COVER CROP EXTRACT EFFECTS ON RADISH RADICLE ELONGATION

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ABSTRACT

Conservation systems using cover crops offer many benefits, including enhanced weed suppression. Researchers have shown that some cover crops leach allelopathic chemicals that contribute to weed growth inhibition. Twelve cover crops were evaluated for allelopathic potential in two experiments using an extract-agar technique. Five weeks after planting, plants were clipped at the soil surface and cut into 15 mm pieces, which were soaked in distilled water for 24 h. After 24 h, filtered extracts, along with a distilled water control, were mixed with autoclaved agar and poured into petri dishes. After solidification, five pre-germinated radish seeds with radicals less than 2 mm in length were placed on each petri dish. Radish radicle lengths at 48 h were recorded. Significant differences were found among cover crops in both experiments. All cover crop extracts inhibited radicle elongation significantly more than distilled water, supporting previous research which noted allelopathic effects in cover crops.

INTRODUCTION

Conservation systems using cover crops offer many benefits, including enhanced weed suppression. High biomass cover crops can physically suppress early-season weeds. In addition, field researchers have shown that some cover crops possess allelopathic chemicals that can inhibit weeds; however, conclusive allelopathic research is difficult to obtain due to the inability to distinguish allelopathic effects from other cover crop effects (Sustainable Agriculture Network, 1998). Extract-agar bioassays have been developed to separate allelopathic potential of crop residues from plant competition effects (Pederson, 1986; Ben-Hammouda et al., 1995). Allelopathic bioassays often use standard indicator species, such as radish, for preliminary allelopathic testing (Wu et al., 2001). This study assessed the effects of cover crop extracts on radish radicle elongation.

MATERIALS AND METHODS

Twelve cover crops were evaluated for allelopathic potential in two experiments. For experiment 1, cover crops included black oat (*Avena strigosa* Schreb.) cv. SoilSaver, crimson clover (*Trifolium incarnatum* L.) cv. AU Robin, white lupin (*Lupinus albus* L.) cvs. AU Homer and AU Alpha, rye (*Secale cereale* L.) cv. Elbon, wheat (*Triticum aestivum* L.) cv. Vigoro Grazer, and triticale (*X Triticosecale* Wittmack) cv. Trical 2700. For experiment 2, cover crops included winter forage rape (*Brassica napus* L. var. *napus*) cv. Licapo, sunn hemp (*Crotalaria juncea* L.), Austrian winter field pea (*Pisum sativum* spp. *arvense* (L.) Poir), black medic (*Medicago lupulina*), hairy vetch (*Vicia villosa* Roth), black oat cv. SoilSaver, and crimson clover cv. AU Robin.

A modified procedure of Pederson (1986) was followed for both experiments. Cover crops were planted in the greenhouse. Each cover was replicated eight times. At 5 weeks after planting, plants were clipped at soil level and cut into 15 mm pieces, which were soaked for 24 h at a ratio of 10 g (fresh weight) to 50 ml distilled water. A control, 50 ml of distilled water only, was added to each rep. After 24 h, samples were filtered through coffee filters. Granulated agar (12 g L^{-1}) was autoclaved, cooled to 50°C and mixed with 20 ml of filtrate in a 1:1 ratio. The solutions were poured into petri dishes and allowed to solidify.

Radish seeds were surface sterilized and pre-germinated on moistened paper towels. Five seeds with radicles less than 2 mm in length were placed onto each solidified plate. Plates were kept in the dark at room temperature for 48 h. Radicle length was measured for each seed. The five lengths from each plate were averaged for a plate value. Plate values were compared using SAS analysis of variance (ANOVA). Mean separations for cover crop were made using Fisher's LSD ($p \leq 0.05$).

RESULTS AND DISCUSSION

For both experiments, radish radicle elongation was significantly higher in plates containing distilled water than those plates containing any cover crop extract (Tables 1 & 2), supporting previous research which noted allelopathic effects in cover crops.

Significant differences in allelopathic potential among cover crops were noted in both experiments. The extent of these differences and relative ranking of each cover crop differed among runs, implying that allelopathy potential in cover crops can vary based on external factors not addressed in this experiment. However, some cover crop differences were consistent throughout all three runs. In experiment 1, radicle elongation was significantly higher in lupin (AU Homer) and triticale extracts than for black oat extracts. In experiment 2, hairy vetch and black medic extracts inhibited radicle elongation more than forage rape or crimson clover extracts. Additionally, elongation was higher for forage rape extract than for sunn hemp extract in all three runs.

Table 1. Experiment one radish radicle length means 48 h after placement on plates containing agar-extract solution.

	Radish radicle length		
Species	Run 1	Run 2	Run 3
	---------- mm ----------		
Distilled water	39.5a†	42.0a	28.3a
Lupin (AU Homer)	20.3b	21.7bc	17.5b
Triticale	12.9c	24.1b	17.7b
Crimson clover	12.7c	24.5b	16.8bc
Rye	11.7cd	16.1de	16.4bc
Wheat	9.1d	14.3de	17.7b
Lupin (AU Alpha)	9.0d	18.5cd	12.7d
Black oat	8.6d	12.4e	14.5cd
LSD 0.05	3.4	5.2	2.8

† Radicle length means within the same column followed by the same letter are not significantly different at the 0.05 level according to Fisher's LSD.

Table 2. Experiment two radish radicle length means 48 h after placement on plates containing agar-extract solution.

	Radish radicle length		
Species	Run 1	Run 2	Run 3
	---------- mm ----------		
Distilled water	45.6a†	34.0a	39.7a
Forage rape	29.6b	20.3bc	27.2b
Crimson clover	21.8c	23.1b	15.3d
Winter pea	18.0cd	15.4cd	21.6c
Black oat	14.7de	24.9b	14.1de
Sunn hemp	16.6de	15.1de	16.6d
Hairy vetch	12.2e	13.7de	10.1e
Black medic	15.4de	10.2e	10.3e
LSD 0.05	5.1	5.1	4.7

† Radicle length means within the same column followed by the same letter are not significantly different at the 0.05 level according to Fisher's LSD.

In experiment 1, radish radicle length from the two lupin cultivar extracts differed significantly in two out of three runs. Therefore, allelopathic potential may also vary among cultivars of the same species.

CONCLUSIONS

All cover crop extracts inhibited radicle elongation more than distilled water, showing that the cover crops evaluated in this experiment exhibited allelopathy. Cover crops differed significantly in their allelopathic potential. Allelopathic potential may also vary between cultivars within a cover crop species. Therefore, to maximize allelopathic effects, both cover crop species and cultivar must be considered.

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