Resilience, Stability, and Productivity of Alfalfa cultivars in Wisconsin

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Climate change is a major issue for agriculture and food security. For livestock production, productive, resilient and stable forages are needed, which can endure increasingly frequent climatic crisis like drought and persist on the long term. Most research on forages historically has focused on yield, resistance to diseases and tolerance to extremes (winter hardiness). However, relatively little attention has been paid to maximizing the ability to recover after a major climatic crisis event (like drought) or minimizing long term variability of yields.

The main goal of this paper is to study the resilience (ability to recover from a crisis) and stability (minimal long term variability) of various alfalfa cultivars in Wisconsin, in order to identify cultivars that optimize these features. We hypothesize that 1) some cultivars are more resilient to drought and more stable in the long term than others; 2) trade-offs may exist between maximizing yield vs resilience and stability over time.

The methodology for this study was to analyze historic data from alfalfa variety trials conducted at the University of Wisconsin, over the last 20 years. Mayor climatic events (like droughts in summer) were identified from the meteorological record of the experimental stations. Quantitative measures for resilience and stability for each cultivar were calculated for those cultivars with longer historic records. Resilience was defined as the ratio between the yield on the year of the drought over the average long term yields for each cultivar. Stability was defined as the inverse of the variance coefficient of the series for each cultivar. Productivity was the average yield for the series.

Differences in resilience and stability were quantified. Few cultivars were included in the analyses, because of rapid turnover of cultivars in the seed industry. In order to conclude about tradeoffs, this study should be expanded to more locations and cultivars in the future. This methodology allowed to identify cultivars with different long term features. This can be useful for farmers because it provides information to choose cultivars that can be more profitable over the long term. This results can be incorporated into plant breeding to develop materials more adapted to climate change.