identify RFLP markers associated with the nondormancy trait. The marker linkages they have identified in 2 of the 3 lines will be confirmed in further studies.

In a separate study initiated in the summer of 1995, we have estimated the heritability of early seed germination as a measure of reduced dormancy to be 66% (confounded with any GxE variability). The average germination after one month of storage was 26 seeds per 5 g (150 seeds), or 17%. Gain from selection (assuming half-sib family selection, no pollen control, 10% selection intensity) was calculated to be 10.8% per year (equivalent to a gain of 3 seeds per year) At this rate, 80% germination would be reached in 34 cycles of selection, making this approach less desirable than the qualitative gains likely from the Z. aquatica nondormancy.

Seed Tensile Strength Variability. Again this year, we have secured funds for an Assistant Scientist Program for K-12 science teachers to work on research projects. Robert Shaner, Grand Rapids High School chemistry and physics teacher, worked for a second season on a project quantifying variability in seed tensile strength. Tensile strength (TS) began to decline sharply in the shattering population 10 days after anthesis, while TS of the two nonshattering populations declined gradually until 23 days, then more sharply. These findings should lead to improved methods for comparing and quantifying seed tensile strength and shattering resistance.

Collaborative Research with Dr. Qinqin Liu, UMD. Dr. Liu's undergraduate student, Ryan Reuter, made several crosses under my supervision between plants of sister populations which differed in proportion of female florets in the panicle. Short seed-head plants were crossed to long seed-head plants. The progeny will be selfed to determine the inheritance of the trait. I will also collaborate with Dr. Liu on further studies this summer relating to flowering biology.

Increases for Possible Release. Although we increased seed of K-2Pi, a pistillate line we were intending to release, large-plot field studies indicated lodging problems. Growers cooperating on these studies have indicated some reluctance to accept this as a variety unless lodging can be managed through fertility or reduced through breeding and selection. Shattering resistance continues to be the main characteristic sought by growers in a new cultivar. Many have reported satisfaction with "Franklin", released by the U of M in 1992, although its yield can be surpassed by other cultivars. We also began increasing SRTF1-4, which had been thought to be fixed for nonshattering (at least for one of the major genes). However, three shattering plants were found in the population of approx. 5000 plants, so a request for release of this population is not imminent.

MOLECULAR GENETIC MARKERS FOR WILD RICE

Project Leaders: Dr. Wayne Kennard, Dr. Raymond Porter and Dr. R.L. Phillips

The primary objectives of the molecular genetics project are to increase the understanding of wild rice genetics and facilitate breeding objectives through application of genetic markers. We are using markers to develop a saturated genetic linkage map and this map will be compared to maps of other cereals. We will use markers to detect location of genes controlling shattering resistance, nondormancy, and the pistillate trait. We have developed F_2, mapping populations and are emphasizing one which may contain two or more segregating loci for shattering resistance. Currently, we have screened 180 probes used as markers in white rice and have

obtained segregation data in our wild rice mapping population for 60 loci. Expected 1:2:1 segregation ratios are found with 53 of 60 loci. A preliminary linkage analysis with 60 loci indicates some colinear regions with white rice. Many other linkages are not colinear. This may be due to duplication of whole or parts of wild rice chromosomes with respect to white rice. The mapping population consists of plants qualitatively scored for shattering versus nonshattering (125:63). We will continue to saturate the map with more markers to resolve effectively the location of genes controlling traits with complex inheritance (i.e. shattering resistance). In a separate study, we are using probabilities associated with donor parent allele elimination through recurrent backcrossing to detect markers linked to genes controlling nondormancy (e.g. it is unlikely that donor parent germplasm remains in backcross lines except that which is linked to genes under selection). We evaluated three different backcross families generated by crossing nondormant *Z. aquatica* to dormant *Z. palustris* with repeated backcrossing to *Z. palustris* and selection for nondormancy for 4 to 5 generations. We evaluated 30 probes and unique DNA fragments were readily observed between *Z. aquatica* and *Z. palustris* (16 of 30 probes). Evaluation of backcrosses indicated Z aquatica DNA introgression in one of the three families (P=0.093 by chance) and one probe indicated Z aquatica DNA introgression in two of the three families (P=0.003 by chance). There is a strong likelihood this latter marker is linked to a gene controlling nondormancy. We will test other markers that are linked to this probe on the basis of the recently determined linkages in wild rice. Detection of linkage to the gene controlling pistillate is also underway. We detected a putative linkage in an open pollinated population, and are in the process of confirming this linkage in segregating F_2 and backcross populations.

WILD RICE DISEASE RESEARCH CONDUCTED IN 1996

Project Leader: Dr. Robert Nyvall

Research on diseases of cultivated wild rice focused primarily on three objectives in 1996:

1. **Disease/fertility interaction.** This research is in cooperation with Dr. Paul Bloom and involves the effect of nitrogen and nitrogen plus potassium on disease (fungal brown spot and spot blotch) incidence and severity. Research was conducted on the Ross Rennemo farm. Preliminary results indicate that inadequate fertility contributes directly to both incidence and disease.

2. **Determination of overwintering sites of causal organisms of fungal brown spot and spot blotch.** The objective of this research is to determine where and how the causal organisms survive. When this is known, an agronomic technique may be employed that will either reduce the amount of fungicide usage on wild rice or increase the yield through reduction of inoculum. Andrea Westergaard is determining the effect of grasses on overwintering and Robert Nyvall is studying other means of fungal survival. Preliminary results to date indicate that grasses may not contribute significantly to overwintering and most inoculum may arise from survival in residue or directly as survival structures on the water.

3. **Disease chronology.** The purpose of this research is to determine when during the growing season diseases occur. This information will be used to determine the proper