NOT FOR PUBLICATION

PROGRESS REPORT # 5

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Improvement of Poa annua for Golf Turf

The University of Minnesota

Department of Horticultural Science and Landscape Architecture

Project: Biology and Utilization of Turfgrasses

and

The United States Golf Association

Cooperating

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I EXECUTIVE SUMMARY

"Improvement of Poa annua for Golf Turf", 1988 Annual Report. University of Minnesota and USGA Cooperating

Severe drought and heat conditions resulted in identification of stress tolerant strains of Poa annua and Poa supina. Summer dormancy mechanisms were observed in several materials in the field. All these materials were collected, increased and established in a new field space planting. New materials were added to the program from Alabama, California, Texas, Rhode Island, and Minnesota. Several Tall seeded accessions were collected in Northern Minnesota. Stolons of Poa annua and Poa supina maintained viability throughout 24 weeks of cold storage. Chlorophyll (green color) was maintained in the dark cold storage in Poa annua for 12 weeks. Replicated plantings of 8 selections were established at 18 golf courses located in 16 different states for evaluation. Progeny testing is being conducted for heritability for materials up to the 7th generation from when received. Seed dormancy of up to 3 months was found in some biotypes. Divergence - Incongruity (Barriers to crossing and hybridization) were found. The phenomena were found in materials that were collected from wide geographic areas. For instance, materials from Arizona will not cross with materials from western Canada and materials from New York did not cross as well as local materials with Canadian materials. The "floral pic" technique for isolation and control of crossing performed equally well whether the carbon sources was sucrose or fructose sugar. Approximately 1,000 matings and seed collections were accomplished with the floral pic technique and analysis of resulting data is underway. Analysis of data indicates that, with some biotype, more than twice as much seed is produced from sib crossing as with selfs or crosses. This information is extremely important to developing a seed production system. 27 different esterases were found in 54 Poa annua biotypes while 23 were displayed by 10 Poa supina biotypes. The electrophoretic gels of the 64 biotypes displayed 46 different esterase patterns. Poa annua was separable from Poa supina and pedigree relationships were distinguishable in some crosses and selfs. Papers on stolon storage, electrophoresis, reproductive biology in poas, and chemical suppression of flowering to maintain pure stands were or will be presented at Society meetings. Experiments demonstrated that Poa annua and Poa supina are resistant to the grass herbicide Sethoxydin. In addition to maintaining the vitality of the project, the work for 88-89 will focus on seed production evaluations and problems and field evaluation of selected materials.

II INTRODUCTION

The following is report of the research conducted under the Project: "Improvement of Poa annua for Golf Turf" for 1988. The activities pursued during 1987 are offered in outline form. More detail is available upon request.

III ENVIRONMENTAL IMPACTS 1987-88

The last two years have presented us with two of the driest, hottest summers and two of the mildest winters on record in the upper Midwest. In addition the irrigation system in the research fields on campus was inoperable at critical times during periods of very high stress. The field plantings were subjected to little snow cover over winter and extremely dry, hot periods during the spring and summer. The field space planting materials for evaluation of individual characteristics and heritability were severely damaged. However, this presented a special opportunity to broaden our original objectives for the planting and evaluate for stress (both drought and heat stress) tolerance. This really presented an unprecedented opportunity to evaluate the materials to see if "summer dormancy" mechanisms were possessed by any of the materials. Encouragingly, several "Poa's" exhibited what appears to be summer dormancy type characteristics. Survivors of all of the materials under evaluation were collected and propagated for replanting in the field.

The original space planting has also been maintained for future stress selection.

Field plantings were evaluated for over-wintering, water and heat stress tolerance and summer dormancy characteristics. Materials that survived the severe stress were propagated for further study. These materials were included in a new space planting which was planted after the severe stress period and has become well established. Outstanding performers have been recorded.

IV NEW COLLECTIONS

New materials were collected and added to the project from Alabama, California, Texas, Rhode Island and Minnesota.

A collection trip in Minnesota resulted in collections from Oak Ridge, Interlachen, and several Roseau County (far northern Minnesota) courses. The materials all exhibited attractive characteristics of perenniality, color, texture, density, seedhead or flowering, persistance, and the like.

All of the materials collected or received from other sources this year are in the process of propagation and integration into the program.

Last year it was reported that Howard Kaerwer had collected some "Poa" materials in Turkey and that the materials had been forwarded to the USDA, under permit, for future release to this breeding project. Unfortunately, the USDA reported to us that none of the materials survived either the trip or their evaluation.

IV COLD TOLERANCE

A stolon storage experiment was conducted evaluating the cold storage tolerance of stolons of four Poa annua and four Poa supina selections. Stolon materials were collected, prepared and placed in a dark storage at approximately 40F. Stolons were removed at regular intervals for a period of 22 weeks. All materials survived and became established, with essentially no loss for the full extent of the experiment.

This may offer a way of increasing materials for testing and evaluation in the future. It is interesting to note that leaves on Poa annua stolons maintain chlorophyll and green color for up to 20 weeks in the dark, cold storage while the chlorophyll is not maintained in the leaves of Poa supina over the same period.

VI EVALUATIONS & DISTRIBUTION OF EXPERIMENTAL MATERIALS

A. The eight most promising selections to date were prepared for distribution to golf courses in selected locations around the country. They were propagated in 3 inch pots on sand medium and maintained at collar height (1/2"). An initial trial effort to produce and ship sod pieces of many of these proved to be too complicated. Each of the 19 cooperating golf courses were to receive a randomly chosen subset of 4 out of the 8 selections. The locations participating in this field evaluation effort were:

Wisconsin: Milwaukee Country Club; Danny Quast, Superintendent

Ohio: Sylvania Country Club; Michael Barton, Superintendent

Montana: Green Meadow Club; Ray Petrelli, Superintendent

Colorado: Denver Country Club; Bill Shrum, Superintendent

Illinois: Cog Hill Country Club; Ken Lapp, Superintendent

Oregon: Oswego Lake Country Club; Dick Fluter, Superintendent

New Jersey: Pine Valley Golf Club, Rick Christian, Superintendent

New Jersey: Baltusrol Golf Club; Joe Flaherty, Superintendent

Pennsylvania: Merion Golf Club; Richard Valentine, Superintendent

Massachusetts: The Country Club; Bill Spence, Superintendent

Utah: Willow Creek Country Club; Chip Arbarno, Superintendent

North Carolina: Country Club of Sapphire Valley;
Bo Alexander, Superintendent

North Carolina: Pinehurst; Brad Kocher, Superintendent

Georgia: Sea Island Club; Tom Burton, Superintendent

Virginia: Farmington Country Club; Dick Fisher, Superintendent

Missouri: Norwood Hills Country Club; Roger Null, Superintendent

California: Big Canyon Country Club; Ray Layland, Superintendent

Minnesota: Oak Ridge Country Club, Keith Scott, Superintendent

All but two of the sets were shipped on or between the dates of 27 September and 4 October. Additional shipments are planned for Texas and California. The superintendents will notify us when they are ready for us to ship the materials. All the Superintendents participating in this evaluation have been very cooperative and interested in assisting with these evaluations.

B. Materials from selections in the original space planting that survived the drought and heat were collected, propagated and planted in a new space planting in the research field on the St. Paul Campus. These materials will also be maintained at collar (1/2") height. Data from these plantings will contribute toward understanding heritability of some of the characteristics of the lines we are working with. Over 500 biotypes are involved in this study.

VII BREEDING AND GENETICS

A. Advanced generation material from some of the earliest material accessioned into the project was maintained under study for progeny testing and heritability of important characteristics. Materials into the 7th generation are included in these studies as well as 1st generation materials from newly collected or acquired materials.

B. Seed viability and variation in germination are important characteristics that have been included. Great variation in seed dormancy characteristics related to individual biotypes has also been observed. Dormancy of up to 3 months has been observed. The data will be analyzed with the view of identifying patterns within and among different families of material. This information could be critical to seed production and establishment of these materials.

C. Another part of the comparisons relates to comparisons of germination patterns between selfs, potential crosses, and siblings. Partial analysis of this data has indicated barriers to crosses with biotypes that come from widely spaced geographic areas. Germination failure is one of the indications of post-fertilization breakdown. This information could be extremely valuable in maintaining purity of materials in the seed fields as well as in being critical in determining amounts of seed produced from certain crosses.

D. Approximately 3500 matings and seed collections were accomplished utilizing the "Floral Pic - 8HQC" method of isolating individual flowering stems of selected plant materials and collecting seed from the controlled pollinations. Seed counts are currently underway as the first step in evaluation of the materials generated from these crosses.

E. Experiments developing the ":Floral - Pic" technique were completed showing that there is no difference between carbon sources of sucrose or fructose sugars.

At least 2 other USGA supported projects have now adopted this technique because it immensely simplifies the problems associated with obtaining effective isolation of flowering materials for selfing, sibbing, and crossing. Enquiries have been received from at least 2 other breeders as well.

F. Partial analysis of data from crosses, sibs, and selfs, indicates that more than twice as much seed is produced from some sib crosses as compared to selfing and/or crossing with some biotypes. This will be one of the considerations in the work that will be proceeding into seed production of potential introductions.

G. Seed counts in relationship to specific crosses and subsequent germination and plant characteristic data for evaluation of heritability continues in progress. There are several thousand collections in this effort. Seeds are being (and will be) germinated and grown on to assess plant type characteristics.

VIII ELECTROPHORESIS [Isozyme (protein)] SEPARATION FOR IDENTIFICATION & PEDIGREE CERTIFICATION

The objective of this research was to develop an electrophoretic technique that could identify and separate selected Poa annua and Poa supina biotypes from each other. Our main interest was in being able to identify the pedigree of offspring and to ascertain whether or not actual hybridization had taken place or not. Fifty four "annua" and 10 "supina" biotypes were used as protein sources (esterase) for electrophoresis. The "annuas" displayed 27 different specific esterases while the "supinas" displayed 23. These esterases were found in 46 different electrophoretic gel patterns. Thirty eight of these patterns are unique and can be used to distinguish individual biotypes. The other 26 biotypes produced 8 different esterase patterns.

This research demonstrated that Poa annua biotypes can be distinguished from Poa supina biotypes. It also demonstrated that many biotypes within either species can be identified and that hybridity can be distinguished in some cases. The conclusion is that further work is need with other isozyme systems or different electrophoretic techniques before all biotypes will be distinguishable. Work was terminated on this effort as soon as it became apparent that substantially more research would be required for it to be of the greatest use.

IX SELECTIVE CHEMICAL CONTROL OF GRASSES FOR SEED PRODUCTION

An experiment assaying a large number of poa selections showed that Poa annua is tolerant of chemical treatments with the herbicide Sethoxydin (Poast). No comparisons of effect on annual versus perennial types were possible. This offers the possibility of cleaning other grasses out of a Poa annua stand in a seed field, but more work will be needed to ascertain if annual types can be selectively removed from seed fields of perennial types. .

X PUBLICATIONS - PRESENTATIONS

One paper was presented at the annual meetings of the American Society for Horticultural Science in August. Three papers are scheduled to be presented a the annual meeting of the Crop Science Society of America in November. (abstracts are enclosed with this report.)

1. Effect of Protracted Cold Treatments on Excised Poa annua L. and Poa supina Schrad. Stolons. D. B. White, B. A. Ruemmele, and P. D. Ascher. University of Minnesota, Agron. Abstracts

2. Variability in Reproductive Biology Among Poa annua L. Biotypes: Incongruity and Compatibility Analyses. B. A. Ruemmele, D. B. White, P. D. Ascher. University of Minnesota, Agron. Abstracts

3. Separation of Poa annua L. and Poa supina Schrad. Biotypes by Isozyme Electrophoresis. S. A. Berman, D. B. White, and B. A. Ruemmele. University of Minnesota, Agron. Abstract.

4. The Influence of Mefluidide on Vegetative Suppression and Seedhead Inhibition of Poa annua and Poa supina Schrad. Bridget A. Ruemmele, Donald B. White, and Peter D. Ascher,
University of Minnesota, Hort. Abstracts

XI PLANS FOR 1988 - 89

A more complete outline of proposed work for 1988 - 89 will be forwarded under separate cover.

A. The work on developing an understanding of the incongruity phenomena and self-incompatibility in Poa annua will be continued.

B. Evaluation of superior selections from the program will continue. This will include the materials currently out to golf courses as well as other less advanced generation materials exhibiting characteristics that deserve attention.

C. Efforts into investigating and solving seed production problems associated with the materials under advanced evaluation will be increased. Small plots will be established in the field to investigate seed production problems that may be associated with each cultivar. These plots will also serve to furnish data on potential seed production associated with each selection.

D. We hope to be able to examine some techniques that may assist in harvesting seed of these short stemmed grasses.

E. Data on performance of the eight selections that are currently out on golf courses will be collected on a regular basis. Data will include performance of each selection, cultural regimes, flowering habit, disease susceptibility - resistance, color, texture, and any other information that may become available.

F. We hope to be able to propagate enough material of the eight initial selections and a few more that have been identified so that the field testing at golf courses can be expanded. The objective will be to establish some small (1' x 1 ' or 1' x 2') plots of some of those that appear to be performing well at a selected group of the participating locations. In addition, we expect to be able to make more potted material available for mowing at closer heights of cut.

G. Progeny testing - heritability studies will continue with the seed that has already been generated from specific selfs, sibs, and crosses as well as from crosses that will be accomplished this year.

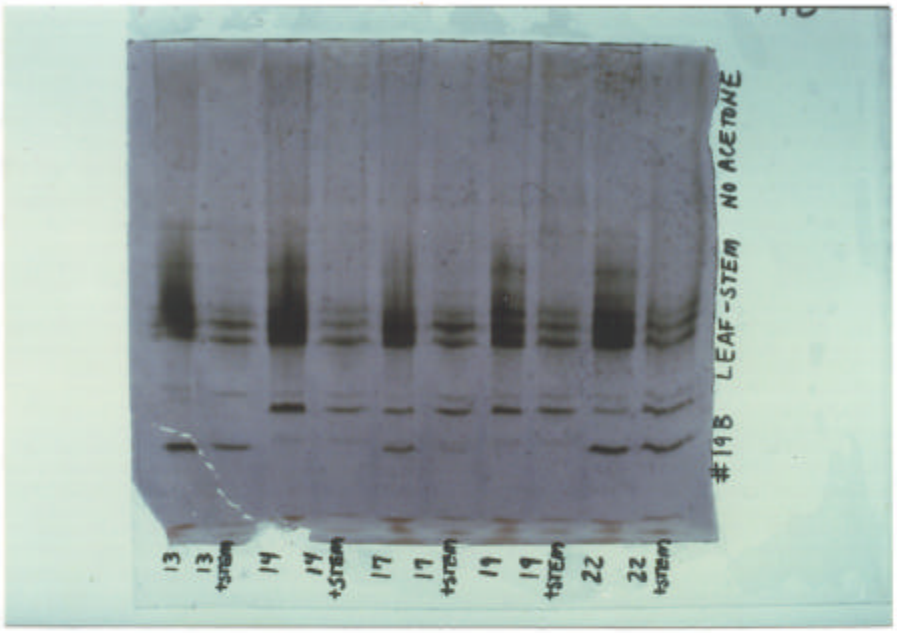
H. Selective breeding that is focussed on seeding habit(s) that are related directly to harvesting seed will be initiated. The crosses generally will be between materials selected for golf turf quality and materials that have been selected for seeding habit characteristics.

I. The collection of materials from golf courses will continue. Ways of increasing this effort and the identification of materials on golf courses will be investigated. Hopefully, more Poa supina germplasm can be acquired and integrated into efforts with that grass.

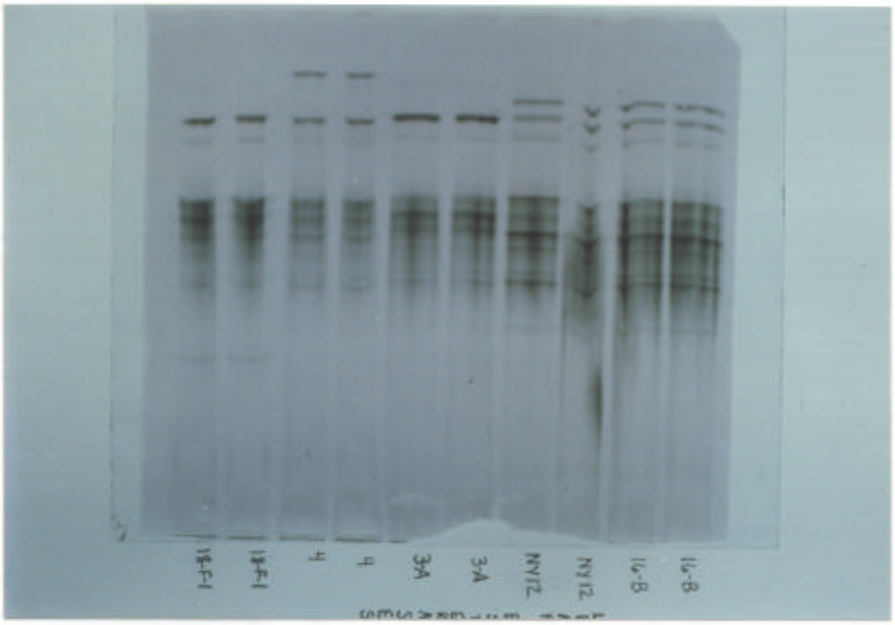
J. Efforts in 88 - 89 will focus on seed production problems and field evaluations of selected materials.

Respectfully Submitted,

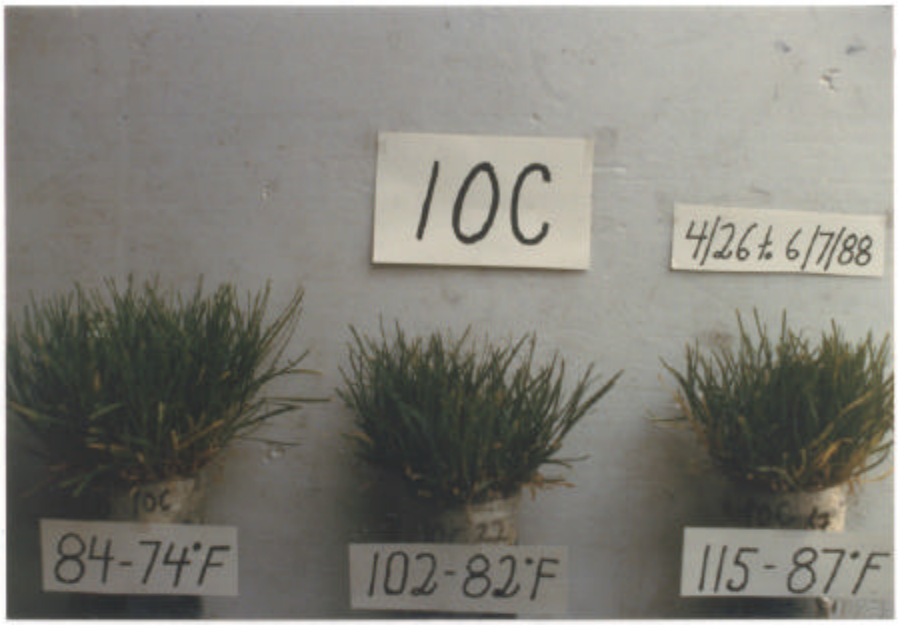
Donald B. White,
Professor, Turfgrass Science



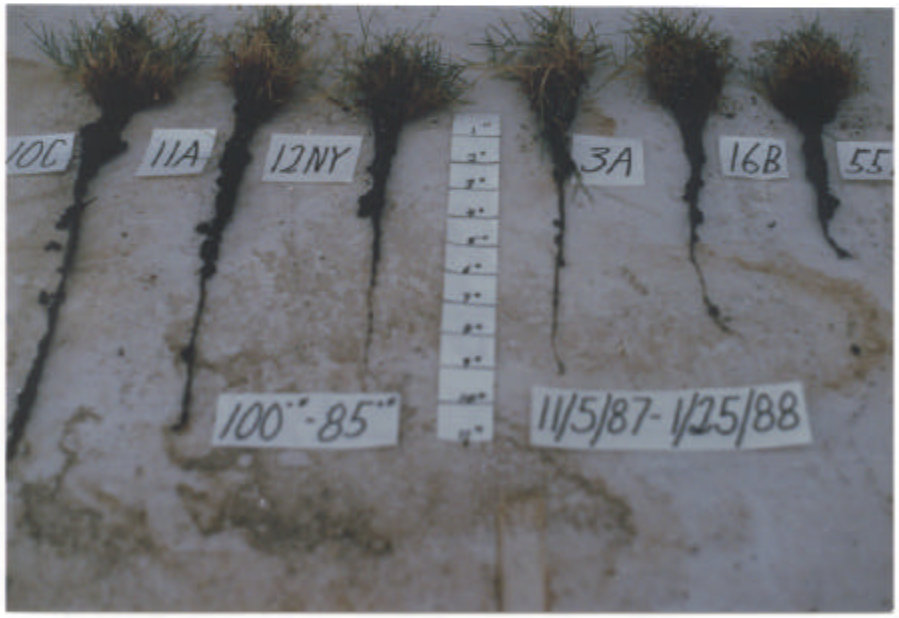
Electrophoresis gel showing leaf and stem esterase patterns in selection 19B.



Leaf esterase banding patterns of 5 different selections of Poa annua. Note similar bands with NY12 and 16B, its female parent. The others are not as closely related.

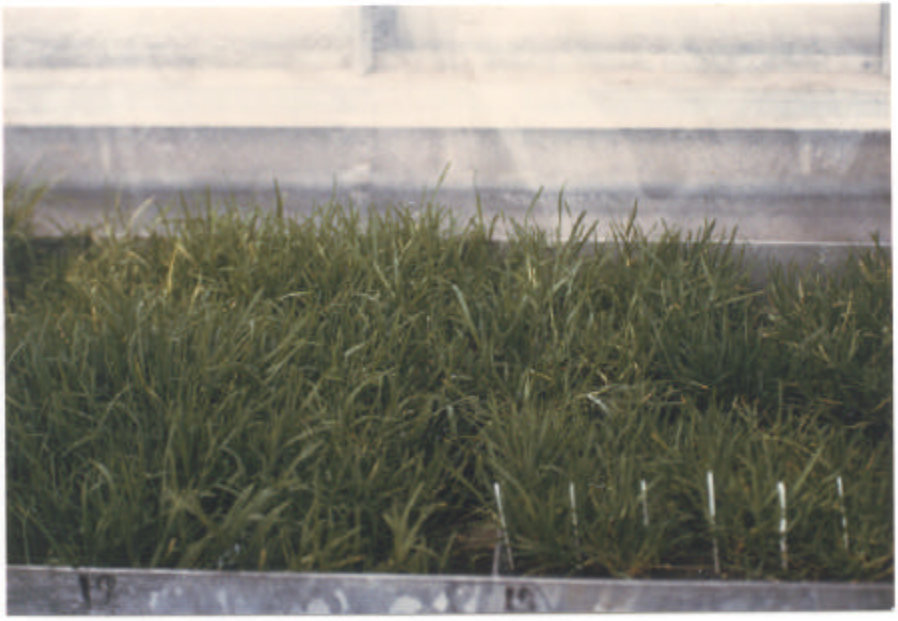


Poa annua selection 10-C exhibiting extraordinary tolerance to high rootzone temperatures. Treatment period was 42 days long.



Rootgrowth comparisons comparisons of 6 different selections to 100°F day 85°F night temperature after 80 days.

Vigorous rooting habit of a plant related to PA-14; demonstrating the heritability of good rooting in this line.

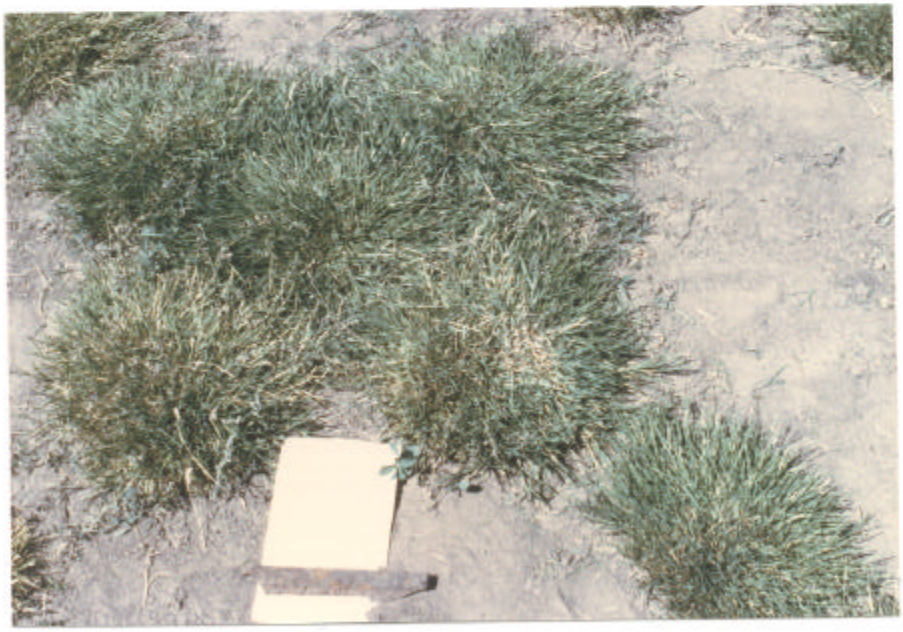


Stolon growth after cold storage for up to 15 weeks, picture shows growth 4 weeks after removal from storage.

Field space planting taken in spring of 1988 before affects of severe heat.

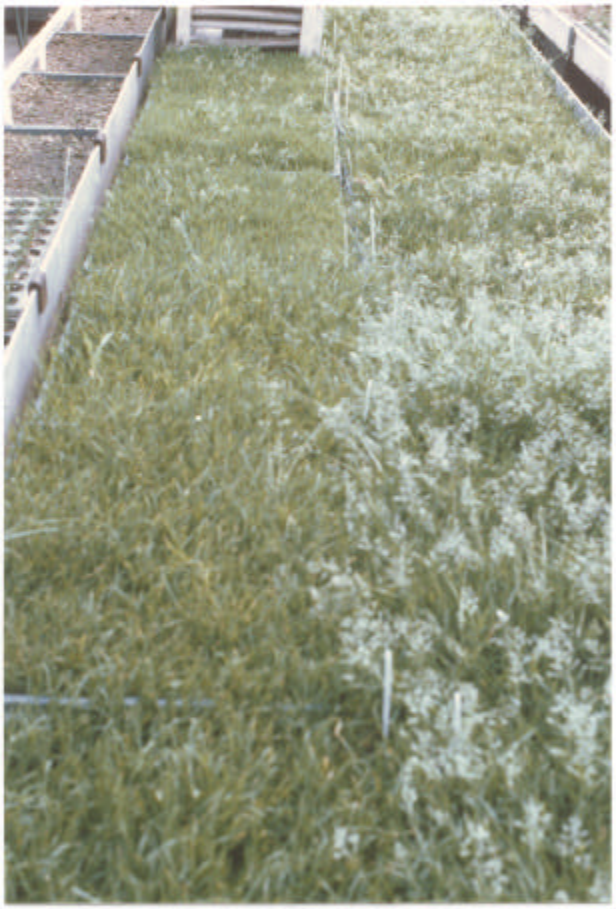
Replication of 1987 space planting adjacent to original that was damaged by the 1988 summer heat.

High temperature effects causing sterility in Poa annua flowers. (deformed inflorescence at lower left)



Vigorous, uniform Poa supina showing heat and water stress symptoms.

Fine-textured, dark green Poa annua selection in space planting. Note dense growth habit.



Flats of Poa annua showing minimal flowering of selection 10-C.