Project No. RB-6

ANNUAL REPORT
COMPREHENSIVE RESEARCH ON RICE

January 1, 1990 - December 31, 1990

PROJECT TITLE: Methods and Technology Development for Head Rice Improvement in California - Heritability Investigation for Three Californian Grain Types.

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LEVEL OF 1990 FUNDING: $16,500

OBJECTIVE FOR 1990:

To continue to assess the heritability and coheritability of 24 short, 23 medium, and 24 long grain lines. The characteristics to be measured are the head rice yield (HRY) for different portions of the panicle, seed dimensions and weight, panicle length, number of seeds per panicle, and number of blanks per panicle. A promising line developed by the Rice Research Station may be incorporated into the experiment.

EXPERIMENTS CONDUCTED IN 1990 TO ACCOMPLISH OBJECTIVE:

A completely randomized block design with three blocks, a nitrogen stress and nonstress condition and with three harvest times was conducted at the U.C. Davis rice facility. Twenty-four lines of short, medium and long grain types were examined with respect to their panicle characteristics. The harvesting dates were at full heading, soft and hard dough. The panicle growth rate after full heading was observed in a completely randomized block design. The lines studied were the parental, F2 and F3 generations for all grain types. A similar experiment was set up in Biggs to examine the grain filling rate, however this was largely curtailed because cross contamination of the lines shortly after flooding.

Part of the analysis of 1990's experimental results for all 24 lines of each grain type is completed. This data will be compared to that of 1988 and 1989 so that the environmental influence on milling quality and its

heritability can be quantified. The characteristics being studied are heritability and coheritability for head rice yield (HRY) of different portions of the panicle, panicle length, seed dimensions and weight and the number of blanks per panicle. The inheritance of the growth rate for the parental, F2 and F3 lines for the three grain types will be investigated together with the climatic variables most likely to affect this trait.

SUMMARY OF 1990 RESEARCH:

Heritability (h^2) values were obtained for the various panicle characteristics investigated in the 1989 experiments. High values (h^2 between 0.24 to 0.81) were obtained for the panicle length with the highest occurring in the F1/F2 and F2-F3 generation and the lowest in the F4/F5 (Tables 1-3). Similar results were apparent for the seed length, width, breadth, weight, volume, density and panicle moisture content. These results agreed fairly well with those of 1988 (r^2 between 0.55 to 0.93).

The h for the HRY for the top, middle and bottom portions of the panicle at three different harvest dates was quite variable (Tables 7-9). It was generally high for the first two generations (h^2 between 0.17 to 0.48) but low for the F3/F4 and F4/F5 lines (h^2 between 0.06 to 0.31). These results strongly suggest the milling quality may be improved through a breeding program.

The number of blanks per panicle was much higher in 1989 than in 1988 with no clear trend in h between generations being evident (Tables 4-6). There was a significant difference between 1988 and 1989's results.

The lowest h values were obtained for the panicle growth rate (h^2 = 0.06 - 0.18). The highest h occurred in the F1/F2 line. The h for the F1/F2 was generally very high for the grain characteristics (h^2 0.84-1.00). It decreased rapidly over all generations for all characteristics with values for the F4/F5 being below 0.23. There was no apparent difference in h between the stress and nonstress environment.

Co-heritability results and the correlation between HRY and selected climatic variables (air and water temperature, growth degree days) need further comparison with 1990's data to determine their utility.

PUBLICATIONS:

S. Jonkaewwattana. 1990. A comprehensive study of factors influencing rice milling quality. Ph.D. Dissertation, UCD.

D. Paige, S. Geng and S. Jongkaewwattana. 1991. An apparatus for the automatic measurement of grain weight, kernel length and thickness. Crop Science.

CONCISE SUMMARY OF 1989 RESULTS:

Heritability (h^2) values have been determined for the panicle length, panicle moisture content, seed length, breadth, width, weight, volume and density as well as for head rice yield at different harvesting dates for the top, middle and bottom portions of the panicle. The observations agree favorably with those of 1988.

The h=2 value for the number blanks per panicle varies inconsistently between generations and there is a significant difference between the years.

Generally speaking the heritability of panicle and kernel characteristics is very high, and the heritability of milling quality is lower than the other traits. In all cases, the heritability rapidly decreases with progressive generations. There seems no significant difference in heritability estimates between stressed and non-stressed environments.

Co-heritability for certain panicle characteristics has been tentatively elucidated. The purpose of the study is to enhance our understanding of the fundamental characteristics of the heredity of milling quality. It is hoped that these results will facilitate breeding efforts in improving head rice yield for California rice.

Table 1. Heritability (h=2) of Panicle Length of Long Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.843	0.914	0.887
F2/F3	0.792	0.752	0.841
F3/F4	0.315	0.325	0.292
F4/F5	0.182	0.104	0.112
		STRESS	
F1/F2	0.770	0.684	0.805
F2/F3	0.813	0.937	0.821
F3/F4	0.322	0.262	0.233
F4/F5	0.135	0.122	0.131

Table 2. Heritability (h^2) of Panicle Length of Medium Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.916	1.055	0.942
F2/F3	0.835	0.862	0.841
F3/F4	0.230	0.274	0.271
F4/F5	0.221	0.164	0.102
		STRESS	
F1/F2	1.070	0.901	0.765
F2/F3	0.803	0.872	0.882
F3/F4	0.242	0.232	0.268
F4/F5	0.166	0.211	0.122

Table 3. Heritability (h^2) of Panicle Length of Short Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.995	1.025	0.934
F2/F3	0.862	0.841	0.841
F3/F4	0.278	0.227	0.252
F4/F5	0.123	0.168	0.112
		STRESS	
F1/F2	0.697	0.843	0.912
F2/F3	0.893	0.881	0.872
F3/F4	0.293	0.284	0.286
F4/F5	0.114	0.102	0.188

Table 4. Heritability (h^2) of the Number of Blanks per Panicle of the Long Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.453	0.562	0.488
F2/F3	0.512	0.534	0.460
F3/F4	0.282	0.195	0.165
F4/F5	0.113	0.047	0.104
		STRESS	
F1/F2	0.563	0.572	0.473
F2/F3	0.518	0.612	0.484
F3/F4	0.206	0.239	0.253
F4/F5	0.225	0.143	0.185

Table 5. Heritability (h^2) of the Number of Blanks per Panicle of the Medium Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.613	0.564	0.610
F2/F3	0.563	0.625	0.547
F3/F4	0.189	0.226	0.253
F4/F5	0.102	0.168	0.152
		STRESS	
F1/F2	0.625	0.585	0.577
F2/F3	0.574	0.549	0.538
F3/F4	0.200	0.234	0.164
F4/F5	0.136	0.197	0.106

Table 6. Heritability (h^2) of the Number of Blanks per Panicle of the Short Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.635	0.643	0.628
F2/F3	0.655	0.612	0.593
F3/F4	0.273	0.275	0.260
F4/F5	0.126	0.109	0.038
		STRESS	
F1/F2	0.639	0.704	0.654
F2/F3	0.683	0.694	0.691
F3/F4	0.237	0.221	0.152
F4/F5	0.145	0.105	0.089

Table 7. Heritability (h^2) of Head Rice Yield (HRY) for the Long Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.353	0.383	0.351
F2/F3	0.418	0.392	0.350
F3/F4	0.232	0.252	0.212
F4/F5	0.172	0.246	0.185
		STRESS	
F1/F2	0.386	0.323	0.365
F2/F3	0.429	0.348	0.377
F3/F4	0.218	0.276	0.131
F4/F5	0.131	0.175	0.082

Table 8. Heritability (h^2) of Head Rice Yield (HRY) for the Medium Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.420	0.438	0.493
F2/F3	0.424	0.415	0.514
F3/F4	0.241	0.262	0.225
F4/F5	0.132	0.147	0.110
		STRESS	
F1/F2	0.486	0.428	0.602
F2/F3	0.527	0.434	0.473
F3/F4	0.231	0.255	0.226
F4/F5	0.148	0.163	0.136

Table 9. Heritability (h^2) of Head Rice Yield (HRY) for the Short Grain in 1989.

Generation	Harvest 1	Harvest 2	Harvest 3
		NONSTRESS	
F1/F2	0.545	0.473	0.534
F2/F3	0.452	0.471	0.552
F3/F4	0.279	0.308	0.246
F4/F5	0.180	0.132	0.159
		STRESS	
F1/F2	0.338	0.429	0.520
F2/F3	0.473	0.434	0.541
F3/F4	0.265	0.295	0.249
F4/F5	0.181	0.102	0.137