

# Physiological and Morphological Bases for Breeding Dual-purpose Wheat Cultivars with Improved Forage Production



In Texas, wheat is planted on 5-6 million acres of which 30 to 80% is grazed and 10 to 40% used exclusively for forage.

Fluctuating climate and varieties developed strictly for grain production may contribute to low economic return.

By developing cultivars with increased forage production, balanced with grain yield potential, producers will be given more flexibility in decision making on how to use the wheat crop to maximize the net return in dual-purpose systems.

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**This research project is being conducted in cooperation with [Dr. Jackie Rudd](#) (Texas AgriLife Research and Extension Center, Amarillo, TX) and [Dr. William E. Pinchak](#) (Texas AgriLife Research and Extension Center, Vernon)**

## Rationale

Wheat historically has been bred for increased grain yield and for tolerance to abiotic (drought, soil mineral imbalance) and biotic (insects, pathogens) stresses. Although grain yield potential of modern cultivars is higher than older cultivars, breeding progress for forage production, forage quality, and grazing has been very limited. Texas A&M University has released only one variety (Lockett) bred exclusively for grazing and one dual-purpose (TAM-202) wheat variety. The lack of adequate selection criteria has hampered breeding efforts to develop improved forage-type and dual-purpose wheat varieties.

Because of a lack of clearly defined selection criteria for breeding forage-type wheat, breeders usually rely on forage quantity and quality during the fall-spring growing season as selection tools. Such an approach may not be the most appropriate to develop disease and insect resistant, productive cultivars with a maximal potential to withstand various grazing pressures and climate fluctuations.

There are several criteria determining the potential of forage production in wheat. Leaf appearance rate (phyllochron) affects the number of leaves on a tiller and the tillering rate. The phyllochron of wheat is strongly related to air temperature, soil water availability, and nitrogen supply. Tillering rate and final tiller number depends on cultivar characteristics, especially hormonal regulation (auxins), and seeding rate. Leaf

morphology determines leaf area, which is often correlated with plant biomass. The rate of leaf area development is closely associated with embryo size, so selection for large embryo size should improve early growth rates. Selection for leaf width, however, may not be beneficial under drought; thus, traits like glaucousness or rapid leaf rolling in response to water deficit should be considered. Residual leaf area following defoliation has been considered more important for regrowth of grasses than the pool of nonstructural carbohydrates; therefore, our candidate lines should have at least the first leaves on tillers placed horizontally (to avoid being grazed). Following defoliation, residual leaves should express a high degree of compensatory photosynthesis in order to maximize regrowth rate after grazing.

A forage-type, dual-use wheat has to be resistant to pests and foliar diseases. Such resistance is often related to production of secondary metabolites such as phenolic compounds. Recent results suggest phenolic compounds may be one group of metabolites in wheat forage controlling frothy bloat, a serious digestive disorder of cattle grazing wheat. In an independent series of studies (Malinowski, Min, Pinchak 2003-2005), we evidenced a relationship between rapid changes in solar radiation and temperature (e.g., during passing cold fronts) and phenolic concentration in wheat forage. Frothy bloat incidences usually amplify during conditions of rapid weather changes in the late winter-early spring season. Previous research evidenced the importance of foam stability in the rumen for the potential of frothy bloat (Gregory and Auricht, 2003). We showed that wheat entries with low phenolic concentrations exhibited an increase in foam strength measured *in vitro*.

## **Objectives**

The objective of this study was to determine morphological and physiological traits for selection of dual-use wheat with improved forage productivity. In this presentation we discuss correlations between forage production in the early grazing season (November-December) and wheat plant morphological parameters, and phenolic concentrations in wheat cultivars and breeding lines.

## **Summary of Results**

D.P. Malinowski, Kramp, B.A., Min, B.R., Baker, J., Pinchak, W.E., and J.C. Rudd. 2006. [Physiological and morphological traits for selection of dual-use wheat with improved forage production](#). Southern Conservation Systems Conference. 26-28 June 2006. Amarillo, TX.

## **Funding Sources**

Texas Wheat Producers Board (2003-2005)  
Texas AgriLife Research

[Forage Systems Program Homepage](#)