

Alfalfa autotoxicity의 농도관련 및 특성

건국대학교 농업자원개발연구소

정일민*, 김기준, 김광호, 안종국

CONCENTRATION DEPENDENCY AND CHARACTERIZATION OF ALFALFA AUTOTOXICITY

The Research Institute of Agriculture Resources, Kon-Kuk University

Ill-Min Chung* Ki-June Kim, Kwang-Ho Kim, Joung-Kuk Ahn

Objectives:

To determine which alfalfa plant parts contains the most autotoxic substances, to evaluate the effects of various concentrations of water extracts on seed germination and seedling growth, to determine whether soil microorganisms are involved in autotoxic reduction in alfalfa growth, to evaluate the allelopathic potential of soil in which vetch and rye were the crops preceding alfalfa, to study how aqueous extracts of leaves and an inhibitory substances, affects water uptake was studied.

Materials and Methods:

Bioassay by using leaves, stems, roots, flowers, seeds, and soils was sampled from the area where the alfalfa plants were grown. Each part was soaked in 100ml distilled water to give concentrations of 3, 6, 9, 12g (w/v). Soil test by collecting alfalfa vegetative, reproductive stage which was divided into sterilized and non-sterilized, and vegetative stage vetch and rye soil. Water uptake was studied by soaking one gram alfalfa seed for different time in leaves aqueous extracts. All of the above studies were repeated twice with CRD. Tested alfalfa seed was WL-320.

Results and Dicussion:

Increasing the extract concentration caused a corresponding increase in growth inhibition. Radicle length was more sensitive to the aqueous extracts than seed germination or hypocotyl length. Based on radicle length growth, the degree of toxicity of different alfalfa plant parts can be classified in order of decreasing inhibition as follows: leaf, seed, complete plant mixture, root, soil, flower, and stem. Leaves extracts from vegetative stage was more inhibitory. Soil in which alfalfa had been grown was the most inhibitory to alfalfa growth and these effects were greater for soil collected at the reproductive than the vegetative growth stage. Non-sterilized soil was more inhibitory than sterilized soil in the reproductive stage. Vetch and rye soil exhibited a potential allelopathic effect as a crop preceding alfalfa. The degree of alfalfa growth inhibition was greater in vetch soil treatment. Water uptake was progressively decreased as the concentration of extracts increased, suggesting that seed water uptake may be at least partially responsible for decreased seed germination. Autotoxicity in alfalfa may result from an interaction of effects attributable to each plant part and soil. Further investigations are required to identify the inhibitory substance, and to determine seasonal and cultivar variations.

Table 1.9. Water uptake by alfalfa seeds treated with different concentration of aqueous extracts of vegetative stage leaves at different soaking periods.

Concentration(%)	Soaking Times(h)				LSD(0.05)
	8	16	24	48	
0.0	1.04	1.05	1.19	1.09	0.03
3.0	0.68	0.91	0.97	0.93	0.04
6.0	0.64	0.82	0.94	0.86	0.02
9.0	0.60	0.80	0.93	0.79	0.03
12.0	0.54	0.69	0.89	0.71	0.07
LSD(0.05)	0.02	0.06	0.03	0.04	

Table 4.5. Germination percentage, seedling length and weight as affected by the growth stage.

Stage	Germs ^a (%)	STL ^b (cm)	STWC (cm)	pH
Vegetative Stage	59.2	4.9	1.4	6.02
Reproductive Stage	74.9	6.0	1.7	6.95
LSD (0.05)	10.1	1.0	0.2	

a. Germination percentage; b. Seedling Total Length (Shoot+Root); c. Seedling Total Weight.

Table 7.3. Effect of various treatment on inhibition of the alfalfa leaves extracted from vegetative stage.

Treatment	Germination Percentage (%)	Total Length (cm)	Total Weight (cm)
Control	91.3	8.4	2.0
Untreated Extract	74.5	6.2	1.7
Charcoal Treated Extract	76.0	5.6	1.7
Dowex 50-w Treated Extract	75.0	6.3	1.6
Amberlite Treated Extract	72.0	6.5	1.6
LSD (0.05)	4.4	0.3	0.1

Table 1.10. Influence of various treatments on growth of alfalfa plants following 25 days of growth and on the pH of each soil.

Treatment	Plant Height (cm)	Fresh (mg)				Dry		pH ^c
		Leaf Area (cm ²)	Stem Weight	Leaf Weight	Stem Weight	Leaf Weight		
Control	20.1	5.2	59.9	66.2	14.6	13.1	6.9	
Rye Soil	17.4	4.9	52.5	62.0	12.8	11.4	6.8	
Vetch Soil	17.2	4.5	47.3	52.5	12.4	10.1	6.5	
Vegetative Soil Sterilized	15.0	4.4	48.2	63.5	11.0	10.6	6.2	
Non-Sterilized	15.1	4.4	48.1	65.3	10.9	10.7		
Reproductive Soil Sterilized	15.3	3.9	46.7	51.1	10.7	9.7	6.0	
Non-Sterilized	13.5	3.7	43.1	42.2	10.4	9.4		
LSD(0.05)	0.9	0.4	5.1	5.7	1.9	1.8		

* Means control, rye, vetch, alfalfa vegetative and reproductive soil pH.

Table 1.3. Influence of various concentrations of different aqueous extracts made from alfalfa plant parts or soil on the radicle length of 5 day old alfalfa seedlings¹.

Extractant	Extraction Concentration (%)				LSD(0.05)
	3	6	9	12	
Leaf	2.4	2.2	1.0	0.8	0.2
Stem	3.7	3.3	3.0	2.6	0.3
Flower	2.9	2.8	2.5	2.4	0.1
Seed	2.6	2.4	1.3	1.0	0.1
Root	3.8	2.8	1.5	1.0	0.1
Soil	2.5	2.6	2.4	1.8	0.6
Mixture	2.7	2.6	1.7	1.0	0.2
Control		4.5			
LSD(0.05)	0.2	0.2	0.2	0.3	

¹ Plants in the vegetative growth stage were used for leaf, stem, and root extracts, while reproductive plants were used to obtain flower and seed. For soil extracts, the soil in the immediate vicinity of a vegetative alfalfa plant was used. The mixture was prepared by mixing equal parts from leaf, stem, flower, seed, root, and soil extracts.

Table 4.1. Inhibition of total length and weight of alfalfa methanol, methylene chloride, and water extracts of fresh alfalfa leaves.

Concentration(%)	Inhibition (%) of control ^a					
	Total Length (cm)			Total Weight (mg)		
	MeOH	CH ₂ Cl ₂	H ₂ O	MeOH	CH ₂ Cl ₂	H ₂ O
0	100.0a*	100.0a	100.0a	100.0a	100.0a	100.0a
3	72.2b	86.0b	78.8b	90.1b	76.9b	80.2b
6	71.2b	63.4c	72.2bc	76.9c	73.6b	68.1c
9	50.0c	44.4d	64.7cd	61.5d	73.6b	68.1c
12	38.9d	29.1e	56.5d	57.1d	57.1d	62.6c

a. The average total length and weight for control were 7.7 cm and 2.3 mg, respectively. * Means in each column not followed by the same letter are significantly different at the 5% level by the Least Significant Difference (LSD) test.