

# 1982

## SEED PRODUCTION RESEARCH

### AT OREGON STATE UNIVERSITY

### USDA-ARS COOPERATING

#### Introduction

Harold Youngberg

The viability of the seed industry of Oregon is dependent upon its ability to compete in national and international markets. Maintaining a position in this highly competitive situation depends upon the capability to react to problems and to respond to needs. The close working relationship between the seed industry and research staff is essential to deal with problems.

The seed research capability at Oregon State University is not a discrete unit, but is integrated through several departments on the campus. Its success depends upon the cooperative spirit among the research and extension staff. School of Agriculture units involved include the Departments of Agriculture Engineering, Botany and Plant Pathology, Crop Science, Entomology and Soil Science.

Oregon has a strong group of USDA-ARS staff associated with the Departments working closely with state supported colleagues on seed-related problems. This group has supported the seed industry from the beginning of seed production in Oregon.

In addition to research funds from federal and state sources, a major grant from the Oregon Department of Environmental Quality, Field Burning Fund has supported the post-harvest management research and other programs. Grants from firms, commissions, and other sources support several specific projects. The support and advice of the Seed Council Research Committee, the Oregon Seed Trade Association Research Committee and other advisory committees is appreciated.

Information on results of current research work has been made available at the Annual Seed Crop Research Field Day held in late May. Publications relating details of the research and results are prepared at the conclusion of a project. The purpose of this summary is to report the status of work in progress and list the written summaries available to the public.

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## Weed Control in Perennial Grasses Grown for Seed, 1981-82

*Orvid Lee, USDA-ARS*

Research was continued in western Oregon in 1981-82 on management practices that permit production of a perennial grass seed crop the first summer after early September plantings. The grasses were carbon-planted and irrigated until established. Several herbicides were superimposed on the plantings to control weeds coming in the grass rows. Economic yields were produced the first summer on all perennial grasses except creeping red fescues. Seed yields were as follows: creeping red fescues 300-400 lb/A, bentgrass 600-700 lb/A, Kentucky bluegrass 600-700 lb/A, orchardgrass 800-900 lb/A, and tall fescue 800-1100 lb/A.

Nortron continued to give excellent control of annual bluegrass and other susceptible grass weeds in the carbon bands when applied in early November at rates from 0.5 to 1.0 lb/A. The use of Nortron on fall carbon-planted tall fescue was recently added to the Nortron label and was used on some commercial plantings this fall. Nortron also looks very promising in September-planted orchardgrass and Kentucky bluegrass but has not been added to the label yet. Barban, which looked promising for selective control of annual ryegrass in fall-planted perennial grasses in 1979, 1980, and 1981 experiments, injured all grasses except Kentucky bluegrass in 1982. Thus, more needs to be known about this herbicide before it can be recommended for use.

Sethoxydim (Poast) showed considerable promise for selective control of several hard-to-kill grass weeds in creeping red, chewings, and hard fescues. No visible effects were noted on any fescue plants when sethoxydim was applied at rates to 1.5 lb/A at any stage of growth from 2 leaves through well established plants. Grasses that were sensitive included downy brome, annual ryegrass, perennial ryegrass, bentgrass, Kentucky bluegrass, Canada bluegrass, orchardgrass, tall fescue, sweet vernalgrass, and creeping velvetgrass. Weed grasses that were tolerant included annual bluegrass and rattail fescue. In western Oregon, applications from November through February were more effective in controlling grasses than were applications made later in the spring when the grasses were actively growing. Applications made from November through mid-March did not adversely affect seed production at any rate of application.

## Rate and Time of Spring-Applied Nitrogen on Linn and Pennfine Perennial Ryegrass

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

Nitrogen is the most critical element affecting seed production. Varying the nitrogen rate and time is known to alter the tillering pattern and influence seed yield. Current recommendations for perennial ryegrass suggest 90-112 kg/ha<sup>1</sup> of spring-applied nitrogen split with 50% in March and 50% in April. Crucial to this study is the time of spring-applied nitrogen in relation to morphological stages of crop growth and development.

The primary objective is to determine how spring nitrogen management influences the total number of tillers which produce seed heads. Also, the number of new spring tillers formed and how these tillers influence the final seed yield is important in improving nitrogen efficiency. Early nitrogen treatments were timed before the onset of reproductive development (during vegetative growth) and compared with a later application date following the transition to reproductive development.

The total tiller number of Pennfine perennial ryegrass at anthesis increases with increased nitrogen rate; however, the stand is comprised of a higher percentage of vegetative tillers where nitrogen has been applied early. Split applications appear to increase the number of reproductive tillers at anthesis. The ratio of fertile tillers at maturity to the number at anthesis provides an index of tiller survival. Stimulating the development of numerous spring tillers may increase lodging and cause competition among the developing reproductive tillers which result in tiller mortality. Nitrogen applied early resulted in a greater percentage of tiller survival, whereas nitrogen applied after reproductive development has begun increased tiller mortality. A split application of 60 kg/ha + 60 kg/ha was equal to nitrogen applied vegetatively; however, split applications totaling rates greater than 120 kg/ha caused a decrease in tiller survival.

Additional yield component data has shown an increase in spikelets per spike when nitrogen is applied early, while florets per spikelets were seen to increase as higher total rates were applied. Seed yield was not dramatically affected by the rates or time of application in this study due to yield component compensation. However, improved efficiencies in seed production may result from splitting the spring application.

Nitrogen applied during vegetative growth of Linn perennial ryegrass reduced tiller survival. This suggests that spring-formed tillers cannot contribute to final seed yield as they do in Pennfine perennial

<sup>1</sup> 1 kg/ha equals 0.89 lbs/acre

ryegrass. Furthermore, the highest percent tiller survival was observed for 60 kg/ha + 60 kg/ha and equally when all nitrogen was applied after reproductive development had begun. Split applications greater than 120 kg/ha total caused a decrease in tiller survival. No effect on the number of spikelets per spike was seen; however, higher rates of nitrogen applied after reproductive development did benefit the number of florets per spikelet. As with Pennfine, the Linn seed yields were not dramatically influenced by these rates of time of nitrogen application.

The most efficient use of nitrogen fertilizer results from a split spring application of 60 kg/ha applied during vegetative growth, followed by an additional 60 kg/ha after the transition to reproductive development. If, however, only one application can be made, Pennfine should respond more favorably when nitrogen is applied while the crop is developing vegetatively. Conversely, Linn perennial ryegrass would benefit from delaying the nitrogen application until after the onset of reproductive development.

## Seed Yield Enhancement in Grass Seed Crops with Growth Regulators

*D.O. Chilcote, H.W. Youngberg, W.C. Young, D. Ehrensing, D. Albeke, J. Hunter and C.C. Moon*

Much of the potential seed yield created by grass seed crops is not realized in the final harvest of seed. Lodging in many of the grass seed stands contributes to this lack of realization of the full potential for seed yield. In addition, grass seed crops are developed for their forage and turf characteristics which are not always consistent with good seed yield. For these reasons, it appeared desirable to examine methods which would enhance seed production of grass crops in this region without altering their genetic constitution.

Growth regulators and, more specifically, certain growth retardants, have shown potential for enhancing seed yield in grass crops. With the need to be more efficient in our use of resources, a study on the use of growth retardants seemed desirable. Two new growth retardants with a different mode of action (soil activity) have given predictable and consistent results in terms of chemical dwarfing and lodging prevention. Positive grass seed yield results in England and in early tests at Oregon State University were the stimuli for continuing and extending research on growth retardants. The two compounds utilized in experiments conducted in 1980, 1981, and 1982, were Imperial Chemical Industry compound coded PP-333 and Eli Lilly compound coded EL-500. Research efforts were devoted to identifying the proper rate and stage of application as well as understanding the bases for yield increases. Effects on potential yield components, including heads/unit area, spikelets/head, and florets/spikelet, along with actual seed yield,

were evaluated. Although these chemicals are still experimental, there is every indication that development to commercial use is a good possibility.

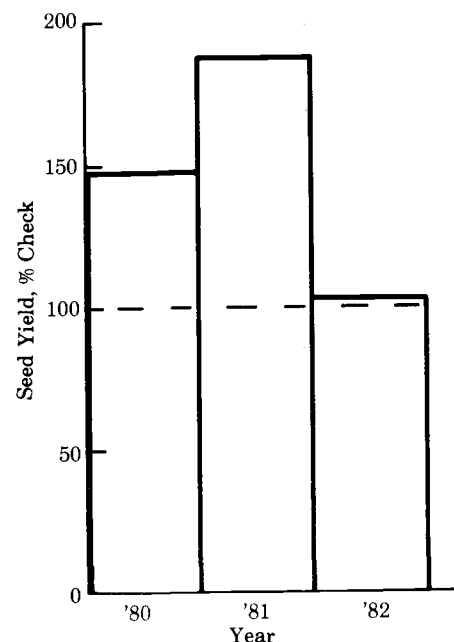
These compounds show consistent reduction in height and stem growth with very little effect on leaf area or reproductive development. Tests were conducted with different varieties of perennial ryegrass, tall fescue, fine fescue, orchardgrass, and bluegrass.

The 1980 results were very striking, with increases in yield ranging from 27-64%. In 1981, 54-150% increases in yield of ryegrass varieties were obtained. In both years, lodging was severe and occurred several days before anthesis. Unfortunately, bluegrass showed no such yield enhancement in either year. Bluegrass also appeared very sensitive to the growth retardant compounds, resulting in the need for testing lower rates in subsequent trials. Orchardgrass also seems to be quite sensitive to the compounds and lower rates of application will be evaluated in 1982-83.

A unique weather pattern in 1982, dry hot weather in May, and the subsequent effects on growth, led to inconsistent effects on seed yield. In general, seed yield increases were small or non-existent and although trends were similar to those in earlier years, variability within treatments was much greater. The average yield response comparing untreated control plots to growth retardant applications across varieties of several species, including tall fescue, fine fescue, and perennial ryegrass, is shown in Figure 1. In 1980, an average yield increase of 47% was obtained. In 1981, the enhancement was even larger, 87% greater than the check. However, in 1982, little or no statistically significant yield response was observed.

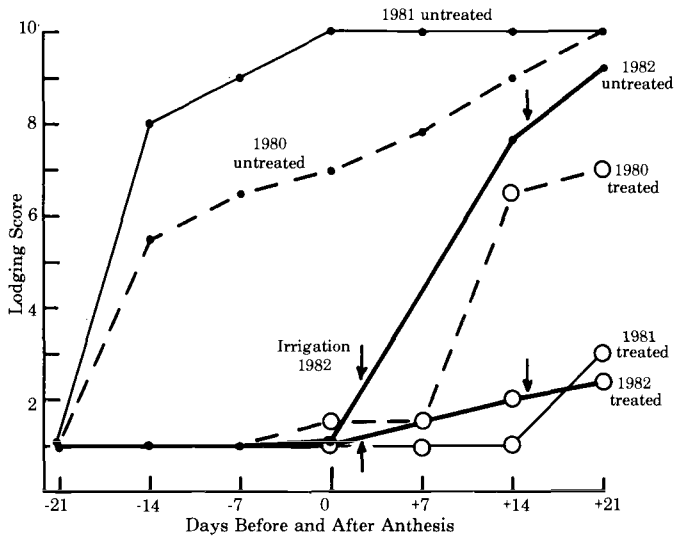
*(continued)*

**Figure 1.** Average seed yield response to optimum growth retardant application across different varieties of tall fescue, fine fescue and perennial ryegrass.



## Seed Enhancement (continued)

Figure 2. Lodging pattern for perennial ryegrass 1980-1982. Arrow indicates irrigation in 1982.



In Figure 2, lodging scores at various dates before and after anthesis are plotted for the years 1980, 1981, and 1982. In 1980, and to a greater extent in 1981, lodging was very severe several days before anthesis. In contrast, in 1982, lodging did not occur until several days after anthesis and then only after irrigation, which was provided to prevent severe damage to the experimental trials. Thus, in 1982, the lodging occurred well after seed filling was underway and this appears to be a major factor in the lack of seed yield response. Evidence of the unique weather pattern in 1982 was also seen in the lack of rust infection of the ryegrass, which usually is quite severe. The reduction in moisture availability and high temperatures early in the season (May) in 1982, could have affected the results in several ways. Since the growth retardant compounds are held fairly tight in the upper regions of the soil profile, the very dry conditions later in the season could have facilitated deeper root activity so that the amount of growth retardant compound taken up over the season would have been reduced, particularly in the later stages of development. The other factor was evidence of reduced total growth by the plants and reduced height. Therefore, the primary benefit of the growth retardant, lodging control, would not have been demonstrated under these conditions.

Another important observation in 1982 was the response differences among varieties within a species, perhaps due to differential growth and development rates under these rather unique weather conditions. Further study of cultivar response is definitely needed.

Studies on lodging control with growth retardant versus mechanical support indicated that the yield enhancement from the growth retardant is

due mainly to prevention of lodging, although some effects of differential dry matter partitioning were observed. The effects of changes in dry matter partitioning by reduced stem elongation were a minor part of the total yield effect in 1982. Results in 1982 showed again that seed filling appears to be benefited by the application of growth retardants.

Work with wettable powders and granular materials showed a benefit for the wettable formulation in terms of seed yield and further work may be necessary to determine if this same difference would occur under more normal weather patterns.

Germination results for 1982 substantiate the findings in 1980 and 1981, which showed no carry-over effect of the growth retardant on seed germination or seed vigor.

Continued investigations are planned to more clearly define the optimum rate and date of application for different species and varieties of grass seed crops. Later growth stage treatment was superior under the 1982 weather conditions, so further study in this area is appropriate. The amount of moisture needed for activation and the effect of foliage uptake on effectiveness will also be investigated.

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## Cereal Seed Yield Enhancement with Growth Regulators

*D.O. Chilcote, H.W. Youngberg, and W.E. Kronstad*

In Europe, it is a common practice to use dwarfing compounds (growth retardants) to reduce the height and prevent lodging in tall-growing cereal varieties, particularly wheat. Little work has been done in this country on growth retardants on cereals, in part because semi-dwarf varieties predominate and lodging in wheat is usually not a serious problem. However, there are occasional lodging problems, particularly in irrigated or high rainfall areas, especially where nitrogen rates are high. Other cereal crops, such as barley and oats, do have lodging problems. It was therefore of interest to determine if increases in yield of cereal crops could be obtained using an experimental dwarfing compound from Imperial Chemical

Industries, PP-333, which has worked so effectively in grass seed crops.

The objectives of this research were to identify the stage of growth and the proper rate of application of the growth retardant compound for optimum response. Studies were conducted at the Hyslop Agronomy Farm, with two varieties of wheat, Yamhill and Stephens, and a winter oat variety. Different nitrogen levels were used to assess yield benefits from reduced culm height and prevention of lodging, with the use of a growth retardant.

Because of the rather unique weather pattern in 1982, there was no lodging in any of the crops, even with the substantial increases in nitrogen application. The results show a trend toward higher seed yield in the taller growing wheat variety with the use of growth retardant (see Table 1), even though little reduction in height occurred. The compound seemed to benefit partitioning of dry matter to the seed (seed filling) since seed weight was enhanced (Table 1).

Table 1. Yield and thousand seed weight response from PP-333 treated Yamhill wheat at two nitrogen levels.

Treatment	Yield		Mean thousand seed weight
	134 <sup>1</sup>	178 <sup>1</sup>	
(g/ha)	(kg/ha)	(kg/ha)	(g)
0	6409	6925	48.77
75	6761	7759	50.93
150	6732	7923	51.53
300	6874	7192	50.26

<sup>1</sup> kg/ha N

Winter oat yields were not increased, although there were reductions in height related to rate and date of chemical application. In the absence of lodging, we would not expect major effects on final seed yields in either wheat or oats.

Work is continuing with the cereal crops. Studies will be conducted in 1982-83 in the Willamette Valley and in eastern Oregon at two locations, working with both wheat and barley, to further evaluate the potential for the use of these growth retardant compounds in enhancing seed yields.

The assistance of the following are gratefully acknowledged:

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Personnel of Cereal Project

## Potential Benefits in Grass Seed Production from Combined Use of Growth Retardants and Improved Spring Nitrogen Management

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

Previous research results have shown growth retardant chemicals capable of improving grass seed yields by reduced or delayed lodging which improved light penetration into the canopy, tiller survival, and improved the processes of pollination, seed set, and seed filling (Chilcote, Youngberg & Albecke, 1982). Thus, there may be potential for using growth retardants to improve the efficiency of spring nitrogen used in seed production.

Nitrogen application in the spring will encourage the production of new tillers; however, the number of fertile tillers at maturity are less affected as those tillers destined to become fertile must compete with an increased number of vegetative tillers which subsequently died. Reduced lodging and improved light penetration should improve tiller survival and increase the total number of inflorescences per unit at harvest. Seed yield in grasses is a product of the number of inflorescences per unit area, seeds per inflorescence and weight per seed. Growth retardants have improved the number of seeds per inflorescence without influencing the weight per seed. Therefore, if the survival of an increased number of spring-formed tillers is possible, the opportunity to improve upon fertile tiller densities at seed harvest may result from a combined use of spring nitrogen and growth retardants.

In a preliminary experiment in 1981, 120 and 150 kg/ha of spring-applied nitrogen significantly increased the number of florets per spikelet. This effect, combined with increased tiller survival due to 1/2 kg/ha of PP-333, resulted in significantly higher yields for Caravelle perennial ryegrass. A single application of spring nitrogen was made in the late spring (after floret initiation) during reproductive growth. Subsequent research has suggested that later maturing perennial ryegrasses could benefit from nitrogen applied early (or split) by allowing spring-formed tillers to contribute to seed yield. Research is currently underway to investigate the interaction of date of nitrogen application with growth retardants.

### Literature Cited

- Chilcote, D.O., H.W. Youngberg, and D. Albecke. 1982. Potential for growth retardants in grass seed production. Crop Science Report EXT/CS 42, Oregon State University, February 1982.

# Post-Harvest Management Alternatives for Grass Seed Production

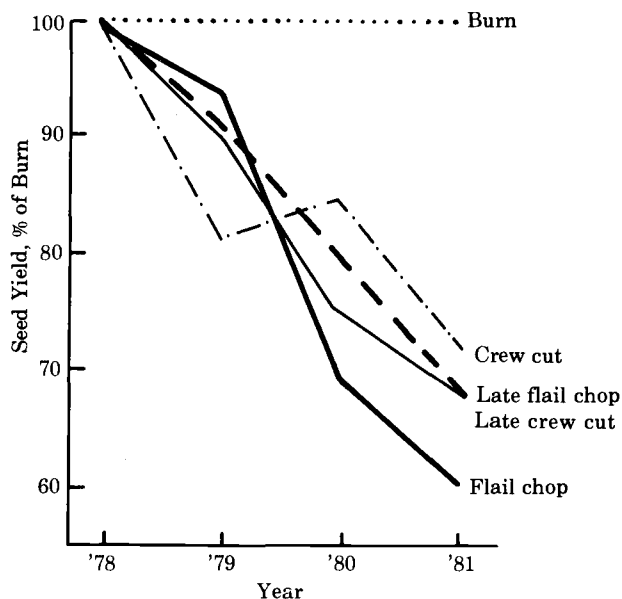
D. O. Chilcote, W.C. Young and H.W. Youngberg

## Long-term effects of crew-cutting

The benefits of open field burning have been documented; however, continued concern over the contribution to air pollution from this practice has encouraged alternative research programs. The primary objective of this study is to investigate the long-term (4-5 years) effectiveness of close-cutting and removal of crop residues (crew-cutting) from grass species grown for seed production. Treatment effects through two (fine fescue and bluegrass) or three (perennial ryegrass) years have been reported (Young, Youngberg and Chilcote, 1982).

In perennial ryegrass, a definite pattern between burned and non-thermal treatments has become evident. The long-term effects of any treatment other than burning results in a reduction of seed yield. The yield reduction of all non-thermal treatments was 11% per year, resulting in a decline of 33% over three years when compared to continuous burning (Figure 1). Treatment effects have significant influence on growth and development of fine fescue. Continuous crew-cutting results in a more prostrate or creeping growth habit. However, crew-cutting has been successful in maintaining seed yields equal to burning over two years, and has been shown to be superior to the flail chop treatment. Similar treatment effects have been observed in bluegrass.

**Figure 1.** Mean seed yield of perennial ryegrass, shown as percent of burn treatment, plotting treatment effects across three years beginning in 1979 with 1978 shown as a base year.



Burning remains the most effective method for complete removal of straw and chaff, which results in improved herbicide efficiency and improved quality of the harvested seed.

## Non-yearly burning

The objective of this research is to evaluate the feasibility of alternating either burning, crew-cutting, or flail-chopping in an effort to reduce the acreage of perennial grasses burned annually. Also, under study are non-yearly burning alternatives for annual ryegrass seed production.

In perennial ryegrass, continuous burning has been shown superior in the ability to maintain high seed yields (Table 1). Crew-cutting for one year followed by burning (B/CC/B) has not significantly reduced seed yield. Results from every third year treatments, B/CC/CC and CC/CC/B, reduced yields by 24% and 36%, respectively. Thus, seed yield cannot be maintained if crew-cut for two consecutive years following a burn, and will not recover by burning following two consecutive years of crew-cutting.

**Table 1.** Cumulative Effect on Seed Yield in the Non-yearly Burning Plots on Perennial Ryegrass, 1981.

Treatment 78/79/80	% of Annual Burning			3 year average
	'78	'79	'80	
B/B/B	100	100	100	100.0
B/CC/B	100	97	93	97.7
CC/B/CC	99	99	52	83.3
B/CC/CC	100	97	76	91.0
CC/CC/B	99	83	64	82.0
B/FC/B	100	94	80	91.3
FC/B/FC	94	101	50	81.7

Seed yield is maintained in annual burning through an increased number of fertile tillers per unit area and a slightly greater seed weight. The less-than-annual burning study in fine fescue and bluegrass has been in progress through only two complete seasons. Seed yields in both crops appear to be reduced by burning one season out of two, as compared to annual burning. This response appears to be greater in fine fescue than bluegrass.

Establishing annual ryegrass without burning has not significantly reduced seed yield. However, seed quality is improved by annual burning followed by sod seeding. Sod seeding reduces competition from volunteer annual ryegrass plants; however,

incorporation of straw residue plus using the herbicide ethofumesate (Nortron®) can maintain yields equal to sod seeding.

#### Literature cited

Young, III, W.C., H.W. Youngberg, and D.O. Chilcote. 1982. Agronomic and economic effects of crew-cutting and non-yearly burning programs in the Willamette Valley. Department of Environmental Quality Field Burning Report, Volume 17C.

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## Decomposition of Straw as Affected by Nitrogen Fertilizers and Mechanical Choppers

*T.L. Jackson*

Decomposition of straw (stubble) on grass seed and wheat fields is a major problem in the Willamette Valley. Preliminary research has shown that urea-sulfuric acid combinations reduce cellulose--the major component of mature grass straw--to more simple sugar molecules that decompose at a faster rate by biological systems. Other sources of nitrogen fertilizers sprayed on chopped stubble may increase crop residue decomposition rates. Increased decomposition of crop residue might reduce severity of some diseases.

The objective of the research is to evaluate the treatment of straw with urea-sulfuric acid, ammonium chloride to reduce yield losses associated with not burning stubble. Preliminary demonstrations in 1982 showed a 50% yield increase where urea-sulfuric acid was sprayed on a tall fescue field that was not burned.

Experiments were established on tall fescue, perennial ryegrass, orchardgrass, and common ryegrass during August and September, 1982. The effects of straw removal and treatment of straw with different nitrogen fertilizers on yield of these grass seed crops will be studied. Preliminary measurements on effects of these treatments on disease will be evaluated. This is the first year of this project. Treatment effects on seed yield will be recorded in 1983.

## Cooperative Study of *Epichloe typhina* Infection of Tall Fescue Clones and Open-Pollinated Progenies at Corvallis, Oregon and Lexington, Kentucky

*Robert C. Buckner, USDA-ARS,  
University of Kentucky and  
Harold Youngberg, Oregon State University*

Cattle grazed on tall fescue pastures in the southeastern U.S. that were infected with the fungal endophyte *Epichloe typhina* gain significantly less weight than those grazing noninfected pastures. The organism has been shown to be carried in the seed. Pastures planted with uninfected seed and kept free of infection produce greater animal gains. The objective of this study was to determine the effect of environment on reinfection of tall fescue plants under seed production conditions.

In an earlier study, breeders class seed of Kenhy, tall fescue which was infected with the fungal endophyte *E. typhina* produced foundation class seed in the Willamette Valley will less than 1% endophyte infection, while the foundation class grown at Lexington, Kentucky was heavily infected.

This study was undertaken to determine the effect of location on endophyte infection of a seed crop. Parental clones known to be infected with the endophyte and open-pollinated seed of those clones were established at Corvallis, Oregon and Lexington, Kentucky during the fall of 1980. The planting included 8 clones of the Kenhy variety and G1-307 (low perlolone) strain that had been harvested during the spring of 1980. The clones were divided and established at both locations while the open-pollinated seed was seeded in spaced rows at both locations. Seed from these plantings was harvested during 1981 and 1982, at both locations.

The seed of parents and progenies were dried and processed by the usual method. Clean seed were examined for the endophyte by the ELISA (enzyme-linked immunosorbent assay) technique. Seed produced by parents and progenies at both Corvallis and Lexington were equally infected by *E. typhina* during 1981 and 1982. Therefore, it appears that the environment is not responsible for low level infection in progenies of highly infected parents of tall fescue.

## Grass Variety Seed Yield Evaluation

*H.W. Youngberg, W.C. Young & D.O. Chilcote*

The development and release of new varieties by private and public plant breeders is expanding. Growers are contracting to produce seed of these varieties and in many cases there is little information available to relate seed production potential to standard varieties. A pilot program was started in 1980 to compare seed yield potential of material available at this time.

One hundred forty-six entries were submitted for the trial. Species included perennial ryegrass, Italian ryegrass, Chewings and red creeping fescue, hard fescue, Kentucky bluegrass, orchardgrass and tall fescue. The perennial varieties were seeded in May 1981 and the Italian ryegrass seeded in October 1981.

First year seed yields were harvested in 1982 and summarized. A detailed report is available from the Crop Science Extension Office, Oregon State University. The publication is titled "Forage and Turf Grass Variety Seed Yield Trial - 1982", EXT/ACS 43. A second harvest measurement will be taken if funds are available.

A new trial planting is planned for May 1983. An entry fee will be charged.

## Seed Productivity and Management of Timothy for Seed Production

*H.W. Youngberg and W.C. Young*

Late-maturing forage-type and turf-type timothy varieties may have potential for seed production in western Oregon. A timothy variety and management trial was established in 1980, at Hyslop Farm near Corvallis to evaluate certain practices.

Eleven varieties of timothy were established. A significant difference in seed yield potential was observed among them. The range of seed yield of the best variety was 4.4 times the poorest in 1980 and 10.5 in 1981. The ranking was consistent in the 3 years. Late-maturing varieties may have suffered more from drought stress than early varieties. Lodging was a serious problem with some varieties.

Stubble burning is not a common practice in timothy seed production because tillers are more subject to heat injury than in other species. A study was made of the response of 5 varieties to a flame treatment applied by a propane flamer following harvest in 1980 and 1981. The autumn vegetative growth in the flamed plots appeared more vigorous than when stubble was removed with a flail chopper. A slight increase yield was associated with burning in both years.

The study suggests that turf-type timothy may be a profitable seed crop for the Willamette Valley. There is a wide range in seed yield potential among available varieties. Care should be taken to select a high yielding variety or be assured of compensating seed prices.

## Wheat Variety Identification by Laboratory Methods

*Aomar Ait Amer and D.F. Grabe*

There is an increasing need for development of laboratory variety identification procedures for purposes of plant variety protection, seed certification, quality control and consumer protection. As the number of varieties grows, visual differences become smaller, and the task of identification becomes increasingly difficult. Field testing methods often require too much time to be of practical use. This study was initiated to investigate various morphological, chemical and biochemical characteristics of 25 white wheat varieties grown in the Pacific Northwest. On the basis of these findings, an identification key to the varieties was developed.

Morphological studies were based on coleoptile color and pubescence of the sheath and leaf buds. Each of these characteristics separated varieties into two distinct groups; i.e., purple or green coleoptile, and pubescent or non-pubescent sheath and leaf blade.

Chemical studies were based primarily on variety responses to phenol treatment. Varieties in this study were separated into light brown and dark brown color groups.

Biochemical studies involved electrophoresis of gliadin proteins and peroxidase, esterase, catalase, acid phosphatase and glutamic oxalacetic transaminase enzymes. Several varieties developed different gliadin electrophoregrams and could be easily separated. Closely related varieties, such as Gaines and Nugaines, and Fielder and Fieldwin, developed identical patterns. Except for peroxidase, all varieties developed the same enzyme patterns. Peroxidase electrophoresis divided the varieties into two different groups.

It is not possible to distinguish individual varieties with any single test, but they can frequently be distinguished by using a combination of tests. For example, McDermid and Hyslop are similar electrophoretically, but can be distinguished by their different phenol staining patterns.



## Cause of Growth Termination in Wheat Seeds

*Andy Huber and D.F. Grabe*

It has been well documented that larger seeds produce more vigorous seedlings and greater total yield. However, the factors which bring about the termination of seed growth and limit seed size are poorly understood. In the grass family, seed size is determined mainly by the growth of the endosperm. This study was conducted to determine the factors which result in the termination of cell division in the endosperm. Wheat was chosen for this study because of its relatively large seed size. The developing seeds were harvested each day after fertilization until maturity. Sections were cut for microscopic examination of the whole caryopsis.

The study is nearly completed and the results are being prepared for publication. The morphologic changes which result in the termination of endosperm growth have been identified. Ultimately, the extent of endosperm cell division is limited by the growth of the surrounding maternal tissues. Likewise, the termination of endosperm cell division occurs because a proper microenvironment for cell division is not maintained between the endosperm and nucellus.

This information is essential for efforts to breed grass and cereal varieties for extended seed growth. Selection for genotypes with greater growth capacity of the inner integument could lead to larger and more vigorous grass and cereal seeds.

## Establishment of Grass Seed Crops with Cereal Companion Crops

*Jeroen deHass and D.F. Grabe*

One of the serious problems associated with seed production in Oregon is that many perennial grass seed crops are normally established with a cereal companion crop to prevent the loss of a year's income. The objectives of this project are to: (1) determine the feasibility of establishing grass seed crops with cereal companion crops in Oregon, (2) identify optimum cultural practices for companion cropping to maintain grass seed production at acceptable levels, and (3) measure the competitive effects of the companion crops on the grass seed crop.

The following conclusions are drawn from the 1980-81 and 1981-82 trials with Kentucky bluegrass and orchardgrass established with a wheat companion crop:

(1) Light transmittance through the wheat canopy was greater when the wheat rows were parallel to the grass rows than when planted across the grass rows.

(2) Light transmittance through the wheat canopy was similar at 67.2 and 100.8 kg/ha planting rates.

(3) The number of tillers, leaf area index and specific leaf weight of Kentucky bluegrass and orchardgrass were suppressed by the presence of the companion crop, while tiller height and leaf area per tiller were increased.

(4) Soil water potential remained higher during June and July in plots with a companion crop.

(5) Stephens winter wheat produced low yields (3075 kg/ha) in the Gervais plots in 1981, due to Septoria leaf blotch and a heavy weed infestation. Kentucky bluegrass seed yield in 1982 was 280 kg/ha higher when planted without a companion crop. Returns on the wheat crop did not compensate for the extra costs of cleaning up the field after harvest of the wheat and the lower grass seed yield the following year.

(6) Yields of Stephens winter wheat at Hyslop Farm in 1982 were high. Visual examination of the stand of the grass seed crop indicates that grass seed yields in 1983 can be expected to show the same type of response to companion cropping as did Kentucky bluegrass in the 1982 experiment at Gervais.

(7) Fields on which the companion cropping system is to be practiced should be fairly free from weeds to prevent weed control problems from occurring.

## Maturation of Subterranean Clover Seed

*Chuck Mouwen and D.F. Grabe*

Subclover seed is presently harvested with vacuum harvesters after the plants have died down in the fall. At this stage, the seed burs are mostly detached from the dried plants and lying on or near the soil surface. Vacuum harvesters are extremely slow, covering about  $\frac{1}{2}$  acre per hour. One possible alternative to the vacuum harvester would be to develop a windrower that would cut the plants at ground level while the plants are still green and the burrs are still attached to the plant. Success of such a system would depend on a knowledge of when the seeds are mature and can be safely harvested.

The objective of this study was to determine when seed maturity is reached in seeds of Mt. Barker and Nangeela subclover. Maturity indices included seed weight, moisture content, germination, and seedling vigor.

In 1981, maximum seed dry weight was attained 38 and 40 days after flowering at moisture contents of 55 and 57% for Mt. Barker and Nangeela, respectively. In 1982, maximum seed dry weight was attained 37 and 43 days after flowering at moisture contents of 54 and 52% for Mt. Barker and Nangeela. Germination reached 90% on the 26th day after flowering. Maximum seedling vigor, however, did not occur until maximum seed weight was attained. During early development, the seed coats were permeable to water, but by July 15, 95% of the seeds had developed hard seed coats which were impervious to water.

# Seed Harvesting and Conditioning

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Seed conditioners frequently are unable to remove contaminants efficiently from seed lots when using conventional separators. This problem is aggravated by increasingly restrictive tolerances for weed seed, soil particles, and other contaminants in seed lots being cleaned to meet certification or export requirements. Inadequate removal of contaminants may result in a lower grade and value of seed, a reduced yield of acceptable seed, or complete rejection of the seed lots.

Seed cleaning equipment manufacturers devote relatively little effort to the development of new or improved seed-conditioning equipment because potential sales of such new machines do not justify large research and development costs by manufacturers. To meet the need for improved seed separation capability, this project is conducting engineering research aimed at the development of improved equipment and techniques for conditioning seed.

Objectives of this research effort are to develop seed conditioning equipment that will reduce contaminants, minimize seed losses, improve germination, lower seed damage, improve efficiency, and reduce costs.

Projects are currently underway in three general areas: (1) Establishing new or modified concepts for making seed separations; (2) Developing experimental conditioning machines; (3) Determining effective techniques for separating seed mixtures representing industry problems.

## Seed Scarifier

Scarification refers to any procedure that modifies the outer protective layers of hard seeds to permit the entry of water and the exchange of gases, and allows the developing seed embryo space for growth, thus improving germination. In the vegetable, herb, flower, and forage legume seed industries, seed scarification is a desirable procedure for conditioning some seeds prior to planting. Commercial scarifiers generally lack adequate control and frequently damage seed.

An experimental device for scarifying seeds was designed, built, and tested. It allows continuous controlled operation with several degrees of aggressiveness to accommodate seed types with varying scarification requirements and susceptibilities to damage.

Scarification trials were conducted with several seed types and evaluated by standard germination tests. In most cases, the machine effectively reduced hard-seed content and improved germination values. Hard-seed content of arrowleaf clover was reduced from 74 to 6% while normal germination increased from 24 to 86%. For alfalfa seed, the changes in hard

seed and normal germination were from 14 to 1% and 71-80%, respectively; for geranium seed, 65 to 1% and 31 to 96%; for lupine seed, 62 to 0% and 37 to 99%; for dichondra seed, 22 to 7% and 53 to 68%; and for morning-glory seed, 24 to 0% and 68 to 93%.

Where scarification is desirable, it may offer considerable benefit. For example, if the time required for acceptable germination levels for a hybrid geranium seed is decreased by 65%, the overall planting-to-marketing time for the bedding-plant industry can be reduced about 25%. In addition, scarification can increase crop yields, produce more uniform stands, and reduce volunteering in subsequent crop years.

## Special Indent Separator

A commonly used seed separator is the indent cylinder which separates on the basis of length differences. Short seeds or contaminants rest in indents located on the inner surface of a horizontal cylinder and are lifted from a contained seed mass as the cylinder rotates. When the lifted items fall from the indents, they are collected and transported out of the machine.

Indents of the usual commercial cylinders are hemispherical with rounded shoulders, but other indent shapes also have been proposed and evaluated. An early USDA ARS design used straight-side indents provided by round-hole perforated metal backed by sheet metal. This special indent cylinder showed good separating capability, but was subject to plugging or lodging of seeds in the indents. A new version of the special cylinder has been designed with a "self-cleaning" feature to correct the plugging problem. The new version uses a thin flexible belt rather than sheet metal to enclose the cylinder of perforated metal. A roller supports the belt above the cylinder to provide space to mount a rotary cleaning brush whose bristles penetrate the perforations and force plugged seeds out of the indents.

Performance trials with the machine have shown the self-cleaning feature to be very effective when removing pigweed from alfalfa. At feed rates from 165 to 675 lb./hr., the brush-cleaned section showed an 1800-fold reduction in the rate of indent plugging while removing from 60 to 90% of the pigweed with crop losses of 2% or less.

A successful development of this type will make it possible to improve the selectivity of many separations now being made on the basis of length differences. In addition, separation of other mixtures are not now feasible with commercial indent cylinders will become possible.

## Magnetic Fluid Separation

Some seed lots are now separated magnetically if the contaminants are sufficiently different from the crop seeds in texture. When such lots are pretreated conventionally by the addition of iron powder and moisture, the rough or sticky contaminants, but not the smooth crop seeds, pick up the iron powder.

A separation can then be made by passing the treated lot over a magnetic drum that attracts the iron-coated items away from the uncoated crop seeds.

An investigation is now underway using a newly-available magnetic fluid to pretreat the seed lot. The fluid is a colloidal suspension of submicron-sized ferri-rite particles in a liquid carrier (kerosene, heptane, silicone, fluorocarbon, or water). The fluid is truly magnetic, and the fine iron particles remain in suspension permanently due to an added dispersing agent. Separation trials of soil particles from bentgrass seeds were carried out using three dilution rates of the fluid and four magnetic field intensities of the magnetic separator. A specific aim was to reduce soil particles to a level of 0.03% by weight to meet phytosanitary tolerances for bentgrass lots being exported to Japan. The test separations were evaluated by purity and germination tests of the resulting fractions.

It was found that the soil particles readily absorbed the magnetic fluid and could be removed from bentgrass along with some crop loss. The best results were usually obtained with the greatest fluid dilution and the greatest magnetic field intensity. Under these conditions, soil particles were reduced from an initial level of 0.30 to 0.03% or less. Crop loss averaged 30%, but this fraction is not an actual loss. All or most of this reject material can meet purity standards where phytosanitary restrictions regarding soil particles are not applicable. The fluid treatment and magnetic field exposure had no adverse effect on germination capability, but the bentgrass seeds were slightly discolored by the fluid.

This technique needs further investigation to examine application methods, seed drying requirements, effect on seed marketability, and potential application to other seed/contaminant mixtures.

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