

SOIL SOLARIZATION, SOIL AMENDMENTS, AND SEED TREATMENTS INCREASE LUPIN YIELD

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Summary

The objectives of this experiment were to study the effect of soil solarization in factorial combination with chicken litter soil amendment and/or seed treatments on agronomic traits and root/hypocotyl rots. Soil solarization and soil amendment/seed treatments had a positive effect on yield and some yield components.

Key words : soil solarization, *Lupinus albus* L., biocontrol, yield

Introduction

White lupin has potential as an alternative winter grain/silage crop for Alabama. Disease surveys have shown lupin emergence and stands to be reduced by root and hypocotyl rots. Fungi isolated from diseased tissue have been: *Rhizoctonia solani*, *Fusarium solani*, *Fusarium oxysporium*, *Pleiochateta setosa*, *Pythium* spp. and *Macrophomina phaseolina*. Fungicide seed treatments have been used to control soilborne diseases of lupins in different geographic regions around the world (1-4). The objective of this study was to evaluate the effects of soil solarization in factorial combination with soil amendments and/or seed treatments on stand establishment, seedling disease, yield and yield components.

Materials and methods

A field experiment was conducted at the Plant Breeding Unit of E. V. Smith Research Center, Tallassee, Alabama. The sandy loam soil had previously been cropped to lupins. The experiment was a factorial treatment design within a RCBD (6 blocks) with factors soil solarization and soil amendment and/or seed treatment (chicken litter, Rival™ [Captan + PCNB + Thiabendazole] seed treatment at a rate of 2.5 ml kg seed⁻¹, Kodiak [B. subtilis GB03] seed treatment (Gustafson Incorporated, Plano, Texas) applied at the rate of 1.8 g kg seed⁻¹. Chicken litter (2.6 % N, .33% P, 2.25% K) was manually spread over the plots at a rate of 6 Mg ha⁻¹, then incorporated in the soil by rototilling. Soil solarization was carried out on July 27 by mulching 10 m² plots of pre-irrigated soil with 0.4 mm clear polyethylene plastic. Soil temperature was recorded weekly at 5 cm and 20 cm depths. Cultivar Lunoble was planted on 15 October, 1993.

Results

Solarization was carried out for a total of 79 days. Maximal soil temperatures at 5 and 20 cm were 51.6 and 39.6, and 40 and 31°C for solarized and nonsolarized soil plots at 5 and 20 cm, respectively. All treatments were effective compared to the untreated control (Table 1). The highest yield was obtained with treatment No. 5. Soil solarization significantly increased stand counts and yield, and yield components related to branches. Main stem yield components were not affected. The B. subtilis GB03 seed treatment resulted in marginally lower root and hypocotyl rot ratings and a correspondingly higher grain yield than the fungicide (Rival™) treatment.

Conclusions

Soil solarization shows promise as a management strategy of increasing plant stand and yield of lupin, however more research is needed on using this technique in treating large acreage and use of other biological control agents, organic amendments, plant residues, or green manures to improve the pesticidal efficacy of soil solarization.

Table 1. Treatment means, significance levels for linear contrast among soil solarization, soil amendment, and seed treatment means, and experimental error. All effects were tested against MSE because the solarization x soil amendment/seed treatment interaction was non-significant.

No.	Treatment		Grain yield kg ha ⁻¹	Plants m ⁻²	Yield Components				Hypocotyl/ root rot rating		
	Solarization	Soil/Seed			Grain yield - g		Grain No. - mg			Seed Mass - mg	
			Main	Branch	Main	Branch	Main	Branch			
1	Control	Control	1935.7	8.5	92.9	23.0	454	117	323.4	152.5	1.86
2	+	Litter (L)	2644.5	14.2	79.5	15.6	373	77	235.7	235.5	1.45
3	+	Kodiak (K)	2412.5	14.3	65.9	16.6	324	83	232.0	217.3	1.23
4	+	Rival (R)	2685.0	13.9	76.8	16.1	412	80	237.1	220.8	2.00
5	+	L+K+R	2845.2	13.1	87.9	19.2	406	95	280.3	188.7	1.75
6	+	None	2427.8	14.1	82.4	17.1	403	88	252.9	200.5	1.88
7	-	None	2045.5	10.9	83.3	24.7	394	123	330.5	160.5	1.88
8	-	Litter (L)	2089.3	10.2	86.8	20.3	439	106	289.7	197.3	1.90
9	-	Kodiak (K)	2002.5	11.1	87.5	20.9	412	105	296.3	177.8	1.46
10	-	Rival (R)	2274.0	11.2	87.4	23.7	410	115	324.2	156.2	1.75
11	-	L+K+R	2325.3	12.4	82.5	16.5	413	88	246.9	200.3	1.18
Contrasts											
Controls (1,7) vs. treatments (2-6,8-11)			0.01	0.01	0.45	0.05	0.32	0.05	0.97	0.03	0.16
Solarization (2-6) vs. non-sol. (7-11)			0.01	0.01	0.17	0.01	0.10	0.01	0.01	0.01	0.70
Kodiak (3,9) vs. Rival™ (4,10)			0.05	0.87	0.50	0.64	0.30	0.77	0.52	0.7	0.10
Exp. Error with 50 df			105570	5.8	389	33	10227	223	4528	3250	0.10

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