Adaptation of Soybean Cultivars to Restrictive Soil Environments

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RESEARCH PROBLEM

Many modern soybean cultivars are capable of producing yields of more than 60 bu/acre when grown in high-yield environments (Dombek et al., 2001). Some soybean growers, however, have reported decreasing seed yields in recent years, even when modern cultivars and sound cultural management practices are used. Rice yields have also decreased in soybean-rice rotations grown in such environments. Research is being conducted in conjunction with an ongoing soybean breeding program to identify factors that limit soybean seed yield in specific environments and to develop new cultivars, which produce higher yields than conventional cultivars when grown in environments that limit productivity.

BACKGROUND INFORMATION

Yield potential of cultivars developed by conventional breeding programs is estimated by growing experimental strains in environments that maximize seed production. Growers who have soil conditions that restrict seed yield because of unidentified factors do not have a source of cultivar performance information from environments that are closely related to their own.

RESEARCH DESCRIPTION

Four fields, located in Craighead (1), Cross (1), and Monroe (2) counties, have been used in this study. Growers have reported that each field has produced progressively lower seed yields in recent years although cultivars grown have been highly productive in the Arkansas Soybean Performance Tests. Soil test results from two of the fields have been described in a previous publication (Widick and Harrell, 1999). Each year in these four study sites, a variety of diverse soybean genotypes were grown in yield-restrictive fields. Sources of these genotypes include commercial cultivars, experimental strains, plant introductions, and old cultivars. New germplasm is added for evaluation each year as new cultivars and experimental strains become available. Yield, agronomic characters, and foliar nutrient composition are measured. Leaflets of the uppermost trifoliolate leaves are sampled at the R3 growth stage to determine the nutritional status of plants as seed development begins (Fehr and Caviness, 1977). Selections for crossing are based on seed yield and plant growth each year. Foliar nutrient data are used to determine whether any nutrients are present in deficient or toxic levels. Seed of promising populations derived from crosses is increased at the Northeast Research and Extension Center (NEREC) located at Keiser, AR. Advanced strains developed from these populations are evaluated at NEREC and at the Pine Tree Branch Station (PTBS) to determine their yield potential in conventional soybean production environments. Tests to determine the effects of deep tillage and potassium (K) fertilization have been conducted in past years to help identify factors responsible for yield decreases in restrictive environments.

Strains derived from crosses among selections made in restrictive environments were grown for seed increase and for evaluation at the NEREC and at PTBS in 2001. In 2002, these strains were again grown at NEREC and PTBS for evaluation of yield potential in productive environments. Strains were also grown in a production field in St. Francis County. A late planting date of 25 June 2002 accompanied by dry soil conditions delayed emergence until after 1 July 2002. The test was irrigated as needed after plants reached the V4 growth stage. Cultural practices were those used by the farmer. Sufficient quantities of seed from newly devel-

oped strains are now available for testing in the restrictive environments where selection of parents were made. These tests will begin in 2003 and continue in future years.

RESULTS

Preliminary results from the St. Francis County test indicate 2002 seed yields ranged from 40 to 55 bu/acre even with late planting and delayed emergence. The test was harvested 13 November. Preliminary data from NEREC and PTBS indicate yields were higher than for the late-planted test in St. Francis County, but the on-station tests were planted one month earlier. Further conclusions will be made as complete data become available.

PRACTICAL APPLICATIONS

Conventional cultivars have been shown to interact with tillage depth and fertility. Further studies will be made using these newly developed genotypes in yield-restrictive environments. These new genotypes will be used to increase productivity of environments that have restricted yields of conventional cultivars.

ACKNOWLEDGMENTS

The authors express their appreciation for the support provided by Arkansas soybean growers with funds administered by the Arkansas Soybean Promotion Board. Additionally, we wish to thank the soybean farmers who have provided land and labor for these tests.

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