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ENHANCING DROUGHT TOLERANCE IN PERENNIAL RYEGRASS

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Perennial ryegrass (Lolium perenne L.) is one of the most important forage and turf grass species in temperate regions worldwide. Its yield and persistency will be severely affected by global climate change, because it reacts sensitive to heat and drought. We studied the tolerance for periodical drought in various L. perenne genebank accessions and in breeding material in rain-out-shelter experiments. Based on this, six genotypes gradually differing in drought response were selected and crossed in a diallelic way (tolerant x tolerant and susceptible x tolerant). In total 14 crossing populations were produced, and the F1-progenies with 140 individual genotypes per population were phenotyped in rain-out-shelters in 2017 and 2018 at two sites (Malchow/Poel, Freising/Pulling, Germany). These where compared to the parent plants and standards in an augmented randomized block design. Drought phases were applied twice a year (early spring and midsummer) by keeping the soil moisture below the permanent wilting point for six weeks. One half set of genotypes was cultivated under field conditions at each trial site. Biomass formation before and after cut, heading date, disease as well as drought susceptibility were scored on a scale from 1 (lowest) to 9 (highest). Biomass yield was determined after cutting and oven-drying at 60 °C for two days.

At Malchow/Poel, an increasing differentiation in biomass development within and between the crossing populations became visible during the experiment. The biomass scoring in November 2018 revealed a low share (13-37 %) of genotypes with medium to high vitality (score 4-9) but a high share of dead plants (32-62 %) in worst performing crossings. In contrast, best crossing populations still exhibited a high number of medium to very vital genotypes (80-90 %) at the end of the experiment in 2018. These observations were consistent with the harvested dry matter. Comparisons of the results from the field and rain-out-shelter identified three crossing populations which produced high yield under natural conditions and were amongst the highest yielding populations after drought stress in the shelter. The results obtained at Malchow/Poel coincide well with the results recorded at Freising/Pulling. From ten crossing populations the most tolerant genotypes were selected at the end of the experiment, multiplied and included as new drought tolerant L. perenne accessions in the IPK Gene Bank. Furthermore, based on results from populations sharing a common parent, we identified parent plants which were very successful in producing drought tolerant progenies.

Keywords: Lolium perenne L., drought tolerance, phenotyping

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ANALYSIS OF THE FREQUENCY OF DISTRIBUTION OF THE RELATIVE IRRIGATION SUPPLY INDEX IN THE WATER USERS ASSOCIATION OF SECTOR BXII OF THE LOWER GUADALQUIVIR RIVER

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The Relative Irrigation Supply index (RIS) allows the evaluation of water use from the applied water and the estimation of the water needs of the crops. This work analyzes the tail of the RIS distribution frequency in the area of Sector BXII of the Lower Guadalquivir, where previously the irrigation needs were estimated by remote sensing for the spring campaign of 2017 and the data of the hydrants of each plot for the same period were analyzed. If the index is greater than 1 it will indicate over irrigation and if it is less, deficit irrigation. Sector BXII is characterized by being a marsh area with a typically Mediterranean climate where crops are grown throughout the year and where the high salinity of the soil requires salt washing tasks with some frequency. 56% of the plots obtained a RIS between 0.8 and 1.2, so it was considered that the applied irrigation was around the water needs of the crops and the agricultural management of the area. 13% of the plots had a RIS <0.8 and 30% a RIS> 1.2. In this work, all the plots with a RIS greater than 1.2 and less than 0.8 were examined. For this purpose, satellite images for the study period, the supervised crop classification used to estimate irrigation needs and the database of the Water Users Association (WUA) were re-evaluated. From this information, common errors were identified in the infra and overestimation of the RIS values obtaining the following results: in 43% of the plots with RIS> 1.2, other crops not declared in the WUAs database were detected, 24% were incorrectly classified, 19% declared horticultural crops whose irrigation needs were not taken into account by the classification, and 14% assumed that the farmer made an over use of water. This error, the smallest in percentage, was more common as RIS values approached to values of 1.2. As for the plots with values of RIS <0.8, in half of the cases the application of deficit irrigation was detected in crops such as cotton, sunflower and wheat and the remaining 50% was divided between an error in the crop classification or the presence of horticultural crops not detected by the supervised classification.

Keywords: Water management, Remote Sensing, Monitoring tools, Crop management, Horticulture

0080

MAIZE MONOCULTURE UNDER MEDITERRANEAN CONDITIONS: ASSESSING THE EFFECT OF DIFFERENT IRRIGATION AND TILLAGE SYSTEMS

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Irrigation is a needed for most of the summer crops under Mediterranean conditions. In the NE Spain, maize (*Zea mays* L.) is one of the predominant summer crops, and usually cultivated under intensive tillage practice and in different irrigations systems. Therefore, the objective of this work was to assess the impact of two irrigation systems (i.e. sprinkler irrigation, S, and flood irrigation, F) and three different tillage systems (i.e. conventional tillage, CT, no-tillage maintaining the crop stover, NTr and no-tillage maintaining the crop stover, NT) on the performance of maize crop on a four year monoculture (2015-2018).

Over the four years, S irrigation resulted in an increase of 15% of the maize yield compared with F irrigation, with an average grain yield value of 14.76 and 12.49 Mg ha^{-1} for S and F irrigation, respectively. In contrast, tillage system only presented significant differences in two of the four years, observing a trend to obtain greater grain yields under CT tillage system. On average of the four years, CT increased grain yield by a 6% compared with both no-tillage systems.

Likewise, grain nitrogen use efficiency, NUEg, was 18% greater under S irrigation than under F irrigation, respectively, over the four maize growing season. However, the different tillage systems showed similar NUEg values, presenting average NUEg values over the four years of 55, 53 and 54 kg N kg^{-1} grain for CT, NTr and NT, respectively. Grain water use efficiency, WUEg, showed the largest difference between irrigation systems, being 30% greater under S irrigation compared with F irrigation. However, during the four maize seasons, tillage systems did not show significant differences in WUEg.

The greater irrigation frequency provided by S irrigation favored a steadier soil water content values and allowed to apply less irrigation water compared to F irrigation. This fact explained the highest grain yield observed in S irrigation and thus the greater efficiency in the use of N and water compared with F irrigation.

This work highlight the importance of an adequate selection of irrigation system, and showed the feasibility of no-tillage together with sprinkler irrigation as an alternative to conventional tillage for maize monocultures under Mediterranean conditions.

Keywords: Irrigation system; conventional tillage; no-tillage; NUE; WUE

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OPTIONS TO ENHANCE WHEAT YIELD AND WATER PRODUCTIVITY IN A MEDITERRANEAN RAINFED ENVIRONMENT BY AGRONOMIC INNOVATIONS

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Wheat is the main staple food crop grown in the Mediterranean rainfed regions, but productivity is insufficient to meet the demand. The existence of large attainable yield gap suggests potential for increasing wheat yield in the region. However, high variability in inter- and intra-season rainfall presents a big risk for the farmers to invest in best practices. Optimizing genotype selection, seeding time, and crop demand-based water management have the potential to alleviate the risk associated with rainfall variability and enhance the stability of yield.