5th IMPB INTERNATIONAL MEETING ON PLANT BREEDING

INTEGRATED DATA ANALYSIS AS A TOOL TO REVOLUTIONIZE PLANT BREEDING

INIA URUGUAY

VARIATION OF TEMPERATURE AND RADIATION AT FLOWERING RESPONSE IN RICE

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Introduction

To provide stability in Uruguay's rice production, INIA's rice breeding program (IRBP) aims to develop varieties with high yields and tolerance to low temperature and radiation at reproductive stage.

Objective

This work aims to study the genetic parameters of this traits under a controlled environment and at the experimental field in IRBP's advanced germplasm.

Materials and methods

A population of 965 inbred lines and cultivars (395 indica and 470 japonica) was genotyped by sequencing with 50854 and 23614 SNP respectively. For a subset of 655 lines, grain yield (GY) and mean temperature and radiation at flowering stage was retrieved from historical records of yield trials with variable sowing date at El Paso de la Laguna Experimental Unit (33.27 E, 54.17 S), and grain weight (GW) after a treatment with cold stress (5 °C for 24 h at flowering stage) and without cold stress (24 °C) was measured. For both GY and GW a single-step analysis was performed fitting a mixed random regression model accounting for line, temperature and radiation (for GY) effects. Line effect was modelled with the H matrix combining the numerator relationship matrix for 13205 phenotyped lines accounting for self-breeding generations with the genotypic relationship matrix of the genotyped ones. Genetic variance and covariance for all effects was estimated.

Results and discussion

Both for GY and GW genetic variance captured by the line effect was the highest (87,990,000 kg2 and 95,705,000 kg2 for GY and 1.23 g2 y 0.97 g2 for GW for indica and japonica respectively). The general response effect in GY per °C at flowering represented a variance of 137,760 kg2 for indica and 151,600 kg2 for japonica, while the variance of the response at each hour of sun was 157.23 kg2 for indica and 171.56 kg2 for japonica. The variance in GW per °C at flowering was 0.002 g2 for both subspecies. The line effect covariated negatively both with the response to temperature (-3,323,900 kg2 for GY and -0.04 g2 for GW) and to radiation (-97,133 kg2 and -105,280 kg2 for GY). The genetic covariance between the response to changes in temperature and radiation is positive (2,945.6 kg2 for indica and 3,191 kg2 for japonica), which implies that lines with sensitivity to one factor are also sensitive to the other.

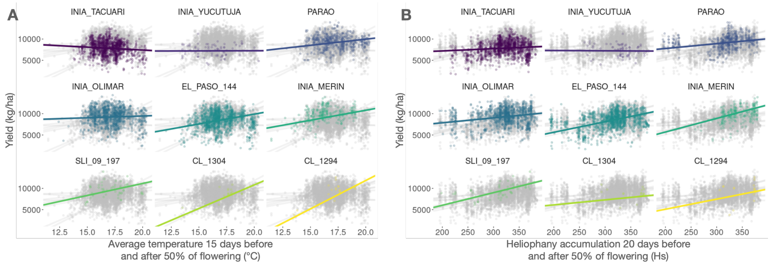

Figure 1. Response to average temperature during the period of 15 days before and 15 days after flowering, under average radiation conditions (A) and to the accumulation of radiation during the 20 days before and 20 days after flowering, under average conditions of temperature (B) of some varieties and selected advanced lines.

The correlation between line and response to temperature effects for GY and GW was low (-0.17 and -0.28 for indica and -0.04 and -0.12 for japonica respectively).

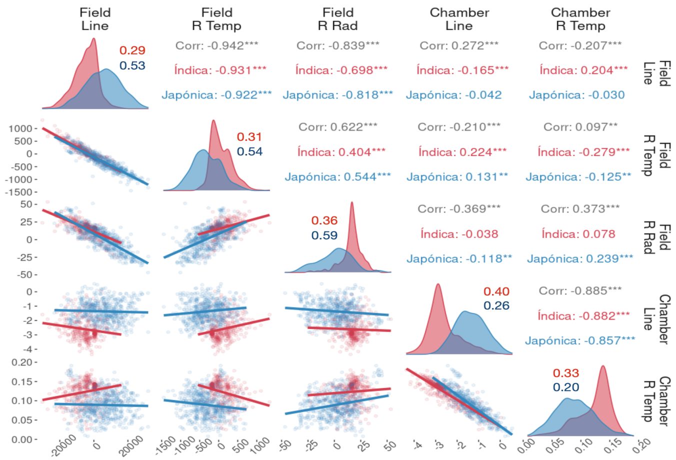

Figure 2. Distribution of the predicted phenotypic values for the deviations of the average performance in the line effect in field conditions (Field Line) and Chamber (Chamber Line), response to temperature in field (Field R Temp) and chamber (Chamber R Temp) and response to radiation in the field (Field R Rad) and its heritabilities (diagonal), correlations (above the diagonal) and scatter plots (down the diagonal) for both subspecies: indica (red) and japonica (blue).

Conclusion

Our results suggest that that lines with the highest general performance are also the most stable against changes in temperature and radiation. Also, within the genetic variability of locally adapted germplasm, the response to low temperature in the controlled environment was not a good predictor of the response to low temperatures under field conditions.