

Alfalfa Lignin Modification Doesn't Affect Disease Resistance

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Lignin in plant stems provides strength and rigidity to keep plants upright. In alfalfa, lignin increases with plant maturity, reducing ruminant animal foliage digestibility. Lignin also plays a role in disease resistance by forming a barrier to inhibit pathogen growth once infection has occurred, reducing disease severity. However, this disease resistance mechanism has not been investigated in alfalfa. Experiments were conducted to determine if reduced lignin content in alfalfa would affect foliar disease resistance.

Four Roundup Ready alfalfa varieties, 54R02, DKA43-22RR, WL 355.RR, and reduced lignin variety 54HVX41, were planted in three Minnesota locations (Becker, Rosemount, St. Paul). During the first production year, plants were evaluated at four maturity stages (early bud, bud, early flower, flower). At each stage, 10 randomly selected stems were scored for percent leaf loss as a measure of disease severity. Over the season, all stages were evaluated two times (Harvest 1 & 2) and commonly occurring alfalfa foliar diseases were rated.

Occurrence and severity of foliar diseases varied over time and by location (Table 1). Spring black stem and leaf spot (SBSLS) was observed throughout the study, not just in spring. It was the most damaging disease overall, causing significant leaf loss and broken stems. The pathogen also infects the alfalfa crown, causing crown rot and killing crown buds, making SBSLS the most destructive alfalfa foliar disease. While most foliar pathogens persist on fallen leaves that are rapidly degraded, the SBSLS pathogen persists on crowns and lower stems, producing millions of spores infecting foliage regrowth. Leptosphaerulina leaf spot (LLS) and common leaf spot (CLS) were also seen through the season and increased in severity later in the summer. Summer black stem and leaf spot (SuBSLS) was most prevalent late in summer, particularly at Rosemount.

Table 1. Occurrence and severity of foliar diseases: SBS, LLS, CLS, and SuBS.

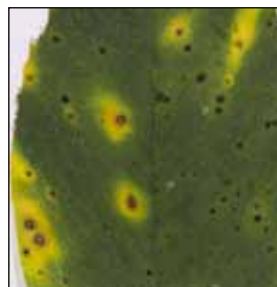
Location	June				July				Aug				Sept			
	SBS	LLS	CLS	SuBS	SBS	LLS	CLS	SuBS	SBS	LLS	CLS	SuBS	SBS	LLS	CLS	SuBS
St. Paul	2	2	0	0	2	0	0	1	2	0	3	2	4	0	4	0
Becker	0	3	4	0	4	2	2	1	0	3	4	0	0	4	5	2
Rosemount	2	3	0	0	4	3	0	1	3	3	4	4	2	4	3	2

0 = no disease; 1 = very low amount of disease, occasional symptom on a few stems; 2 = low amount of disease, occasional symptom on most stems; 3 = moderate amount of disease, symptoms on 25-50% of leaves; 4 = high amount of disease, symptoms on >50-75% of leaves; 5 = very high amount of disease, symptoms on all leaves.

SBSLS – small brown-black spots & yellowing of leaflets.



LLS – tan centers & large yellow halos.



CLS – irregular margins of spots.



SuBSLS – large chocolate brown spots.



Disease severity depended on location, but also on the interaction of location with alfalfa maturity and harvest timing. In all locations, leaf loss amount caused by diseases increased with maturity (Table 2). When harvest was delayed to flowering stage, up to 64% leaf loss occurred. This result is in agreement with the long-standing recommendation to harvest the crop early when high levels of foliar leaf spots are observed. Early harvest reduces leaf loss and removes infected material that can be the source of new infections.

When analyzing percent leaf loss across all locations, there was a significant effect of variety with location and maturity stage. Some varieties differed for the amount of foliar disease observed at some maturity stages (Table 3). For example, at Becker 54R02 at the early flower stage had significantly more leaf loss than other varieties. However, this was fairly unusual. For most maturity stages and most locations, there were no significant differences between the reduced lignin variety 54HVX41 and the other varieties for percent leaf loss. These results indicate the HarvXtra trait did not affect foliar disease resistance.

Table 2. Average % leaf loss of alfalfa at four maturity stages.

Location	Maturity	Harvest	
		Harvest 1	Harvest 2
		-----% leaf loss-----	
Becker	Early Bud	34 cdA	25 eB
	Bud	37 cA	40 cA
	Early Flower	46 bB	57 bA
	Flower	53 aB	64 aA
Rosemount	Early Bud	24 eA	16 fB
	Bud	32 dA	32 deA
	Early Flower	31 dB	56 bA
	Flower	42 bB	64 aA
St Paul	Early Bud	31 dA	8 gB
	Bud	36 cdA	28 eB
	Early Flower	37 cA	31 deB
	Flower	38 cA	32 dB

Values followed by a different lowercase letter are significantly different ($P<0.05$) by maturity stage. Values followed by a different uppercase letter are significantly different ($P<0.05$) between harvest 1 and 2.

Table 3. Average % leaf loss of four alfalfa cultivars at four maturity stages.

Location	Cultivar	Maturity			
		Early Bud	Bud	Early Flower	Flower
		-----% leaf loss-----			
Becker	54R02	28 abC	40 aB	57 aA	62 aA
	DKA43-22RR	30 aD	39 abC	48 bB	55 bA
	54HVX41	30 aD	36 abC	53 bB	59 abA
	WL 355.RR	29 abD	39 abC	48 bB	58 abA
Rosemount	54R02	21 bcD	32 bC	42 cB	56 abA
	DKA43-22RR	19 bcD	30 bC	44 bcB	52 bcA
	54HVX41	21 bcC	33 bB	44 bcA	49 cA
	WL 355.RR	19 bcD	33 bC	43 bcB	55 bA
St Paul	54R02	19 bcC	32 bB	39 cdA	36 dAB
	DKA43-22RR	18 bcB	31 bA	34 dA	32 dA
	54HVX41	17 cC	34 abAB	30 dB	37 dA
	WL 355.RR	24 bB	30 bA	34 dA	35 dA

Values followed by a different lowercase letter are significantly different ($P<0.05$) by cultivar. Values followed by a different uppercase letter are significantly different ($P<0.05$) by maturity stage.

This study demonstrates the need for improving alfalfa foliar disease resistance due to their large impact on leaf loss, particularly at later maturity stages. Several highly effective fungicides are available for alfalfa, but must be applied before symptoms are visible and need to be applied multiple times each year to protect newly developed foliage.