WISCONSIN– Assessing Alfalfa Resilience to Drought

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Alfalfa is the most important forage legume produced for high-quality hay and silage for dairy and beef cattle. Extreme climate conditions such as drought can result in a loss of yield and acres. The lowest national alfalfa yield, area harvested, and total production in the last 15 years was reported during the extreme 2012 drought. Thus, it is critically important to develop alfalfa production systems resilient to climate extremes. Alfalfa resilience is the ability of an alfalfa system to withstand and keep producing under climatic crisis. Understanding alfalfa resilience to drought is necessary to minimize risks. This is a portion of an Alfalfa Seed & Alfalfa Forage Systems (ASAFS) research project to study the resilience of alfalfa cultivars to drought and traits associated with alfalfa resilience.

Alfalfa plots and rainout shelters at Arlington, summer 2020.

Methodology. Drought stress field experiments were established in 2019 in Arlington, WI, and Klamath, OR. For each, 24 cultivars were used, based on their diverse morphological and physiological traits. Each cultivar was evaluated under drought stress using rainout shelters (WI) and reduced irrigation (OR) and normal conditions (normal rain in WI and full irrigation in OR) in a completely randomized block design. Total DM yield of each cultivar was determined and compared between stress and no-stress plots for the first production year (2020). The DM yield of stress plots were divided by yield of no-stress plots to calculate resilience.

Preliminary Results. Mean forage yield across cultivars from cumulative water stress and no-stress plots is given in Table 1. In the first harvest, there were no water stress treatments in WI or OR. As the season progressed, cumulative water stress increased, therefore, forage yield declined with 2nd and 3rd harvests in WI. The mean forage yield in the water stress treatments was 85% and 63% of the no-water stress treatments at 2nd and 3rd harvests in WI. A cumulative water stress of 51% resulted in 82% forage yield in the stressed treatment in WI. The trend was similar in OR, where decreased forage yield was associated with increased water stress. Irrigation was 60% in the 2nd harvest, 75% in the 3rd, and 50% in the 4th harvest. A cumulative water stress of 43% resulted in 91% forage yield in the stressed treatment in OR. We found variability in yields under drought among cultivars (data not shown). A second year of data collection is ongoing and cumulative effects of drought will be evaluated.

Table 1. Means of DM yield (kg/ha) under drought stress and normal water management and estimated resilience to drought (RD) for 24 cultivars grown at Arlington and Klamath during 2020 (2nd year). Stress refers to cumulative water deficit (excluded from rainout shelter or deficit irrigation) expressed as percent of cumulative water in normal treatment.

	Arlington, WI				Klamath, OR			
Harvest	% Stress	Drought Stress	Normal (rainfall)	RD	% Stress	Drought Stress	Normal (irrigation)	RD
1	0	2866	2994	0.96	0	8347	8370	0.99
2	43	3582	4317	0.85	28	5507 b	6116 a	0.90
3	51	1704 b	2692 a	0.63	40	4431	4807	0.92
4	-	-	-	-	43	2927 b	4230 a	0.69
Total*	***51***	***8153 b***	***10003 a***	***0.82***	***43***	***21212***	***23522***	***0.91***

Means followed by different letters in a row within each location are different at $P \leq 0.05$.
*Statistical analyses on the cumulative biomass.