Does Grain Sorghum Preceding Winter Wheat Affect Productivity?

John Fenderson - Technical Product Manager/WestBred® wheat

**Background:** Winter wheat is commonly double-cropped following grain sorghum where moisture and the calendar permit. Winter wheat is the most widely planted crop across the Great Plains and is a key component in today’s cropping systems that include warm season grasses like grain sorghum and corn along with broadleaf crops like soybeans, cotton and sunflowers. Crop rotations that include complementary warm and cool season plants have proven effective for limiting the potential buildup of certain weeds, insects, diseases and, in some cases, allelochemicals that may limit productivity. In the southern parts of the Great Plains and High Plains, grain sorghum is a common rotational crop with winter wheat, which raises questions and concerns since sorghum plants are known to produce allelochemicals.

What are allelochemicals and allelopathy? "Allelopathy is a biological phenomenon by which an organism produces one or more biochemicals that influence the germination, growth, survival and reproduction of other organisms. These biochemicals are known as allelochemicals and can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms and the community. Allelochemicals are a subset of secondary metabolites which are not required for metabolism (i.e., growth, development and reproduction) of the allelopathic organism. Allelochemicals with negative allelopathic effects are an important part of plant defense against herbivory."[1]

Research conducted in arid and semiarid regions of the world has studied the interaction of winter wheat and sorghum species since they are commonly grown in similar climates and on the same fields. Research has focused on the magnitude of yield reduction in winter wheat and, to a lesser extent, emergence and vigor of seedling wheat plants.

Research conducted by Roth et al.[2] at Kansas State University found that grain sorghum preceding wheat reduced yield of hard red winter varieties by 10-25%. They also discovered that tilling sorghum (chopping it up) after harvest slowed wheat emergence and growth but did not significantly reduce wheat yield. Wheat yields were lower in all circumstances after sorghum compared to seeding on fallow ground or in no-till pearl millet stubble. No-till wheat planted into standing sorghum residue did not display slower emergence and growth but did exhibit significantly reduced wheat yields in 11 of 14 comparisons versus a fallow treatment. In all circumstances, moisture was adequate and soil fertility was equalized based on soil test values for
each planting system, indicating that neither moisture nor fertility were yield-limiting factors. These results indicate that tilling sorghum residue soon after harvesting speeds up release, leaching and degradation of allelochemicals from sorghum residues, while leaving harvested sorghum plants standing and intact delays the release of allelochemicals and ultimately affects winter wheat yield more than when tilled. However, both production practices resulted in lower wheat yields than non-sorghum rotations.

Since sorghum has demonstrated the ability to negatively affect wheat yields, what are the best options to improve wheat yield potential after sorghum? Kansas State University research suggests finely chopping and incorporating sorghum residue as soon as possible after harvest and delaying wheat planting (within reason). This may reduce sorghum allelochemical effects on winter wheat yield potential.

However, tilling residue is not an option for many no-till producers due to conservation plans, lack of equipment or the conviction that any tillage is too much tillage. When tillage of sorghum residue is out of the question due to no-till production practices, an early-maturing sorghum variety planted early and terminated early—utilizing herbicides—may reduce the effect of allelochemicals and improve wheat yield potential. Hard data is not available to quantify a reduction in the allelopathic effects of sorghum on wheat when terminated in the late summer or early fall. But intuitively, increasing the time between crop termination and wheat planting may have a beneficial effect. Kansas State University research supports the idea of improved winter wheat yields with early sorghum crop termination. Their research demonstrated an 11-12% increase in winter wheat yields when sorghum was terminated early with glyphosate[3] but did not attribute the yield increase to any specific factor.

References