Corn Silage Intercropping Summary

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Much of the intercropping research at the CREC has recently focused on growing two grain crops at the same time. However with innovations in silage harvest equipment, and the increase in custom harvest acres, more options are possible for corn silage. A trial was initiated in 2018 to begin screening possible companions to pair with corn. The focus of the pairing was legume crops. The goal of the research was to find combinations that could increase the potential silage tonnage and quality. In total, 11 combinations were tested. Plots were planted to corn and the companion on the same day. The companion crops were planted in paired rows 7" on either side of the corn rows and at 66% of a full seeding rate. The corn was planted on 30" centers at 32,000 plants/ac. Due to extremely dry conditions in 2018, the overall yield with corn was quite low.

Based on the results from 2018, a larger more focused study was conducted in 2019. Field peas and soybeans were evaluated as corn silage companions in the same configuration as 2018. Plant populations of each legume were tested in an attempt to optimize the production practices of intercropped silage. Legume seeding rates were 100, 66, and 50% of a full seeding rate for each legume. Grain soybeans (Proseed 30-20 RR2Y) were used along with a dual-purpose field pea variety (Flex). The trial was fertilized as if it was a silage field, using 150 lb/ac N. The concept was to add crops that would have mature or nearly mature grain at silage harvest so that the grain would boost the protein content of the silage. A one-row corn chopper was refurbished and fitted with load cells and a hopper to weigh the resulting chopped forage. In both years, a productivity index called Land Equivalency Ratio (LER) was used to compare the production of corn silage alone, with intercrop combinations. Values greater than one indicate a net yield gain.

In 2018 every intercrop combination resulted in a reduction in corn silage yield (Table 1). Some of the companion crops produced enough biomass to overcome this reduction. Field peas, soybeans, and scarlet runner bean produced a high amount of biomass as an understory crop. Scarlet runner bean was too vigorous and competitive with the corn crop resulting in a net negative yield. Faba bean and cowpea also produced net negative yields, however this could be attributed to poor performance of the crops late in the season, coupled with early-season competitiveness. Field pea and grain soybeans produced enough biomass to overcome and surpass the tonnage of corn silage alone so they were the only companions to produce a positive LER. The comparison of grain vs. forage soybeans was interesting to study. The forage soybean never reached reproduction, so the plants were quite large and grew better than grain soybeans in the corn understory, however the lack of kernel production put them at a biomass yield disadvantage compared to grain soybeans. Field pea and grain soybeans also added to the silage quality, increasing protein content by 1.88 and 0.51% respectively. This potentially offsets substantial off-farm input investment into protein supplements.

Table 1. intercropping performance of corn with and without companion legumes in 2018.

Treatment	Corn Dry Matter	Broadleaf Dry Matter	Total Dry Matter	Corn DM Reduction	Total LER	Crude Protein	Protein Change
	ton/ac	ton/ac	ton/ac	%	%	%	%
Corn only	4.66	.	4.66	0.0	1.00	8.39	.
Forage Soybean + Corn	4.06	0.41	4.47	LER	0.96	7.55	-0.84
Forage Field Pea + Corn	3.67	1.74	5.41	32.1	1.16	10.27	1.88
Faba Bean + Corn	4.16	0.24	4.41	5.5	0.95	6.93	-1.46
Sunflower + Forage Soybean + Corn	3.39	1.16	4.55	25.5	0.98	9.22	0.83
Cowpea + Corn	4.14	0.14	4.28	3.2	0.92	8.34	-0.05
Scarlet Runner Bean + Corn	2.68	1.74	4.42	39.4	0.95	7.84	-0.55
Grain Soybean + Corn	3.48	2.23	5.71	39.1	1.23	8.9	0.51

In 2019, the corn production was much better. It was believed that this would also lead to better intercropping performance. Yet, field peas had a large impact on corn biomass production (Table 2). The corn plants were shorter for much of the year which had a cascade of effects. First, the stunted corn did not yield as well, but it also created more lanes for sunlight which in turn created a more robust field pea crop. Normally this would be an advantage, but the conditions this year were favorable for lodging, and the majority of the field peas were not harvestable with silage equipment. It is estimated that only 25% of the field pea biomass was harvested. It is possible that enough field pea biomass remained in the field to offset the corn yield reductions. In 2018 the corn yields were reduced 32% with field peas, but in 2019 the reduction was only 23%. Capturing this lodged biomass likely would have created a positive LER. Reducing the nitrogen rate in the future would likely counter lodging potential but it could also negatively impact corn silage. Soybean production had minimal impact on corn yields, however the corn was too robust in this mix. This created a poor environment for soybeans to contribute much seed production. The best advantage with soybeans was 5% more tons/ac compared to corn alone, achieved with the middle soybean population of 145K seeds/ac. For both soybeans and field peas, it appears that the lower populations were generally more favorable for the system.

Table 2. Corn silage paired with field peas or soybeans planted at different populations in 2019.

Treatment	Legume Population	Corn Stand	Legume Stand	Corn Ear Height	Corn Plant Height	Legume Height	Fresh Yield	Total LER
	target pl/ac	pl/ac	pl/ac	cm	cm	cm	ton/ac	
Corn only	0	30,855	0	89.5	261.0	0	25.4	1.00
Field Pea	330,000	28,738	353,925	91.5	238.0	134.0	19.5	0.77
Field Pea	217,800	30,704	205,549	89.3	245.0	122.5	20.6	0.82
Field Pea	165,000	31,309	194,659	95.3	270.0	122.3	23.2	0.92
Soybean	220,000	29,494	157,905	94.5	274.0	96.0	25.2	1.00
Soybean	145,200	29,645	127,958	93.3	276.0	110.3	26.4	1.05
Soybean	110,000	29,645	81,675	96.8	265.0	95.5	26.3	1.04

Overall, these results were very meager or negative compared to 2018. This system still holds promise with further optimization. One of the assumptions was that the field peas would cling or climb on the corn plants. This did not happen. Choosing a different variety or using different management strategies could enhance the field pea production substantially. Field peas could also be planted after corn emergence to reduce the competition with corn. Using wider rows or lower corn plant populations, or planting the legume in the center between rows could all be options for creating more growth opportunity for the companion crops.