Testing improved modeling solutions for cold-induced spikelet sterility in rice

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Rice is very sensitive to cold stress during the reproductive phase, especially at booting stage, during microsporogenesis (Hayashi et al 2006, Andaya et al., 2003). Flowering also is affected, as low temperatures hampered fertilization and seed set (Sanchez et al., 2014; da Cruz et al., 2013). In temperate growing areas, such as Northern Italy, North Japan, South Australia and Korea, yield losses due to cold-induced spikelet sterility can reach values up to 30-40% (da Cruz et al., 2013; Imin et al., 2004). Modelling approaches accounting for cold stress events during the pre-flowering period are available, as those implemented in the crop model WARM (Confalonieri et al., 2009). Instead, the MODEXTREME component, implementing a library of approaches for the impact of weather extremes, provides approaches to reproduce the impact of cold stress occurring around anthesis.

The objective of the study was to evaluate whether the inclusion of the MODEXTREME component in the WARM modeling solution would lead to an improvement of the estimates of rice yield losses due to cold-induced spikelet sterility.

Data provided by Ente Nazionale Risi – field trials carried out in five years, with *Indica* and *Japonica* varieties, in two locations in Northern Italy (nine datasets) – were used for the evaluation. The inclusion of the MODEXTREME component improved the estimates of yield losses for cold-induced spikelet sterility in seven datasets out of nine (up to 20%; R^2 between simulated and measured values: 0.76), highlighting the relevance of considering also the impact of cold stress around flowering. The models implemented in the MODEXTREME component showed a high responsiveness to temperatures, estimating significant yield losses when temperatures are slightly below the temperature threshold for spikelet sterility. Further improvement may thus involve the inclusion of dedicated functions to modulate the intensity of the simulated damage.

References

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