"Subsurface Drip Irrigation, Deficit Irrigation Strategies, and Improved Varieties to Improve Alfalfa Water Use Efficiency"

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Alfalfa producers in many irrigated regions must develop strategies to maximize water productivity (kg/ha per mm of water) when water supply varies from year to year due to periodic droughts, excess water demands, or climate change. Partial yields may be feasible for alfalfa under drought conditions, unlike other crops where complete failure is likely. Summer deficit irrigation or mid-season cut-offs utilizing irrigation systems with greater efficiency, such as subsurface drip irrigation (SDI) may be practical solutions to easing seasonal water supply fluctuations and restrictions. The objective of this research was to determine the possible interaction between cultivar and deficit irrigation utilizing SDI technology. Fifteen commercial or newly released alfalfa varieties were established fall, 2014 at Davis, CA using a split plot design with four replications with four different irrigation regimes utilizing SDI. Irrigation treatments were: 1) Full - 100% of ET_c, 2) 75% of ET_c with an August cutoff, 3) 75% of seasonal ET_c, -fully irrigated to 50% of seasonal ET_c, then 1⁄2 of full irrigation for the remainder of the season, and 4) 50% of ET_c –with a July cutoff. Over three years of data collection (2015-2017), yields averaged 90% of fully-irrigated plots when receiving 50% water application and averaged of 96% of the fully-watered yields at 75% of full water applications. The results showed that varieties differed significantly in yield potential ($P<0.05$), but there was no significant interaction between variety and deficit irrigation strategies, indicating no particular advantage in drought tolerance to any of these lines tested. Key aspects of the significant tolerance to late season deficits in alfalfa are likely due to 1) alfalfa's deep rooted characteristics, 2) utilization of residual moisture on clay-loam soils, 3) lower late-season yields even if fully watered, lessening the impacts of deficits during that period. There was little consistent excess damage to crop stand resulting from deficits at the end of the trial at this site, but this may differ significantly dependent upon soil type and location. Economically, stand decline due to water deficits are likely to be more important than short-term yield impacts, and although stand impacts were not seen in this trial, we have observed stand impacts due to deficits under desert conditions on commercial farmer's fields. While alfalfa is a crop well-suited for deficit irrigation strategies, soil type and environment are likely to be important factors in determining deficit irrigation success. This data supports the concept of late-season deficit irrigation strategies as a means to adjust alfalfa production techniques to water uncertainties and restrictions in the future.