The Oklahoma Cooperative Extension Service

WE ARE OKLAHOMA

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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EXTENSION

Impacts of Winter and Summer Crop Selection on the Performance of Double-crop Systems

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Double-crop systems are one of the most important and productive systems in Oklahoma. Double-cropping typically entails planting a summer crop following the harvest of a winter crop, allowing growers to harvest two crops within a single year. The success of this system is primarily due to the state's ability to produce a high-yield potential winter crop as well as a typical extended fall conditions to allow for the summer crop to grow, produce and mature prior to the first major freeze. A traditional double-crop system utilizes winter wheat as the winter crop and soybean as the summer crop. However, the conditions in Oklahoma allow for the integration of several other summer crops into this double-crop system, such as grain sorghum, sesame or even corn. In addition, canola is considered a viable alternative to wheat during the winter crop season. While information regarding a wheat-soybean double-crop system is widely available, less information is available on rotations with other summer crops or when winter canola is substituted for winter wheat within the system. Therefore, an evaluation was conducted to determine if there was an "optimum" rotation for each crop within a double-crop system in Oklahoma.

Field Trials

Trials were conducted at the North Central Research Station near Lahoma in 2015 and 2016 and Cimarron Valley Research Station in Perkins in 2016 and 2017, yields were averaged among years and locations. Both winter wheat and winter canola were evaluated as potential winter crops, while soybean, sesame, grain sorghum and corn were evaluated for summer crops. Winter canola was planted during the last week in September. As a means to minimize variability between the two winter crops, the winter wheat plots were planted the same day. The winter crops were planted at 75 pounds and 3 pounds of seed per acre of Gallagher and DKS 46-15 for winter wheat and winter canola, respectively. Each winter crop was managed in accordance to OSU Extension in-season recommendations. As the winter canola crop was harvested, on average, two weeks prior to the winter wheat crop, an additional treatment was established that also evaluated winter

Table 1. Impact of double-crop rotation on crop yield, emergence percentage and early season vigor from multi-year, multi-site study.

Summer Cash Crop	*Previous Crop*	*Yield (lbs/ac)*	*Emergence (%)*	*Seedling Vigor*
Grain Sorghum	Wheat	2,406A	65	5
	Canola	4,127A	70	8
	Delayed Canola	3,634B	60	6
Soybean	Wheat	2,046A	65	7
	Canola	1,572B	65	7
	Delayed Canoloa	984C	40	5
Corn	Wheat	3,747A	70	7
	Canola	3,267B	74	9
	Delayed Canola	2,397C	55	4
Sesame	Wheat	626B	60	3
	Canola	856A	85	8
	Delayed Canola	774C	50	5

Different letters indicate significant yield differences within the summer crop.

canola as a winter crop, but planting for the summer crop was delayed until the remaining winter wheat plots were planted. For summer crops, due to seed availability, a different cultivar was used each year of the evaluation. However, all other planting practices were maintained. Seeding rates of 127,500; 94,500; 45,500 and 24,500 seed per acre were planted for soybean, sesame, grain sorghum and corn, respectively. All summer crops were planted on 30-inch row-spacing. As a means to minimize edge effect between different summer crops, six row plots were used and evaluations were done on rows three and four. Stand counts were taken on all plots every two weeks following planting and a seedling vigor rating was assigned approximately 30 days after planting. For this document, emergence percentages 14 days following planting are presented. Grain weights were measured from the full length of rows three and four for each plot, averaged across the four replications and used to estimate yields on a per acre basis. Simple means separation was used to document differences of the winter crops within summer crops. Evaluations were not conducted within winter crops across summer crops as the magnitude differences limited comparison.

Grain Sorghum

No significant yield differences of grain sorghum existed following winter canola or winter wheat. There was a slight increase in yield behind winter wheat but this increase was less than 100 pounds per acre and well within the error range. Delaying planting behind canola did result in a significant yield decrease compared to timely planting behind either wheat or canola. Emergence for the grain sorghum was slightly lower behind winter wheat compared to canola and early season vigor was much lower behind winter wheat. This included more delayed maturity, slower canopy development and slight chlorosis early in the season. With these challenges earlier in the season, it might be expected that yield would be negatively affected. However, potential moisture savings from the residue cover were evident later in the season. This data demonstrates both the challenges and benefits associated with these different winter crops. Grain sorghum is typically planted as shallow as soil moisture will allow for timely emergence. If proper planting equipment is not utilized, heavy residue can be a major obstacle for achieving adequate stands and early growth. However, the moisture retained with plant residue can be beneficial later in the season. While grain sorghum is considered a more drought-tolerant crop, moisture stress can still occur and could will limit yields. Therefore, the residue can be a great asset in the system. It is evident that either winter crop could be utilized in double-crop sorghum production but growers must understand the obstacles with each winter crop.

Soybean

Soybean yields were significantly higher following winter wheat compared to winter canola, with yields decreasing nearly 500 pounds per acre following canola compared to wheat. Another significant decrease in yield was found when soybean planting was delayed behind canola harvest. This delay of planting resulted in approximately 600 pounds per acre reduction in soybean yield. It should be noted there were no differences in soybean emergence or early season vigor following winter wheat and canola. Therefore, the differences in yield were potentially associated with the benefits of residue and soil moisture dynamics. These results suggest winter wheat may be a better option for double-crop soybean production. However, there are producers who have made canola-soybean double-crop systems successful. In more semi-humid or humid environments, such as those on the eastern portion of the state, where in-season moisture is more predictable and consistent, this system may still have viability. However, in more arid environments, canola-soybean double-crop systems carry a greater risk due to potentially higher moisture stress.

Corn

Similar to soybean, there was a significant yield decrease when corn was planted behind canola compared to behind winter wheat. Corn planted behind wheat had slightly lower emergence and low early-season vigor compared to canola. As this did not negatively influence yields, it could be assumed the residue provided some value later in the season. While moisture savings due to the residue could be a potential reason for the improved performance, it also could be the differences in the planting system. Corn is a relatively new and unique summer crop in a double-crop system. In a normal system after harvest of the winter crop, the planting of corn is typically delayed until early to mid July. This allows the crop to progress through critical growth stages (tasseling through grain fill) during generally more favorable conditions experienced during September and October. This means corn planted after canola would have been planted several weeks earlier than recommended planting periods. The lack of residue provided by the canola crop paired with crop going through critical growth stages during more unfavorable conditions could have contributed to the yield decline. The data with the delayed canola planting further showed while later planting is typically required for this system, doing so behind canola could negatively impact the corn crop. This information shows wheat should be the preferred winter crop rotation in a double-crop system with corn.

Sesame

As opposed to other crops discussed, sesame yields were significantly higher behind canola compared to behind winter wheat. It should be noted, while delaying planting behind canola did significantly decrease yield compared to timely planting following canola, this delayed planting still significantly increased yields compared to behind winter wheat. Two potential factors could contribute to the advantages of following canola. First, a similar impact was seen for both emergence and early-season vigor. Sesame planted behind wheat had thinner stands and delayed canopy development. The delaying planting, paired with slower early growth, could have resulted in the decreased yields. Furthermore, full-season planting for sesame typically occurs during the latter half of May. This means planting behind canola more closely matched the typical planting window. While the difference in planting often was only two weeks to three weeks, harvest maturity often was a month or more. This resulted in the sesame behind wheat maturing in more unfavorable conditions than when planted earlier. Therefore, if sesame is planted as a second crop behind wheat, growers need to ensure planting equipment is adequate to achieve early stands and growth as well as they use a variety that will mature prior to the risk of early freeze events.

Planting Behind Canola

Across all crops, delaying planting after canola harvest consistently decreased yields. Due to the lowered amount of residue following harvest of canola, these two weeks of potentially high surface evaporation could have been the reason. Therefore, if planting a double-crop behind canola, it is best to plant with available moisture as soon as the crop is harvested.

Summary

Overall, both winter wheat and canola can be used as a winter crop in a double-cropping system. Likewise, all four summer crops evaluated would be a suitable option. However, it should be noted there are several options that have fewer challenges associated with different systems. The primary factor of suitability arises from two factors, 1) the ease of crop establishment and requirement for rapid early-season growth and 2) the need for residue in-season to help with moisture conservation. Based on the observations of field trials, sesame did better following canola than following wheat, grain sorghum had no differences between canola and wheat, while corn and soybean performed better following wheat than canola.