kg ai/ha)	1 WAT*	3 WAT	5 WAT	7WAT	9WAT	11WAT	13WAT
Mefluidide	0.42	18.0 a	19.1 ab	19.6 abc	18.2 bcd	21.0 bcd	21.8 abc	24.7 a
Mefluidide	0.28	18.6 a	19.6 ab	19.7 abc	19.7 ab	22.8 ab	24.2 ab	25.3 a
EPTC	3.36	18.3 a	19.1 ab	20.3 ab	20.8 ab	24.7 a	24.8 a	24.8 a
EPTC	4.48	16.7 a	17.9 ab	17.8 bc	20.3 ab	20.4 bcd	22.3 abc	23.7 ab
EPTC	6.72	17.4 a	18.8 ab	20.0 ab	18.3 bcd	20.1 bcd	21.1 bc	25.2 a
EPTC + dicamba	3.36 + 0.56	16.9 a	18.0 ab	19.7 abc	18.3 bcd	21.8 b	23.4 abc	23.9 ab
EPTC + dicamba	6.72 + 1.12	16.0 a	18.7 ab	20.1 ab	18.9 bc	20.2 bcd	23.1 abc	25.1 a
Amidochlor	2.80	15.1 a	16.3 b	17.7 bc	18.3 bcd	18.1 d	21.2 bc	21.8 ab
Mefluidide + metsulfuron methyl	0.07 + 13.8g	15.3 a	16.7 ab	15.9 c	15.8 d	18.8 cd	20.4 c	20.4 b
Mefluidide + flurprimidol	0.28 + 1.68	16.7 a	17.3 ab	18.3 abc	16.7 cd	20.0 bcd	21.9 abc	20.4b
Mefluidide + flurprimidol	0.14 + 1.12	16.9 a	20.1 a	20.2 ab	21.0 ab	21.4 bc	21.3 bc	22.9 ab
Check	0.00	16.9 a	19.3 ab	22.2 a	21.7 a	22.8 ab	22.2 abc	24.1 ab

Means followed by the same letter are not significantly different ($P < 0.05$; Duncan's New Multiple Range Test).
* Weeks after treatment

Conclusions:

- Mefluidide alone, amidochlor alone, EPTC at 6.72 kg ai/ha, and mefluidide 0.14 + flurprimidol 1.12 kg ai/ha provided desirable seedhead suppression and did not cause significant phytotoxicity.

- Injury caused by mefluidide 0.06 kg ai/ha + metsulfuron methyl 13.8 g ai/ha, along with mefluidide 0.28 + flurprimidol 1.68 kg ai/ha was unacceptable as noted in their ratings at 3 and 7 weeks after treatment. These same treatments also tended to reduce tiller development.

- EPTC applied in combination with dicamba tended to provide better seedhead suppression when compared with EPTC applied alone.

FIELD EXPERIMENT #2 - TYRONE SITE

Objective: To evaluate several commercial and experimental PGR compounds alone and in combination with low doses of herbicides for their potential on roadside turf.

Treatment List Application Date: April 30, 1986	Rate lbs ai/ha	kg ai/ha
Mefluidide	0.375	0.42
Mefluidide + furprimidol	0.25 + 0.5	0.28 + 0.56
Amidochlor	2.5	2.80
Amidochlor + flurprimidol	1.0 + 0.5	1.12 + 0.56
EPTC	3.0	3.36
EPTC	6.0	6.72
XE-1019	0.045	0.05
XE-1019	0.1	0.11
Mefluidide + XE-1019	0.25 + 0.04 5	0.28 + 0.05
Flurprimidol	1.5	1.68
Mefluidide + metsulfuron	0.25 + 9.4g	O.28 + 10.5g
Glyphosate + sulfometuron methyl	0.125 + 11.5g	0.14 + 13.0g
Glyphosate + chlorsulfuron	0.125 + 11.5g	0.14 + 13.0g
Check	0.00	0.00

Quality Evaluation:

Tall fescue treated with either mefluidide + MSM or EPTC at 6.72 showed unacceptable injury eight weeks after treatment (Table 24). Injury caused by XE-1019, flurprimidol, amidochlor + flurprimidol, and glyphosate + chlorsulfuron was slight and insignificant. All other treatments caused some discoloration but the injury was assessed to be acceptable for roadside vegetation.

Seedhead Suppression Evaluation:

The mefluidide + MSM combination provided excellent seedhead supression although it was not significantly greater than mefluidide alone, EPTC at 6.72, glyphosate + SMM, or glyphosate + chlorsulfuron, all of which provided adequate seedhead suppression (Table 24). All other treatments provided poor seedhead suppression. XE-1019 alone caused practically no seedhead suppression.

Table 24: Seedhead suppression and foliar quality of tall fescue

Treatments	Rate (kg ai/ha)	% Seedhead suppression	Foliar injury** 8 WAT*
Mefluidide	0.42	75.0 ab	6.8 cd
Mefluidide + flurprimidol	0.28 + 0.56	63.3 bc	6.8 cd
Amidochlor	2.80	68.3 bc	7.3 bc
Amidochlor + flurprimidol	1.12 + 0.56	41.7 cd	7.7 ab
EPTC	3.36	66.7 bc	6.7 d
EPTC	6.72	81.7 ab	5.3 e
XE-1019	0.05	3.3 e	8.0 a
XE-1019	0.11	6.7 e	7.7 ab
Mefluidide + XE-1019	0.28 + 0.05	68.3 bc	6.8 cd
Flurprimidol	1.68	35.0 d	7.8 ab
Mefluidide + metsulfuron methyl	0.28 + 10.5g	99.0 a	4.5 f
Glyphosate + sulfometuron methyl	0.14 + 13.0g	85.0 ab	6.7 d
Glyphosate + chlorsulfuron	0.14 + 13.0g	80.0 ab	7.7 ab
Check	0.00	00.0 e	8.0 a

* Weeks after treatment
** Quality Rating 0 = dead grass, 9 = high quality

Means followed by the same letter are not significantly different (P = 0.05; Duncan's New Multiple Range Test).

Tiller Evaluation:

The total number of tillers was highest for turf treated with glyphosate + SMM (Table 25). No other treatment was statistically different from the check although turf treated with mefluidide + MSM tended to have the fewest tillers.

Untreated turf produced the greatest total dry weight of tillers, but the amount was not significantly greater than turf treated with either rate of XE-1019 alone. Mefluidide + MSM caused the greatest reduction in tiller dry weights followed by EPTC at both rates, mefluidide + flurprimidol, amidochlor, and flurprimidol alone.

Average individual tiller weights of turf treated with XE-1019, amidochlor + flurprimidol, flurprimidol alone, glyphosate + chlorsulfuron or EPTC at 3.36 was no different from tillers harvested from untreated turf. Glyphosate + SMM, EPTC at 6.72, amidochlor alone and all treatments that included mefluidide significantly reduced average individual tiller weight.

Table 25: Tiller production of tall fescue - (14 WAT)

Treatments	Rate (kg ai/ha)	No. tillers per quadrant	Wt.(g) tillers per quadrant	Individual tiller wt.(g)
Mefluidide	0.42	48.0 bc	20.7 bcd	0.14 cde
Mefluidide + flurprimidol	0.28 + 0.56	45.0 bc	17.7 de	0.13 de
Amidochlor	.80	49.7 bc	19.3 cde	0.13 de
Amidochlor + flurprimidol	1.12 + 0.56	41.1 c	21.4 bcd	0.17 abc
EPTC	3.36	41.3 c	19.2 cde	0.15 bcde
EPTC	6.72	49.1 bc	17.7 de	0.12 e
XE-1019	0.05	42.5 bc	24.9 ab	0.20 a
XE-1019	0.11	42.1 c	23.4 abc	0.18 ab
Mefluidide + XE-1019	0.28 + 0.05	52.5 b	22.9 bcd	0.15 cde
Flurprimidol	1.68	41.7 c	20.4 bcde	0.16 abcd
Mefluidide + metsulfuron methyl	0.28 + 10.5g	40.2 c	15.3 e	0.13 e
Glyphosate + sulfometuron methyl	0.14 + 13.0g	61.8 a	21.5 bc	0.12 e
Glyphosate + chlorsulfuron	0.14 + 13.0g	45.0 bc	21.9 bcd	0.16 abcd
Check	0.00	50.2 bc	28.1 a	0.19 ab

Means followed by the same letter are not significantly different (P = 0.05; Duncan's New Multiple Range Test).

Total Vegetation Suppression Study:

Vegetation production (seedheads and foliage) was most suppressed by glyphosate + SMM although mefluidide + MSM, EPTC at 6.72, amidochlor, and mefluidide applied alone caused statistically similar results (Table 26). All other treatments did not significantly suppress vegetation production.

Weed Control Study:

Because weed invasion across the plot area was inconsistent, statistically valid results were not be determined (Table 26). It was noted however, that plots treated with either mefluidide + MSM or glyphosate + chlorsulfuron were almost entirely grass species with only a few weeds, while other plots often contained substantial amounts of weeds.

Table 26: Total vegetation suppression of tall fescue and broadleaf weed control - (9 weeks after treatment)

Treatments	Rate (kg ai/ha)	Fresh harvest weight (g)	Oxeye daisy count
Mefluidide	0.42	254.7 cdef	7.3 bc
Mefluidide + flurprimidol	0.28 + 0.56	330.2 bcde	28.0 ab
Amidochlor	2.80	235.8 def	26.3 ab
Amidochlor + flurprimidol	1.12 + 0.56	433.9 ab	7.7 bc
EPTC	3.36	386.8 abc	11.0 abc
EPTC	6.72	226.4 def	26.7 ab
XE-1019	0.05	500.0 a	10.3 abc
XE-1019	0.11	405.6 ab	10.0 abc
Mefluidide + XE-1019	0.28 + 0.05	301.9 bcdef	12.0 abc
Flurprimidol	1.68	405.6 ab	29.0 a
Mefluidide + metsulfuron methyl	0.28 + 10.5g	188.7 ef	0.0 a
Glyphosate + sulfometuron methyl	0.14 + 13.0g	169.8 f	13.0 abc
Glyphosate + chlorsulfuron	0.14 + 13.0g	339.6 bcd	1.3 c
Check	0.00	443.4 ab	13.0 abc

Means followed by the same letter are not significantly different (P = 0.05; Duncan's New Multiple Range Test).

<u>Height Evaluation:</u>

Four weeks after application, treatments that included the sulfonyl urea products significantly suppressed the vertical foliar growth of tall fescue (Table 27). By 7 weeks after application all treatments suppressed grass growth except XE-1019 and all treatments that included flurprimidol. By 11 weeks, all treatments continued to retard growth except those that included XE-1019 and the mefluidide + flurprimidol combination. When measured at 27 weeks after treatment, the foliar height of grass treated with either mefluidide + MSM or glyphosate + SMM was still significantly less than that of untreated grass.

Table 27: Vertical foliar height (cm) of tall fescue at various weeks after treatment .

Treatments	Rate (kg ai/ha)	2 WAT*	4 WAT	5 WAT	7 WAT	9 WAT	11 WAT	27 WAT
Mefluidide	0.42	17.8 abc	18.7 bc	18.1 bc	20.2 bcd	20.3 bcd	20.9 cd	22.0 ab
Mefluidide + flurprimidol	0.28 + 0.56	19.3 a	20.7 ab	19.8 ab	22.0 ab	21.2 abc	22.1 abc	21.5 ab
Amidochlor	2.80	18.8 abc	18.3 cd	18.7 b	18.9 cd	18.4 cde	18.9 de	20.2 abcd
Amidochlor + flurprimidol	1.12 + 0.56	17.2 abc	20.0 abc	18.7 b	22.1 ab	20.8 abcd	20.3 cde	21.4 ab
EPTC	3.36	17.7 abc	20.2 abc	20.0 ab	20.1 bcd	21.0 abcd	19.3 de	20.7 ab
EPTC	6.72	17.1 abc	19.4 abc	18.9 b	19.0 cd	18.2 de	20.7 cde	20.3 abc
XE-1019	0.05	19.1 ab	20.2 abc	21.4 a	23.7 a	22.4 ab	21.9 bc	22.7 a
XE-1019	0.11	18.6 abc	20.8 a	19.7 ab	21.1 abc	21.7 ab	24.0 a	21.9 ab
Mefluidide + XE-1019	0.28 + 0.05	17.7 abc	20.0 abc	19.1 b	20.0 bcd	19.7 bcde	21.7 bc	19.2 bcd
Flurprimidol	1.68	18.1 abc	19.3 abc	18.4 b	22.1 ab	20.8 abcd	20.9 cd	20.1 abcd
Mefluidide + MSM**	O.28 + 10.5g	16.6 bc	16.4 e	16.2 cd	18.1 d	18.1 de	19.1 de	17.4 d
Glyphosate + SMM***	0.14 + 13.0g	16.7 abc	15.6 e	15.9 d	17.8 d	17.0 e	18.7 e	17.8 cd
Glyphosate + chlorsulfuron	0.14 + 13.0g	16.2 c	16.8 de	15.9 d	18.9 cd	18.7 cde	18.9 de	19.1 bcd
Check	0.00	17.0 abc	19.7 abc	20.1 ab	23.8 a	23.4 a	23.4 ab	20.9 ab

Means followed by the same letter are not significantly different (P < 0.05; Duncan's New Multiple Range Test).
* Weeks After Treatment
** Metsulfuron methyl]
*** Sulfometuron methyl

Conclusions:

- All treatment combinations that included sulfonyl urea compounds provided adequate seedhead suppression, but only chlorsulfuron did not cause undesirable injury and prolongedthe foliar suppression.

- Treatments that included XE-1019 and flurprimidol did little to effect vegetative and reproductive growth of tall fescue.

- Glyphosate + chlorsulfuron and mefluidide alone showed the most potential in this experiment for roadside applications due to a desirable degree of growth suppression with minimal injury and/or stand loss.

FIELD EXPERIMENT #3 - TYRONE SITE

Objective: To determine the effects of different rates of EPTC applied to tall fescue and to compare results with a standard rate of mefluidide.

Treatment List Application Date 4/30/86

Treatments	Rate lbs. ai/a	kg ai/ha
EPTC 10G	3.0	3.36
EPTC 10G	4.0	4.48
EPTC 10G	6.0	6.72
Mefluidide 2S	0.375	0.42
Check	0.00	0.00

Quality Evaluation:

Eight weeks after application EPTC at 4.48 and 6.72 caused the most foliar discoloration to tall fescue but was still considered acceptable for the roadside (Table 28). Other treatments caused slight, yet tolerable injury to tall fescue.

Seedhead Suppression Evaluation:

EPTC at 6.72 provided the greatest seedhead suppression but was not significantly greater than either EPTC at 4.48 or mefluidide (Table 28). EPTC at 3.36 provided some seedhead suppression but was considered unacceptable for a roadside situation.

Table 28: Seedhead suppression and foliar quality of tall fescue.

Treatments	Rate (kg ai/ha)	% Seedhead suppression	Foliar injury* 8 WAT*
EPTC	3.36	63.3 b	7.5 b
EPTC	4.48	82.3 a	6.5 c
EPTC	6.72	83.3 a	6.7 c
Mefluidide	0.42	75.0 a	7.3 b
Check	0.00	00.0 c	8.0 a

Means followed by the same letter are not significantly different (P = 0.05; Duncan's New Multiple Range Test).

* Weeks after treatment.

**Quality Rating: 0 = dead grass, 9 = high quality

Tiller Evaluation:

Tiller density when measured by a quadrant was not statistically effected by any treatment (Table 29).

The dry weight of harvested tillers was significantly decreased by all treatments when compared with the harvested tiller dry weights of the check. Average individual tiller weights were not statistically altered by any chemical treatment.

Table 29: Tiller production of tall fescue at Tyrone, PA.

Treatments	Rate (kg ai/ha)	No. tillers per quadrant (g)	Wt. tillers per quadrant (g)	Individual tiller (g)
EPTC	3.36	39.7 a	18.7 b	0.16 a
EPTC	4.48	42.2 a	16.3 b	0.13 a
EPTC	6.72	38.3 a	16.6 b	0.15 a
Mefluidide	0.42	41.3 a	18.9 b	0.15 a
Check	0.00	45.2a	21.9 a	0.17 a

Means followed by the same letter are not significantly different (P = 0.05; New Multiple Range Test).

Height Evaluation:

At seven, nine and eleven weeks after application, all treatments of EPTC provided significant foliar height suppression when compared with the check (Table 30). Grass treated with mefluidide tended to have suppressed canopy height but was not statistically different from untreated grass. At 27 weeks after treatment only mefluidide displayed continued foliar height suppression.

Table 30: Vertical foliar height (cm) of tall fescue at various weeks after treatment at Tyrone, PA

Treatments	Rate (kg ai/ha)	2 WAT	4 WAT	5 WAT	7 WAT	9 WAT	11 WAT	27 WAT
EPTC	3.36	17.7 a	18.3 ab	18.0 a	18.8 b	19.8 b	17.9 b	19.8 ab
EPTC	4.48	16.4 a	16.9 b	17.4 a	18.2 b	19.4 b	18.0 b	20.0 ab
EPTC	6.72	17.9 a	18.1 ab	17.8 a	19.1 b	20.0 b	17.7 b	19.2 ab
Mefluidide	0.42	16.9 a	18.0 ab	17.2 a	19.6 ab	21.3 ab	20.1 ab	18.3 b
Check	0.00	17.2 a	19.4 a	19.6 a	22.9 a	22.2 a	22.6 a	20.7 a

Means followed by the same letter are not significantly different (P = 0.05; Duncan's New Multiple Range Test).

Total Vegetation Suppression Study:

EPTC at 4.48 provided the greatest vegetation suppression but was not significantly different than EPTC 6.72 (Table 31). EPTC 3.36 and mefluidide also provided significant vegetation suppression when compared with the check.

Broadleaf Weed Study:

Due to inconsistent weed pressure across the plot area, the treatments did not reveal significant broadleaf weed control when compared with the check (Table 31).

Table 31: Total vegetation suppression of tall fescue and broadleaf weed control (9 WAT).

Treatments	Rate (kg ai/ha)	Fresh harvest weight (g)	Oxeye daisy no.
EPTC	3.36	716.9 b	4.3 b
EPTC	4.48	471.7 c	13.0 ab
EPTC	6.72	556.6 bc	35.7 a
Mefluidide	0.42	735.8 b	12.3 ab
Check	0.00	1141.4 a	28.0 ab

Means followed by the same letter are not significantly different (P = 0.05; Duncan's New Multiple Range Test)

Conclusion:

The high rates of EPTC and mefluidide provided acceptable seedhead suppression and total vegetation suppression without causing unacceptable injury.

FIELD EXPERIMENT #4 - STATE COLLEGE SITE

Objective:

To evaluate the efficacy of commercial and experimental plant growth regulators for vertical growth suppression and seedhead inhibition on tall fescue.

Treatment List Application Date: April 25, 1986

Treatment	Rate lbs ai/a	kg ai/ha
EPTC	3.0	3.36
EPTC	6.0	6.72
EPTC + dicamba	3.0 + 0.5	3.36 + 0.56
S-1615	*	*
Mefluidide	0.38	0.42
Check	0.00	0.00

* Experimental Compound - Rate unknown.

Quality Evaluation:

All treatments in this experiment proved to be safe for use on tall fescue at all rating dates (Table 32). Plot quality for this experiment was rated 13 weeks after treatment and the overall appearance of the sward was evaluated. Seedheads, weeds, and foliar injury detract from plot appearance and decrease the quality rating. Mefluidide was the only treatment that provided acceptable plot quality. All the other treatments caused sward appearances that were not different than the untreated check.

Seedhead Suppression Evaluation:

Mefluidide provided excellent seedhead suppression on tall fescue (Table 32). Seedhead suppression caused by the EPTC at 6.72 was significantly greater than the check but was considered inadequate for a roadside application. All other treatments provided minimal seedhead suppression when compared with the check. Dry conditions following application probably reduced EPTC effectiveness as seedhead suppression at the Tyrone Site (where rain occurred) was much better.

TABLE 32: Seedhead suppression and quality ratings

Treatment	Rate (kg ai/ha)	% Seedhead suppression	Foliar quality 7 WAT**	Foliar quality*** 9 WAT	Foliar quality 13 WAT	Plot quality 13 WAT
EPTC	3.36	16.7 bc	7.8 b	8.0 b	8.0 b	5.2 bc
EPTC	6.72	43.3 b	8.0 b	7.5 c	7.8 b	5.2 bc
EPTC + dicamba	3.36 + 0.56	25.0 bc	7.7 b	8.0 b	7.2 b	4.7 c
S-1615	*	25.0 bc	9.0 a	8.7 a	8.0 b	4.7 c
Mefluidide	0.42	95.0 a	7.0 c	6.5 d	9.0 a	7.5 a
Check	0.00	00.0 c	8.0 b	8.0 b	8.0 b	5.3 bc

Means followed by same letter are not significantly different
(P = 0.05; Duncan's New Multiple Range Test).
* Experimental Compound - Rate unknown.
** Weeks after treatment
*** Quality rating 0 = dead grass 9 = high quality

<u>Height Evaluation:</u>

Three weeks after treatment, mefluidide, EPTC 6.72 and EPTC 3.36 + dicamba 0.56 were causing significant growth suppression to tall fescue (Table 33). At the 5, 6, 9, and 13 week after treatment ratings, mefluidide was the only product that still provided vertical foliar growth suppression. EPTC at 3.36 and S-1615 had little effect on the foliar growth of tall fescue throughout the 13 week rating period.

TABLE 33: Vertical foliar height (cm) of tall fescue

Treatment	Rate (kg ai/ha)	1 WAT**	2 WAT	3 WAT	5 WAT	7 WAT	9 WAT	13 WAT
EPTC	3.36	18.6 a	21.0 a	23.6 bc	24.3 a	26.4 ab	27.9 ab	30.0 a
EPTC	6.72	17.7 a	18.0 b	21.4 cd	21.4 ab	24.9 b	24.6 bc	26.8 b
EPTC + Dicamba	3.36 0.56	17.9 a	20.2 ab	20.8 d	23.4 a	25.7 b	27.4 ab	28.3 ab
S-1615 *	19.9 a	22.7 a	24.4 ab	24.6 a	29.3 a	29.0 a	28.0 ab	
Mefluidide	0.42	18.0 a	18.0 b	17.3 e	18.8 b	20.1 c	23.1 c	26.7 b
Check	0.00	19.0 a	21.1 a	25.9 a	25.3 a	26.9 ab	28.6 ab	29.9 a

Means followed by same letter are not significantly different
(P = 0.05; Duncan's New Multiple Range Test).
* Experimental Compound - Rate unknown.
** Weeks after treatment

<u>Broadleaf Weed Control/ Total Vegetation Control Evaluation:</u>

At the State College experimental site, the major weed competition in the tall fescue was from birdsfoot trefoil and crownvetch. During the rating period, data was gathered on the weeds' competition the grass. With the exception of mefluidide, all treatments provided similar control of birdsfoot trefoil when compared to the check. Mefluidide suppressed grass to an extent that allowed the birdsfoot trefoil to significantly invade. Due to the inconsistency of the crownvetch community within the plot area, no statistical differences were noted for the ability of the treated grass to compete with the crownvetch or of the treatments' affects on the crownvetch (Table 34).

TABLE 34: Percent broadleaf weed and total vegetation suppression

Treatment	Rate (kg ai/ha)	Percent trefoil 12 WAT**	Percent vetch 12 WAT	Clipping weight (g) 12 WAT
EPTC	3.36	0.3 b	18.7 a	2622.5 a
EPTC	6.72	2.3 b	12.0 a	2226.3 a
EPTC + dicamba	3.36 + 0.56	2.3 b	3.3 a	2254.6 a
S-1615	*	0.7 b	20.0 a	3282.8 a
Mefluidide	0.42	17.0 a	13.7 a	2264.0 a
Check	0.00	2.3 b	17.0 a	2839.4 a

Means followed by same letter are not significantly different (P = 0.05; Duncan's New Multiple Range Test).
 * Rate unknown.
** Weeks after treatment

Conclusions:

- The experimental compound S-1615 enhanced the foliar appearance of the tall fescue, but had little affect on the suppression of its vegetative or reproductive growth.

- Mefluidide provided excellent seedhead and foliar suppression with minimal phytotoxicity to the tall fescue. The mefluidide treatment however, allowed the encroachment of broadleaf weeds into the treated areas.

- All treatments involving EPTC provided acceptable foliar quality, but the seedhead and foliage suppression was inadequate in this experiment.

FIELD EXPERIMENT #5 - STATE COLLEGE SITE

Objective: To determine the efficacy of plant growth regulators alone and in combination with a herbicide on a tall fescue sward infested with birdsfoot trefoil.

Treatment List Application Date: April 25, 1986

Treatment	Rate lbs ai/a	Rate kg ai/ha
1. EPTC	3.0	3.36
2. EPTC	6.0	6.72
3. EPTC + dicamba	3.0 + 0.5	3.36 + 0.56
4. EPTC + dicamba	6.0 + 1.0	6.72 + 1.12
5. Mefluidide	0.375	0.42
6. Check	0.00	0.00

Quality Evaluation:

Although all treatments in this experiment proved to be safe on tall fescue at all rating dates, the only treatment that displayed an acceptable quality appearance was mefluidide. The quality of all other treatments were rated as unacceptable (Table 35) .

Seedhead Suppression Evaluation:

Mefluidide provided excellent seedhead suppression of tall fescue (Table 35). Treatments that included EPTC at 6.72 provided significant seedhead suppression when compared with the check, but was rated as unacceptable for a roadside situation. Treatments that involved EPTC at 3.36 were inadaquate in suppressing seedheads.

TABLE 35: Seedhead suppression and quality ratings

Treatment	Rate (kg ai/ha)	% Seedhead suppression	Foliar quality 7 WAT*	Foliar quality** 9 WAT	Foliar quality 13 WAT	Plot quality 13 WAT
EPTC	3.36	00.0 d	7.8 a	8.0 a	7.2 ab	2.8 b
EPTC	6.72	25.0 bc	7.7 ab	7.0 b	8.0 ab	4.0 ab
EPTC + dicamba	3.36 + 0.56	15.0 cd	7.3 c	7.0 b	6.8 b	3.2 b
EPTC + dicamba	6.72 + 1.12	43.3 b	6.8 d	6.8 b	7.7 ab	4.8 ab
Mefluidide	0.42	95.0 a	8.2 a	6.7 b	8.5 a	7.2 a
Check	0.00	0.00 d	7.3 bc	8.0 a	7.5 ab	4.3 ab

Means followed by same letter are not significantly different
(P = 0.05; Duncan's New Multiple Range Test).
* Weeks after treatment
** Quality rating 0 = dead grass, 9 = high quality

Height Evaluation:

Grass treated with EPTC at 3.36 tended to have greater foliar height than untreated turf throughout the 13 week rating period (Table 36). Mefluidide was the only treatment to significantly suppress the growth of tall fescue through 5 weeks after treatment. All other treatments tended to suppress the foliar growth of the grass but were not significantly different from the check.

TABLE 36: Vertical foliar height (cm) of tall fescue

Treatment	Rate (kg ai/ha)		1 WAT*	2 WAT	3 WAT	5 WAT	7 WAT	9 WAT	13 WAT
EPTC	3.36		18.9 ab	20.4 a	22.6 a	22.7 a	27.0 a	28.0 a	28.7 a
EPTC	6.72		17.7 b	18.8 ab	19.8 bc	18.9 bc	20.7 b	24.3 a	25.7 a
EPTC + dicamba	3.36 + 0.56		19.4 a	19.4 ab	18.0 d	19.1 bc	23.8 ab	24.0 a	23.6 a
EPTC + dicamba	6.72 + 1.12		18.6 ab	17.1 b	20.4 b	19.4 bc	21.8 b	24.4 a	26.3 a
Mefluidide	0.42	16.3 c	17.0 b	18.4 cd	17.6 c	22.0 b	24.9 a	26.6 a	
Check	0.00		18.9 ab	19.7 a	19.6 bc	21.7 ab	25.3 ab	26.1 a	27.4 a

Means followed by same letter are not significantly different
(P = 0.05; Duncan's New Multiple Range Test).
* Weeks after treatment

Broadleaf Weed Control Evaluation:

Plots treated with either EPTC + dicamba or mefluidide had significantly less birdsfoot trefoil than untreated areas (Table 37). Plots treated with EPTC alone were not significantly different from untreated checks.

Total Vegetation Suppression Study:

All treatments significantly suppressed vegetation growth of tall fescue when compared with the check (Table 37).

TABLE 37: Percent broadleaf weed and total vegetation suppression

Treatment	Rate (kg ai/ha)	Percent trefoil 13 WAT*	Clipping weight (g) 13 WAT
EPTC	3.36	24.3 ab	2429 b
EPTC	6.72	40.0 a	2773 b
EPTC + dicamba	3.36 + 0.56	5.0 b	1080 b
EPTC + dicamba	6.72 + 1.12	17.0 b	2349 b
Mefluidide	0.42	18.3 b	2368 b
Check	0.00	38.3 a	5132 a

Means followed by same letter are not significantly different (P = 0.05; Duncan's New Multiple Range Test).
* Weeks after treatment

Conclusions:

- All treatments involving EPTC provided acceptable foliar quality, but seedhead and foliage suppression was inadequate in this experiment.

- EPTC applied in combination with dicamba tended to improve seedhead suppression than EPTC applied alone.