WINTER WHEAT INTERCROPPING AND DOUBLE-CROPPING SYSTEMS

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Relay-intercrop production involves overlapping growth cycles of two or more crops. This production system is common with legumes seeded into small grains; however, the companion crops may compete for water, nutrients, and sunlight, which may slow development of either crop. Relay-intercropped soybean production involves seeding wheat in the fall and an intercrop seeding of soybeans into standing wheat. This cropping system has been proposed to reduce risk associated with double-crop soybean production, move double-crop production farther north, and increase farm profitability. Diversifying crops used in a relay-intercropping system may allow farmers more crop production choices.

The objectives of this research were to 1) evaluate winter wheat inter- and double-crop production systems using a variety of alternative crops, 2) evaluate the impact of 7.5 and 15 inch wheat row spacings within the intercropping systems and, 3) evaluate the difference between early broadcast and later planted alternative crop seedings.

Applied Questions

1. Does intercropping into wheat decrease yields of either crop alone?
2. How do crops differ in their tolerance to an intercropping system compared to full-season or double-cropping?
3. Do the yields of alternative crops compensate enough to make these cropping systems profitable?
4. How does 15 inch row wheat affect wheat and intercrop yields?

Methods

In 2011, a project at the Greenley Memorial Research Center (Novelty, Missouri) was initiated to evaluate intercropping and double-cropping various crops into winter wheat and continued for a second growing season through 2013 and 2013. 'MFA 2525' was planted on 3 October 2011 and 11 October 2012 at 100 lbs/acre in 7.5 and 15 inch rows following conventional tillage. Ammonium nitrate was spread on all plots at a rate of 100 lbs N/acre on 1 March 2012, and on 3 October 2012 diammonia phosphate and potash at 31 lbsN/acre, 80 lbs P2O5/acre, and 120 lbs k2O/acre. On 4 April 2012 and 21 February 2013, buckwheat at 55 lbs/acre, tillage radishes at 6 lbs/acre, sunflowers at 5 lbs/acre, hairy vetch at 35 lbs/acre, and fava beans at 200 lbs/acre were broadcast as well as planted (John Deere 7200, Moline, IL) in 15 inch rows into wheat.

In a separate experiment, cowpeas at 50 lbs/acre, soybeans at 180,000 seeds/acre, peas at 30 lbs/acre, hairy vetch at 35 lbs/acre, red clover at 10 lbs/acre, grain amaranth at 10 lbs/acre, grain sorghum at 10 lbs/acre, and pearl millet at 15 lbs/acre were planted (John Deere 7200,

Moline, IL) into 7.5 and 15 inch row wheat. These crops were chosen for a variety of reasons. Peas, cowpeas, fava beans, hairy vetch, and clover all legumes could provide nitrogen for the soil. The most common intercropping system is wheat and a legume such as soybean or red clover, as the nitrogen fixing properties of legumes work well with wheat and a subsequent rotational crop. Other crops including grain sorghum, grain amaranth, and sunflowers have drought tolerance and could be harvested for grain and create additional income as there are potential markets for these crops in Missouri.

Results

- Wheat yields were 70 bu/acre in 7.5 inch double-crop soybean in 2012 and 69 in 2013 (Table 1). Yields were reduced 11 bu/acre with intercropping in 2012 and 9 bu/acre in 2013. This was probably due to the reduction in wheat row spacing and physical injury due to the planter at the time of relay-intercrop seeding.
- 7.5 inch wheat intercepted 3% more light and had a leaf area index that was 0.3 greater than 15 inch wheat in 2012 (Table 2).
- In a separate experiment, an April relay-intercrop seeding reduced yields 11 to 12 bu/acre compared to an early broadcast seeding or double-crop wheat (Table 3) which was probably due to physical damage caused to the wheat during seeding of the intercrop (visual observation). However, in the second year of the experiment yields were only reduced by 3 bu/acre.
- There was no difference in wheat yields among crops that were interseeded into the wheat in either experiment (data not presented).
- We observed germination and emergence of many intercrops including hairy vetch, soybeans, peas, buckwheat, fava beans, radishes, and red clover. In 2012, once we harvested the wheat there was no survival of any of the intercrops in 7.5 and 15 inch rows. This could have been due to a competitive wheat cultivar, interference from the wheat, and hot, dry spring/summer conditions (data not presented). However, in 2013, there were healthy plants in the plots interseeded with soybeans, hairy vetch, clover, buckwheat, and fava beans.

Table 1. Wheat yields in 7.5 and 15 inch rows inter- and double-cropped with cowpea, grain sorghum, amaranth, soybean, red clover, hairy vetch, and pea for both years. Data were combined over inter-crop.

	2012			2013		
Wheat row spacing	Moisture	Test weight	Yield	Moisture	Test weight	Yield
	%	lbs/bu	bu/a	%	lbs/bu	bu/a
7.5 inch relay-intercrop	12.0	59.5	59[†]	12.0	54.6	65[†]
15 inch relay-intercrop	12.6	59.0	59	19.5	54	60
7.5 inch double-crop	12.4	59.6	70	19.9	54.7	69
LSD (*P*=0.1)	0.6	0.4	11	0.4	0.4	3.9

[†]Crop injury was observed due to intercrop seeding with a 15 inch planter.

Table 2. Light interception and leaf area index of 7.5 and 15 inch wheat in June 2012.

	2012		2013	
Light	Light interception	Leaf Area Index	Light interception	Leaf Area Index
	%	%	%	%
7.5 Inch row	77	2.7		3.4
15 Inch row	74	2.4		4
LSD (*P*=0.1)	2	0.2		0.11

Table 3. Wheat yields of broadcast, intercropping (April seeded), and double-crop systems. Data were combined over intercrops (buckwheat, sunflower, radish, fava bean, and hairy vetch).

	2012			2013		
	Moisture	Test weight	Yield	Moisture	Test weight	Yield
	%	lbs/bu	bu/a	%	lbs/bu	bu/a
Broadcast	12.7	59.5	74	14.1	55.2	55
April seeded	13.0	59.2	62	14.1	54.6	52
Double-crop	13.1	59.4	73	14.1	55	55
LSD (*P*=0.1)	NS	NS	9	NS	0.5	3.5