EVALUATING CROP WATER STATUS FOR GUAR USING WINDS MODEL

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In the western states of the U.S., including Arizona and New Mexico, water is a limited resource, making deficit irrigation one of the highly adopted agriculture practices. Additionally, researchers are now considering drought tolerant crops as alternatives to overcome water stress. One of the drought tolerant crops is guar, a legume that is sun-loving and perfect for arid regions. With limited moisture in soil, it faces delays in maturity but doesn't die. It takes about 120-150 days until harvest, for the indeterminant variety. Guar has a multitude of products including guar gum, fodder, vegetable, and green manure. Over the years, there has been an increase in industrial interest for its gum. In this experiment, guar was grown in 2018 at New Mexico State University Agriculture Research Center in Clovis, New Mexico using split-split Randomized Complete Block Design (RCBD) with 3 factors. The first factor was pre-irrigation condition where one condition was giving 5 inches of water to the field, and the other condition was with no water given to the field before sowing. The second factor involves four irrigation treatments; namely, full irrigation, water stress at vegetation stage, water stress at reproductive stage, and rainfed. The third factor includes 2 different cultivars of guar: Kinmen and Monument. For this study, only Kinmen cultivar was considered. The crop water status was additionally assessed by estimating the normalized difference vegetation index (NDVI) using a multispectral sensor carried on a drone. The NDVI values were correlated to soil moisture content. The crop coefficient (Kc) for guar was another parameter that was outdated and not available for the study area. The study developed the crop coefficient for guar and with a total of 8 treatment combinations and modeled using WINDS model (Water-use, Irrigation, Nitrogen, Drainage, and Salinity). It is a computer-based tool that runs by soil-water flux and energy distribution equations. Crop coefficient, Evapotranspiration (ETc), soil moisture, soil water depletion, and an irrigation schedule were simulated from the model. Guar was harvested 137 days after planting and the results show the developed Kc values as 0.4, 1.14, and 0.267 for Kc_initial, Kc_mid and Kc_end, respectively. These values are very close to the FAO-56 coefficient values for legumes. Furthermore, the model results depicted correlation with the measured soil moisture and due to rainfall in the year 2018, the crop did not get much water stressed at any of the growth stages. The cumulative difference between the rainfed and full irrigation treatments was 200 mm. The results of NDVI showed great potential to precision using remote sensing. The overall crop water status shows that guar is an excellent drought-tolerant crop and based on weather prediction, lesser irrigation can also be given.

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