TECHNICAL PROGRESS REPORT

DEVELOPMENT OF INNOVATIVE TECHNIQUES AND PRINCIPLES THAT MAY BE
USED AS MODELS TO IMPROVE PLANT PERFORMANCE

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1. Title of Project: DEVELOPMENT OF INNOVATIVE PRINCIPLES AND TECHNIQUES THAT MAY BE USED AS MODELS TO IMPROVE PLANT PERFORMANCE.
2. Institution: USDA-ARS, Coastal Plain Experiment Station, Tifton, GA 31793.
3. Summary Statement: Methods and techniques for transferring germplasm from wild to cultivated species are being developed. The transferred germplasm is being shown to be valuable in plant breeding and in cultivar development. Forty cytoplasms from the wild grassy subspecies monodii (primary gene pool) of Pennisetum glaucum are being tested in 1991 for cytoplasmic effects on morphological characteristics and forage yield. A'-genome chromosomes from P. purpureum (secondary gene pool) have been transferred to cultivated pearl millet. The A'-chromosome derived lines have been developed into excellent male pollinator lines to produce a new high quality, high yielding grain hybrid for the U.S. Significant progress is being made in transferring the gene(s) controlling apomixis (to produce true-breeding hybrids) from the tertiary gene pool to cultivated pearl millet. Backcross-4 plants are more pearl millet-like and reproduce by apomixis. New genome combinations have been produced in the apomixis gene(s) transfer program which demonstrate the impact of apomixis on speciation and evolution.

INTRODUCTION

Plant breeding has made possible a large portion of the record yields of our major food crops, and can claim credit for at least half of their increased yield. It can continue to do this but the population explosion demands that it be done in less time. Innovative techniques must be developed.

The purpose of this research is to develop techniques and principles of transferring germplasm from the primary, secondary, and tertiary gene pools of the wild species to cultivated species and evaluate the transferred germplasm.

RESULTS

We have been able to develop fundamental methods and techniques for transferring germplasm from wild to cultivated species. In addition, some of the germplasm has been shown to be valuable in plant breeding and the development of commercial cultivars.

Primary Gene Pool - Wild grassy Pennisetum glaucum subspecies monodii has been an excellent source of genes for resistance to most diseases of pearl millet in Africa, India and the U.S. We now have cytoplasms from 40 monodii accessions transferred into the uniform genetic background of inbred Tift 23. Each of the cytoplasmic lines have been crossed with Tift 383 (as male parent) in 1990. The hybrids are being tested in 1991 for forage yields and data are being obtained on morphological characteristics to detect cytoplasmic effects. 1991 data will be reported in 1992 after it is all collected and analyzed.

Secondary Gene Pool - The A' genome of P. purpureum (napiergrass with the A' and B genomes) has been transferred to pearl millet. Details of this research are reported in Reprint #1. Studies are

continuing on the mechanism in the hexaploid (6x) pearl millet x napiergrass hybrids that produces the 7-chromosome A- or A'-genome gametes. The A' genome derived inbreds have proven to be excellent pollinators on an early disease resistant cytoplasmic-nuclear male sterile to produce grain hybrids. Additional studies on planting dates, fertility requirements, planting rates, and animal performance are being conducted to develop a marketing package for the farmer. The germplasm derived from the secondary gene pool may have a significant impact on developing a new productive grain crop in the U.S.

Tertiary Gene Pool - The tertiary gene pool provides the greatest challenge. However, significant progress has been made in making interspecific hybrids and gene transfer.

Exciting progress is being made with the transfer of gene(s) controlling apomixis from Pennisetum squamulatum ($2n = 6x = 54$) to tetraploid pearl millet ($2n = 4x = 28$). In 1990, nine (9) apomictic pearl millet-like backcross-4 plants were produced with $2n = 27, 28,$ or 29 chromosomes. Progeny tests in 1991 indicated that two of these are highly apomictic. The apomictic lines were backcrossed again to tetraploid pearl millet. A problem has been encountered with the apomictic lines. Although early seed set is almost 100% on these plants, many of the seeds do not develop past the 11 to 12 day stage. We are developing some new pearl millet tetraploids which we can use as the recurrent parent in hopes of overcoming the abortion problem.

The apomictic gene(s) transfer program has produced a number of plants with unique chromosome combinations (Reprint #2). The study showed that apomixis is an effective mechanism in speciation and a

dynamic factor in evolution.

There will be no significant changes in the current scope and methods of conducting the research.

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