PROGRESS REPORT #3

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

United States Golf Association
Turf Research Foundation

Cooperating

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I. INTRODUCTION:

The following is a report of the research conducted for the Project: "Improvement of *Poa annua* for Golf Turf" for 1986. The activities pursued during 1986 are offered in outline form. More detail is available upon request.

II. COLLECTIONS:

A. Acquisition of new materials continued to a limited degree during the 1986 research year. Accessions from California, Ohio, Minnesota, and the collections Howard Kearwer made in Europe while at the International Turfgrass Research Conference were incorporated into the project. The European materials were subjected to a rigid screening program before being incorporated into the project.

B. Seed collection from selections and new accessions continues on a regular basis. Seed is collected accessioned and either stored for future work or seeded for evaluation of offspring and compatibility evaluations.

C. Plants and seed of original collections that have proven to possess some desireable charactistic(s) have been maintained from the time of incorporation into the program. This entails regular periodic vegetative reproduction in the greenhouse to maintain a viable seed source of the materials in question. Many of these materials have also beeen established in the field this year for long term maintenance.

III. EVALUATIONS:

A. Germination and evaluation of 1st and 2nd generations of selections from the best original accessions continues. Superior genotypes have been advanced one to five generations. The third generation of the "16" group was placed under observation for heritability, segregation, and selection. The best of these will be transferred to the field in the spring of 87 for observation under putting green, collar and fairway conditions. In addition some will be placed in the space planting for growth habit and variation evaluation.

B. Evaluation, selection and data collection continues in field and greenhouse for stoloniferous habit, color, rooting, texture, density, hardiness and other desirable traits.

C. 251 selections of *Poa annua* and *Poa supina* were germinated and grown in the greenhouse for transfer to a field space planting. 49 other selections were increased for observation and research in the greenhouse. Plants resulting from this seeding were transplanted to a space planting in the field for further evaluation.

D. The space planting of 1200 plants representing 145 selections that was established in the field during 1985 continued under observation for plant type variation and heritability. Additional selections were added during the year.

Overwintering ability, spring green up, summer, and fall performance evaluations were completed on the space planted materials established in 1985.

E. The field planting of stolons of 15 different materials in the program that was established and maintained at putting green height for evaluation of the superior selections continued under observation. Overwintering, spring, summer and fall performance evaluations were completed on all materials in this planting. One clone (10-C) in particular stood out during the spring, summer and fall due to a dark green color, dense turf, and limited flowering. Other selections exhibiting limited flowering habit throughout the growing season included Poa annua selections 2E, 18L and 21. Poa annua # 21 resulted from a collection at the University of Minnesota Golf course.

F. One-hundred-twenty-one F2 plants of 16B selection were started in the greenhouse and transferred to the field to a space planting in the field for further field observation of growth characteristics and genetic variation.

G. Twenty two clones of Poa annua selections from 16, 16B, 16E, 11, and some F1's of 16B were grown in the greenhouse and interplanted into existing collar height conditions in the field to evaluate competitive ability, growth habit under competition and disease tolerances and susceptibilities.

IV. BREEDING RESEARCH

A. Incompatability:

1. Controlled pollinations both, selfing and crossing, continue with selected materials. A diallele cross with incompatible and compatible types was initiated to further investigate the selfing-crossing-compatibility characteristics of selections.

2. In order to further the work on self-incompatibility a selfing program of annual bluegrass with selection pressure for low self pollination (incompatible) has been initiated. Two selections have shown signs of inbreeding depression indicating that some form of outcrossing may predominate in them. This work will require continuing investigation.

3. Seed resulting from selfing and crossing several 16 accessions was germinated and transferred to the field. These materials resulted from selfing, crossing and incompatibility studies. One of the most desireable selections of 16 has been advanced three generations.

A separate part of this investigation included observations on germination and seedling vigor of the resulting seed and plants. It was observed that germination time decreased and germination increased with increasing time from harvest. The seed sown one month after harvest did not germinate as well as seed sown six months after harvest.

B. Technique Development:

1. Work continues in an effort to develop reasonable technique for emasculating florets of Poa annua. Techniques have been developed that are relatively easy to apply to Poa supina. However the smaller florets in Poa annua increase the difficulty of effective emasculation without excessive mutilation of the remaining flower parts. At present the most effective technique requires removal of all but the male sterile florets which are found at the top of the flower stalks.

2. A follow-up experiment into suppression of flowering and growth was conducted to fine tune the use of Embark for flower suppression in Poa annua and Poa supina. Data is currently under analysis. Preliminary observations indicate varying degrees of vegetative growth suppression in the greenhouse at effective floral suppression rates of 1/16 to 1/4 the recommended rate for growth suppression. The technique has a prime application in suppression of flower and seed development in plants that are under maintenance conditions where flowering is not desired. The technique could save many hours now devoted to controlling contamination by volunteer seedlings.

3. Poa annua stolons maintained viability when stored for over seven months in plastic bags in a cooler maintained at approximately 37°F. Variability in survival appeared to be related to the genotype and the size of stolons at the time they were placed in storage. Stolon diameter appeared to be particularly related to survival. Earlier investigations with stolons indicated that survival was strongly related to genotype and species.

4. A technique utilizing floral pics to assist in investigating selfing, crossing, and cross compatibility is under evaluation. The technique appears to be particularly useful in accomplishing paired isolation pollinations. However it also holds promise for higher numbers of pollinations where selfing or polycrosses are desired. "Floral pics" save space and time while allowing larger numbers of crosses and more flexibility in matching parents with different culm sizes and maturity times. The technique will also allow investigation of effects of timing of anthesis on seed set. Pics are filled with nutrient solution containing sucrose and the preservative 8HQC. Flower heads maintained this way produced larger seeds which matured faster than seed from inflorescences in water alone. Experiments are underway comparing carbon source (sucrose) levels to determine the optimum leve(s) to support flowering through seed maturity. Experiments are planned to investigate the effects of different carbon sources and levels on the success of pollination, seed maturity and quality.

Removal of leaves is sometimes necessary to ensure submersion of the stem in the nutrient solution. Data indicate that leaf removal has no affect on seed set or seed maturity. Environmental effects such as light and temperature on anthesis, seed set, seed quality and maturity are currently underway. Research will continue in adapting and improving this method for the Poa breeding project.

5. Investigations into the timing of antheses of Poa annua and Poa supina were conducted to ascertain the relationship to emasculation for the breeding program. Poa annua timing is more critical because of the short time between appearance of stigmas and the dehiscence of pollen than for Poa supina. There may be only a one hour time lapse between appearance of stigmas and pollen-shed in Poa annua while it may take as much as 24 hours to happen in Poa supina. Observation has also revealed that although anthesis typically proceeds from the distal end of the inflorescence, some anthers of Poa annua may emerge from the middle portion of the inflorescences first. This has strong implications in emasculation and in completing controlled selfing-crossing efforts.

Typically the apical florets in a Poa annua inflorescence will be male sterile which can assist in completing crosses. Male sterile inflorescences in some Poa supina was observed for the first time during the spring flowering season of 1986. This characteristic should be very useful in developing interspecific crosses with Poa annua.

6. Several interspecific cross of Poa annua with Poa supina were attempted resulting in seed from two crosses. Results of these crosses will become available as plants develop from the seed.

7. Cytological observations of meiosis and mitosis in Poa annua are currently underway. Cells are being examined for diploid versus polyploid chromosome numbers as well as chromosome characteristics.

8. Hardiness evaluations with poa selection in the program have been conducted on field grown plants that have been brought in from the out-of-doors and subjected to cold stress in a special deep freezer. Preliminary results indicate that, generally speaking, Poa supina may be somewhat more cold tolerant than Poa annua. Poa supinas: Ps13, Ps13D, Ps29, Ps29F, Ps2 and Ps550 withstood the coldest temperatures in the freezer trials. These were followed closely in cold tolerance by Poa annuas: Pa16, Pa16B and Pa8J. Two Poa annuas and one Poa supina did not survive any of the freezer treatments. However the plants subjected to the cold treatment had survived 2 winters in the field. What this indicates is that like many other characteristics, there is great variation in both of these grasses and that cold tolerance is and will be important to the development of any new variety.

V. TISSUE CULTURE:

A. The integration of our tissue culture research into the breeding program continues. Accession 16B and two other clonal lines of annual bluegrass and two of P. supina have been used in culture media development. Work is focussed on generation of callus from vegetative plant parts and regeneration of plants from the callus tissue. Experiments are planned to investigate the effect of different carbon sources on callus development and plant regeneration.

VI. SELECTIONS:

1. We are continuing to identify and evaluate superior selections from the breeding program. For example last year some selections were identified out of the F1 generation of a 16B maternal parent. In the greenhouse one selection is dark green, fine textured, mows well, tolerates putting green height well and performs well under moderate to low fertility and maintenance. Other selections have been identified out of the families 10, 8, and 19.

2. A selection, PA #10C, has been identified from the stolonized field planting. This selection exhibits a dark green color and very limited flower production. Work has been initiated to increase this material for further research.

VII. PUBLICATIONS:

1. One poster presentation related to work in this project was presented at the 1986 International Tissue Culture Conference:

a. "Behavior of Clonal Vegetative Explants as Sources for Culture of Annual Bluegrass (Poa annua Var. reptans Hauskkn.), D. B. White and K. L. Ruser."

2. Two Papers will be presented at the 78th Annual meeting of the Crop Science Society of America in December 1986.

a. "Variation in Domestic and Exotic Poa annua L. and Poa supina Schrad. Germplasm Sources. D. B. White, B. A. Ruemmele, and P. D. Ascher."

b. " Techniques for Investigating Self Compatibility and Self-Incompatibility in Poa annua L. and Poa annua Schrad. B. A. Ruemmele, D. B. White, and P. D. Ascher."

VII. PLANS FOR 1987:

1. The work on developing an understanding of self-incompatibilty in Poa annua will continue.

2. We will continue to evaluate several selections, including 16B and it superior F1 progeny, and other progeny by transplanting into existing golf green turf to evaluate competive ability, disease tolerance and characteristics under actual field conditions.

3. The tissue culture experiments will include developing techniques for the regeneration of plants from callus derived from vegetative tissue. Cell groups that are available from callus may be conducive to development of new lines for subsequent breeding purposes. We also plan to investigate the use of different carbon sources other than sucrose.

4. PA #10C and others identified above show promise. We plan to expand our efforts to increase these superior sellections by vegetative and sexual means. We plan to distribute several of these selections to other investigators associated with USGA projects so that they can proceed with stress and other evaluations.

5. The collection of seed from selections and new accessions will continue. Any expansion in the program will include evaluation of more progeny from parents that appear to offer desireable traits.

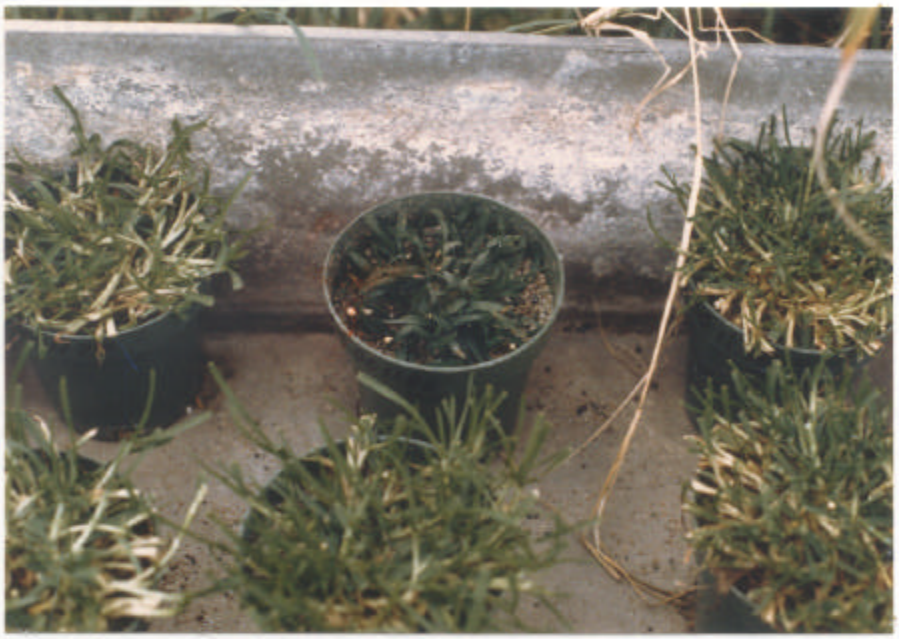
VIII SUMMARY:

We are very encouraged by the progress made during this last year. Results have been very satisfying. The project is at a point where increased support could be very productive in terms of shortening the time to introduction of an improved Poa annua. Any increase in support now could be applied to seed increase of superior selections and research could be initiated into some aspects of seed production of some materials. This could help to shorten the introduction process. We continue to believe that progress is being made which is beyond what could be normally expected under the current support conditions.

The primary investigator, along with the others associated with this project thank the USGA for its support. It is so important to the progress of efforts to improve Poa annua for golf turf purposes.

1. Two F1 plants from Poa annua #16B mowed at 1/4" in pots. Note darker green color of right hand pot. Density and texture are uniform.

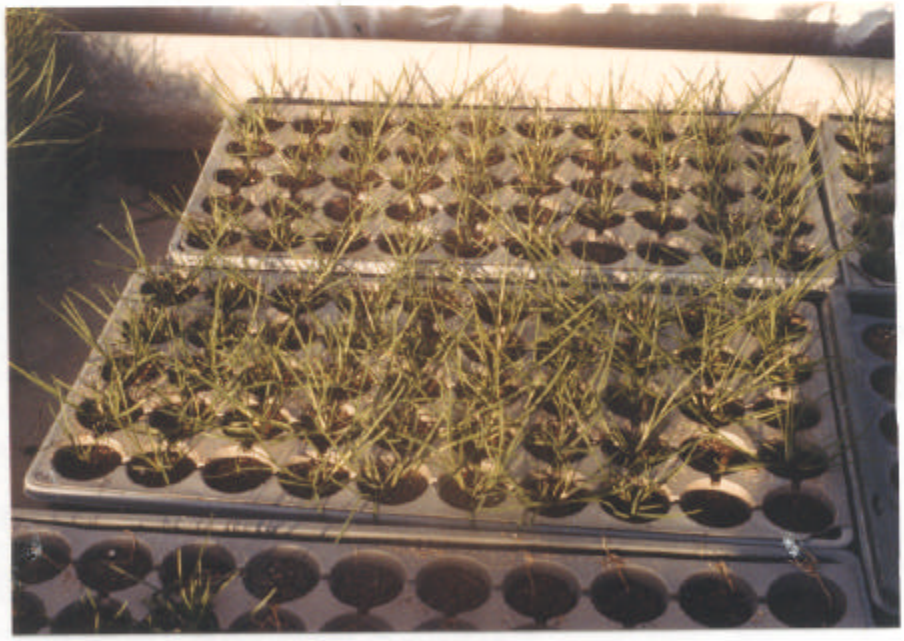
2. Example of the variation in the F1 plants from open pollinated seed of Poa annua #16B. One sib exhibits a high number of flowers while the other sib exhibits no flowering at all.



3. Dwarf variant of Poa annua from original clone #17. Picture taken 5 months after planting. The plant has never been mowed and is the same age as the other plants around it in the picture.

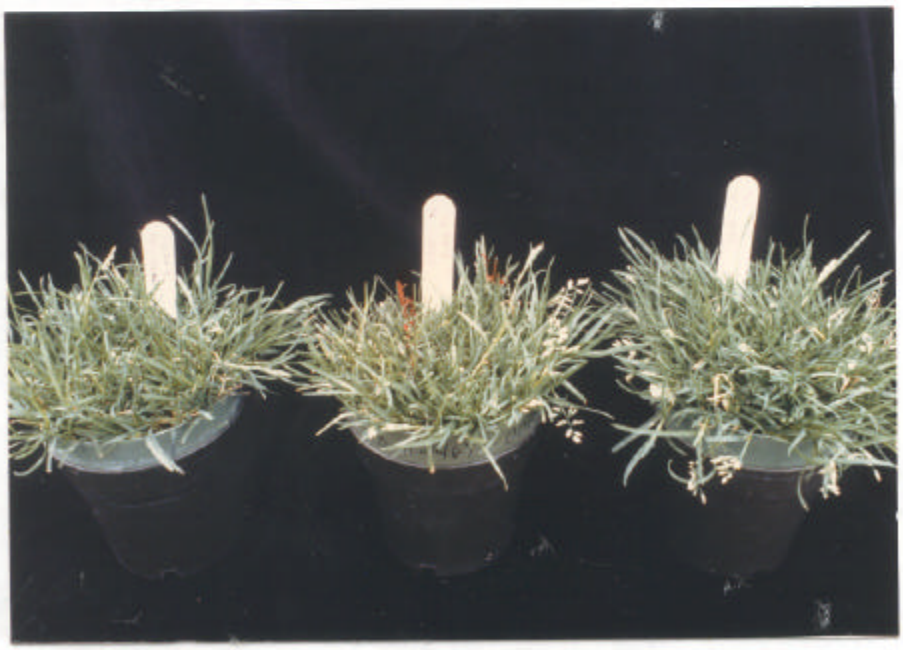
4. Non-typical offspring from Poa annua selection #11A in the greenhouse. Note compact growth and dark green color. Number 11 plants are usually light green and open plants with long stolons.

5. An example of Poa supina selection #29E as example of fine texture and dark green color in that species.



6. Flats showing increase of Poa annua selections for use in further investigations into compatibility/incompatibility and its affect on pollination and seed formation.

7. Overview of the experiment to fine tune Embark for control of flowering, one day after treatment.



8. Poa annua #11 plants 4 weeks after treatment in the greenhouse with 1/16 and 1/32 of full label rate of Embark and a water check. The 1/16 rate (left side of picture) appears to be the most appropriate concentration for acceptable flower control.

9. Overview of field space planting of Poa annua and Poa supina planted in the fall of 1985, picture taken 9/30/86.

10. Close up of Poa supina #9 exhibiting dense, dark green color with vigorous stoloniferous spreading habit of growth in the field space planting.

11. Poa annua exhibiting bunch type growth habit in the field space planting.

12. Poa annua exhibiting dark green color and vigorous spreading habit of growth in the field space planting.