PROGRESS REPORT #4

October 1987

Improvement of *Poa annua* and *Poa supina* for Golf Turf

The University of Minnesota
Department of Horticultural Science and Landscape Architecture

Project: Biology and Utilization of Turfgrasses

and

United States Golf Association

Cooperating

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EXECUTIVE SUMMARY

The severe winter of 86-87 resulted in a powerful hardiness evaluation of space planted materials and the identification of superior selections. Advanced generation of some showed highly improved hardiness. Collections were received from California, Ohio, Wisconsin, Texas (via Oregon) and Sweden (via Canada). Materials collected in Turkey by Howard Kaerwer were forwarded through the USDA and have yet to be received. *Poa supina* was generally more cold hardy than *Poa annua*. The perennial *Poa annua* materials were consistently hardier than the annual types. Stolons of some selections survived more than 7 months in dark cold storage. Sibbing resulted in more seed than selfing or crossing in some genotypes. This has potentially strong implications on seed production strategies. Experiments with electrophoresis indicate there is a good possibility of identifying differences in genotype. This will be extremely important to the introduction and protection of any new variety in the future. Potted material is available for planting on golf courses and stolon material should be available next year. Papers dealing with stolon storage and self incompatibility will be presented at the ASHS and ASA meetings this fall.

PERSONNEL

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I. EXECUTIVE SUMMARY

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II. INTRODUCTION:

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

III. USGA Research team visit

A thorough review of this project was completed on 18 and 19 August, 1987. USGA Representatives included: Dr. Victor Gibeault, Dr. James Watson, Dr. Paul Reike, Mr. James Prusa, and Mr. Jerry Faubel, GCSAA. Priorities identified by the team include: 1) Place 16-B and as many top lines as possible in field evaluation on golf courses and experiment stations; 2) continue line breeding and incompatibility work; 3) continue study of reproduction of 16-B and others regarding seed, vegetative and tissue culture methods; 4) continue electrophoresis work, as financially capable, and possibly expand to other grasses that are being developed; and 5) continue to try to get desirable seedhead growth characteristics into P. annua.

Other items discussed but not prioritized were: water use rate information; pathology characteristics of advanced selections; and plant collection trips.

We are waiting for final development of the USGA agreement that will control and protect materials from this program placed on golf courses and other private and public lands.

IV. ENVIRONMENTAL EFFECTS OF THE WINTER OF 86-87:

Last winter was one of the warmest and driest in Minnesota history. Because of this situation, much of the field space planting was subjected to extremely dry conditions when temperatures would actually support growth. In short, plants in the space planting, with many culms near terminal height, were hit hard over winter. In contrast, the interplanted "poa" in the disease evaluation, putting green competition evaluation and general competition plantings that were mowed until the end of the season survived very well. This has been approached as a opportunity to identify those selections that survived and/or prospered over winter. Most of the selections produced materials that did survive. All surviving materials were collected, propagated, and re-established in a new space planting in the field research area on campus.

Field plantings were evaluated for over-wintering and turf quality characteristics. The outstanding performers were identified. Some of the advanced generation materials exhibited greater over-wintering ability than average for the planting.

V. NEW COLLECTIONS IN THE PROGRAM:

A. One accession was added from California.

B. Although not received by the project yet, Howard Kaerwer collected "Poa" materials while on a trip to Turkey during the month of April. Collected materials were forwarded, under permit, to Dr. Jack Murray, at the USDA for evaluation and future release to the breeding project in Minnesota.

C. A seed sample of a "poa" variety of Swedish origin was received and planted to ascertain characteristics and variation within the variety. At this stage it appears that the variety is composed of annual or intermediate types. Evaluation will continue.

D. A collection trip, by Don White and Jim Latham, to Tagalong Golf Course near Rice Lake, Wisconsin resulted in collection of 5 groups of Poa annua being added to the program. This is an old course that has a history that would lead one to suspect that it should be populated with

grasses that are adapted to low maintenance. Future collection trips are planned for the summer and fall of 1988. If ecotypes of other species are identified on any of these trips, they will be collected and forwarded to projects that might have primary interest.

E. Several accessions were collected from Muirfield (Ohio). They are exhibiting strong stoloniferous growth habits and other desirable turf characteristics. These materials were propagated and integrated into the program.

F. Dr. Bill Meyer furnished the project with some material of Poa autumnalis that is supposed to carry an endophyte. Although not Poa annua, we felt it worth the effort to see if interspecific crosses could be accomplished and if the endophyte could be transferred by that means to Poa annua.

VI. COLD TOLERANCE:

A. Cold tolerance evaluations were conducted with six Poa annua and six Poa supina selections that show the most promise. The evaluations were conducted in controlled temperature chambers in a special low temperature freezer. Generally, the Poa supinas tolerated greater cold than the Poa annuas. However, the perennial Poa annua selections tolerated lower temperatures than other Poa annua materials (especially the annual type) that are not in the breeding program.

B. Several stolons survived seven months in cold storage. They were planted in the greenhouse and became established and are under propagation for increase.

VII. EVALUATIONS:

A. Materials of the seven most promising Poa annua selections were propagated and grown at 1/2" (collar) height for distribution to golf courses and researchers in selected locations this fall. Poa supina plots are being established which can be used for production of stolons for eventual distribution to selected golf course test sites.

B. A new space planting was established. This new planting utilizes 1-1/2" greenhouse-grown plugs with 5 replicate plants in a 2' square. Materials are being maintained at collar height in the field for further evaluation. This effort involves approximately 100 Poa supina genotypes and up to 400 Poa annua genotypes.

VIII. BREEDING AND GENETICS:

A. Controlled interspecific crosses have been attempted between Poa annua and Poa supina which have resulted in minimal amounts of seed. Concurrent pollen tube growth observations with these crosses support the results in that pollen tube growth indicated very low compatibility in the crosses under investigation.

B. Isolation of selected pairs of Poa annua inflorescences for purposes of completing a diallel continue. The prime objective is to develop information about selfing versus sibbing versus crossing regarding seed-set patterns and compatibility. Interestingly, in some genotypes sibbed seed set was greater than selfed or crossed seed-set. Progeny from these crosses will be evaluated for other characteristics as well. This could have important implications on seed production strategies is the future.

C. An investigation comparing self versus sibbed versus crossed seed-set patterns in open pollinated genotypes was initiated. Patterns will be examined in genotypes producing variable progeny versus genotypes producing relatively uniform progeny. This is being approached on the basis that the plants producing variable progeny might normally have greater outcrossing (less selfing) than those producing uniform progeny.

D. Attempts at crossing Poa autumnalis and Poa annua have not been successful to date. This effort will continue with the objectives of completing the cross to see if transferring a potentially beneficial endophyte from Poa autumnalis is possible.

VII. ELECTROPHORESIS (ISOZYME OR PROTEIN) FOR VARIETAL IDENTIFICATION:

A. Experiments are being conducted to investigate the potential use of electrophoresis of proteins or isozymes for identification and separation of selections in our program. Sodium didecyl sulfate polyacrylamide gel electrophoresis of Poa annua seed protein experiments showed that it did not have the resolving power for differentiation between selections. Acid and basic gels are under investigation. Some success has been observed with the acid gel. The most recent work has been with slab gels (they are easier to work with than the columns). It appears , at least in the last couple of runs, that the annual types have quite distinctive banding patterns when compared to perennial types.

In the most recent series, separation of esterase isozymes from mature seed by electrophoresis was used to differentiate between genotypes of Poa annua. Each selection had a grouping of 5-7 bands about two thirds of the way down the gel. More distinct banding was visible both above and below this banding area. It appears that the annual types exhibit a cluster of bands near the top of the gel that are not exhibited by the perennial types. Closely related materials appear to have common banding patterns.

IX. CONTACT WITH OTHER PROJECTS:

Michigan State University has applied for a patent on a particular strain of wilt-causing bacteria that may be useful in control of unwanted Poa annua. Materials from several selections were furnished for use in investigating the susceptibility of perennial poas to this organism. To-date, there has been no report of results.

X. PUBLICATIONS - PRESENTATIONS:

A. Three papers are currently scheduled for presentation this fall (please see enclosed abstracts):

1. Cold Storage Effects on Survival and Regrowth of Excised Poa annua and P. supina Stolons; Ruemmele, B. A.; White, D. B.; Ascher, P. A. ; 84th ASHS Meeting.

2. Reproductive Biology in Poa annua L.: Seed Set Analysis; Ruemmele, White, & Ascher; 1987 ASA Meeting.

3. Factors Affecting Seed Set from Detached Poa spp. Inflorescences; Ascher, Ruemmele, & White; 1987 ASA Meeting. (Poster Presentation).

XI. PLANS FOR 1987-88:

A. The work on developing an understanding of self-incompatibility in Poa annua will continue.

B. We will continue to evaluate superior selections, including 16B, its progeny, and newly collected accessions.

C. The tissue culture efforts will be continued over winter and will focus on developing techniques for the regeneration of plants from embryogenic callus derived from immature and immature embryo tissue.

D. We will initiate new stolon storage experiments with the objective of establishing realistic recommendations for future storage and transport of vegetative plant parts. This technique will be used to plant the selections on golf courses.

E. The floral pic technique development will continue with in-depth evaluation of the effects of sucrose and fructose sugars in the medium.

F. Work with electrophoresis will continue as funding allows. The current work has been supplied by a temporary, part-time person with a MS degree. Poa supina will be incorporated into the next phase of this research.

G. We plan, over winter, to propagate several selections by means of stolons and to use these for establishing small plots on golf courses for field evaluation. Howard Kaerwer has offered to assist with these operations.

We have material to move into this phase of evaluation. However, an USGA approved agreement is needed before we can place any materials under the control of anyone outside the project.

XII. CLOSING

The principal investigator, along with the others associated with this project wish to thank the United States Golf Association for support of these efforts. We continue to feel that exceptional progress is being made with the resources available and maintain our enthusiasm for the project.

Respectfully Submitted,

Donald R. White,
Professor, Turfgrass Science

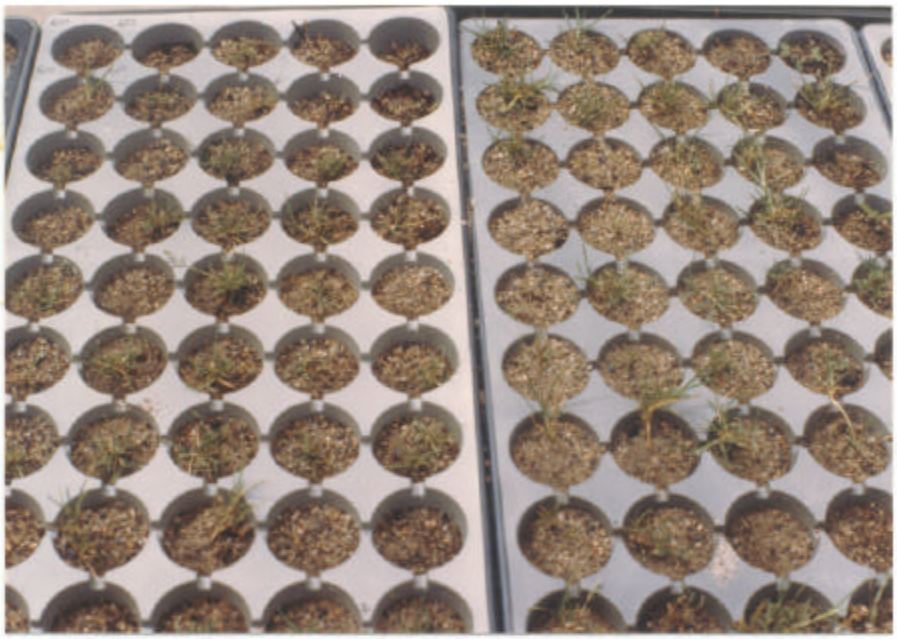
XIII. FIGURES:

1. Overview of field space planting of selections from the program as prepared to go into the winter of 1986-87. Photo taken October 1986.

2. Example of winter damage to a selection in the field space planting. Note heavy seeding habit exhibited by adjacent plant.

3. Winter damage to Poa supina #40 in field space planting. Note that the center of the plant is dead while the stolons around the edge of the plant survived well.

4. Complete survival of a Poa supina F1 selection in the field space planting. Photo taken in May 1987.



5. Plants in flats in the greenhouse in preparation for transplanting to the field. Plants were started from single stolons collected from surviving materials in the over-wintered space planting. Plug size was 1 1/2".

6. Materials started as in #5 above were set out in a spaced planting July / August 1987. Plantings were grouped in a five replicate row unit.

A.) Clockwise from top left; 4,1,2,3

B.) 6,3,4,6,center,5

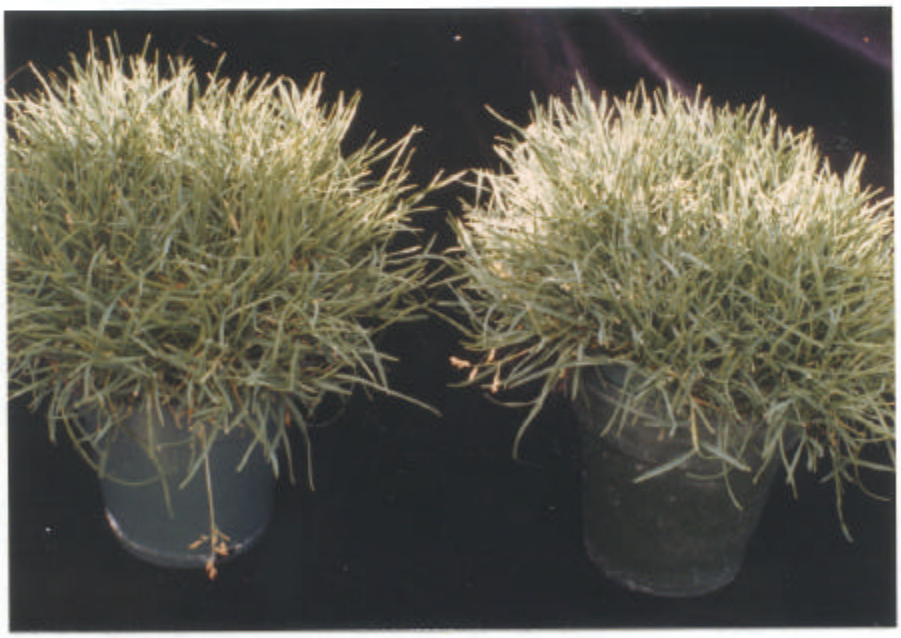
C.) 8,5,7,6, center, 8

D. 5,8,9,7,center, 9

7. Individual plant ratings taken in mid - October illustrate rating scale used to evaluate new space planting. Growth was rated on a 1 to 9 scale; 9=best.

8. Poa supina stolonized plot in the field. These plots will be useful for stolon production.

9. Vigorous Poa supina interplanted into a mixed bentgrass-poa annua turf. Note dollar spot affecting grasses all around this selection. This planting has been maintained under less than normal fertility.



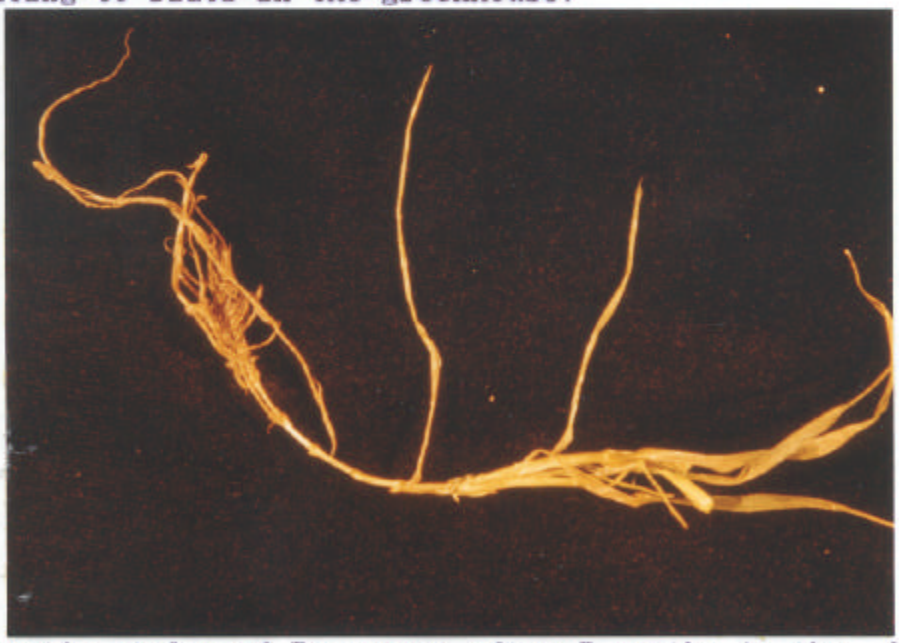
10. A Poa annua selection with limited flowering habit. These plants can be traced back to material received from Illinois.

11. Different Poa annua types used in a diallel crossing study designed to investigate compatibility/incompatibility in breeding behavior of Poa annua.

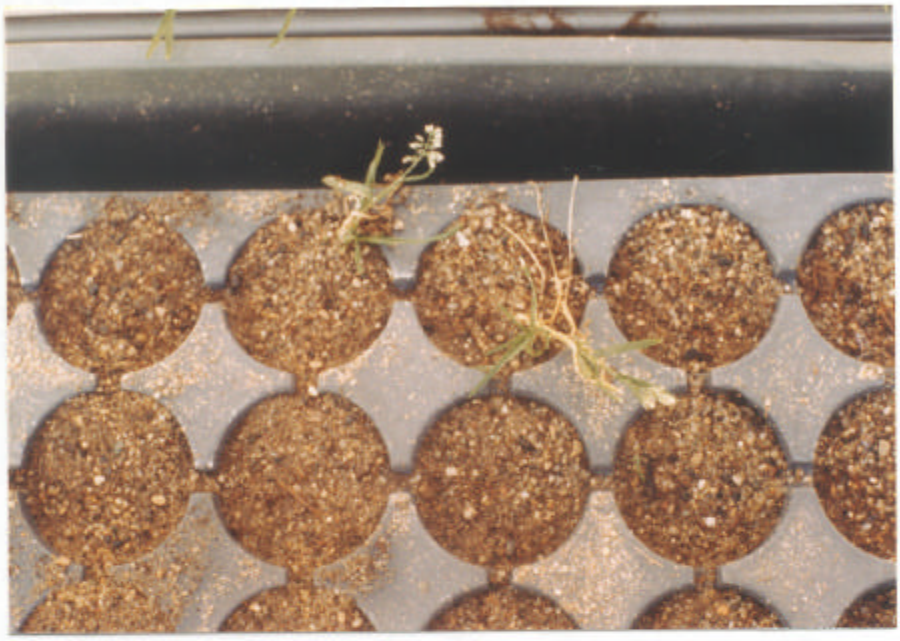
12. Examples of contrasting flowering and growth habits in 2 different elections of Poa annua. Selection #18 exhibits no flowers while selection # 8500010 exhibits vigorous flowering habit.

13. Poa annua selection 16B closely mown in preparation for sending to the field for interplanting into existing golf course turf.

14. Stolons stored for 7 months in the dark in a 36° to 40°F cold storage. Some of the chlorotic (shiny-white) stolons are alive. This shows the condition of the material just before transplanting to flats in the greenhouse.

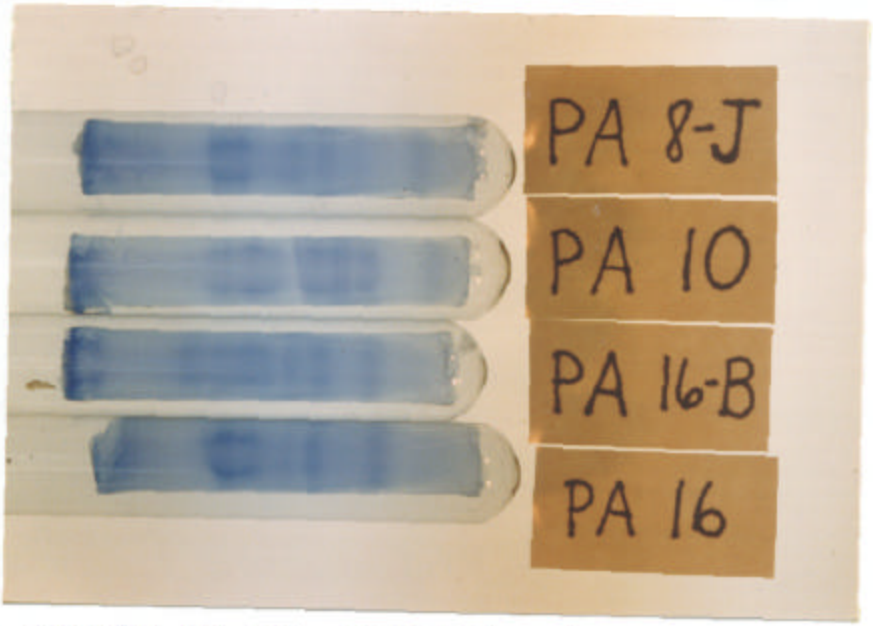


15. Chlorotic stolon of Poa annua after 7 months in the dark in a cold storage. Stolon is viable and grew once planted into soil.



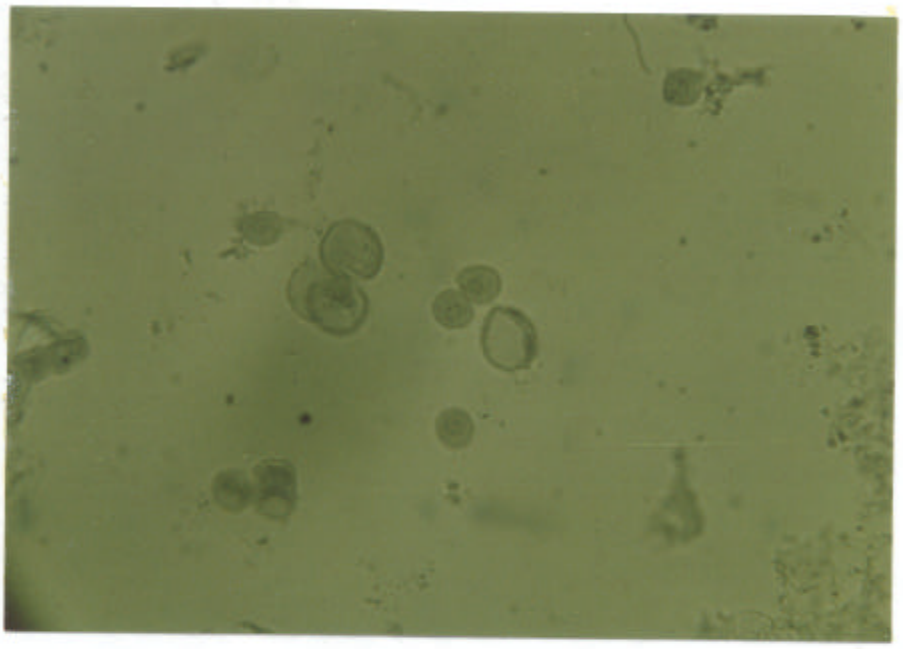
16. Regrowth from a stolon from Poa annua selection # 23 after 7 months of storage.

17. View of one of three root zone waterbaths maintained in photoperiod control rooms with a diurnal temperature cycle of 100/80°F. It is notable that some of the Poa annua selection materials have survived these root zone temperatures for substantial periods of time. This technique is used as one of the selection pressures being placed on plants in this program.

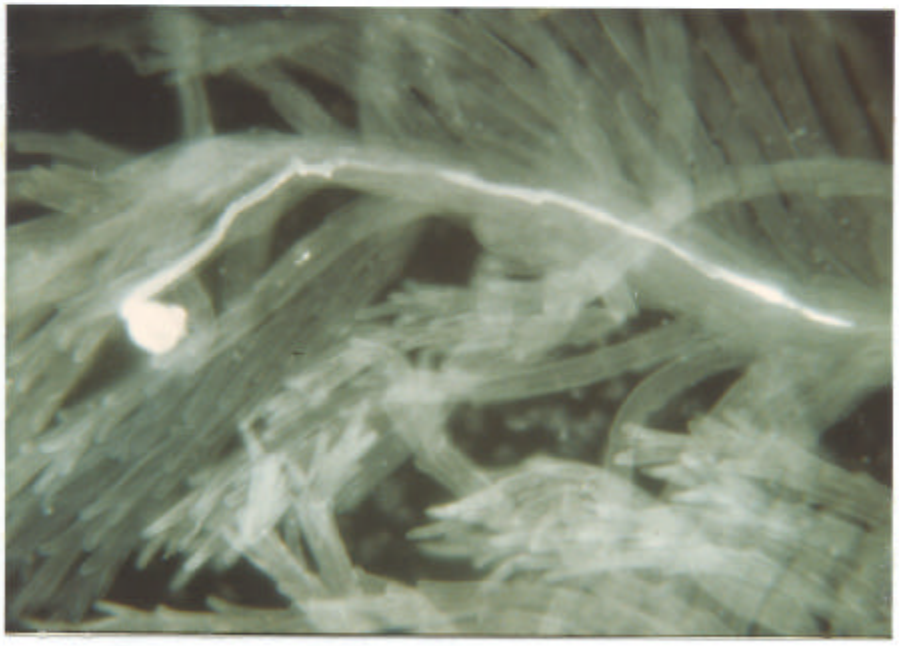


18. An example of the electrophoresis research efforts to chemically identify the different selections in this program. The picture shows different protein bands in gels expressing differences between Poa annua selections 8J, 10, 16B, and 16 (a parent of 16B).

19. This is an example of the floral pic technique for maintaining excised flower heads through pollination and seed maturation. From left to right: Stems before flowering; stems during flowering; stems showing almost mature seed heads.



20. Developing pollen grains of Poa annua. Note different sizes which could indicate differences in chromosome numbers.



21. Pollen tube growth from Poa annua pollen on a Poa supina stigma. Pollen tube growth probably indicates a compatible cross.

22. Overview of greenhouse section in July 1987.

XIII. ABSTRACTS:

The following are the three abstracts for the papers mentioned in the text.

ABSTRACT FORM -- AGRONOMY ABSTRACTS

1987 Annual Agronomy, Crop Science, and Soil Science Society Meetings

Factors Affecting Seed Set From Detached Poa spp. Inflorescences. P. D. ASCHER, B. A. RUEMMELE*, and D. B. WHITE. University of Minnesota.

Reproductive biology in Poa annua L. and Poa supina Schrad. was investigated for breeding improved turf types. One method involved isolation of excised culms placed in floral pics containing nutrient and preservative solutions. The advantages of this method are: reduced seed shattering, enhanced isolation and environmental control, manipulation of wider crosses with variability in flowering, and facilitation of seed count data collection. Factors evaluated to determine if seed set was affected included: fructose versus sucrose concentrations as the nutrient source; 97.65 mg L^{-1}, 195.3 mg L^{-1}, 488.25 mg L^{-1}, and 976.5 mg L^{-1} eight hydroxy quinoline citrate (8 HQC) concentrations as the preservative; stem length; whether or not leaves were removed from the culms; and differing environments for isolation of the excised culms. Significant differences were observed among 8 HQC concentrations and environments. Leaf removal did not significantly influence seed set. Factors which may affect seed set require standardization in order to control possible interactions.

ABSTRACT FORM -- AGRONOMY ABSTRACTS

1987 Annual Agronomy, Crop Science, and Soil Science Society Meetings

Reproductive Biology in Poa annua L.: Seed Set Analysis.

B. A. RUEMMELE*, D. B. WHITE, and P. D. ASCHER.
University of Minnesota.

Poa annua L. has been reported as both self compatible and self incompatible. Related and unrelated biotypes from Europe and North America were self, sib, and cross pollinated to determine the variability and degrees of selfing and outcrossing which exist in these genotypes. Results ranged from three times higher self seed set than cross seed set to three times higher cross seed set than self seed set, depending on genotypes. Sib seed set was two times higher than self or cross seed set in some comparisons. These results on breeding behavior directly impact selection of breeding methods for a concurrent Poa annua breeding project. When incompatibility is a factor, there may be cases where sibbing can offer opportunities for increased productivity.

ABSTRACT FORM -- HORTICULTURE ABSTRACTS

84th Annual Meeting of the American Society for Horticultural Science
6-12 November 1987; Orlando Florida

COLD STORAGE EFFECTS ON SURVIVAL AND REGROWTH OF EXCISED POA ANNUA AND POA SUPINA STOLONS

Bridget A. Ruemmele*, Donald B. White, and Peter D. Ascher,
University of Minnesota, Department of Horticultural Science and Landscape Architecture, 305 Alderman Hall, 1970 Folwell Avenue, St. Paul, Minnesota 55108

The ability to store excised stolons can be important for developing adequate clonal research material. Excised Poa annua and Poa supina stolons were subjected to either -2 to -3°C or +3 to +5°C, when stored between moist paper towels in plastic bags for up to ten weeks. Five replications of four Poa annua and Poa supina genotypes were removed from each storage temperature at weekly intervals. Stolons were planted in moist sand and maintained for three weeks after treatment and before evaluation. Significant differences were observed among species, genotypes within species, and temperatures for survival; rooting; stolon elongation; vigor; and fresh and dry weights of leaves, stolons, and roots. Treatments may have enhanced flower and root induction.