1986
SEED PRODUCTION RESEARCH
AT OREGON STATE UNIVERSITY
USDA-ARS COOPERATING

Edited by Harold W. Youngberg

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INTRODUCTION

H.W. Youngberg

This edition of "Seed Production Research at Oregon State University" is the fifth edition of research in progress prepared for Oregon seed growers. It is published in cooperation with the OSU Extension Service and the U.S. Department of Agriculture, Agricultural Research Service. Financial support for publication is provided by a grant from the Oregon Seed Council.

The National Forage Seed Production Research Laboratory was completed and occupied in early January, 1987. The $3.2 million facility includes a 19,500 square foot laboratory/office and a 6,500 square foot greenhouse/headhouse.

Completion of this facility is the culmination of work over many years by state and regional industry groups. The present staff of four scientists will be expanded in June by the addition of a plant physiologist, an agricultural engineer, and a plant pathologist enabling the USDA-ARS to enable forage seed producers to better serve the needs of consumers.

Acknowledgements: Appreciation is expressed to the Oregon Seed Council for grants in support of printing and for distribution.

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STAND ESTABLISHMENT OF CUPHEA

C. Garbacik and D. Grabe

In the process of investigating cuphea as a potential oilseed crop, there has been little research on the optimum methods of stand establishment. Field trials were conducted in 1986 to determine the optimum time of planting and rate of seeding.

Weekly plantings of *Cuphea laminuligera* and *C. wrightii* were made on May 12, 19, 27, and June 3. Multiple harvests were made using a small plot vacuum harvester. A three- to four-fold yield increase was observed with earlier planting (Table 1). *C. laminuligera* senesced much earlier than *C. wrightii*; therefore, only three harvests were made on that species. These results indicate that cuphea should be planted as soon as possible in the spring when danger of frost is past and soil is workable, instead of waiting for soil temperatures to increase.

Table 1. Yield of cuphea from four planting dates, 1986.

Planting	Harvest date				Total
Date	8/12	8/28	9/11	10/22	yield
	-----------(lb/a)--------				
Cuphea wrightii					
May 12	97	168	207	135	607
May 19	65	135	138	146	484
May 27	24	86	125	106	341
June 3	18	33	50	110	210
Cuphea laminuligera					
May 12	54	17	148	--	319
May 19	40	121	132	--	292
May 27	19	83	139	--	241
June 3	3	12	57	--	72

Table 2. Yield of cuphea planted at five seeding rates, 1986.

Planting rate	Harvest date 8/12	8/28	9/11	10/22	Total yield
	----------(lb/a)----------				
Cuphea wrightii					
0.5	42	133	143	112	430
1.0	51	144	129	147	470
2.0	69	162	127	140	498
3.0	67	145	125	123	460
4.0	69	141	120	146	476
Cuphea laminuligera					
0.5	20	93	94	--	207
1.0	37	122	101	--	260
2.0	48	127	108	--	283
3.0	56	117	88	--	261
4.0	53	115	113	--	281

The same two species were used to determine the optimum rate of planting. Each species was planted at 0.5, 1, 2, 3, and 4 lb/a on May 19 and yield was determined over a series of harvestings. Seeding rate did not greatly affect seed yield. Although the higher rates are commonly used in cuphea production, the results indicate that a 2 lb/a rate may be just as productive as a 4 lb/a rate, perhaps even more. The 0.5 and 1 lb/a rates may prove to be sufficient, but a 2-lb rate might help assure good stands when field conditions are less than ideal.

WHEAT SEED TREATMENTS WITH YIELD ENHANCING AGENTS

D. Grabe, F. Bolton, and C. Garbacik

Yield trials were conducted to determine response to several compounds purported to have yield enhancing effects on winter wheat. The products tested included YEA!, containing chitosan, a derivative of crabshell; Amplify-D, containing sodium phosphates and adenosine monophosphate; Cardak, containing super slurper, a starch derivative; and Golden X, containing *Aspergillus oryzae* in a carrier of sand washings. Another treatment consisted of passing the seed through a Bio-Mag magnetic seed treater. Controls consisted of untreated seed and seed treated with Vitavax 200.

The products were applied to Vitavax-treated seed at rates recommended by the suppliers. Three wheat varieties were used - Hill 81, Malcolm, and Stephens. Plots were established at Hyslop Farm, near Corvallis, and the Columbia Basin Agricultural Research Center, near Moro. The experimental design was a randomized complete block with four replications.

No yield increases were obtained from any of the products tested at either location (Table 1). The yield trials have been re-established in 1987.

Table 1. Yield of three winter wheat varieties treated with yield enhancing agents grown at Corvallis and Moro, Oregon, 1986.

Seed treatment	Corvallis Stephens	Hill-81	Malcolm	Ave.	Moro Stephens	Hill-81	Malcolm	Ave.
YEA!	8833	9164	9040	9012	2335	2775	2593	2568
Cardak	9051	8625	9312	8996	2358	2721	2470	2516
Amplify	8871	9582	9151	9201	2493	2606	2534	2544
Golden-X	8937	9485	9268	9230	2040	2776	2786	2534
Bio-Mag	9090	9227	9195	9171	2416	2636	2695	2582
Vitavax-200	9006	9491	9527	9341	2241	2680	2585	2502
Untreated	8731	9494	9226	9150	2306	2779	2784	2623
Average	8931	9295	9246	9157	2313	2710	2635	2553

DEVELOPMENT OF ACCURATE OVEN MOISTURE TESTING METHODS FOR GRASS SEEDS

E.Benjamin and D.Grabe

Seed moisture is a primary factor influencing seed quality during harvesting, storage and marketing of grass seed. However, the Association of Official Seed Analysts' Rules for Testing Seeds does not contain methods for moisture testing. Seed testing laboratories in the U.S. use many combinations of drying times and temperatures and many of these methods produce erroneous results. The International Seed Testing Association's Rules for Seed Testing contain methods for 76 kinds of seeds, but many of the methods are empirical in nature and lacking in accuracy. The objective of this research was to develop accurate oven moisture testing methods for grass seeds for use by seed testing laboratories.
The test variables investigated were oven temperature, time of drying, grinding the seed, and original moisture level of the seed. Chi square analysis was used to determine if the results of the oven methods were within 0.5% of those obtained by the Karl Fischer method. The Karl Fischer method is a basic reference method in which the seed moisture is extracted with methanol and titrated with Karl Fischer reagent to determine the water content. It is an extremely accurate method that is independent of time and temperature of drying. The species studied were perennial ryegrass, orchardgrass, tall fescue, red fescue, Kentucky bluegrass and bentgrass.

Drying seeds to constant weight at temperatures of 90, 100, and 105°C gave moisture percentages lower than the true value, while drying to constant weight at 130°C overestimated the true value. Drying periods of 6 hours or less at 130°C gave moisture percentages in agreement with Karl Fischer results. Ground and whole seeds gave similar moisture percentages after drying to constant weight, but moisture was removed more rapidly from ground seeds. Unfortunately, the required drying time for greatest accuracy depended on the original moisture content of the seed. Moisture was removed most rapidly from the highest moisture seed; thus, it is not possible to select one drying period that will provide the same degree of accuracy on seed with different moisture levels.

It is recommended that seed moisture tests on these six temperate climate grass species be conducted on whole seeds at 130°C. The drying periods should be 3 hours for perennial ryegrass, Kentucky bluegrass, tall fescue and red fescue, 1.5 hours for orchardgrass, and 1 hour for bentgrass.

GRASS SEED MOISTURE TESTING WITH A MICROWAVE OVEN

D. Grabe, X. Cascante, S. Currans, C. Garbacik, and T. Chastain

There is increasing interest in windrowing grass seed crops at the proper moisture content to reduce shattering and in combining at the proper moisture content for safe storage. If moisture content is to be used as a guide for proper timing of harvest, then an accurate moisture tester must be available. The oven method, using a laboratory drying oven, is the most accurate, but is usually available only in seed testing laboratories. Electric meters, while easy to use and accurate on grains, are not very accurate on grasses. Moisture testers using a heat source such as an infrared heat bulb are quite accurate on grasses but can be expensive. The ordinary microwave oven found in many farm kitchens may be a practical alternative for testing occasional seed samples for moisture.

We conducted extensive tests with the microwave on grass seeds during the 1985 and 1986 harvest seasons. Grass seed crops studied were annual ryegrass, perennial ryegrass, orchardgrass, tall fescue, red fescue, and Kentucky bluegrass. Field samples were taken during the seed maturation period, starting at about 60% moisture and continuing until the moisture reached 10% or the seed had shattered. For each sample, comparative moisture tests were made using the microwave and laboratory oven method.

For the microwave test, a 20-gram sample was placed in a microwave dish (paper plates contain moisture and lead to errors). The seed was placed in the microwave for 4 minutes, weighed, and placed back in the oven. After that, the seed was removed and reweighed every 2 minutes until constant weight was reached. The time required to reach constant weight and complete the test was usually 12-14 minutes. Moisture percentage was calculated by dividing the grams of weight lost by the original weight of 20 grams and multiplying by 100.

GERMINATION UNDER WATER STRESS AS A VIGOR TEST FOR WHEAT

M.Than and D.Grabe

Germinating seeds often encounter moisture stress conditions in the field. Germination tests conducted under water stress conditions in the laboratory might be a realistic method of differentiating high and low vigor seeds.

The objectives of this study were to (1) determine if water stress conditions reduce germination performance of low vigor seeds more than high vigor seeds and (2) determine the potential for using water stress as the basis of a vigor test to predict relative field performance of wheat seed.

Seed lots of varying levels of deterioration were produced by artificial aging of Malcolm wheat. Germination tests were conducted at temperatures of 5, 10, 15, 20, 25, and 30°C at water potentials of 0, -0.2, -0.4, -0.6, -0.8, -1.0, -1.2, and -1.4 MPa. Water potentials were controlled by germinating the seeds in various concentrations of polyethylene glycol solutions. Laboratory germination results were compared to field emergence percentage of artificially- and naturally-aged seed lots.

Germination percentages and rates of germination of low vigor seeds were depressed more than those of high vigor seeds at all water potentials and temperatures. At 0°C, for example, germination percentages of high, medium and low vigor lots at -0.6 MPa were 76, 48, and 20%, respectively, compared to nearly 100% in water. Similar relationships existed at the other temperatures.

Twenty-four naturally-aged seed lots representing six varieties and four production years were evaluated for germination under water stress and field emergence. Correlation coefficients between germination at -0.6 MPa and field emergence were 0.61** and 0.59** ($P > 0.05$) for untreated and Arasan-treated seeds, respectively.

It is clear from these studies that water stress reduces the germination of low vigor seeds more than that of high vigor seeds. A vigor test based on water stress has potential for being a practical and realistic method of predicting the relative field performance of wheat seed lots.

FACTORS AFFECTING STAND ESTABLISHMENT AND YIELD OF MEADOWFOAM

S.Nyunt and D. Grabe

New crops such as meadowfoam (*Limnanthes alba* Benth.) have serious problems that must be overcome to facilitate commercialization of the crop. Because of seed dormancy problems, germination of meadowfoam seed is inhibited by warm soil temperatures. This has led to recommendations to delay planting to early or mid-October when soil temperatures are below about 59°F. Objective data on the effects of planting date on stand establishment and yield are not available.

Studies were initiated to obtain information on the earliest safe planting date to obtain adequate plant populations and maximum yield. Specific objectives were to determine the effects of:

1) high temperature, light, and reduced oxygen on induction of secondary dormancy;
2) soil moisture and temperature on seed germination and seedling emergence;
3) planting date, planting depth, and soil temperature on stand establishment; and
4) planting dates on seed yield.

Imbibed seeds of dormant and non-dormant lots of Mermaid meadowfoam were subjected to high temperature, light and reduced oxygen treatments for 0, 3, 6, 9, 12, and 15 days. Following treatment, the seeds were removed to optimum germination conditions to assess the degree of dormancy induced by the various environmental factors.

The effect of soil moisture on seed germination was determined at four alternating temperatures in seed germinators to simulate field conditions from August through November. Field plantings were made on several dates in 1984 and 1985, and soil temperatures were recorded during the emergence period. Yield trials with three lots of Mermaid meadowfoam were planted on six dates in 1985.

Exposure of imbibed seeds to 77°F was the most effective means of inducing dormancy, with significant increases in dormancy occurring in both lots after three days of exposure. Germination of the non-dormant lot decreased from over 90% to less than 30% after 15 days of warm temperature. Dormancy was induced after 6 days of exposure to continuous light. Seed germination was decreased after 9 days imbibition in an atmosphere of 2% oxygen. The reduction in germination by light and reduced oxygen treatment was only moderate, and a greater degree of dormancy would be expected with longer exposure.

Optimum conditions for seedling emergence under simulated field conditions were a soil moisture content of 70% of field capacity and an alternating temperature of 50-59°F. In field trials, maximum seedling emergence occurred in the September 24, 1984 and September 26, 1985 plantings. Emergence was negatively and significantly correlated with the average minimum temperature for the 7- and 14-day periods after planting. There was less association with average maximum and daily temperatures. Seed yield increased from 594 lb/a from the August 29 planting to 1139 lb/a from the October 10 planting. The low yield from the earliest planting was largely due to lower plant density.

These experiments affirmed that meadowfoam seeds exposed to factors that inhibit germination will induce secondary dormancy after a minimum exposure period. In the field, induction of dormancy and reduced seedling emergence can be expected if soils are warm or poorly aerated. While light would not be a factor in field emergence, it should be avoided to obtain maximum germination in laboratory germination tests.

These studies support advancing the recommended early planting date to October 1 if irrigation is available or soil moisture is adequate. Planting depths between 0.5 and 1.0 inch are equally satisfactory. Seed dormancy at this time is not a problem when planting 3-month-old seed from the current harvest year.

MEADOWFOAM SEED MATURITY

S. Currans and D. Grabe

Meadowfoam harvesting should not occur before maximum dry weight and oil content are attained for maximum seed yield. On the other hand, delayed harvesting may lead to excessive seed loss due to shattering. A study was conducted during 1986 to follow the seed maturation process and determine the earliest harvesting date to achieve maximum yield.

A bulk planting of Mermaid meadowfoam was made at Hyslop Farm on October 10, 1985. Peak flowering occurred about May 25, 1986. Beginning June 2, developing seeds were hand-harvested at 2-day intervals for 2 weeks and daily thereafter until the seeds were dry. At each harvest, determinations were made of 1000-seed weight (dry basis), seed moisture, stem moisture, and seed oil content.

The seed reached maturity on June 19, 26 days after peak flowering (Table 1). At this time, seed had attained maximum dry weight (5.591 g per thousand seeds) and maximum oil content (28.1%). Seed moisture content at maturity was 42.3%. No shattering had occurred at the time maturity was reached and the stems were still green and pliable. Windrowing at this time would produce maximum yield and minimum shattering. The study will be repeated in 1987 to confirm these conclusions.

Table 1. Seed development and maturation of Mermaid meadowfoam in 1986. Maturity was reached on June 19.

Date	1000-seed wgt.	Seed moisture	Stem moisture	Oil content
(June)		(g)	--------(%)----------	
2	1.859	79.3	90.3	4.4
4	2.576	78.6	90.4	7.6
6	3.391	75.8	90.5	13.8
8	3.805	71.9	90.3	17.4
10	4.349	71.0	--	21.5
12	5.200	61.8	90.2	25.0
14	5.241	55.0	85.4	24.2
15	5.110	54.3	85.5	25.4
16	5.060	49.1	82.1	24.9
17	5.430	42.9	81.8	27.2
18	5.335	51.2	83.1	26.3
19	5.591	42.3	72.1	28.1
20	5.526	36.4	68.6	27.8
21	5.527	25.9	53.8	28.1
22	5.508	20.5	45.5	27.4
23	5.529	11.1	53.2	27.1
24	5.473	10.6	48.8	27.7

GERMINATION AND DORMANCY OF MEADOWFOAM SEED

O. Mmolawa and D. Grabe

Meadowfoam (*Limnanthes* spp.) is a potential oilseed crop being developed for commercial production in the Willamette Valley. The seeds are characterized by poor germination at warm temperatures. It would be desirable to overcome this temperature-related dormancy problem so better stand establishment could be realized from early fall plantings.

The objectives of this study were to determine the factors influencing seed germination of meadowfoam, characterize the types of dormancy involved, and develop methods of overcoming dormancy.

Experiments were carried out with different-aged seed lots of *L. alba* Mermaid, *L. floccosa*, and a cross of *L. floccosa* x *L. alba*. Germination requirements were investigated by studying seed responses to temperature, light, oxygen, growth regulators, scarification, and chemical inhibitors.

The most favorable germination temperatures were 10, 5-15, and 10-20°C. No germination occurred above 20°C. Prechilling 5 days at 5°C promoted germination at higher temperatures. Potassium nitrate and thiourea effectively promoted germination, while kinetin, gibberellic acid, and ethepon did not.

Daily 8-hour exposure to light inhibited germination, particularly at the warmer temperatures. Increasing the length of the daily light periods resulted in corresponding decreases in germination. Removal of portions of the seedcoat improved germination, as did germination at higher concentrations of oxygen. The seedcoat was not a barrier to water uptake by dormant seeds. Water-soluble extracts from the seeds inhibited germination of non-dormant seeds.

A number of treatments imposed on meadowfoam seed overcame dormancy partially or fully, suggesting that there are several mechanisms regulating seed dormancy. Evidence from this study suggests that the seedcoat is partially responsible, acting as a barrier to diffusion of oxygen and because it is a source of germination inhibitors. Embryo dormancy is also implicated, in that seeds responded to treatment with potassium nitrate. For routine germination testing of meadowfoam, it is recommended that seeds be planted on a substrate moistened with 0.1% KNO_3 and placed in the dark at 10°C for 14 days. If circumstances warrant, additional germination of dormant seed lots can be obtained by germination on a substrate of KNO_3 in an atmosphere of 100% O_2.

EFFECT OF CLOPYRALID APPLICATION TIME ON MEADOWFOAM SEED YIELDS

D.C. Peek, R.L. Spinney, and A.P. Appleby

Clopyralid (Lontrel) has been shown to be a reasonably selective herbicide in meadowfoam in research at Oregon State University. It is effective primarily on legumes, composites, and knotweeds. A trial was conducted at Hyslop Crop Science Field Laboratory to evaluate application timing of clopyralid for crop safety.

Table 1. Meadowfoam size at time of treatment and effect of clopyralid timing on weed control and meadowfoam seed yield, 1986.

Applic. date	Clopyralid rate	Meadowfoam size	Knotweed control	Seed yield
	(lb/a)		(%)	(lb/a)
Check	0		0	624
11/14/85	0.125	1-2 leaf	0	658
	0.25	1-2 leaf	0	771
12/22/85	0.125	4-6 leaf	0	709
	0.25	4-6 leaf	0	684
1/24/86	0.125	3-4 in/dia	0	700
	0.25	3-4 in/dia	0	696
2/28/86	0.125	4-5 in/dia	0	633
	0.25	4-5 in/dia	0	547
3/26/86	0.125	8 in/dia	14	545
	0.25	8 in/dia	49	474
4/23/86	0.125	14 in/dia	5	676
	0.25	early bud	7	633
LSD .05				85.3

Clopyralid was applied at rates of 0.125 and 0.25 lbs acid equivalent (a.e.) per acre at monthly intervals from mid-November to mid-April. The meadowfoam plants ranged in size from 1 to 2 leaves at the November application to 14 inches in diameter (early bud stage) at the April application. No visible damage to the crop was observed from any treatments. Seed yield was reduced statistically only from the March application at 0.25 lb/a rate. Knotweed suppression was observed from the February and March applications at 0.125 and 0.25 lb/a, but this did not affect meadowfoam seed yields.

SPRING ESTABLISHMENT OF GRASS SEED CROPS WITH CEREAL COMPANION CROPS

T.G. Chastain and D.F. Grabe

Over the past several years, we have examined the potential of establishing red fescue seed crops with winter wheat and barley companion crops. Our work has demonstrated that net income may be increased by $205 per acre over a three-year period. In response to suggestions by growers, we began an exploratory investigation to ascertain the feasibility of establishing grass seed crops in spring with cereal companion crops.

Hallmark orchardgrass, Bonanza tall fescue and Pennlawn red fescue were planted in March 1985 and 1986 at Hyslop Crop Science Field Laboratory. Waverly wheat, Steptoe barley, and Cayuse oats were drilled in 6- and 12-inch rows at right angles to the grass rows.

Companion crops reduced light availability and increased plant water stress of grass seed crops, inhibiting their growth and development. Furthermore, the use of companion crops impaired the production of fertile tillers during the following spring. This, in turn, resulted in seed yield reductions for tall fescue and orchardgrass established with cereals but not for red fescue (Table 1). These reductions ranged from 52 to 75% for tall fescue and from 26 to 60% for orchardgrass, depending on the companion crop and row spacing used. The employment of wider cereal row spacings improved grass crop growth and subsequent seed yield by improving the growth environment for the seed crop. Wheat companion crops had the most favorable effect on seed yield, whereas barley proved to be the most negative companion crop. No combination of companion crop and row spacing was significantly more conducive to grass seed yield than others.

Table 1. First year seed yield of tall fescue, orchardgrass, and red fescue established under cereal companion crops in 1986. Grass seed crops were planted with cereals at 6 and 12 inch row widths in March 1985.

Grass seed crop	Companion crop	Row spacing (inch) 6	12	Mean
		------(lb/a)------		
Tall fescue				
	Wheat	677	826	752
	Barley	470	665	567
	Oats	781	895	838
	No companion crop	--	--	1862
	Row spacing mean	643	796	--
LSD .05	Row spacing		NS	
	Crop		255	
	Row spacing x crop		NS	
Orchardgrass				
	Wheat	556	696	627
	Barley	381	605	493
	Oats	537	632	584
	No companion crop	--	--	946
	Row spacing mean	491	645	--
LSD .05	Row spacing		70	
	Crop		187	
	Row spacing x crop		NS	
Red fescue				
	Wheat	329	433	381
	Barley	270	365	317
	Oats	256	423	339
	No companion crop	--	--	430
	Row spacing mean	285	407	--
LSD .05	Row spacing		132	
	Crop		NS	
	Row spacing x crop		NS	

The effect of companion crops on net income of the three grass seed crops was determined by using a partial budget analysis (Table 2). The economic return

Table 2. Net change in income over two-year period from establishing grass seed crops with cereal companion crops.[1]

Row spacing	Companion crop	Net change in income		
		Tall fescue	Orchard-grass	Red fescue
(inch)		-------(dollars/acre)-------		
6	Wheat	-204.80	47.91	166.03
	Barley	-349.93	-61.57	48.83
	Oats	-230.40	- 2.34	81.90
12	Wheat	-160.97	93.13	194.62
	Barley	-287.62	7.55	92.56
	Oats	-207.09	24.46	143.02

[1]Results are based on estimated income and expense for cereal crops in 1985 and on estimated income from grass seed crops in 1986.

for establishing tall fescue with cereal crops was very poor because of low first-year seed yield. However, other studies have shown that low first-year seed yields were followed by greater yields in subsequent years, making this a profitable method. Despite the initial negative effect on orchardgrass growth, establishment with wheat companion crops planted in 12-inch rows increased net income by $93 per acre over planting orchardgrass alone. Red fescue responded well to companion cropping by producing substantial increases in net income. These results are similar to those obtained in our fall establishment work. In general, the worst net economic returns were noted when barley was used and the best when grasses were established with wheat.

The long-term economic effects of companion cropping on grass seed production and comparisons of fall and spring establishment systems will be examined in future studies.

SEED DEVELOPMENT AND MATURITY IN CUPHEA

I. Kaliangile and D. Grabe

Cuphea is a potential source of medium-chain triglycerides for manufacture of soaps, pharmaceuticals and nutritional products. Indeterminate flowering and seed shattering are wild-type plant characteristics that make it difficult to determine the time to harvest for maximum yield of seed and oil. The primary objective of this study was to investigate the relationship between stage of *Cuphea* seed development and yields of seed and oil.

Seed development of *C. lutea* and *C. wrightii* was compared in two greenhouse and one field experiment by harvesting seeds at frequent intervals from tagged flowers and measuring several quality components.

Maximum seed dry weight was attained 18 days after anthesis in both species in greenhouse studies. At this time, dry weight was 2.7 mg/seed, moisture content was 36%, and oil content was 43% in *C. lutea*. Measurements for *C. wrightii* were 1.9 mg/seed dry weight, 37% moisture and 43% oil content. Simple correlation coefficients for oil and dry weight were 0.97 and 0.96 for *C. wrightii* and *C. lutea*, respectively. Seed growth rate of *C. lutea* was 1.4 times that of *C. wrightii*. Similar relationships between seed quality components were evident in the field experiments.

Seeds of *C. lutea* were mature at the time of emergence from the calyx tube when grown in the field. Waiting beyond this time for green seeds to turn yellow or brown before harvesting did not increase seed yield or oil content.

CONTROL OF ROUGHSTALK BLUEGRASS IN PERENNIAL RYEGRASS

G. Mueller-Warrant

Roughstalk bluegrass (*Poa trivialis* L.) has become a serious weed in perennial ryegrass grown for seed production in western Oregon. This perennial grass is an extremely competitive, aggressive weed, spreading mainly by means of prolific seed production. It also spreads vegetatively through stolons. Response of this weed to currently registered herbicides and to experimental compounds was evaluated in field trials in 1985-86. Seedling stage control was studied at the Hyslop Crop Science Field Laboratory, while control in natural mixtures of established plants and new seedlings was studied at two established ryegrass stands in western Oregon.

Fall applications of herbicides were made to dry soil surfaces in early October 1985 preemergence to seedling weeds in the case of all herbicides except Nortron, which was applied in late October after rains had begun. Spring applications of dalapon and fenoxaprop were made in late March 1986 shortly after grasses had resumed vigorous growth.

Control of roughstalk bluegrass with currently registered herbicides was generally unsatisfactory. Both Furloe and Nortron failed to control even seedling roughstalk bluegrass at Hyslop Crop Science Field Laboratory, although they did control annual bluegrass. Results with triazine herbicides were better, but the specific level of control that could be achieved was strongly dependent on rate and timing. The maximum rate of atrazine labelled for use in perennial ryegrass, 1.2 lbs a.i./a, provided only 72% season-long control of roughstalk bluegrass in a clean-tilled seedbed. Use of a higher rate of atrazine or 2.0 lb/a of simazine was required for good control of seedling roughstalk bluegrass at Hyslop. Triazine herbicides can be expected to provide somewhat poorer control in actual production fields, where the presence of carbon and unburned crop residues on the soil surface interferes with herbicide effectiveness. While use of higher rates of the triazines might improve control of roughstalk bluegrass under such conditions, higher rates could also increase the danger of crop injury. Triazine herbicides are probably most effective against roughstalk bluegrass when applied just at the onset of fall rains and weed germination, but such optimum timing cannot always be arranged. Even if triazines were applied in such a manner, roughstalk bluegrass germinating in late winter and spring might escape control if too little herbicide remained near the soil surface.

In England, it has been reported that Nortron is effective against roughstalk bluegrass if applied at high rates of 2.0 or more lb/a to seedlings that are not past the 1- to 2-leaf growth stage. It was clearly not very effective at 1.0 lb/a in this test even though applied preemergence to seedlings, which should be the optimum timing.

Given the difficulty of controlling even seedling roughstalk bluegrass with currently registered treatments, the acute need for ways to control established roughstalk bluegrass becomes obvious. Dalapon has been successfully used for this purpose in England, but ryegrass injury has sometimes occurred. In our tests, dalapon treatment did delay heading and increase the proportion of small, green, immature tillers at harvest, but seed yield was not significantly different from yield with standard, registered treatments.

At one of the sites, however, yield with dalapon was significantly lower than yield with the best treatment there, which was fenoxaprop applied at 0.125 lb/a. Fenoxaprop is under commercial development as Acclaim 1EC for turf use in several grasses, including perennial ryegrass, and for use in other crops as Whip 1EC. Fenoxaprop provided excellent control of established roughstalk bluegrass, and appeared to possess slightly better crop safety than dalapon in perennial ryegrass. Research is continuing into details of best timing and rate of fenoxaprop and dalapon application to maximize roughstalk bluegrass control and minimize crop injury.

Use of a company or product name does not imply approval or recommendation of the product to the exclusion of others which may also be suitable.

Table 1. Roughstalk bluegrass control and perennial ryegrass seed yield with registered herbicides applied in the fall, 1986.[1]

Herbicide treatment: Trade name	Herbicide treatment: Common name	Rate	Roughstalk bluegrass control[2]: Seedlings only	Roughstalk bluegrass control[2]: Mixed stands	Perennial ryegrass seed yield
		(lb/a)	---------------(%)---------------		(lb/a)
Untreated	---	--	0	0	820
Furloe	chlorpropham	2.0	18	14	1190
Nortron	ethofumesate	1.0	0	17	1180
Atrazine	atrazine	1.2	72	59	1130
Princep	simazine	2.0	99	74	1050

[1]Roughstalk bluegrass mixed stand control ratings (established weeds plus new seedlings) and perennial ryegrass seed yield are averages of data from the Shedd (variety Regal) and Tangent (variety Derby) test sites. The control rating for seedlings only was made at Hyslop.
[2]Rating one month before harvest.

Table 2. Roughstalk bluegrass control and perennial ryegrass seed yield with experimental herbicide treatments, 1986.[1]

Herbicide treatment: Trade name	Herbicide treatment: Common name	Rate	Roughstalk bluegrass control ratings[2]: Seedlings only	Roughstalk bluegrass control ratings[2]: Mixed stands	Perennial ryegrass seed yield
		(lb/a)	--------------(%)--------------		(lb/a)
Untreated		--	0	0	820
Atrazine[4]	atrazine	1.8	93	74	1070
Karmex[4]	diuron	2.4	99	60	1070
STD[3]+Dowpon	dalapon	1.5	92	97	1140
STD+Dowpon	dalapon	2.0	97	99	1050
STD+Whip	fenoxaprop	0.125	99	98	1200
STD+Whip	fenoxaprop	0.25	100	100	1210

[1]Perennial ryegrass seed yield and roughstalk bluegrass mixed stand control ratings (established weeds plus new seedlings) are averages of data from the Shedd and Tangent test sites. The control rating for seedlings only was made at Hyslop.
[2]Rated one month before harvest.
[3]STD: Standard treatment of atrazine at 1.2 lb/a was applied in the fall prior to the dalapon and fenoxaprop treatments applied in the spring.
[4]Experimental (non-registered) treatments of diuron and high rate of atrazine were also applied in the fall.

HERBICIDE TOLERANCE OF CALIFORNIA BROME INVADING SEED PRODUCTION FIELDS IN WESTERN OREGON

G. Mueller-Warrant

California (or Mountain) brome (*Bromus carinatus* H. & A.), a short-lived perennial grass, has been reported to be increasing in tall fescue and orchardgrass seed production fields, apparently tolerating normal use rates of diuron and triazine herbicides. Herbicides were applied to seedling California brome at Hyslop Crop Science Field Laboratory and to established stands of orchardgrass and tall fescue containing California brome in Corvallis, Tangent, and Brownsville, Oregon. Materials tested included herbicides currently registered for use in these crops as well as experimental compounds, and were applied during the fall, winter, and spring of the 1985-86 growing season.

Brome species typically possess moderate tolerance to diuron, but California brome is exceptionally tolerant, and its seedlings were able to successfully establish even when treated with a preemergence application of 2.4 lb/a of diuron. Seedling tolerance to atrazine also appeared to be quite high until the onset of freezing weather in late November. Before arrival of the severe weather, control of California brome with atrazine was incomplete even at a rate of 4.0 lb/a.

Table 1. Visual rating of weed control and crop injury in response to herbicides applied for California brome control in orchardgrass and tall fescue, April - June, 1986.

Herbicide treatment			Weed Control (%)			Crop Injury (%)		
			Calif. brome			Tall fescue		Orchard-grass
			Seed-ling	Estab. + seedling				
Trade name	Common name	Rate (lbs/a)	A[1]	B	C	B	C	D
			---(%)---					
Untreated	check	--	0	0	0	0	0	0
Karmex	diuron	2.4	27	0	0	0	0	0
Atrazine	atrazine	1.0	17	0	0	0	0	3
Atrazine	atrazine	2.0	77	0	5	0	0	3
Atrazine	atrazine	4.0	99	60	30	0	0	3
Princep	simazine	2.0	98	0	20	0	0	3
ChemHoe	propham	3.0	85	50	13	0	0	4
Nortron	ethofumesate	1.0	100	50	10	0	0	4
Cinch	cinmethylin	0.5	98	50	25	0	0	8
Hoelon	diclofop	1.0	67	0	15	35	40	15
Poast	sethoxydi	0.25	93	60	79	98	100	91
Fusilade	fluazifop-P	0.061	88	30	64	61	63	53
Fusilade	fluazifop-P	0.125	100	40	81	83	83	85
SC-1084	-----	0.125	100	80	74	61	73	65
SC-1084	-----	0.25	100	100	93	79	95	94
Kerb	pronamide	0.5	96	90	95	39	55	0

[1]Location: A = Hyslop Farm, which had only seedling California brome from Oct. 1985 planting; B = Brownsville and Location; C = Tangent, both established tall fescue stands with established brome and new seedlings; D = Corvallis, established orchardgrass with established brome and new seedlings. Brome control ratings at Location B are for the only replication out of four having a meaningful level of weed infestation. Ratings for Location D are not reported due to the low and erratic level of weed pressure there.

Following a month of alternate freezing and thawing of the soil, seedling control was excellent at 4.0 lb/a of atrazine and 2.0 lb/a of simazine, and good at 2.0 lb/a of atrazine. Given this pattern of response to the herbicide, it is likely that control of California brome with atrazine might be much poorer in more typical years that have more favorable growing conditions during late fall.

Control of seedling California brome with 1.0 lb/a of Nortron, 3.0 lb/a of ChemHoe, and 0.5 lb/a of cinmethylin varied widely between locations: control was close to 100% at Hyslop in a clean-tilled seedbed, but dropped to near zero at Tangent, where density of weed seedlings and quantity of unburned crop residues were both very high. Control with ChemHoe appeared to be strongly influenced by relative timing of application and weed seed germination; early application was vital for successful control of seedling California brome.

Kerb applied at 0.5 lbs a.i./a in the winter provided good control of California brome regardless of growth stage of the weed, but crop tolerance was marginal. Injury to orchardgrass was much less severe than injury to tall fescue, in which the number of heads per area was seriously reduced. Likewise, Hoelon applied in the fall was tolerated well by orchardgrass but not by tall fescue, which remained stunted through harvest. Control of California brome seedlings with 1.0 lb/a of Hoelon was marginal, and future research will need to employ slightly higher rates.

All other graminicides tested, Poast, Fusilade 2000, and SC-1084, generally lacked sufficient selectivity between crops and California brome to be of any use. Indeed, Poast applied in the early spring at 0.25 lb/a was tolerated better by California brome than by tall fescue, which was completely killed by it.

No completely satisfactory methods to control established California brome were found in these tests. The best treatment program for controlling new seedlings would start with early fall application of ChemHoe or Furloe just as rains are beginning and weed seed germination is imminent. In heavily infested fields, this treatment would need to be followed by Nortron application later in the fall to control escapes and any seedlings germinating in late fall.

While attempting to establish new stands of tall fescue and orchardgrass in fields likely to be invaded by California brome, it is important to consider the fact that the carbon-banding, broadcast-diuron planting system will not control California brome seedlings. Nortron could be applied later in the fall to control California brome seedlings in new stands of tall fescue but not orchardgrass. A more satisfactory program for control of California brome during establishment of new stands of these crops might involve substituting an alternate herbicide capable of controlling the weed for the diuron normally used as the broadcast herbicide during carbon-banding seeding. Unfortunately, no other herbicides are presently registered for such a use.

Since tall fescue and orchardgrass seldom produce seed crops the first year after planting, the best method to establish clean stands of these crops free from California brome might be use of a registered chemical seedbed treatment such as ChemHoe + 2,4-D applied in the fall, following this with paraquat or Roundup treatment at time of planting in late winter to control any escapes. Crop rotation is also a viable alternative, since bromes generally possess little seed dormancy and can be eradicated from a field in as brief a time period as two years if none of the weeds are allowed to go to seed.

Use of a company or product name does not imply approval or recommendation of the product to the exclusion of others which may also be suitable.

SEED CONDITIONING RESEARCH

A.G. Berlage, D.M. Bilsland, and T.M. Cooper

Threshing. An experimental seed thresher was developed to remove seed appendages such as awns, pappus, hair, and awns. Commercially available threshers do not effectively remove appendages from seeds such as marigold *Targetes* spp., gazania *Gazania* spp., arctotis *Arctotis grandis* Thunberg, and anemone *Anemene pulsatilla* L. If these seeds are to be mechanically planted, they must be conditioned to remove the appendage while maintaining the germination.

The machine consists of a vertically-mounted cylinder, a rotor shaft with multiple spools of threshing filament, a high-speed motor, and an aspirator. The 0.28

mm diameter nylon monofilament is automatically paid out as end wear occurs during operation. Seeds are aspirated into the cylinder through a feed tube and repeatedly impacted by the filament while suspended in the air column. Adjustment of the velocity of aspirated air to the seed's approximate terminal velocity allows various seeds to be conditioned in this manner. As the appendages are removed, the terminal velocity of the seed particles increases and they fall to the lower end of the cylinder where they are discharged. Most of the appendage fragments are removed through the upper opening with the aspirated air.

Results of threshing tests for the four seed types are shown (Table 1). Appendage removal was complete or nearly complete on all but the marigold which required a screening procedure to separate those seeds which still retained their awn.

Table 1. Effect of appendage removal with a filament thresher on seed.

Seed Type	Appendage Removal[1]	Germination[2]	
		Control	Threshed
Marigold	50-60	91	92
Gazania	90-100	78	78
Arctotis	90-100	36	29
Anemone	100	52	49

[1]Per industry evaluation
[2]Per AOSA procedures

The action of the filaments on the seed appears to be a combination of abrasion and impact. The relationship between the breakage resistance or strength of the appendage and the seed coat governs the effectiveness of the treatment. Greater strength difference between these portions of the seed allows more complete, less damaging threshing. Soft, less-rigid appendages, such as those of gazania, are most effectively removed. Similar results were obtained in preliminary tests with sugarcane *Saccharum* spp., gaillardia *Gazania* spp., winter fat *Eurotia lanata* (Pursh) Moq., and Apache plume seed. For threshing more resistant seed types, a heavier filament and larger cylinder may be appropriate. For final cleaning, an air separation is used to remove non-seed particles not removed with the aspirated air.

Seed Physical Property Database. The machine vision system (MVS) was used to gather digital image data to calculate certain factors shown to be effective for classifying seed into groups. Some factors are area, perimeter, shape, and aspect ratio. Once calculated, these physical property values can be stored in a comprehensive database for future use in seed identification as part of a quality control operation.

Software was developed to provide a menu-driven general image processing environment for experimentation. A data-gathering system as well as conversion and compression routines to prepare raw data for loading to the database was also produced. The most important function of the operator interface system is to initialize the data-gathering program. During data collection, average seed reflectance relative to the background is calculated from the image histogram. During conversion and compression, data files are reduced in size by approximately one-third.

Currently, data can be gathered on about three seeds per minute. Although this system is not fast, it demonstrates the feasibility of adapting an existing MVS through software to gather visually-sensed physical property data on seeds. The utility of the operator interface was demonstrated by length and width measurement of ryegrass seeds. A non-programmer was able to use the system to gather data on 500 seeds in two days and then later gather verification for 200 additional "unknown" seeds in a single afternoon.

Research in cooperation with the Oregon Agricultural Experiment Station.

NITROGEN, PHOSPHORUS, AND POTASSIUM FERTILIZATION OF KENTUCKY BLUEGRASS FOR SEED PRODUCTION IN NORTHEAST OREGON

F.V. Pumphrey

Optimum seed yield increase from applying nitrogen (N) fertilizer to Kentucky bluegrass is dependent on numerous management practices such as residue management, pest control, and time of application. Sulfur (S) is needed to aid N utilization. The need for fertilizing with additional nutrients in the Grande Ronde Valley has been questionable. Phosphorus (P) and potassium (K) have been applied by many grass seed growers even though some soils have high and very high soil test values for these elements.

Table 1. Seed yield in response to nitrogen, phosphorus, and potassium fertilization of Kentucky bluegrass grown for seed near Imbler, Oregon, 1984-85-86.

		Seed yield (lb/a), Year and Experiment									
		1984			1985			1986			
Treatment number	N-P-K	1	2	Mean	1	2	Mean	1	2	Mean	3-year Mean
1	160-0-0[1]	1530	1320	1425	1020	1440	1230	1180	780	980	1210
2	160-40-40[1]	1380	1320	1350	1180	1290	1235	1220	875	1050	1210
3	120-40-40[2]	1420	1240	1330	870	885	880	1240	820	1030	1080
4	160-40-40[2]	1400	1610	1505	1040	1380	1210	1150	840	995	1240
5	160-40-0[1,3]	1535	1210	1370	1080	1440	1260	1070	830	950	1190
6	160-40-40[1,3]	1390	1380	1385	1140	1130	1135	1200	870	1035	1185
7	160-80-0[1]	1440	1340	1390	1240	1390	1315	1150	900	1025	1240
8	160-80-80[1]	1320	1315	1320	1180	1270	1225	1050	800	925	1155

[1] 120 lb N/a late fall plus 40 lb N/a early spring.
[2] All N late fall applied.
[3] No P or P + K applied for the 1985 seed crop.

Two experiments have been conducted using the same fertilizers have been applied for three consecutive years on Kentucky bluegrass grown for seed. The primary objective was to evaluate the need for P and K in addition to N and S. All P and K plus 15 lb N/a were applied after residue burn when fall growth was starting. Most of the N and all S were applied when cooler weather reduced the rate of fall growth (late October); the remainder of the N was applied with the approach of warmer spring temperatures (early April).

Average seed yields for three years indicate little positive response from applying P or P plus K in addition to N and S (Table 1). Seed yield was consistently lower each year in each experiment where 80 lb K/a was applied (treatment 8) compared to no K applied (treatment 7). This slightly negative effect from K at rates of 80 lb/a or more was observed in work conducted two decades earlier.

Soil test values for P and K prior to fertilizing indicate high and very high levels of these nutrients in the surface soil (0-8 inches). Soil samples from other grass seed fields growing on Imbler-Palouse-Alicel and Catherine soils in the Alicel-Imbler-Summerville area indicate similar levels of available P and K. These high levels are believed to reflect three or more decades of liberal, intensive fertilizer programs by grass seed growers.

Modest increases in available P and K were measured one year after the second application of these fertilizers. This is consistent with earlier work in the area which indicated (1) modest increases are measured in available soil P and K one and two years following P and K fertilizer application when the soil tests prior to fertilizing indicate moderate or higher levels of P and K and (2) little increase in available soil P and K are measured one year after application of P and K fertilizers when soil tests prior to fertilizing indicate low and especially very low levels of these nutrients.

Kentucky bluegrass fertilized with 120 lbs N/a (treatment 3) produced significantly less seed than grass fertilized with 160 lb N/a (all other treatments) (Table 1). Grass receiving 160 lb N/a late in the fall and no additional N in the spring (treatment 4) produced as much seed as grass receiving a split application of N (treatments 1, 2, 5, and 6). This is not consistent with previous research results or grower practices. Applying all the N in late fall is not suggested until additional information is obtained.

EFFECT OF PLANT POPULATION ON CARROT SEED YIELD IN CENTRAL OREGON

J. L. Nelson, D. Grabe, and S. Currans

Some growers in central Oregon use the seed-to-seed method for carrot seed production. Fields are planted in August to allow time for young seedlings to develop adequate winter hardiness. Rows are thinned in the spring to a carrot plant population of one plant in each four to eight inches, depending upon plant vigor and seed company preference. Questions relative to the most desirable plant density for maximum seed yield and quality led to this study. Seed yield results are reported here and size, weight, and germination of seed from all treatments are being obtained and will be reported later.

Three spring thinning treatments were performed March 17, 1986 on a small production field of Imperator type hybrid carrots at Madras (Table 1). These were compared to a non-thinned control in a randomized complete block design with each treatment replicated four times. Otherwise, the experimental area was managed according to acceptable commercial cultural practices. From each 18 feet long by 10 feet wide (four 30-inch wide beds) treated plot, the two center rows 10 feet long were hand harvested September 10 and 11, 1986. The number of plants harvested were counted. The primary, secondary, and tertiary umbels were clipped, counted, threshed, seed conditioned, and weighed for all plants in one row for each treatment. However, the total seed yield reported included all seed from both rows.

Total seed yield from plants 6 inches apart was significantly higher than all treatments except 4-inch blocks (Table 1). However, individual plants were most productive at the 12-inch spacing but plant density was insufficient to maximize total yield. From observation of all treatments it appeared that profuse stem branching was inversely related to low plant population, but no quantitative data were collected. Control and 4-inch block plants were observed to be about 8 inches taller than the 6 to 12-inch spaced plants until umbel formation. It was judged that primary umbels on the two high density populations flowered about a week before plants in other treatments. There were significantly fewer umbels per plant in control and 4-inch block plants but primary umbels were significantly more numerous and contributed more to yield than the same on plants spaced 6 and 12-inches. It appears that the high total yield from 6-inch spaced plants resulted from more tertiary umbels compared to more primary umbels on 4-inch block plants. Seed quality data should be examined closely for these populations.

Table 1. Effect of plant density on carrot seed production at Madras, Oregon, 1986

Treatment[1]	Seed yield Total	Seed yield per plant	Umbels per plant	Umbels by class[2] P	Umbels by class[2] S	Umbels by class[2] T	Seed yield by umbel class[2] P	Seed yield by umbel class[2] S	Seed yield by umbel class[2] T
	(lb/a)	(oz)	(no.)	(%)	(%)	(%)	(%)	(%)	(%)
Control	1117 c[3]	.2 c	8.5 c	14 a	43 a	44 c	35 a	54 c	11 b
4" Block	1305 ab	.3 c	12.3 c	10 b	44 a	47 bc	23 b	63 bc	15 ab
6" Space	1389 a	1.1 b	43.3 b	3 c	41 a	57 a	6 c	71 ab	23 a
12" Space	1135 bc	1.7 a	69.0 a	1 c	46 a	52 ab	3 c	80 a	16 ab
Mean	1237	0.8	33.3	7	43	50	17	67	16
CV (%)	9	9.9	12.4	35	12	10	38	11	34

[1]Treatment: control -- plants about one inch apart; 4" block -- plants removed from alternate four inch row lengths with about five plants in the 4-inch block; 6" and 12" spacing -- populations thinned to a carrot plant every 6 and 12 inches, respectively.

[2]Class: P=primary; S=secondary; T=tertiary

[3]Values within a column with the same letter are not significantly different at the .05 level of probability using Duncan's multiple range test.

There was no statistically significant difference in the number of secondary umbels among the four plant densities studied but percent seed yield by umbel class shows that the amount of seed from the secondary umbels increased from the highest to the lowest plant population.

The forthcoming seed quality data should be considered for final evaluation of each plant density. Additional data will be collected in 1987 on plant density affects.

HERBICIDE TOLERANCE TESTS WITH FLOWERS FOR SEED

J.A. Yungen

The herbicide tolerances of several flowers were evaluated in two trials at the Southern Oregon Experiment Station in 1986. The first involved seven flower species that were seeded April 5 in the greenhouse. The other seeding was made in the field April 24 on a Central Point sandy loam soil. Herbicides used in each test were of known efficacy, registered on a wide range of vegetable, field, and ornamental crops.

Greenhouse trial: The trial was designed to assess the plants' tolerances to Eptam (EPTC) and Treflan (trifluralin) as pre-plant incorporated treatments. The growth media was field soil screened through an 8-mm screen to remove rocks and to obtain uniform particle size. Metal flats were used as containers, and the soil depth was 2.5 inches.

The Eptam was applied at 3.0 lbs a.i./a, while the Treflan was applied at 0.75 lbs a.i./a. Achillea, aquilegia, blue flax, nemesia, scarlet flax, shamrock, and verbena were seeded. Watering was done by sub-irrigation through the bottom of each flat. Final evaluations were made April 21 so that information gained could be used in establishing the field trial.

Achillea *Achillea millefolium*, blue flax *Linum lewisii*, scarlet flax *Linum rubrum*, shamrock *Trifolium procumbens*, and verbena *Verbena hybrida* showed good tolerance to Treflan. Achillea, scarlet flax, and shamrock showed good tolerance to Eptam, while blue flax was less tolerant. Verbena was not tolerant of Eptam, while nemesia showed poor tolerance to both Eptam and Treflan. Since aquilegia was very slow to germinate, tolerances could not be determined in the 16-day period since seeding.

Field Trial: Pre-plant incorporated treatments of Eptam at 3.0 lbs a.i./a and Treflan at 0.75 lbs a.i./a were applied April 24. Ten different flower species were planted the same day using a Planet Jr. seeder. Preemergence treatments were applied six days later on April 30. The herbicides and rates (pounds of active ingredients per acre) were: Dacthal (DCPA) 7.5, Enide (diphenamid) 4.0, Furloe (CIPC) 4.0, Surflan (oryzalin) 2.0, Tenoran (chloroxuron) 3.0, Ramrod (propachlor) 4.0, and Lorox (linuron) 0.5. Irrigation was applied with overhead sprinklers.

The herbicide treatment effects were rated July 3, and August 20. There was strong competition from grasses and broadleaf weeds in the experimental area because of frequent irrigation and favorable growth conditions. Observations on tolerances to the herbicides under field conditions were recorded on July 3 and August 20 (Table 1). A rating of fair can be considered as being marginal for crop safety. Blue flax was the only flower to show any tolerance to Lorox; the treatment is not shown in the table. Ratings were based on observations made July 3 and August 20.

Achillea showed good tolerance to Dacthal, fairly good tolerance to Tenoran, fair tolerances to Eptam and Ramrod, and rather poor tolerances to Surflan and Treflan. Blue flax showed fairly good tolerance to Ramrod and Surflan but only fair tolerance to Dacthal and Treflan. Blue flax was the only flower with any tolerance to Lorox, even though that was only fair. Celosia was only tolerant to Ramrod. Echinacea, a slow-germinating perennial, showed good tolerance to Furloe, Surflan, and Tenoran. Its tolerance to Treflan, Dacthal, Enide, and Ramrod were only fair to fairly good. Layia showed good tolerances to Treflan, Furloe, Dacthal, Surflan, and Ramrod. Nemesia showed no tolerance to any herbicide except Ramrod.

Phacelia showed the most tolerance to Enide. Scarlet flax showed the most tolerance to Treflan, Surflan, and Ramrod. Shamrock showed some tolerance to Eptam, Treflan, Dacthal, Furloe, and Ramrod. Verbena was most tolerant of Treflan. Zinnia showed a wide range of tolerances. Dacthal, Eptam, and Treflan are registered for use on a number of flower species. Label recommendations should be followed so that application rate and timing is correct.

Table 1. Observed tolerance of flowers to herbicides in a field planting at the Southern Oregon Experiment Station, Medford, 1986.

Flower	Herbicide treatment (lbs a.i./a)[1]							
	Eptam (3.0)	Treflan (0.75)	Furloe (4.0)	Dacthal (7.5)	Enide (4.0)	Surflan (2.0)	Tenoran (3.0)	Ramrod (4.0)
Achillea	F[2]	P	P	G	P	F	FG	F
Blue flax	P	F	P	F	P	FG	P	F
Celosia	P	P	P	P	P	P	P	FG
Echinacea	P	FG	G	FG	F	G	FG	FG
Layia	F	G	G	G	FG	G	P	G
Nemesia	P	P	P	P	P	P	P	FG
Phacelia	P	P	P	FG	G	P	P	P
Scarlet flax	FG	G	P	P	F	G	P	G
Shamrock	FG	F	F	F	P	P	P	F
Verbena	P	G	P	P	P	P	P	F
Zinnia	G	G	G	G	G	G	FG	G

[1]Treatment timing: Eptam and Treflan were pre-plant incorporated; the others were applied pre-emergence.
[2]Rating: G = good; FG = fairly good; F = fair; P = poor.

FLOWER SEED PRODUCTION ADAPTATION TRIALS

J.A. Yungen

Flower seed production trials were conducted over a three-year period in southern Oregon beginning in 1970. Commercial flower seed was produced by several growers for four years. Renewed interest in seed production led to new series of trials in 1984, 1985, and 1986 using new groups of flowers.

Seven different flowers were grown in a seed production adaptability experiment. Verbena was the only flower tested previously. The experiment was seeded April 23, 1986, in replicated, four-row plots on the Central Point sandy loam soil. Rows were spaced 20-inches apart, and irrigation was provided with overhead sprinklers. Treflan (trifluralin) was applied at 0.75 lbs a.i./a as a preplant incorporated treatment prior to seeding achillea *(Achillea millefolium)*, blue flax *(Linum lewisii)*, scarlet flax *(Linum rubrum)*, shamrock *(Trifolium procumbens)*, and verbena *(Verbena hybrida)*. No herbicides were applied for aquilegia and nemesia since they showed poor tolerance to Treflan and Eptam (EPTC) in a greenhouse test.

Emergence, growth habit, flowering date, seed maturity date, seed retention and shattering, and seed yield varied widely among the flowers. Satisfactory stands were obtained with most of the flowers. Competition from weeds restricted emergence and growth of aquilegia and nemesia, so they were removed and reseeded June 3. Some plants emerged from the second planting but no seed was harvested.

Shamrock had a flat, prostrate-type growth, about four inches tall. While a small amount of seed was vacuumed from the plants August 21, no real measure of its productivity was made. Blue flax, scarlet flax, and verbena were swathed prior to combining. Achillea, a perennial yarrow, was direct-combined even though its leaves and stems were quite green. Seedset was considered very good, even though the seeds were very small.

Because many flowers have a high shatter potential, placing the swathed material on paper or a tarp helped reduce seed losses. Scarlet flax and blue flax were dried on tarps. Data for the different flowers are shown in Table 1.

Table 1. Flower production characteristics and seed yield, Medford, Oregon, 1986.

Flower	Harvest date	Harvest[1] method	Shatter[2] hazard	Seed yield (lb/a)
Scarlet flax	Aug. 21	S + C	M	117
Achillea	Oct. 9	C	H	216
Blue flax	Oct. 16	S + C	M	147
Verbena	Oct. 13	S + C	H	70
Shamrock	Aug.21	--	--	--[3]
Aquilegia	--	--	--	--[4]
Nemesia	--	--	--	--[5]

[1]S = swathed; C = combined
[2]M = moderate; H = high
[3]Small amount of seed vacuumed from plants
[4]Late planting, no seeds matured
[5]Late planting, some seeds matured

SUMMARY OF MEADOWFOAM RESPONSE TO FERTILIZER APPLICATION

J. Hart and W. Young, III

Fertilization of meadowfoam, or any other crop, will create a number of changes in the crop's microenvironment that can encourage or suppress disease incidence and severity. The 1986 season provided an example of interaction of nitrogen fertilization and fungicide application for control of *Botrytis cinerea* as measured by disease ratings, seed yield, and oil yield. The latter portion of this report contains some observations about this interaction. This report is an overview of meadowfoam soil fertility work to date, including 1986.

Nitrogen Response. The application of 25 to 75 lbs N/a fertilizer to meadowfoam generally has resulted in small to moderate increases of seed and oil yield and increases in plant N concentration. This amount of fertilizer N added approximates the total amount of N in a meadowfoam crop.

Some qualifications are necessary for this suggested N application rate. No fertilizer N is recommended for meadowfoam following a clover or other legume crop. Application of N in this situation has depressed meadowfoam seed yields; therefore, moderation in N application is appropriate. Yield response to N applications in seasons with a cool dry winter will be less than from N applied after a warm moist winter because residual N is not leached or denitrified appreciably under the cool dry conditions. Disease control will influence yield response to N fertilizer applications. When the severity of *Botrytis* is limited by fungicide application, oil and seed yields increase with N fertilization more than in cases where fungicide treatments are omitted.

Tissue Analysis. Concentrations of nutrient elements in meadowfoam generally reflects applications of fertilizers, but does not influence seed or oil yield. Nitrogen is an exception. N concentrations of 1.2 to 1.4% at bloom initiation are associated with lower yields than plants containing 1.5 to 1.7% N. Tissue N concentrations higher than 1.8% were generally associated with depressed yields.

Meadowfoam tissue analysis monitors plant nutrient levels and acts as a supplementary data source to estimate yield responses rather than serve as a diagnostic tool. The use of tissue analysis for diagnostic or predictive purposes should be deferred until further soil fertility work is completed.

Response to Other Nutrients. Meadowfoam seed and oil yield is relatively unresponsive to applications of P, K, S, B, Mg, and lime. Phosphorus application has produced some response under certain conditions. When soil test P is below 5 ppm, a seed or oil yield response from fertilizer P may be expected. This indicates a limitation other than soil fertility for meadowfoam seed yield. The limitation may be genetic potential, disease, pollination, another environmental aspect, or a combination of these. Based on studies conducted over several years in the Willamette Valley, until meadowfoam seed yield consistently exceeds 1500 to 2000 lb/a, soil fertility will probably not be a limiting factor, except for N.

1986 Results. Trials were conducted at two locations in 1986 using nitrogen rates of 25 to 75 lbs N/a for three sites. Seed yield at the Hyslop and Jaquet sites increased with any rate or timing of spring N (Tables 1 and 2). Differences in seed yield at the Ringsdorf site were not significantly different, although they followed the same trend as at the other sites (Table 3).

Nitrogen x Fungicide Interaction. Seed yield response to N fertilization with and without fungicide applications at the Hyslop and Schmidt locations is illustrated. N fertilization alone increased meadowfoam seed yield 408 lb/a in 1985 and 80 lb/a in 1986.

Table 1. Meadowfoam seed yield and harvest index response to nitrogen fertilization, Hyslop site, 1986.

N Treatment[1]			Seed	Percent	1000 Seed	Oil	Harvest Index	
Jan	Feb	Total	Yield	Oil	Weight	Yield	Seed	Oil
--(lb/ N/a)--			(lb/a)	(%)	(g)	(lb/a)	(%)	
--	--	25	448	24.11	7.37	108	19.17	4.63
25	--	50	564	23.40	7.43	133	20.75	4.87
--	25	50	572	23.37	7.50	134	18.49	4.35
25	25	75	572	23.86	7.47	136	18.21	4.35
50	--	75	566	23.15	7.42	131	18.73	4.35
--	50	75	553	22.90	7.52	127	16.31	3.75
LSD .05		63	NS	NS	16	1.66	0.58	

[1]Includes 25 lbs N/a at planting

Table 2. Meadowfoam seed yield and harvest index response to nitrogen fertilization, Jaquet site, 1986.

N Treatment[1]			Seed	Percent	1000 Seed	Oil	Harvest Index	
Jan	Feb	Total	Yield	Oil	Weight	Yield	Seed	Oil
--(lb/ N/a)--			(lb/a)	(%)	(g)	(lb/a)	(%)	
--	--	25	238	26.90	6.41	64	23.00	6.17
25	--	50	384	25.95	6.48	100	24.21	6.29
--	25	50	399	25.75	6.44	103	21.18	5.47
25	25	75	453	24.75	6.30	112	20.49	5.07
50	--	75	370	25.48	6.39	94	21.16	5.39
--	50	75	390	23.75	6.03	93	18.17	4.31
LSD .05		111	0.97	NS	NS[2]	2.30	0.71	

[1] Includes 25 lb N/a at planting
[2] Nitrogen main plot P-value for oil yield = 0.058

The combination of N fertilization and fungicide applications increased meadowfoam seed yield 880 lb/a in 1985 and 187 lb/a in 1986. In 1985 the nitrogen x fungicide interaction at the OSU Schmidt site was significant (Figure 1). In 1986 the same interaction at the Hyslop site was not significant (Figure 2), but the trend was similar. These response curves illustrate seed yield is controlled to a great extent by factors other than N fertilization. Within a year, fungicide applications increased seed yield approximately twice as much as did N fertilization. Other factors such as moisture, temperature or pollination influenced seed yield in 1986, as the seed yields were substantially lower than in 1985. The sites are situated on similar, if not the same, soil types, and are not so distant that microclimatic influences should be large. For similar rates and timings of N fertilization, approximately three times the yield was produced in 1985 when compared to 1986. Therefore, environmental factors control seed yield to a greater degree than N fertilization rate or soil fertility.

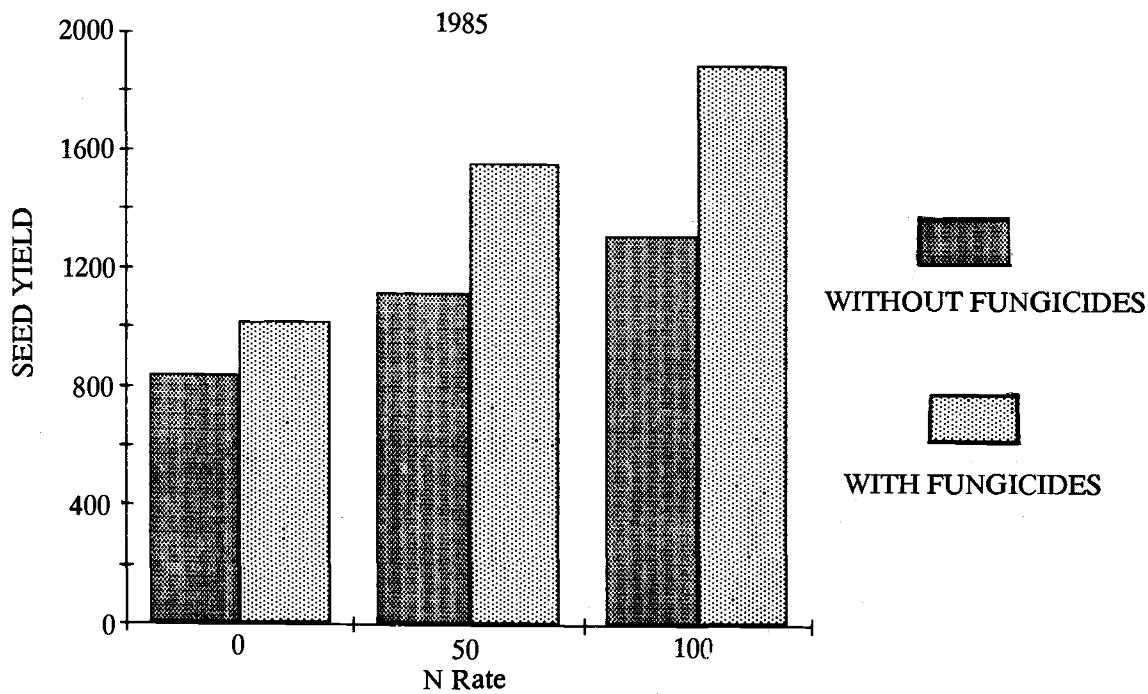

Figure 1. Meadowfoam seed yield (lb/a) response to N fertilization without fungicide, and with Rovral 50 W fungicide at 1.5 lb/a applied at 10% and 50% bloom stage, Schmidt site 1985.

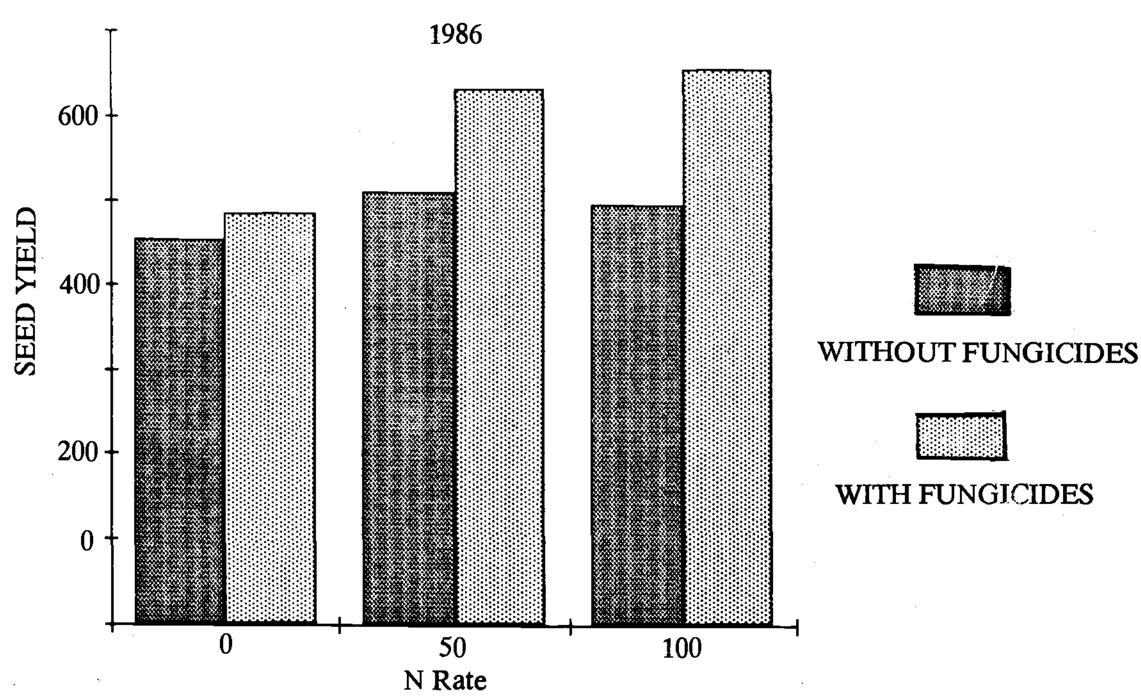

Figure 2. Meadowfoam seed yield (lb/a) response to N fertilization without fungicide, and with Rovral 50 W fungicide at 1.5 lb/a applied at 10% and 50% bloom stage, Hyslop site 1986.

Table 3. Meadowfoam seed yield and harvest index response to N fertilization, Ringsdorf site, 1986.

N Treatment[1]			Seed Yield	1000 Seed Weight	Harvest Index
Jan	Feb	Total			
--(lb N/a)--			(lb/a)	(g)	(%)
--	--	25	882	7.65	25.07
25	--	50	936	7.46	24.06
--	25	50	923	7.54	24.58
25	25	75	982	7.57	22.97
50	--	75	961	7.58	21.59
--	50	75	925	7.63	24.10
LSD .05		NS	NS	1.71	

Note: Oil data lost in an oven fire

[1] Includes 25 lb N/a at planting

AGRONOMIC STUDIES ON TURF-TYPE TALL FESCUE VARIETIES

W.C. Young III and H.W. Youngberg

The introduction of tall fescue varieties in the late 1970's with a higher seed price and greater seed yield potential during the first two or three years of production greatly changed the character of tall fescue seed production in western Oregon. Where formerly tall fescue was grown on relatively infertile soils subject to winter flooding, the crop is now being grown on soils with excellent fertility and better drainage. Generally the management of the turf-type varieties followed practices formerly used for the forage type varieties.

Tall fescue has long been recognized as a hardy and persistent forage plant. It is a good seed producer over a long stand life if proper management practices are followed. Recently, declining seed yield in turf-type tall fescue fields during the third and fourth year of production has been reported by many producers. Several hypothesis have been put forward to explain the condition but the cause is not clear.

In developing the turf characteristic in tall fescue, plant breeders have altered the plant growth habit as compared to the forage varieties. Preliminary observations point to a stronger tillering pattern and more prostrate growth habit in the turf type varieties. These characteristics result in greater vegetative dry matter production, possibly greater straw yields and possibly other differences in growth habit. In selecting a superior turf plant, plant breeders may have created problems for maintaining seed yield when traditional field management practices are followed.

Recommended row spacing, seeding density, fertilizer rate and timing and residue disposal methods for turf-type tall fescue varieties should be reviewed. In addition, more information on the plant growth and development pattern of the turf-type varieties should be obtained to formulate management practices to maintain seed yield throughout the life of the stand or production contract.

Row spacing and seeding density effect. In perennial grass seed production a plant population density should be established which will optimize seed yield throughout the life of the stand. The problem of sod-binding in tall fescue stands accompanied by lower seed yield has long been known. Variation in tillering and vegetative spread of seedlings from the original crown as the stand ages may demand different spacing arrangements for optimum production for turf-type varieties. Optimum intra-row plant spatial arrangement for an aggressively tillering genotype is likely to be different from a weakly-spreading genotype. The influence of altering inter-row spacing as a means of adjusting plant population will change with plant habit.

Four varieties of tall fescue (Falcon, Rebel, Bonanza turf-types and Fawn forage type) were seeded in August 1985 for a long-term study extending over four years. Two 33-foot diameter plant density circles were established for all varieties. One circle was calibrated to plant 7 lb/a of seed at 12-inch row centers, the second at 7 lb/a at 24-inch row centers. Each circle has 32 rays providing inter-row spacing from zero to 36 inches. Number of vegetative and reproductive tillers, and yield component data were collected to quantify relationships between plant population density and seed yield.

A statistical summary of seed yield data from the planting density circles is presented in Tables 1 and 2. These data, although largely nonsignificant, suggest that varieties do not respond the same at equal row spacings. Bonanza had the highest seed yield when seeded in rows between 12- and 24- inches wide; Rebel and Falcon were highest yielding between 18 and 30 inches. However, Fawn yielded higher at row spacings between 6 and 18 inches. Thus, even in the first year of production, turf-tall fescue varieties appear to be higher yielding in wider rows when compared to a forage type.

Table 1. Effects of row spacing and seeding rate on seed yield of four varieties of tall fescue, 1986.

Row spacing	Seeding rate[1]	Seed yield (lb/a) Bonanza	Rebel	Falcon	Fawn
(inch)	(lb/a)				
6	14.0	943	957	1012	1523
12	7.0	1330	1098	888	1269
18	4.7	1379	1233	1051	1373
24	3.5	1357	1409	1281	1148
30	2.8	1188	1394	1150	1189
36	2.3	1036	1274	890	801
LSD .05		NS	NS	NS	NS

[1] Seeding rate extrapolated from 7 lb/a on 12 in. centers.

Table 2. Effects of row spacing and seeding rate on seed yield of four varieties of tall fescue, 1986.

Row spacing	Seeding rate[1]	Seed yield (lb/a) Bonanza	Rebel	Falcon	Fawn
(inch)	(lb/a)				
6	28.0	609	496	784	964
12	14.0	751	922	788	1190
18	9.4	1080	930	1082	907
24	7.0	1098	900	1181	882
30	5.6	930	1135	1174	873
36	4.7	976	952	862	818
LSD .05		NS	317	NS	NS

[1] Seeding rate extrapolated from 7 lb/a on 24 in. centers.

Based on yield component data, a much higher number of total tillers were observed at narrower row spacings in the stand at maturity, and in addition, there were more vegetative tillers. However, fertile tiller number (on a unit area basis) appeared to be much less influenced by row spacings between 12 and 30 inches. Spikelets per panicle were significantly increased at wider row spacings for all varieties except Fawn. Changes in row spacing had little effect on number of florets per spikelet and 1000 seed weight.

Plants were shorter at the wider row spacing due to a reduced stem length. Panicle length was slightly greater as row width increased. As a result, total harvested dry weight and straw weight were reduced at wider row spacings, and harvest index was increased.

Nitrogen management studies. Nitrogen is the most critical fertilizer element affecting seed production. Varying the nitrogen rate and time is known to alter the tillering pattern and influence seed yield. The primary objective of this research is to determine how spring nitrogen management influences the total number of tillers which produce seed heads. Treatments were imposed across two row spacings. In addition, yield component data were collected from individual tillers to evaluate efficiency of nitrogen use.

In August 1985, each variety was seeded separately in 200-foot x 150-foot blocks. Within blocks, each variety was planted in alternating strips 24-foot x 150-foot at either 12-inch or 24-inch inter-row spacing. However, the intra-row density was held constant in both 12-inch and 24-inch plantings by using a seeding rate of 7.0 lb/a and 3.5 lb/a, respectively. These blocks were fertilized in the spring at either vegetative development, reproductive development or split equally between the two stages with urea applied rates equivalent to 90, 130 or 170 lb N/a. Seed yield was determined by using a small plot harvester.

Treatment effects on the first year seed yield are shown in Table 3. The effect of row spacing was significant only for the variety Falcon, where the narrow

Table 3. Effects of row spacing, and time and rate of spring nitrogen application on seed yield of four varieties of tall fescue, 1986.

Treatment	Seed yield (lb/a) Bonanza	Rebel	Falcon	Fawn
Row Spacing (inch)				
12 inch	1441	1330	1320	1144
24 inch	1340	1318	1118	1152
LSD .05	NS	NS	83	NS
Nitrogen Time				
Vegetative	1426	1349	1236	1090
Split (50/50)	1437	1381	1161	1185
Reproductive	1309	1243	1261	1169
LSD .05	NS	NS	NS	NS
Rate of Nitrogen (lb N/a)				
90	1249	1505	1336	1338
130	1431	1267	1158	1072
170	1491	1200	1163	1034
LSD .05	140	149	NS	97

row planting resulted in a higher seed yield. Time of nitrogen application was not significant, however, the later maturing varieties, Bonanza and Rebel, had a slight yield advantage where early and split applications were made. Fawn, an early maturing forage variety, had the best yield where split and late applications were used. Rate of spring-applied nitrogen also affected varieties differently. Bonanza produced the best seed yield when at least 140 lb/a were applied, whereas Rebel, Falcon, and Fawn did not respond significantly to increases in rates greater than 90 lb/a.

Fertile tiller number, on a unit area basis, was significantly greater when all varieties were seeded on 12-inch row spacing. However, the number of seed per tiller recovered at harvest was greatest when the 24-inch row spacing was used. The number of spikelets per panicle and florets per spikelet generally increased at the wider row spacing. In addition, earlier nitrogen applications resulted in more spikelets per panicle, whereas later-applied nitrogen increased the number of florets per spikelet. Higher nitrogen rates resulted in a slight increase in both spikelet and floret number.

Summary. Data presented above are from the first year of study in a research project planned for a duration of four years. In addition to the factors discussed above, the plots in the block planting were alternately burned or flail chopped following seed harvest, thus, the effect of post-harvest management will be considered in subsequent years. As such, it is not appropriate to judge the benefit of one management practice over another at this time. The intent of this report is to give an interim view of a study designed to provide a better understanding of the fate of fall and winter formed tillers, and to identify strategies for insuring their contribution to a high seed yield in the later years of production.

Acknowledgement - This research was supported by a grant from Oregon Tall Fescue Commission.

A COMPARISON OF HARD FESCUE AND CHEWINGS FESCUE TILLERING UNDER FOUR POST HARVEST/RESIDUE MANAGEMENT SCHEMES

G.S. Vollmer, H.W. Youngberg, and W.C. Young III

Hard fescue (*Festuca longifolia* Thuill.) has potential for increased turf use but does not respond well to normal seed production management practices used on other fine-leaved fescues. In commercial practice, open field burning results in reduced seed yields in hard fescue. The purpose of this study was to describe differences in tillering patterns in hard and Chewings fescue (*Festuca rubra* L. Subsp. *commutata* Gaud.) in response to various post harvest residue management treatments. Treatments included early and late clip and vacuum residue removal (crewcut) and post harvest burn treatments. Varieties selected for the study were Waldina and Scaldis hard fescue and Koket Chewings fescue.

Sub-species differences. Hard fescue produced a higher percentage of aerial tillers (tillers with tillering nodes elevated above the soil level) in the autumn (Table 1). Aerial tillers are not in a position to survive and contribute to seed yield. Most aerial tillers died before February. Basal tillers are most likely to contribute to seed yield in the following season. No differences were observed between Chewings and hard fescues in the number of basal tillers formed in the early autumn regrowth. Hard fescue varieties sustained a higher vegetative tiller population until harvest. In Chewings fescue dry matter production was concentrated in fertile tillers and seed development with less competition from numerous vegetative tillers.

Table 1. Aerial tillers as a percent of total tillers, 1980-81.

Treatment	Date: Nov. 7	Dec. 31	Feb. 15
	--------(%)----------		
Cultivar			
Waldina	36.3	19.0	8.4
Scaldis	29.7	24.7	9.1
Koket	9.8	14.4	1.6
Management			
E-burn	1.5	0.4	<0.1
L-burn	8.2	1.1	0.1
E-ccut	34.8	26.0	4.9
L-ccut	52.3	49.2	22.1

Hard fescue varieties studied had a slower vertical growth rate, produced more aerial (non-productive) tillers, and supported a higher percentage of vegetative tillers late in the season. The differences in growth and development pattern between the Chewings and hard fescues appear to reflect different survival mechanisms. Hard fescue varieties studies have a greater dependency on vegetative reproduction for survival than the Chewings variety.

The superior seed yield of the Chewings fescue variety was due to 30% more fertile tillers per unit area and 25% greater mean seed weight (Table 2). Differences in seed yield between species cannot be simply attributed to the availability of early season basal tillers for floral induction but are due to the effects of inter-tiller competition, dry matter partitioning and the genetic propensity to favor seed production over the maintenance of a high population of vegetative tillers.

Table 2. Components of yield, July 1981 harvest.

Treatment	Seed Yield	Fertile Tillers dm^{-2}	Seeds/* Fertile Tiller	Seed* Weight/ Tiller	1000 Seed Wt.
	(gm^{-2})			(mg)	(g)
Cultivar					
Waldina	85.12	212.4	59.15	41.03	0.6965
Scaldis	91.90	190.1	57.15	50.79	0.8888
Koket	133.32	260.9	51.46	50.99	0.9893
LSD P <.05	20.41	53.0	4.98	6.99	0.0869
Management					
E-burn	108.1	238.1	54.27	46.28	0.8599
L-burn	90.7	168.8	63.87	53.44	0.8531
E-ccut	116.4	257.4	53.09	45.88	0.8598
L-ccut	98.5	220.4	52.46	11.80	0.8600
LSD P .05	16.3	35.3	7.74	6.05	NS

*Calculated data.

Post harvest treatment effects. Based on autumn tiller development, Chewings fescue has the ability to recover from all but the most severe (late burn) post harvest management while regrowth in hard fescue was slower and the number of tillers was lower in all but the least severe (early crewcut) management.

The Chewings fescue variety had a greater ability to respond to severe treatment and environmental conditions which accounts for the favorable response to post harvest burning. It produced a similar tiller population in all but the most severe (late burn) treatment whereas the hard fescue was slower to recover from even the early season treatments.

In this study, normal (early) burning with a flamer did not reduce seed yield of hard fescue varieties as compared to the clip and vacuum removal treatments. This was response was attributed to the pre-treatment flail chop and partial removal of harvest litter prior to burning which resulted in a uniform moderate-temperature burn. Although this study covered only one season, it suggests that a controlled burn management system may be able to increase or maintain hard fescue seed yield in later years of the stand. Further investigation of post harvest residue management in hard fescue is needed.

FORAGE AND TURF GRASS VARIETY SEED YIELD TRIAL

H.W. Youngberg, W.C. Young III, and D.O. Chilcote

A fee-supported seed yield evaluation program has been conducted at Oregon State University since 1981. Annual reports of results are available on request. Varieties are grown under western Oregon conditions and observed for two years. Seed yield, harvest index, mean seed weight, plant height, heading date, anthesis date, and lodging characteristics are recorded and reported.

The trial was located at Hyslop Crop Science Field Laboratory, Corvallis, Oregon on a Woodburn silt loam soil. Perennial species in this trial were planted in May, 1985. Italian ryegrass varieties were seeded on September 5, 1985. Seeding rates were adjusted for germination percentages and mean seed weight to allow planting of an equal number of pure live seed per length of row. Row spacing was 12 in (30 cm) for all species except tall fescue and orchardgrass, which were spaced 18 in (45 cm) apart. Four replications of each variety were established. Plots were 3 ft (0.9 m) wide and 15.6 ft (4.75 m) in length. A blank row was used to separate entries within blocks. A standard variety was included for each species.

All varieties were checked on a weekly schedule from March 26, 1986 until maturity. Dates were recorded when approximately 50% of the stand had headed (heading date) and when exerted anthers were first apparent (anthesis date). In addition, the date on which lodging first became apparent within each plot was recorded (lodging date), along with a percentage estimate of the area affected (area lodged) and the severity of that lodging on a scale of 1 - 5. Plant height measurements were recorded on June 18, 1986.

The entire plot area was harvested at maturity using a small plot harvester incorporating a sickle bar cutter and draper designed for efficient bagging of the above ground plant biomass (reported as total dry weight). The bagged material was air-dried, threshed, cleaned and weighed to calculate seed yield. A 3 to 5 g seed sample of each plot was taken with a seed divider to determine the 1000 seed weight. In addition, harvest index was calculated for each entry. Harvest dates and other observations are presented in Tables 1 and 2.

Table 1. Seed yield of perennial ryegrass and Italian ryegrass varieties, 1986.

Variety Name	Seed Yield	1000 Seed wt.	Plant Height	Anthesis Date	First Lodging[1]	Harvest Date
	(lb/a)	(g)	(cm)			
Perennial ryegrass						
Mom Lp 763	1692	1.66	86.9	05-Jun	28-Apr	05-Jul
Kemal	1519	3.38	100.5	05-Jun	03-May	05-Jul
Verna	1281	2.06	102.0	29-May	24-Apr	05-Jul
Linn (Std)	1233	2.29	90.8	29-May	29-Apr	05-Jul
DP-73-4-32	1192	1.97	98.0	29-May	29-Apr	05-Jul
Sisu	1188	1.85	87.8	05-Jun	24-Apr	15-Jul
Chantal	1180	1.74	88.5	05-Jun	24-Apr	15-Jul
DP-1-6P	1174	2.18	90.5	31-May	01-May	05-Jul
Pennfine	1122	1.93	94.1	29-May	24-Apr	05-Jul
Vejo	1113	1.88	100.4	29-May	29-Apr	05-Jul
Tonga	982	3.40	105.0	29-May	06-May	05-Jul
DP-73-4-51	928	2.09	97.4	29-May	24-Apr	05-Jul
DP-233	909	1.60	81.8	09-Jun	24-Apr	17-Jul
DP-26	857	1.47	78.3	12-Jun	26-Apr	17-Jul
DP-78-9-20	792	1.71	86.4	10-Jun	24-Apr	15-Jul
Pippin	475	1.49	75.9	21-Jun	24-Apr	23-Jul
DP-79-2-48	449	2.63	82.0	20-Jun	24-Apr	23-Jul
Trani	394	1.61	82.1	26-Jun	24-Apr	23-Jul
Mean	1027	2.05	90.4	06-Jun	26-Apr	-
LSD .05	234	0.13	9.7	4[2]	5[2]	-
Italian ryegrass						
Marshall (Std.)	2272	2.86	159.2	03-Jun	26-Apr	02-Jul
Bambi	1440	4.09	133.6	03-Jun	29-Apr	30-Jun
Sikem	1410	2.58	140.0	02-Jun	28-Apr	30-Jun
Aubade	1327	3.83	131.0	03-Jun	28-Apr	02-Jul
Westerwold	1262	3.97	133.4	02-Jun	01-May	02-Jul
SI-4	1085	2.99	123.5	15-May	24-Apr	19-Jun
Top 1	1076	4.03	143.2	03-Jun	29-Apr	02-Jul
Wencke	1030	2.54	137.0	02-Jun	29-Apr	30-Jun
Roberta	962	4.00	129.7	03-Jun	28-Apr	02-Jul
WSG TB-1A	959	3.66	143.2	03-Jun	01-May	30-Jun
Kitti	942	2.41	125.5	29-May	28-Apr	30-Jun
Catalpa	872	3.91	129.2	29-May	29-Apr	30-Jun
Mean	1220	3.41	135.7	31-May	28-Apr	-
LSD .05	221	0.17	12.0	5[2]	5[2]	-

[1] Lodging score 1-5; 1 = no lodging and 5 = flat
[2] Days

Note: Seed yields from research plots should be compared with known standard varieties rather than using the absolute figures to estimate potential yields under commercial production conditions. Plot harvest methods reduce shattering and other harvest losses that normally occur in commercial production.

Table 2. **Seed yield of orchardgrass, tall fescue, fine leaf fescue and bluegrass varieties, 1986.**

Variety Name	Seed Yield	1000 Seed wt.	Plant Height	Anthesis Date	First Lodging[1]	Harvest Date
Orchardgrass						
Hallmark	1880	1.09	147.3	29-May	05-Jun	23-Jun
Crown	1421	1.11	155.1	29-May	22-May	27-Jun
Potomac (Std.)	1250	1.12	145.4	29-May	22-May	27-Jun
Rancho	1096	0.99	147.0	29-May	23-May	30-Jun
Cesarina	660	0.85	124.9	29-May	22-May	08-Jul
Mean	1261	1.03	143.9	29-May	25-May	-
LSD .05	251	0.07	5.6	NS	2[2]	-
Tall fescue						
Rebel II	2551	1.97	124.8	29-May	22-May	30-Jun
Rebel	2238	2.17	132.4	03-Jun	22-May	30-Jun
Forager	2192	2.63	145.0	29-May	15-May	19-Jun
Fawn (Std.)	2158	2.56	135.7	29-May	15-May	19-Jun
Sibilla	1955	2.02	141.6	31-May	22-May	30-Jun
Mean	2219	2.27	135.9	30-May	19-May	-
LSD .05	377	0.16	7.6	4[2]	2[2]	-
Fine leaf fescue						
ISI-544 Cornet	1741	1.36	72.6	24-May	26-Apr	23-Jun
ISI-829 Enzet	1449	1.35	71.9	22-May	24-Apr	23-Jun
ISI-504 Fulda	1186	1.38	71.6	24-May	01-May	23-Jun
Mom Frc 626	1097	1.09	73.8	22-May	01-May	19-Jun
Cascade	1090	1.13	89.0	29-May	01-May	23-Jun
Z 72 Frc 205	1036	1.03	74.0	22-May	01-May	19-Jun
LW R75-2 (Furore)	806	1.06	77.3	26-May	05-May	19-Jun
Pennlawn (Std.)	756	1.01	80.3	24-May	08-May	23-Jun
Mean	1145	1.17	76.3	24-May	01-May	-
LSD .05	114	0.04	5.7	4[2]	3[2]	-
Bluegrass						
Newport (Std.)	1023	0.383	71.1	22-May	05-Jun	01-Jul
ZW-42-116	803	0.320	66.6	29-May	22-May	01-Jul
Nimbus	607	0.355	63.1	29-May	05-Jun	01-Jul
Larissa	411	0.378	49.1	15-May	05-Jun	01-Jul
Mean	711	0.359	62.5	22-May	02-Jun	-
LSD .05	250	0.036	6.2	NS	NS	-

[1] Lodging score 1-5; 1 = no lodging and 5 = flat
[2] Days

FLORAL INDUCTION AND DEVELOPMENT OF SELECTED TALL FESCUE VARIETIES

E. Dell'Agostino, H.W. Youngberg, and W.C. Young III

Some of the recently developed turf-type tall fescue varieties appear to respond differently to seed production management systems than the traditional forage-type varieties. In order to develop better seed production programs more information is needed about effects of environmental conditions on phases of vegetative and reproductive development.

In perennial grasses certain physiological changes called floral induction occur during the winter when the plants are dormant. Under the influence of low temperatures and short days tillers are induced (or vernalized). Induced tillers are capable, when temperature becomes favorable for growth, to respond to increasing photoperiod by initiating reproductive structures.

A more thorough knowledge of inductive requirements of tall fescue growing under Willamette Valley seed production management systems will help improve the management practices for seed production. In this study, four tall fescue varieties, three turf type (Falcon, Rebel, and Bonanza) and one forage type (Fawn) were planted in the fall of 1985 for seed production studies at Hyslop Crop Science Laboratory, Corvallis. On a weekly interval, from January 14 to February 11, 1986, 12 plants of uniform size were randomly selected from blocks of each variety and placed in plastic pots with a soil mix added. The potted plants were placed in a growth chamber programmed for 10/20°C, and a 12-hour photoperiod, to stabilize the induced state and after one week the plants were transferred to a second growth chamber set a 13/24°C with 16-hour photoperiod, for two weeks to promote floral initiation. After this conditioning period, the plants were removed to a greenhouse with supplemental fluorescent lighting to maintain a 16-hour photoperiod and temperature of 24±5°C until flowering was evident.

Plants in the greenhouse were observed (every three days) for onset of floral development. Date of heading (date panicle top emerged from leaf sheath), number of panicles (number of fertile tillers), and number of vegetative tillers produced on each plant were recorded.

Field temperature conditions in November and December 1985 were below normal, resulting in reduced growth and a lower number of tillers per plant. However, some floral initiation occurred in all varieties under greenhouse conditions, from the start of the field sampling period (January 14). This indicates that varieties of both types had been induced to flower by the date of the first field sample (January 14).

Fawn, an early-maturing forage type, in general, produced more tillers than the other varieties (Table 1). It had the highest seed yield potential in the seedling year. Response to limited inductive conditions produced the greater number of tillers, and had a higher percentage of fertile tillers. Increasing the exposure to low temperature and short day inductive conditions in the field through mid-February resulted in increased percentage of fertile tillers.

The turf type varieties exhibited a different pattern of initiation than the forage variety, Fawn. Generally, fewer inflorescences emerged after the earliest date of removal from the field, and a lower number of tillers became reproductive. Within the turf varieties studied, Falcon and Rebel were similar in tiller number, inflorescence number and development, and percentage of fertile tillers.

The Bonanza variety exhibited a third type of response. Inflorescence number was not different from Falcon and Rebel at the first sample date but dropped to a low level in the late sampling dates, an apparent devernalization, as increased intertiller competition may have restricted conditions favorable to initiation.

These differences may be due to genetic differences in respect to autumn growth during the seedling year, inductive requirements, existence or duration of juvenile stage in the respective varieties.

Acknowledgement. This research was partially supported by a grant from the Oregon Tall Fescue Commission.

Table 1. Number of vegetative tillers and inflorescences in four tall fescue varieties produced under greenhouse conditions at five dates, 1986.

Collection Date/Variety		Inflor-escences	Tillers		Fertile Tillers (%)
			Veg.	Total	
Jan 14					
	Fawn	1.83 b	12.75 a	14.58 a	12.57
	Falcon	0.66 a	14.08 ab	14.74 a	4.52
	Rebel	0.58 a	17.42 bc	18.00 ab	3.24
	Bonanza	0.50 a	20.33 c	20.83 b	2.40
Jan 21					
	Fawn	1.83 a	9.17 a	11.00 a	16.67
	Falcon	1.58 a	14.50 c	16.08 b	9.84
	Rebel	1.08 a	12.08 b	13.16 a	8.23
	Bonanza	1.83 a	13.75 bc	15.58 b	11.75
Jan 28					
	Fawn	2.42 b	11.83 a	14.25 a	16.96
	Falcon	1.33 ab	9.50 a	10.83 a	10.00
	Rebel	1.17 a	14.25 a	15.42 a	7.57
	Bonanza	2.33 b	11.92 a	14.25 a	16.37
Feb 4					
	Fawn	2.92 b	11.50 ab	14.42 b	20.23
	Falcon	0.92 a	9.50 a	10.42 a	8.80
	Rebel	0.92 a	13.75 c	14.67 b	6.25
	Bonanza	0.75 a	13.33 bc	14.08 b	5.33
Feb 11					
	Fawn	3.08 c	9.08 a	12.16 b	25.34
	Falcon	2.33 bc	8.67 a	11.00 ab	21.21
	Rebel	1.42 ab	9.17 a	10.59 ab	3.39
	Bonanza	0.25 a	9.25 a	9.50 a	2.63

ESTABLISHING FALL-SEEDED RED CLOVER WITH A CEREAL COMPANION CROP

W.C. Young III and H.W. Youngberg

Red clover is an important seed and forage crop in western Oregon. Stands are established in both the spring (mid-April to mid-May) and fall months (mid-August to mid-September). Because of the small seed size and slow seedling establishment, fall plantings must be made early enough for young seedlings to develop four to six true leaves before the onset of excessively cold weather. Interseeding the fall planting of red clover with a cereal grain may benefit stand establishment by protecting the seedlings from frost damage and wind. The increased ground cover provided by the cereal will impede the flow of water reduce soil erosion. The fall-seeded cereal crops can be removed with selective herbicides in December or January, before they become competitive with the red clover seedlings.

An experiment was initiated in the late-summer of 1985 to evaluate the effects of an interseeded cereal nurse crop on red clover establishment and seed yield in the following season. A conventional seedbed was prepared in late-August, with 200 lb/a of 15-15-15 fertilizer incorporated. On September 5, 1985, 7 lb/a of Kenland red clover was seeded in 14 inch rows oriented north-south. On the same day, 40 lb/a of either Malcolm winter wheat or Cayuse spring oats were seeded in east-west rows spaced 12 inches apart. A check plot (no cereal nurse crop) was included. Treatments were in 12 x 50 foot plots, arranged in a randomized complete block design with three replications.

A total of 6 inches of water was applied by sprinkler irrigation on September, 5-6 and September 25-26, 1985 to aid in stand establishment. Weed control was initiated with a broadcast application of 1.5 lb a.i./a dinitro on October 29, 1985, across all plots. On January 31, 1986, 2.0 lb/a Kerb^{R} was broadcast applied to all plots to remove the wheat and control annual bluegrass. On March 25, 1986, 160 lb/a 0-25-0-10 fertilizer was broadcast on all plots.

Plant height, plant number, and plant dry weight data were collected on June 1, 1986 in advance of flail-chopping and removing the foliage to simulate a hay cutting.

On June 13, 1986, 2.0 inches of irrigation was applied by sprinklers to encourage regrowth following clipping. Solubor^{R} at 2.5 lb/a was applied on June 25th, when the crop canopy had closed. Honey bees were provided for pollination on July 3, 1986. On August 28, 1986, final plant height measurements were taken and sections of row were cut to determine yield components. All plots were subsequently harvested to determine seed yield.

The cereals germinated rapidly and the red clover seedlings were extremely slow to emerge and establish. Many had not developed the first true leaf one month after planting. In late-October, 1985, oats were 6 to 8 inches tall with upright, vigorous growth, the wheat was more prostrate in growth habit and 3 to 4 inches tall, and red clover seedlings were at the 3 to 4 true leaf stage. Many small broadleaf weeds and a thick ground cover of annual bluegrass were present. There was no apparent weed suppression advantage to those plots intercropped with cereals.

Broadleaf weeds were completely removed by the dinitro treatment with only minor leaf spotting to the red clover and cereal. Extremely cold weather occurred in late-November and persisted into December 1985. The cold weather killed most of the oats and created a layer of scenescing leaf tissue blanketing the red clover plots in mid-December. The wheat was unaffected by the cold weather, and had grown to a height of 8 to 10 inches by mid-January, 1986. There were almost no surviving oat plants in the plots by late-January. The wheat slowly succumbed to the late-January Kerb application but not before the onset of spring conditions favorable to red clover growth.

Response to the 0-25-0-10 spring-applied fertilizer was visible across all plots. Growth of the red clover in plots previously interseeded with wheat was reduced throughout most of April, 1986. By late-May the entire plot area appeared as a uniform stand of red clover.

No significant differences were observed in plant height, number of plants per foot of row or in hay yield. There was a trend showing slightly reduced height and dry weight in the interseeded wheat plots (Table 1).

There were no visible differences in growth, flowering date, or maturity observed among the treatments throughout the summer. At harvest, there were no significant differences in plant height, seed yield, or yield components in response to nurse crop treatment (Table 2).

Table 1. Plant height, plant number, and dry weight estimates in red clover nurse crop establishment study, June 1986.

Treatment	Plant height	Number of plants	Hay yield
	(in)	(per ft^2)	(ton/a)
Wheat	18.9	11	1.3
Oats	26.4	11	1.7
No cereal	25.2	12	1.9

This trial suggests there was no benefit from intercropping a cereal nurse crop with red clover during fall establishment. These results were observed in a growing season which December 1985, was the second coldest and fifteenth driest in 97 years at Corvallis. On the other hand, providing irrigation immediately after seeding to insure rapid stand establishment may have biased the data in favor of more rapid establishment. The wheat nurse crop appeared to compete with the red clover more than the oat nurse crop. Results under non-irrigated conditions may not be consistent with these data, showing greater differences. A second year seed crop will be harvested from these plots in 1987.

Table 2. Final plant height, seed yield and yield components in red clover nurse crop establishment study, 1986.

Treatment	Plant height (8/28/86)	Seed yield	1000 Seed weight	Number of plants (8/28/86)	Heads per plant	Seeds per head
	(in)	(lb/a)	(g)	(per ft^2)	--(number)--	
Wheat	16.9	278	1.58	15	2.7	51
Oats	18.5	368	1.57	12	3.2	66
No cereal	17.7	351	1.56	17	2.2	69

EFFECTS OF XE-1019 PGR ON KENLAND RED CLOVER GROWN FOR SEED PRODUCTION

T.B. Silberstein, H.W. Youngberg, and W.C. Young III

Red clover grown for seed under western Oregon conditions often makes excessive growth and is difficult to harvest during late summer season conditions. Reducing vegetation volume with plant growth retardants would improve harvest conditions and possibly improve seed recovery. Preliminary studies in Oregon have indicated benefits from the use of growth retardants on red clover.

Two plant growth retardants were evaluated to determine the effects on plant growth and seed yield on red clover grown for seed in 1986. Red clover var. Kenland was planted at the Hyslop Crop Science Field Laboratory in September, 1984. The plots were flail chopped to simulate hay cutting on June 3, 1986.

Growth retardant treatments included soil and foliar applications of XE-1019 and Parlay (Parlay used for comparison). Soil applications were made at the start of the regrowth period (9 days after hay cut). Full and limited irrigation variables were applied to two experiments receiving soil application. The limited irrigation treatment received a two inch irrigation on the day following the PGR application while the full irrigation treatment received six inches irrigation in three applications over the growing season. The foliar application treatments were made on a third experiment on June 26 (at canopy closure), using XE-1019 1.0 lb/gal. EC and Parlay 50wp (with sticker).

Canopy height and gross dry weight were significantly reduced by the soil applied PGR in both the single irrigated and fully irrigated treatments. As the rate of XE-1019 increased, dry weight and canopy height were reduced. This resulted in significant reductions in vegetative volume at harvest for the soil applied treatments. Seed yield for all treatments in the limited irrigation were greater than the check except the

Table 1. Red clover growth and seed yield in response to soil applied PGR, Hyslop Field Laboratory, 1986.

Rate	Limited Irrigation			Full Irrigation		
	Dry wgt.[1]	Canopy height[2]	Seed yield	Dry wgt.[1]	Canopy height[2]	Seed yield
(lb a.i./a)	(lb/a)	(in)	(lb/a)	(lb/a)	(in)	(lb/a)
Check	5030	21.8	620	5535	22.1	757
XE-1019 (50 WP)						
0.125	5305	21.3	689	4874	20.9	688
0.25	4651	19.4	653	5310	20.5	753
0.50	4708	18.7	689	4935	20.2	815
0.75	4072	16.8	654	4120	17.3	728
1.00	3549	14.9	591	4676	16.6	787
PARLAY (50 WP)						
0.25	4866	21.0	621	5873	22.3	837
0.50	4950	19.8	661	5564	20.9	837
0.75	4893	19.0	688	5500	20.9	869
1.00	4855	19.3	703	5741	19.8	898
LSD 0.05	438	1.4	NS	577	2.0	109

[1]Dry weight at maturity
[2]Canopy height at August 25, 1986.

Table 2. Red clover growth and seed yield in response to foliar applied PGR. Hyslop Field Laboratory, 1986.

Rate	Dry wgt.[1]	Canopy height[2]	Seed yield
(lb a.i./a)	(lb/a)	(in)	(lb/a)
Check	5207	22.5	560
XE-1019 (1.0 EC)			
0.0625	5215	21.8	636
0.125	4986	21.0	599
0.25	5295	20.6	662
0.50	5288	20.4	694
1.00	5166	19.6	675
PARLAY (50% WP)			
0.25	5244	21.6	595
0.50	5469	21.5	696
1.00	5376	20.6	737
1.50	5681	21.8	677
LSD 0.05	NS	NS	89

[1]Dry weight at maturity
[2]Canopy height at August 25, 1986.

highest rate of XE-1019. Seed yield showed significant differences with the full irrigation experiment. XE-1019 yield peaked at a moderate rate while Parlay increased as rate increased up to the highest rate used (Table 1).

A significant response in seed yield occurred with the foliar applied PGR's. Seed yield in the foliar applied treatment peaked at moderate rates then decreased as the rate of PGR increased. Seed yield at all rates in the foliar applied experiment were higher than the check (Table 2). Vegetative volume at harvest was not significantly affected with the foliar applied experiment.

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TALL FESCUE - ENDOPHYTE RESEARCH

R.E. Welty

Greenhouse-grown seedlings of G1-307 tall fescue (10 plants) infected with *Acremonium coenophialum* and Forager tall fescue (20 plants) free of *A. coenophialum* were transplanted into the field at each of seven branch experiment stations. Seedling infection was determined by staining leaf sheath tissue and microscopic examination for endophyte hyphae between the cells. Seed was harvested in 1984 (except at Redmond, Klamath Falls, and Union), 1985, and 1986 and assayed for endophyte (Table 1).

Portions of five rows of tall fescue were burned or not burned to evaluate this treatment on the amount of endophyte infection in harvested seeds. Based on a 50-seed sample from the non-burned vs. burned rows, percent endophyte infections in seeds from the burned portion of five separate rows were 72, 26, 0, 6, 88%, while in the burned portion of the rows endophyte infections were 80, 0, 0, and 92%. These results indicate that the effect of burning on endophyte infection is minimal. Conclusions are tentative because the sample size was small, and the data were not statistically analyzed.

Table 1. Percentage endophyte infected seed harvested from endophyte-infected plants of G1-307 and endophyte-free plants of Forager tall fescue, 1984-85-86.

	G1-307			Forager		
Location	1984	1985	1986	1984	1985	1986
Corvallis (Hyslop)	98	88	83	0	0	0
Pendleton	91	92	92	8[1]	3[1]	0[2]
Hood River	89	95	98	0	0	0
Redmond	--	96	95	-	0	0
Medford	95	94	94	0	0	0
Klamath Falls	--	95	96	-	0	0
Union	--	95	99	-	0	0

[1]Seeds from 20 plants were combined and 2 grams of seed sampled; 109-200 seeds were examined for endophyte.
[2]Seeds from 19 plants were combined and 2 grams of seed sampled; 200 seeds were examined for endophyte. Ninety-four percent of the seeds (47 of 50 examined) from an infected Forager plant contained endophyte.

Endophyte infection ranged from 83-99% in seeds harvested from endophyte-infected G1-307; seeds harvested from endophyte-free Forager were free of endophyte at all locations except Pendleton. At Pendleton, endophyte infection of Forager was 8% in 1984 and 3% in 1985. In 1985, one plant in 20 Forager plants tested was identified as contributing endophyte-infected seeds. In 1986, seeds from the infected plant were not combined with seeds from the other 19 plants. Seeds from these 19 plants were combined, and 200 seeds were assayed for endophyte. None of these seeds contained endophyte. Seeds were collected from the endophyte-infected Forager plant, and 47 of 50 seeds assayed (94%) contained endophyte. Several studies are underway at Pendleton to determine if mechanical transmission of the fungus occurs from infected to noninfected plants.

RESPONSE TO APPLICATIONS OF FUNGICIDES TO CONTROL LEAF DISEASES

R.E. Welty

Orchardgrass - Leafspots and Stem Blight. Two studies were conducted at Hyslop Field Laboratory, Corvallis, OR in 1986 to evaluate the effects of applying fungicides at different stages of plant growth for control of leafspots and headblight fungi. Leaf diseases were present in 1986, but damage was not as severe as previous years, most likely due to the generally warmer-than-normal temperatures and less-than-

Table 1. Temperatures and days with measurable or trace amounts of precipitation; deviation from normal temperatures and precipitation, March-June, 1986, Hyslop Field Laboratory, Corvallis, Oregon.

	Temperature				Precipitation				
	Daily Avg.		Deviation Norm.		days with				
Month	Max.	Min.	Max.	Min.	0	Trace	Measurable	Total	Deviation
	(°F)				(days)			(inch)	
March	60.2	41.7	+6.4	+5.6	9	5	17	3.04	-1.59
April	59.2	39.3	-0.1	+0.5	11	3	16	1.84	-0.62
May	65.7	44.5	-0.5	+1.3	9	9	13	2.50	+0.58
June	77.4	51.2	+4.8	+2.9	23	3	4	0.31	-0.89

normal precipitation in March, April, and June (Table 1). Disease pressure was most severe in May when precipitation was slightly above normal.

The first study is in the third year. Bravo (3 pt/a), Difolatan (1.5 lb/a), and Tilt (8 fl. oz/a) were applied on one, two, or three dates (4/18, 5/19, or 6/3). A single application of Bravo on May 19 resulted in a significant increase in yield when compared with the non-sprayed control. No additional increase in seed yield occurred in plots sprayed two or three times with Bravo when compared with the non-sprayed control. Seed yields from plots sprayed with one to three applications of Difolatan or Tilt were not significantly higher than the non-sprayed controls (P = 0.05).

Table 2. Seed yield and blight scores of Potomac orchardgrass as influenced by one, two, or three fungicides to control leaf and head blight, Hyslop Field Laboratory, 1986.

		Fungicides[1]								
		Bravo			Difolatan			Tilt		
		Disease Score[2]			Disease Score			Disease Score		
No. of applic.	Dates applied	(5/21)	(6/04)	Seed yield[3]	(5/21)	(6/04)	Seed yield	(5/21)	(6/04)	Seed yield
				(g/plot)			(g/plot)			(g/plot)
0	Control	6.3	6.5	259	5.3	5.8	262	5.8	6.2	267
1	4/18	3.2	5.0	279	3.8	5.3	305	4.7	5.5	255
1	5/19	5.0	5.2	294	6.0	6.2	283	6.2	6.0	256
1	6/3	5.8	5.8	279	5.7	5.8	277	5.8	5.8	272
2	4/18, 5/19	3.8	5.8	289	4.8	4.7	302	5.5	4.7	281
2	5/19, 6/3	6.2	5.8	294	4.7	5.3	268	5.8	6.0	268
3	4/18, 5/19, 6/3	4.0	4.5	283	4.0	4.7	269	5.2	5.5	289
LSD .05		1.14	1.25	22	1.32	NS	NS	NS	NS	NS

[1]Fungicide rate: Bravo 3 pt/a; Difolatan 1.5 lb/a; Tilt 8 oz/a.
[2]Disease scored 1-9: 1 = few isolated lesions on lowest leaves; 9 = severe infection, all leaves and head.
[3]Seed harvested June 25. Results are an average of 6 replications

Table 3. Seed yield of Potomac orchardgrass receiving one, two or three applications of Bravo (3 pt/a) at 3 stages of growth; Hyslop Field Laboratory, 1984, 1985 and 1986.

No. of applic.	Growth stage at applic.[1]	Seed yield 1984	Seed yield 1985	Seed yield 1986
		----------(g/plot)--------		
0	Control	96	190	259
1	Boot (B)	122	178	279
1	Emergence (E)	125	171	294
1	Flowering (F)	105	178	279
2	B + E	149	184	289
2	E + F	132	184	294
3	B + E + F	141	200	283
LSD .05		17	NS	22

[1]Application dates: 1984 B = 4/13; E = 4/26; F = 5/16; 1985 B = 4/30; E = 5/10; F = 6/3; 1986 B = 4/18; E = 5/19; F=6/3.

These results are generally in agreement with results from 1984 when one or more applications of Bravo at late-boot or head-emergence resulted in significantly higher seed yields. Meteorological conditions in 1985 were less favorable for disease development, and seed yield differences from these fungicide treatments were not significantly different from nonsprayed controls. Review of the data from three years of testing (Table 3) revealed that one properly timed application of Bravo (3 pt/a) resulted in a significant increase in yield in two (1984 and 1986) of three years. When disease pressure is higher, e.g. 1984, two properly timed applications will increase seed yield.

In the second study, a field of Hallmark (sowed September 1985) was sprayed with Bravo (3 pt/a) one to four times at jointing, boot, heading, and/or flowering (Table 4). All fungicide treatments resulted in a significant increase in seed yield over the nonsprayed controls; however, two, three, or four applications did not significantly increase yields over plots sprayed once. Reasons why multiple applications did not result in yield increase are not clear from these data. However, variety difference (Potomac vs. Hallmark), growth stage of plants (mature vs. seedling stand), or low inoculum levels in the first-year stand may account for these differences. This study will be continued in 1987.

Table 4. Seed yield of Hallmark orchardgrass receiving one to four applications of Bravo (3 pt/a) to control leaf fungi and head blight

No. of applic.	Growth stage and: Joint (4/4)	Boot (5/9)	Heading (5/29)	Flowering (6/3)	Disease score[1] 5/22	Disease score[1] 6/4	Seed yield[2] (g/plot)
0	0	0	0	0	6.3	6.5	235
1	X				2.8	4.5	288
1		X			5.0	5.5	270
1			X		6.0	6.8	289
1				X	6.3	5.5	270
2	X	X			3.0	4.0	289
2		X	X		5.5	4.8	302
2			X	X	5.0	6.0	277
3	X	X	X		2.5	3.0	295
3		X	X	X	4.8	5.0	270
4	X	X	X	X	3.3	3.3	300
LSD .05					1.8	1.47	33

[1] Disease score 1-9: 1 = few isolated lesions on lowest leaves; 9 = severe infection, all leaves and head.
[2]Plots harvested 6/25, results are average of four replications.

Table 5. Seed yield of Pennlate orchardgrass as influenced by one to three applications of fungicides to control stripe rust, Hyslop Field Laboratory[1].

No.of applic.	Dates applied	Fungicides[2] Bayleton	Tilt	HWG-1608
		----------(g/plot)----------		
0	Control	187	186	207
1	4/18	196	210	207
1	5/19	185	209	193
1	6/3	182	196	217
2	4/18, 5/19	183	201	209
2	5/19, 6/3	202	205	195
3	4/18, 5/19, 6/3	209	199	201
LSD .05		23	NS	NS

[1]Harvested 7/5/86, results average of six replications.
[2]Fungicide rate: Bayleton 8 oz/a; Tilt 8 oz/a; HWG-1608, 24 fl. oz/a.

Table 6. Seed yields of Linn perennial ryegrass treated with 1 to 6 applications of Tilt (8 fl. oz/a) in a series-omission spray program to control stem rust; harvested July 4, 1986. Results average of 4 replications.

No. of applic.	Application dates 4/2	4/17	5/4	5/19	6/2	6/16	Rust[1] (%)	Seed[2] Yield
							(head)	(g/plot)
0	Control						57	188
1	X						26	180
2	X	X					63	221
3	X	X	X				47	201
4	X	X	X	X			24	191
5	X	X	X	X	X		0	226
6	X	X	X	X	X	X	0	212
5		X	X	X	X	X	0	222
4			X	X	X	X	0	205
3				X	X	X	0	216
2					X	X	2	202
1						X	17	206
LSD .05							15.1	NS

[1]Rust was first observed 5/25; scored 7/3/86
[2]Harvested 7/4/86, results average of four replications

Orchardgrass - Stripe Rust. Plots of Pennlate Orchardgrass were sprayed with three fungicides to evaluate stripe rust control (Table 5). Two or three applications of Bayleton (0.5 lb/a) resulted in significantly higher seed yield than the non-sprayed control. Yields of plots treated with Tilt (8 oz/a) or HWG-1608 (24 fl. oz/a) were inconsistent and not significantly different from the non-treated controls. In 1986, the occurrence of stripe rust was sporadic and not uniform in fields and plots. This study will be continued in 1987.

Perennial Ryegrass - Stem Rust. Six fungicides (Bayleton 4 and 8 fl. oz; HWG-1608 12 and 24 fl. oz; Nustar 10 and 20 fl. oz; Systnane 4 and 6 fl. oz; Tilt 4 and 8 fl. oz; and Bravo 2 and 4 pt per acre, respectively) were applied five times (every two weeks) beginning 15 April to evaluate stem rust control. Rust was first observed on leaves May 25, 1986, and on seed heads June 6, 1986. Rust developed slowly, and heads were scored July 3, the day before harvest. All fungicides at the rates tested controlled stem rust and improved the appearance (brightness) of the crop. None of the treatments in the test resulted in a significant increase in seed yield over the non-sprayed control. Seed yields (control = 187 g/plant) ranged from 169-223 g/plot (average of four replications).

In a series-omission spray schedule with Tilt (8 oz/a), May and June applications provided rust control (Table 6). None of the fungicide treatments resulted in a significant difference in seed yield when compared with the non-sprayed control.

Tall Fescue - Leafspots. Seven fungicides (Benlate 1 lb, Bravo 3 pt, Difolatan 1.5 lb, HWG-1608 24 fl. oz; Mertect 20 fl. oz; Rovral 1 lb and Tilt 8 fl. oz. per acre, respectively) were applied 4 times (every 2 weeks) beginning April 3 to evaluate leafspot control. Seed yields ranged from 257 to 343 g/plot, but yields were not significantly different from the non-sprayed controls.

SEED YIELD OF RED CLOVER REDUCED BY LYGUS BUGS ORIGINATING ON DOG FENNEL

J.A. Kamm

Lygus bugs are known to feed on the reproductive parts of various seed crops. Feeding damage in alfalfa may appear as premature flower drop, failure of pollinated florets to set seed, or smaller-than-normal seeds that are shriveled and do not germinate. However, lygus bugs produce no conspicuous feeding damage to red clover visible to the unaided eye. In alfalfa, 0.5 bugs per sweep are considered an economic problem, and red clover fields in the Willamette Valley commonly have 5.0 bugs per sweep at peak bloom. In 1985 and 1986, field tests were conducted and observations made to determine: 1) the effect of lygus bug feeding on red clover flowers and pods, and 2) the role of weeds as a source of bugs in red clover seed fields. Tests were conducted at various locations in the Willamette Valley.

Adult *Lygus hesperus* Knight inflicted inconspicuous feeding injury to developing florets and seed pods of red clover discernible only under a microscope. Seed set was reduced an average of 20 percent when five bugs were fed two days on culms of red clover in different stages of floral development. The dominant form of damage was small shriveled seed pods about twice the size of dried reproductive organs of unpollinated florets. Lygus bug feeding damage is easily mistaken for the latter. Bugs also produced shriveled seeds by feeding on various-size pods where the seed endosperm was still a watery consistency. Both types of damage reduce seed yield.

Weeds growing in and along red clover fields increase lygus populations. This was established by sampling 11 weed species growing in or along red clover seed fields to determine their suitability as a breeding host for lygus. Despite the presence of red clover and many known weed hosts for lygus, wintering females preferred dog fennel for oviposition the subsequent spring. First-generation adults that developed successfully on dog fennel (whether in or bordering clover fields) produced a second generation on red clover that averaged 4.9 bugs per sweep in two study fields. During August, irrigated red clover fields are especially attractive to lygus because most other hosts have matured and are nutritionally inadequate for growth and development of lygus. Fields with no weeds had significantly fewer bugs than fields with weeds. A weed-control program to reduce lygus populations is recommended for dog fennel both in and bordering red clover fields as part of a lygus-management program.

Contribution of Agricultural Research Service, USDA in cooperation with the Agricultural Experiment Station, Oregon State University.

RED CLOVER VARIETY SEED YIELD EVALUATION

W.C. Young III and H.W. Youngberg

Second year seed yield data were collected in 1986 on eight red clover varieties. The trial, designed to follow commercial field practices, was conducted at the Hyslop Crop Science field Laboratory, Corvallis, on a Woodburn silt loam soil.

Varieties were seeded in late-September 1983, with a 2-row, 15-foot plots using a circular belt planter. Rows were spaced 12 inches apart with a blank row separating entries. Seeding rate was 7 lb/a of inoculated seed, and each variety was replicated four times.

Following seed harvest in 1985, two applications of MCPA at 0.3 lb a.i./a were made on September 18 and October 28, 1985. Additional weed control measures included 1 qt/a Paraquat^R tank mixed with 2.0 lb/a Karmex^R 80W on December 12, 1985, followed by 2.0 lb/a Kerb^R 50W on January 31,1986. An application of 1.5 lb a.i./a dinitro was made on February 24, 1896, for the control of small broadleaf weeds which had escaped earlier treatments. On March 25, 1986, 160 lb/a 0f 0-25-0-10 fertilizer was broadcast applied to all plots. Plots were flail-chopped to remove forage on May 15, 1986, for the control of clover midge. Honey bees were provided for pollination on July 3, 1986.

Plant height was recorded just prior to harvest, and on August 26, 1986, the entire plot was collected using a small plot harvester incorporating a sickle bar cutter and draper for the efficient bagging of the above-ground plant biomass. The bagged material was air-dried, threshed, cleaned, and weighed. A 3- to 5-gram seed sample of each plot was taken with a seed divider to determine the 1000 seed weight, and harvest index was calculated for each entry.

Significant differences in seed yield, mean seed weight, harvest index, and plant height (Table 1).

Table 1. Seed yield, seed weight, harvest index and plant height of red clover varieties, 1986

Variety	Seed Yield	1000 Seed wt.	Harvest Index	Plant Height
	(lb/a)	(g)	(%)	(cm)
Arlington	198	1.75	4.6	50
Medium Red	189	1.63	5.8	39
Lakeland	116	1.64	3.8	43
Kenland	106	1.71	3.2	47
Bartolia	62	1.83	1.9	47
Temara	54	2.22	1.5	53
Hamidori	53	2.19	1.4	49
Jubilatka	45	2.11	1.3	54
LSD .05	57	0.15	1.4	9

Seed yields from the second harvest in 1986 were generally lower than 1985, although the ranked order was not significantly changed (Table 2). Reduced yield was most likely due to the presence of clover root borer. This stand, although not harvested in 1984 due to a late establishment in the fall of 1983, was essentially a third year crop. However, not all varieties were equally affected.

Table 2. Seed yield Comparison of red clover seed yield 1985 and 1986.

Variety	Seed Yield 1985	Seed Yield 1986	Rank '85	Rank '86	86/85
	---(lb/a)---				(%)
Medium Red	309	189	1	2	61
Arlington	211	198	2	1	94
Kenland	169	106	3	4	63
Lakeland	132	116	4	3	88
Bartolia	113	62	5	5	55
Temara	68	54	6	6	80
Hamidori	61	53	7	7	87
Jubilatka	35	45	8	8	130
LSD .05	32	57	--	--	--

MINIMUM TILLAGE SYSTEMS FOR CHANGING VARIETIES IN SEED PRODUCTION

W.C. Young III and H.W. Youngberg

The objectives of this research are to (1) study the effectiveness of minimum tillage systems during the transition period between seed production of one perennial ryegrass variety and another; (2) to determine the impact of non-burning in this process; and (3) to evaluate the acceptability of these systems to meet crop purity standards of the Oregon Seed Certification Service and the OECD Certification Scheme.

Two experiments were established at the Hyslop Crop Science Field Laboratory, Corvallis, in the late summer of 1985. The first is an evaluation of the effectiveness of a one- and two-year red clover crop, established by a no-till system in perennial ryegrass sod, in preparing for production of a perennial ryegrass seed crop of another variety. The second study compares the effectiveness of a one-year rotation to meadowfoam, in changing from one perennial ryegrass seed crop of another variety planted in burned and non-burned stubble.

Perennial Ryegrass/Red Clover Rotation

Following third year seed crop harvest from Pennfine perennial ryegrass on July 2, 1985, all straw was removed from the field. Main plot treatments were imposed by burning with a propane burner on August 26, 1985. Plots not burned were flail-chopped to uniformly distribute stubble and regrowth on August 28,1985. On September 4, 1985, 250 lb/a of 10-20-20-7 fertilizer was broadcast on the perennial ryegrass stubble. Subsequently, Kenland red clover was seeded at 7 lb/a using a John Deere Powr-Till^R (minimum tillage) drill on September 5, 1985. Red clover seed was coated with lime, inoculum, and Apron^R fungicide using Rhizokote^R seed coating by CelPril Industries, Inc. Six inches of water was applied by sprinkler irrigation on September 9 and 25, 1985.

Herbicides applied during the fall and winter included dinitro, Poast^R, and Kerb^R 50W.

Following the first plant sampling, 160 lb/a 0-25-0-10 fertilizer was broadcast applied on March 25, 1986.

Plant samples were collected on March 24 and May 16, 1986 to evaluate stand establishment.

All plots were flail-chopped and forage removed to simulate a hay cutting on June 3, 1986. To encourage regrowth, 100 lb/a of 21-0-0-17 was broadcast applied on June 16, 1986, and followed with 2 inches of irrigation. On August 26, 1986, sections of row were cut to determine yield components. Plant number and plant height measurements were made at this time. Subsequently, all plots were harvested for determination of seed yield.

The irrigation and precipitation provided sufficient moisture for establishment of the red clover. Red clover seedlings were well established in both residue treatments by early October 1985. Seedlings in the flail-chop treatments had greater competition from regrowth of perennial ryegrass stubble, volunteer seedlings, and more numerous small broadleaf weeds.

Despite cold and dry weather in late November and December, 1985, no significant stand loss was observed. However, during the warmer-than-average conditions in January and February 1986, an increased growth rate became apparent for the stand growing on the stubble burned treatments. Increased stubble and residue on the soil surface may have insulated the soil from solar radiation and caused lower soil temperatures in the flail-chop treatments. The stand established in the flail-chopped strips continued to appear less vigorous throughout the spring. Data collected from plant samples at two spring dates suggested that slightly fewer and significantly smaller plants were present.

Although crop growth was enhanced by the March nitrogen application in both burned and flail-chop treatments, plants established in the flail-chopped areas were less uniform in height and color, suggesting that poor nodulation may also have been a factor in their reduced vigor.

The plots were evaluated by Oregon Seed Certification personnel on May 13, 1986. Counts were made to determine the number of perennial ryegrass seedlings and traces of surviving perennial ryegrass plants. No seedlings were observed in the burned plots, and the average contamination in the flail-chopped plots was 1.1%. Oregon Seed Certification Standards allow only 1.0% other varieties of perennial ryegrass in a seed field producing the certified class. However, the seedling inspections made in the spring of 1987 will determine the acceptability of a one-year minimum tillage establishment of red clover between ryegrass varieties. Lastly, during the second production year of the two-year red clover system additional herbicidal controls will be targeted at the contaminating ryegrass plants in an attempt to insure an acceptable level of control.

Hay yield estimates taken before cutting on June 3 confirmed reduced dry matter production in the flail-chopped treatment. Regrowth after hay harvest was fairly uniform across both burned and flail-chopped treatments. However, by mid- to late-July the red clover in the flail-chopped plots was slightly taller and more vigorous, and in addition, a greater number of weeds established, the most dominant were: hawksbeard, false dandelion, and prickly lettuce. The increased crop growth and weed infestation may be the result of greater soil moisture retention where the previous crop residue was not completely removed.

Plants in the flail-chopped treatments were significantly taller (Table 1). A trend suggests both more heads per plant and seed per head in the flail chop treatment. In addition, both total dry weight and seed yield were significantly greater in the flail-chopped plots. There was no difference between burned and flail crop treatments in mean seed weight or stand density at maturity.

Perennial Ryegrass/Meadowfoam Rotation

A similar sequence of methods were used in the minimum tillage establishment of meadowfoam except the previous crop was Caravelle perennial ryegrass. Main plots were established as reported for red clover in late-August following the harvest of the third perennial ryegrass seed crop. A preplant broadcast application of 300 lb/a of 16-20-0 fertilizer was broadcast in the perennial ryegrass stubble on September 4, 1986. Meadowfoam seeding was delayed to October 3, 1986, until the soil temperature was low enough to avoid seed dormancy problems. Mermaid meadowfoam was seeded at 22 lb/a using the John Deere Powr-Till^{R} (minimum tillage) drill.

Rainfall was adequate for germination during the last two weeks of October 1985, and meadowfoam seedlings were visible as seeded rows in both burned and flail-chopped plots by November 5, 1985. By mid-November, increased competition from volunteer perennial ryegrass in the flail-chopped plots had obscured the developing meadowfoam seedlings. Poast^{R} herbicide was broadcast applied on November 13, 1985, at 0.5 lb a.i./a for selective removal of perennial ryegrass. On February 26, 1986, 110 lb/a of 46-0-0 fertilizer was broadcast applied to meet the requirements for good seed production.

On March 24 and May 16, 1986, samples were taken to determine the number of plants per unit area and the dry weight per plant. Two hives of bees were placed at the 0.5 acre plot site on May 15, 1986, to pollinate the crop. On May 22, 1986, 1.5 lb/a Rovral^{R} fungicide was broadcast applied to the plot area for the control of *Botrytis cinerea*. All meadowfoam plots were harvested on June 21, 1986 to determine seed yield and yield components.

Meadowfoam seedlings did not appear to be affected in any way by the cold, dry conditions of late-November and December 1985. As the effect of the Poast^{R} application became apparent, and with the onset of warmer conditions in January and February 1986, an excellent stand of meadowfoam was established in both burned and flail-chopped plots. Thus, the winter annual crop, meadowfoam, was very successfully established under minimum tillage conditions.

Rapid vegetative growth occurred followed the late February nitrogen application. The meadowfoam canopy was completely closed in both burned and flail-chopped plots by early-March 1986. As observed in the red clover stands, growth of meadowfoam in the burned plots was slightly taller, thicker, and generally more vigorous in appearance throughout most of the winter and early spring. These differences disappeared after mid-April. By early-May more weeds (primarily groundsel) were emerging in the flail-chopped plots.

Plant samples showed that although slightly fewer plants were established in the flail-chopped plots, there was no significant difference in the total dry weight or the dry weight per plant. On May 13, 1986, the plots were observed by Oregon Seed Certification personnel. No old crowns or seedling perennial ryegrass were observed in either burned or flail-chopped plots.

The meadowfoam crop matured uniformly across burned and flail-chop treatments. Seed yield and oil yield were both significantly greater where the perennial ryegrass residue was burned before the establishment of meadowfoam (Table 2). These differences were a result of a greater mean seed weight. Residue management of the previous crop had no significant affect on the number of seeds per plant or the oil percentage in the seed.

Summary

Both red clover and meadowfoam were successfully rotated behind perennial ryegrass using minimum tillage establishment methods. Competition and contamination from the previous crop appears to have been eliminated by timely use of available herbicides. Red clover seeded into burned stubble established more rapidly and had greater hay yield. However, regrowth following haying and seed yield were greater in plots which were unburned at planting. Meadowfoam rapidly established across both burned and non-burned treatments with very little difference in vegetative growth, although seed yield was significantly greater where the perennial ryegrass was burned before planting.

On September 19, 1986, a tetraploid perennial ryegrass variety was seeded using the same minimum tillage system discussed above into one half of both the red clover stand and the meadowfoam stubble. The remaining half of each block will be returned to perennial ryegrass in the fall of 1987 to compare the level of contamination of both one and two year non-grass crops in the rotation from diploid to tetraploid perennial ryegrass seed crops. Cooperation with the Oregon Seed Certification Project in this research is continuing.

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Table 1. Seed yield, yield components and plant height data from red clover minimum tillage study, 1986.

Treatment	Total dry weight	1000 seed yield	Plant seed weight	Height (8/28)	Number of plants (8/28)	Heads per plant	Seeds per head
	(ton/a)	(lb/a)	(g)	(cm)	(no./ft^2)		--(no.)--
Burn	0.76	151	1.43	35	21	1.7	33
Flail-chop	1.12	252	1.46	42	19	2.4	47
LSD 0.05	0.11	55	NS	5	NS	NS	NS

Table 2. Seed and oil yield, and yield components data from the meadowfoam minimum tillage study, 1986.

Treatment	Total dry weight	Seed yield	Oil yield	Percent Oil	1000 seed weight	Seeds per plant
	(ton/a)	---(lb/a)---		(%)	(g)	(no.)
Burn	1.79	765	230	30.09	7.36	47
Flail-chop	1.33	583	176	30.04	6.96	61
LSD 0.05	0.23	151	40	NS	0.11	NS[1]

[1] P-value: Seeds per plant = 0.113

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