Chickpea and Flax Intercropping

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Intercropping is the production practice of growing two crops in the same space in the same year. There has been a resurgence of interest in intercropping recently due to increased incorporation of soil health practices, spread of pesticide resistance, and tight agricultural margins. The ultimate goal of intercropping is to produce more yield per acre than with a single crop. The crops in this system are likely competitive with each other, meaning that the yield of a species within an intercrop will be less than if the species was grown on its own. However, when the yield of all crops in the intercrop are added together there would be a net gain. The focus of this research is planting the two crops together (same furrow) and harvesting together, with separation occurring after harvest.

Chickpea and flax intercrops have gained a lot of attention recently. Part of the attention is due to the difficulty in controlling Ascochyta blight in chickpeas. There are many anecdotal reports that indicate flax reduces the amount of Ascochyta when mixed with chickpeas. The mechanism for this reduction is unknown at this time. In 2018 and 2019, an intercropping study was established to evaluate chickpea and flax seeding rate ratios, and in 2019 fungicide applications were added to the protocol. The ratios were based on the percent of a normal seeding rate. For CDC Glas flax, the 100% seeding rate was 30 lb/ac and for Orion chickpeas the 100% seeding rate was 125 lb/ac. The fungicide in 2019 was two applications of Proline applied in early and late July. Ascochyta was scored based on observed severity of infection within a plot. Land Equivalency Ratio (LER) is a productivity index used to compare monocropping with multicropping to compare total production on a unit of land. Values greater than 1 indicate combined yields were higher than with monocropping.

Chickpea emergence was poor in 2019. As a consequence, the flax compensated for the lack of plants and vigorously branched to result in very high yields, even with low populations. Due to the low chickpea population, LER values are skewed and not representative of the individual yield components. In this study, if the intention was to produce a profitable chickpea crop, it would have failed in intercrop settings. LER values in 2018 are more representative of a typical chickpea/flax intercrop. Ascochyta pressure was very high in 2018, but no other diseases were noted in the two crops. In 2018 there was no Ascochyta present in the trial.

In 2018, the chickpea/flax system was optimized by including a higher percentage of chickpeas in the ratio (Table 1). The best performing plots had at least a 66% rate of chickpeas and either 66 or 33% rate of flax. Both combinations provided a total productivity boost of 27% or greater compared to either chickpea or flax alone. The best treatment combination (66/33) resulted in 1863 lb/ac chickpeas and 26 bu/ac flax. This was compared to 3392 lb/ac chickpeas or 35.8 bu/ac flax when each was alone. In this system the flax influenced chickpea yields more than chickpeas influenced flax. Flax yields were only reduced 25% or less by having chickpeas present in any ratio. By comparison, chickpea yields were reduced by up to 75% by having high levels of flax in the mix, and reduced 44% with the lowest flax ratio. In this case, the chickpea yields were so high under monocrop production that it may not have been economically feasible to grow it as an intercrop, depending on the cash/contract price for each species. It should also be noted that white mold existed in chickpea-only plots, but was not present in intercropped plots.

Table 1. Chickpea and flax performance alone and in different seeding rate combinations in 2018.

Treatment	Rate	LER	Chickpea Yield	Flax Yield
	% of check	%	lb/ac	bu/ac
Chickpea/Flax	66/33	1.31	1863	26.9
Chickpea/Flax	50/50	1.15	1280	26.9
Chickpea/Flax	33/66	1.14	805	32.2
Chickpea	100	1.00	3392	.
Flax	100	1.00	.	35.8
Chickpea/Flax	66/66	1.27	1657	27.4
LSD (0.05)		0.18	635	5.9

In 2019, additional seeding ratios were added, along with the inclusion of fungicide as a treatment. However, the different ratios had little effect on results due to the unpredictable resulting stand of chickpeas. The biggest takeaway from 2019 was the disease observation (Table 2). Ascochyta severity in the monocrop chickpea was 60%. The use of two fungicide applications reduced the incidence to 33%. With intercropping ascochyta severity was 29% and reduced to 18% with fungicide treatments. To put it another way, fungicide application or intercropping chickpeas reduced Ascochyta by nearly 50%. Combining the two practices reduced the disease nearly by 50% again, resulting in a total reduction of 70%.

Table 2. Chickpea and flax disease incidence and yield when grown alone or in combination in 2019.

Treatment		Seeding Ratio	Rate	Ascochyta 8/6	Total LER	Flax	Chickpea
		%chickpea/flax	lb/ac	% severity		bu/ac	lb/ac
Fungicide	1	100/0	125/0	33.8	1.00	.	1182
	2	0/100	0/30	.	1.00	38.0	.
	3	66/66	84/20	18.8	1.24	42.6	170
	4	66/33	84/10	20.0	1.13	32.9	331
	5	33/66	42/20	18.0	1.28	44.5	115
	6	50/50	63/15	13.8	1.24	39.5	247
	7	100/100	125/30	15.5	1.36	44.8	210
	8	100/66	125/20	22.5	1.40	41.5	357
	9	100/50	125/15	17.5	1.40	42.1	356
No Fung	10	100/0	125/0	60.0	1.00	.	271
	11	0/100	0/30	.	1.00	44.2	.
	12	66/66	84/20	35.0	1.38	41.1	118
	13	66/33	84/10	30.0	1.42	38.4	147
	14	33/66	42/20	32.5	1.28	44.4	72
	15	50/50	63/15	23.8	1.11	38.9	62
	16	100/100	125/30	23.8	1.15	41.4	56
	17	100/66	125/20	33.8	1.34	40.3	113
	18	100/50	125/15	27.5	1.27	37.3	116
		LSD (0.05)		11.9	0.41	6.2	135.0

Compared to no management, applying a fungicide twice brought chickpea yields from 271 to 1182 lb/a (77% yield reduction with no management). With intercropping, yields declined 64% with no other disease management. In fact, when a high proportion of chickpeas were seeded and treated with fungicide, it out-yielded monocrop chickpea plots without fungicide. Once again in 2019, chickpea yields were heavily influenced by the amount of flax, but flax was only lightly affected by the amount of chickpeas. Both years indicate efficiencies when flax is seeded at less than 50% of a normal seeding rate when intercropped with chickpeas. The chickpea ratio was best at 100 or 66% of a normal seeding rate.