26.0 Winter Wheat-Soybean Intercrop

Project duration: 2019
Collaborators: WADO

Objectives

- To evaluate agronomic performance of relay soybean in winter wheat
- To determine if different nitrogen management systems (100% in fall vs 50% in fall and 50% in spring) affect soybean nodule development

Background

Selection of a cropping system depends of several interrelated climatic, agronomic and economic factors. Compared to monocrop, intercrop systems involving a legume usually result in more benefits such as residual nitrogen, biological control of pests and diseases, weed suppression, improvement of soil organic matter and control of soil erosion. Based on timing and design of crop species, intercropping can be divided into several categories: mixed, strip, row and relay (Goldmon, 1991). Relay intercropping is where a second crop is planted into land area already occupied by the first crop such that the two species overlap for a portion of the same growing season. In Canada, winter wheat is usually seeded by mid-September (fall) and insurance seeding cut off dates depending on the region or zone. Soybean is seeded in May and is initially slow in growth and development compared to wheat as a result of cooler soil temperatures in spring. Performance of wheat and soybean in an intercrop system is largely influenced by the time of interplanting the soybean crop (Khokhar and Jeffers, 2001). Successful relay cropping of soybean is dependent on a range of factors that include: variety attributes, row spacing, soil conditions at planting and during the growing season, soil moisture availability and fertility (Goldmon, 1991). Various fertility management systems can be utilized in wheat and soybean with some producers preferring application of nitrogen in fall while conservative producers opt for split application in fall and spring to account for fertilizer losses. Another concept that measures the success of an intercrop is Land Equivalence ratio, which is a measure of the yield obtained from an intercrop in relation to yield obtained from the monocrop (Mead and Willey, 1980; Delmar, 1994). This study seeks to address possible benefits of winter wheat-soybean intercropping system with respect to yield, nodulation and land equivalence ration.

Materials and Methods

The trial was established in fall 2018 at Melita and arranged as randomized complete block design with 8 treatments replicated 3 times. Seeding of winter wheat was done on oats stubble in fall followed by soybean early in spring as per treatment layout. Preseeding herbicides were applied in fall as burnoff using 0.75 L ac^{-1} Roundup, 0.021 L ac^{-1} Heat LQ and 0.2 L ac^{-1} Merge adjuvant. Top dressing was applied on May

23rd as per protocol. Post emergence weed control in soybean was done using 0.33 L ac^{-1} Roundup on June 24th. Cutworm and grasshoppers in soybean were controlled using Lorsban and Matador at 0.03 L ac^{-1} respectively. Various data collected included plant counts at emergence, date to growth stage 30 of wheat, flowering dates, soybean nodule count per plant, head count, days to maturity, wheat lodging score, plant height at maturity, test weight and yield. These data were analyzed using Minitab 18 and means separated by Fisher's LSD at 10% level of significance. Interaction plots were also examined between soybean and wheat. Treatment materials are presented in Table 26a.

Table 26a. Treatment materials for winter wheat- soybean trial in 2018/19

TRT #	Treatment description	Plant population	Fertility N in row of winter wheat	Spring Application
1	Soybean row crop	16 000 ppa in row	Inoculant	No
2	Soybean solid seeded	18 000 ppa	Inoculant	No
3	Winter wheat-Soybean	16 000 ppa in row	50% Fall, 50% Spring	254 g Agrotain WW
4	Winter wheat-Soybean	16 000 ppa in row	100% Spring	508 g Agrotain WW
5	Winter wheat-Soybean	16 000ppa in row	100% Fall	No
6	Winter wheat mono	250 p m^{-2} in row	100% Fall	No
7	Winter wheat mono	250 p m^{-2} in row	50% Fall, 50% Spring	380 g Agrotain
8	Winter wheat mono	250 p m^{-2} in row	100% Spring	805 g Agrotain

Soybean seeded into winter wheat on May 10 2019 at Melita

Results and Discussion

Table 26b presents findings from the winter wheat- soybean trial in 2018/19 growing season. Treatment 5 (winter wheat-soybean with 16000 plants ac^{-1} and 100% fall N) had significantly (P=0.011) more heads m^{-1} compared to other treatments. The mean number of heads for this treatment was 110.5 compared to 75.67 for treatment 8 (winter wheat monocrop with 250 plants m^{-2} and 100% spring applied N). Wheat yields (row) for treatments 3, 4 and 5 were significantly ($P<0.0001$) higher than treatments 6, 7 and 8. Land equivalence ratio for wheat (field) was significantly higher for treatment 4 (1.0571) compared to treatment 3 (0.9146) and 5 (0.9153). Total land equivalence ratio for wheat and soybean was also significantly higher for treatment 4 compared to treatment 3 and 5. Treatment 3 received 50% N in fall, 50% N in spring and 234g ac^{-1} agrotain but did not have significant differences in LER with treatment 5 which received 100% N in fall only. Treatment 5 recorded an average of 10.633 nodules per plant, which was significantly ($P=0.057$) more than treatments 1 (4.633 nodules), 2 (3.5 nodules) and 4 (6.37 nodules). These results suggest contrasting outcomes in whether or not applying all nitrogen requirements in fall, spring or split application with or without agrotain has benefits in winter wheat-soybean intercropping system. It is important to note that results from this study are only from the first year of the study but there seem to be promising data that could be useful to producers interested in pursuing winter wheat-soybean intercropping systems as an alternative to improve soil health and maximum utilization of land. Additional site years are required in order to make recommendations on whether producers should pursue this cropping system under Prairies weather conditions

Table 26b: Analysis of variance for winter wheat-soybean intercrop agronomic performance in 2019

Trt	Height Cm	WhHeads m^{-1}	TestWt $500g^{-1}$	WhYield kg ha^{-1} (row)	(field)	WhLER (field)	SoYield kg ha^{-1}	SoLER	TOTAL LER	SoNodules $plant^{-1}$	SoEmerg plants m^{-1}
1	*	*	*	*	*	*	2230	*	*	4.633**c**	17
2	*	*	*	*	*	*	2717	*	*	3.5**c**	10
3	58	86.17**b**†	367	4756**a**	3171	0.9146**b**	204	0.074	0.989**b**	9.23**ab**	14
4	57	93**ab**	369	5244**a**	3496	1.0571**a**	152	0.057	1.114**a**	6.37**bc**	21
5	55	110.5**a**	373	4816**a**	3211	0.9153**b**	198	0.070	0.9851**b**	10.633**a**	9
6	54	77.17**b**	371	3508.3**b**	3508	*	*	*	*	*	*
7	54	80.33**b**	368	3462.1**b**	3462	*	*	*	*	*	*
8	51	75.67**b**	365	3311**b**	3311	*	*	*	*	*	*
P values by Treatment											
1,2,3,4,5										**0.057**	0.430
3,4,5,6,7,8	0.151	**0.011**	0.114	**<0.0001**	0.537						
3,4,5					0.505	**0.058**	0.590	0.672	**0.089**	0.404	
1,2										0.486	
6,7,8					0.640						

†Values sharing the same letter within the same column are significantly different. WhHeads= wheat heads, TestWt=test weight, WhYield=wheat yield, WhLER= wheat land equivalence ratio, SoYield= soybean yield, SoLER= soybean land equivalence ratio, SoNodules= soybean nodules, SoEmerg= soybean emergence. P values significant at alpha 0.1 level.

Winter wheat-soybean intercrop at WADO 2019

References

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