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Wheat's Versatility in Farming Systems

Winter wheat in Kansas is well adapted to the weather and soils, fits well in crop rotations, and brings a number of benefits beyond the value of the grain (Simão et al., 2024). Nevertheless, wheat acres are declining in the state at an average of about 1.9% per year since 2005 (Figure 1). This decline is predominantly due to increases in acreage of summer crops that offer greater technological options for growers (for example, genetically modified traits, and availability of hybrids). Summer crops may be more profitable, in part, due to new markets such as biofuels and increased demand by other countries. Kansas producers may miss the cropping benefits that wheat brings. This publication describes the versatility winter wheat brings to farming operations.

On-farm versatility

Because winter wheat is planted in the fall, it goes through many months of vegetative growth before the start of reproductive development. Grain yield is not as sensitive to suboptimal management during this early vegetative growth. This creates opportunities for increased flexibility, enabling farmers to implement both tactical (in-season) and strategic (long-term planning) management practices that are unique to systems where winter wheat plays an integral role.

Wide optimum sowing window. Winter wheat, especially in warm regions like south central Kansas and into Oklahoma, has a wide optimum sowing window. Planting dates spanning 50 to 66 days allow the crop to reach near optimum yields (Figure 2). This happens because typical fall weather is fairly warm, allowing the crop to tiller well and have a low penalty in yield potential (up to 1 bushel per acre per day when sowing past late October) even if planted at a later date. This wide window allows farmers to wait for rain when needed, or to finish other important farm operations, such as harvesting a summer crop, before winter wheat planting. This window is narrower in northern and colder regions such as north central and northwest Kansas and into Colorado, where the onset of colder fall temperatures is earlier and the penalty to yield potential is as steep as 2.8 bushels per acre per day when sowing after early October.

Flexibility in wheat class and sowing time. In northwest Kansas, farmers may grow either spring or winter bread wheat varieties, increasing flexibility for crop adaptation to environmental conditions. This can be valuable, for example, if a dry fall precludes growers from planting the winter wheat crop, or if the economics of growing spring wheat are better that year. Likewise, in southeast Kansas, farmers have the option to grow either hard or soft red winter wheat varieties, providing flexibility for adaptation to market conditions (for example, if soft wheat prices and grain prospects are more attractive than hard wheat).

Nitrogen fertilization timing. Recent research has shown that winter wheat can fully recover from early season nitrogen deficiency as long as the nitrogen is in the root zone and available to the crop near jointing (Figure 3). Some of the nitrogen-deficient wheat crops outyielded their counterparts receiving preplant nitrogen, suggesting a benefit from delaying nitrogen applications versus applying it preplant or early fall.

This research, originally conducted in Oklahoma (Souza et al., 2022), suggested that even after nitrogen

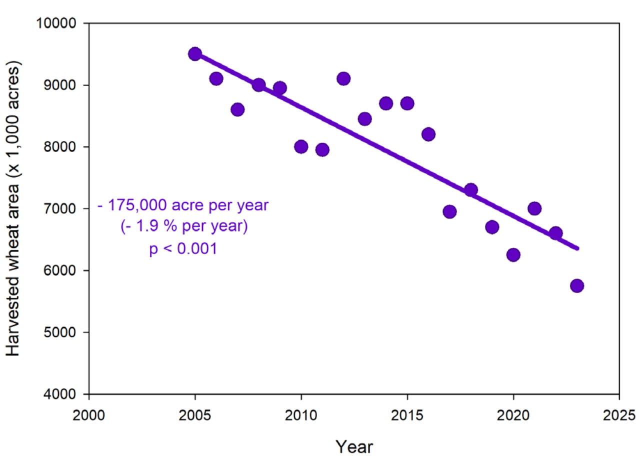

Figure 1. *Kansas winter wheat harvested area from 2005 to 2023 as reported by the United States Department of Agriculture National Agricultural Statistics Services.*

Kansas Wheat Rx is a prescription for economical and sustainable production of high-quality winter wheat in Kansas.

Wheat Rx is partnership between Kansas Wheat and K-State Research and Extension to disseminate the latest research recommendations for high-yielding and high-quality wheat to Kansas wheat farmers.

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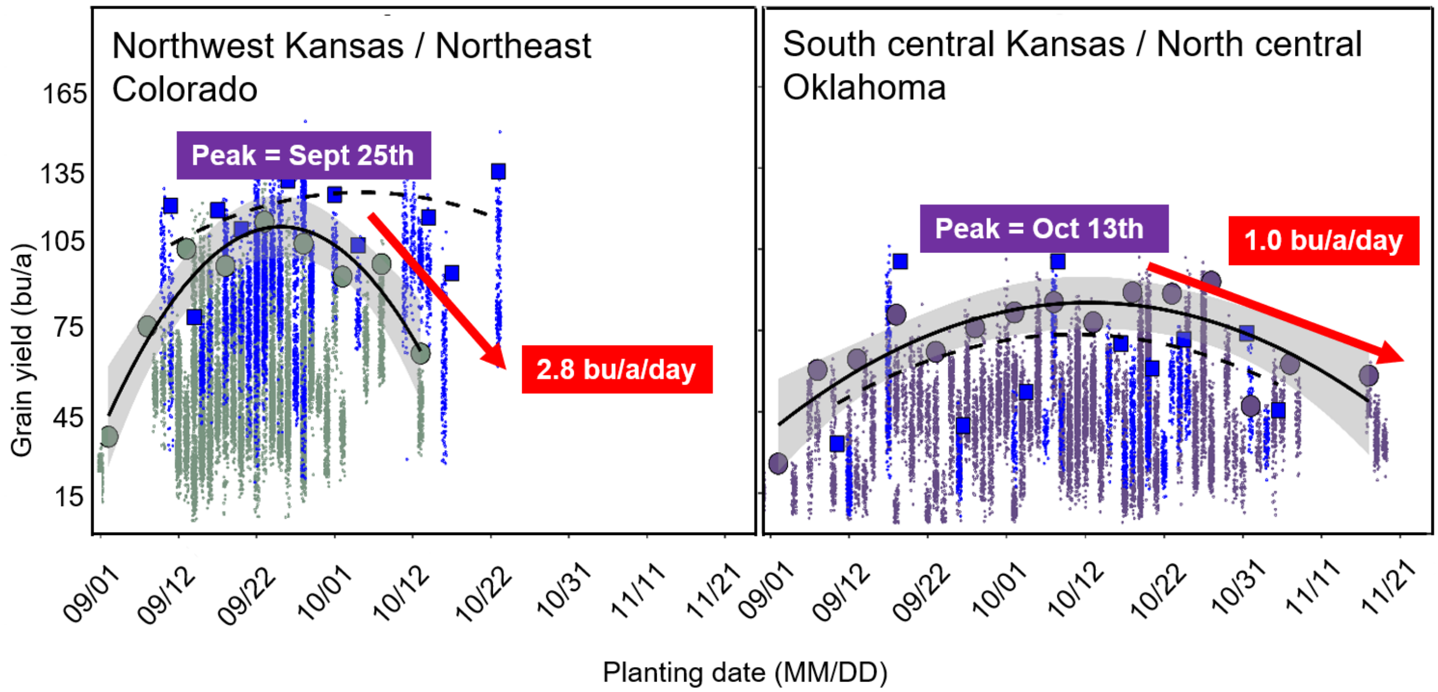

Figure 2. *Winter wheat grain yield as a function of sowing date for northwest Kansas/northeast Colorado (left panel) and south central Kansas/north central Oklahoma (right panel). Planting date resulting in peak grain yield is shown in the purple rectangle and decline in yield potential (bushels per acre per day) is indicated with red arrow and rectangle. Analysis performed with variety performance data and adapted from Munaro et al., 2020.*

deficiency was visually diagnosed, the crop that received a recovery nitrogen application outyielded the crop receiving preplant nitrogen when this application occurred from about 120 days before, to about 20 days after, occurrence of the first hollow stem. Nitrogen deficiency in later stages, from second node to about heading stages (or 20 to 60 days after first hollow stem) resulted in large yield losses and underperformed the crop that received preplant nitrogen.

The relative lack of yield sensitivity to nitrogen-deficient conditions during the vegetative and early reproductive stages provides flexibility regarding the timing of nitrogen fertilization. Growers can wait to plan this activity according to weather conditions to try to maximize nitrogen uptake by the crop. Winter wheat can handle early nitrogen deficiency and recover well. Remote sensing technologies that assess crop status in early spring have great potential for nitrogen management by using tailored nitrogen rate recommendations.

Dual-purpose capability. Wheat's resilience to early-growth stress makes it suitable for dual-purpose production, serving both as high-quality forage for animal production during the fall and winter, and as a grain crop afterward. Wheat provides nutritious forage with high protein content and digestibility, allowing for livestock gains when other forages are not widely available. Wheat also supports substantial livestock stocking rates, enabling significant daily weight gains (see more details in Lollato et al., 2017). This flexibility is a significant advantage for farmers in Kansas and the southern Great Plains, since it also brings market flexibility. Dual-purpose farmers may decide to completely graze out the wheat crop should market conditions be favorable for cattle as opposed to wheat. This decision can be aided via partial budgets of expected grain and beef production and prices.

Soil cover with residue. The amount and quality of the residue produced by wheat and left in the field after harvest are unique and can improve chemical and physical soil characteristics. A high density of stems per unit area ensures a protective layer against soil erosion, and a high carbon-to-nitrogen ratio increases the life span of the wheat residue. Maintenance of the wheat residue on the soil surface can reduce evaporative water losses, and reduce soil temperatures due to shading. Wheat residue attenuates the emergence and development of weeds due to a physical barrier, and chemical mechanisms such as the release of allelopathic compounds. Finally, standing wheat stubble can capture and retain snowfall, increasing soil water content for subsequent crops.

Added revenue from wheat residue. Some growers may choose to bale wheat residue for hay to use as animal feed or to sell for added revenue. Baling wheat residue is more common in wetter states where the water conservation of wheat residue is less beneficial than in drier regions, such as Kansas. Wheat residue can cool the soil and delay the planting and emergence of summer crops.

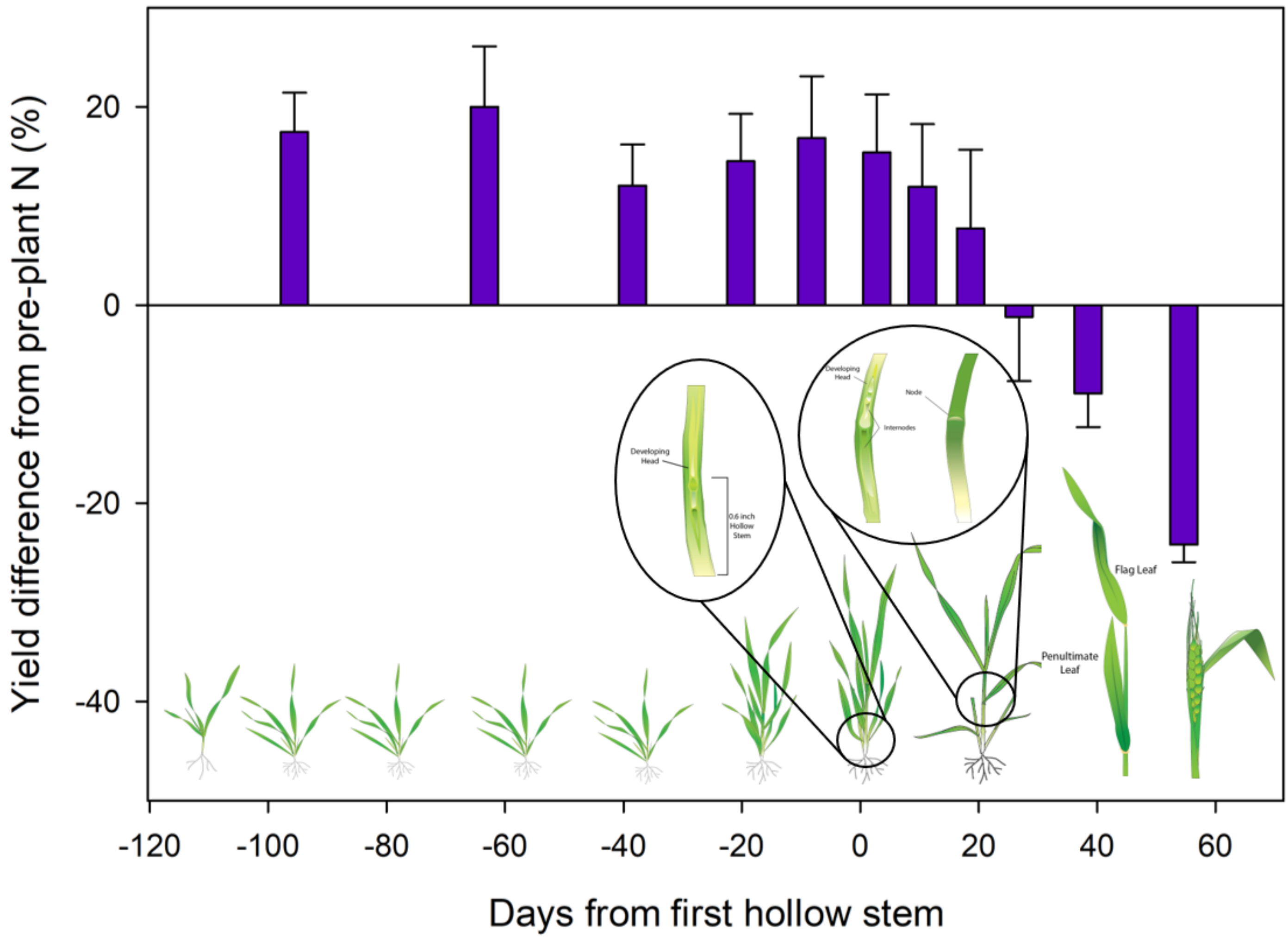

Figure 3. *Difference (%) in winter wheat grain yield in recovery applications (after nitrogen deficiency was diagnosed) versus preplant nitrogen application as function of time in the growing season (days from first hollow stem, with zero indicating date when crop reached first hollow stem). Inset figures demonstrate the approximate growth stage of the crop. Data adapted from Souza et al. (2022) and Simão et al. (2024).*

Double-cropping opportunities. Winter wheat allows for intensification of cropping systems in regions such as Kansas, where the harvest of a summer crop can be followed immediately by the sowing of winter wheat or vice-versa. Intensification of cropping systems allows more cash crops to be grown within the same time period.

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