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Climate change, variability and extreme events : risk assessment and management strategies in a Peach cultivated area in Italy.

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Climate change in Mediterranean area is likely to reduce precipitation amounts and to increase temperature thus affecting the timing of development stages and the productivity of crops. Further, extreme weather events are expected to increase in the future leading to significant increase in agricultural risk. Some strategies for effectively managing risks and adapting to climate change involve adjustments to irrigation management and use of different varieties.
We quantified the risk on Peach production in an irrigated area of "Emilia Romagna" region (Italy) taking into account the impact on crop yield due to climate change and variability and to extreme weather events as well as the ability of the agricultural system to modulate this impact (adaptive capacity) through changes in water and crop management.
We have focused on climatic events causing insufficient water supply to crops, while taking into account the effect of climate on the duration and timing of phenological stages. Further, extreme maximum and minimum temperature events causing significant reduction of crop yield have been considered using phase-specific critical temperatures.
In our study risk was assessed as the product of the probability of a damaging event (hazard), such as drought or extreme temperatures, and the estimated impact of such an event (vulnerability). To estimate vulnerability we took into account the possible options to reduce risk, by combining estimates of the sensitivity of the system (negative impact on crop yield) and its adaptive capacity. The latter was evaluated as the relative improvement due to alternate management options: the use of alternate varieties or the changes in irrigation management.
Vulnerability was quantified using cultivar-specific thermal and hydrologic requirements of a set of cultivars determined by experimental data and from scientific literature. Critical temperatures determining a certain reduction of crop yield have been estimated and used to assess thermal hazard and vulnerability in sensitive phenological stages. Cultivar-specific yield response functions to water availability were used to assess the reduction of yield for a determinate management option.
Downscaled climate scenarios have been used to calculate indicators of soil water availability and thermal times and to evaluate the variability of crop phenology in combination with critical temperatures. Two climate scenarios were considered: reference (1961-90) and future (2021-2050) climate, the former from climatic statistics on observed variables, and the latter from statistical downscaling of general circulation models (AOGCM). Management options were defined by combinations of irrigation strategies (optimal, rainfed and deficit) with use of alternate varieties.
As regards hydrologic conditions, risk assessment has been done at landscape scale in all soil units within each study area. The mechanistic model SWAP (Soil-Water-Atmosphere-Plant model) of water flow in the soil-plant-atmosphere system was used to describe the hydrological conditions in response to climate and irrigation.
Different farm management options were evaluated. In a moderate water shortage scenario, deficit irrigation was an effective strategy to cope with climate change risks. In a severe water shortage scenario, the study showed the potentiality of intra-specific biodiversity to reduce risk of yield losses, although costs should be evaluated against the benefits of each specific management option.

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