BIOACTIVE COMPOUNDS IN SELECTED COVER CROP GRASS AND THEIR POTENTIAL EFFECT ON WEED CONTROL

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ABSTRACT

Wide use of herbicides in conventional agriculture has long lasting effects on food production systems and the environment. We investigated concentrations of total flavonoids and phenolics in four cereal cover crops, with respect to their potential in weed management. Initial results indicated that the concentrations of these compounds vary within shoots and roots of the various plant species studied. Black oat showed the highest concentration of flavonoids (4.50 µg g^{-1}) and phenolics (10.15 µg g^{-1}), in the shoots ($P < 0.05$). The concentrations of these bioactive compounds were not statistically significant ($P < 0.05$) in the shoots of rye grass, triticale, and Georgia gore. With the exception of Georgia gore, the concentrations of flavonoids and phenolics in the plant roots were lower and statistically not significant ($P < 0.05$). Generally, the concentrations of flavonoids and phenolics tend to be significantly higher in the shoots than in the roots suggesting that the weed suppression effects of the cover crops are more expressed in the shoots than in the roots.

INTRODUCTION

The ever increasing world population needs more and more food from the same land. Maximizing production though intensive use of industrial inputs has direct and indirect negative impacts on quality of the produce, environment and overall human health. Incorporation of cover crops into crop rotations and their application as organic mulch provides an alternative weed management strategy in organic farming thus, reducing the need for herbicides. Flavonoids and phenolics constitute a wide class of secondary plant metabolites which display weed suppression characteristics. We investigated the total concentrations of flavonoids and phenolics in different parts of four cereal cover crops; and we are presenting some of their possible effects on weed suppression.

MATERIALS & METHODS

A greenhouse experiment was conducted at Tuskegee University in winter 2012 with four winter cereal cover crops: Black oat (*Stipa avenacea*), rye grass (*Lollium multiflorium*), triticale (*Triticum sp.)* and Geogia gore (*Triticum aestivum*).

MATERIALS & METHODS CONT.

Each of the four cover crops was sown in three pots in a 4x3 split plot arrangement in four replicates and grown for ninety days before harvesting. Following harvest, the plants were separated into shoots, roots, and whole plants, washed in deionized water to remove soil particles and other contaminants. Samples were oven dried at 55 ºC for 72 hrs and ground into fine powder (< 100 mesh).

A 0.2-g of duplicated sample was weighed into a Pyrex culture test tube, 15 mL of ethanol (100% HPLC grade) was added and incubated in a water bath at 30 ºC for 20 min. Contents of the test tube were vortexed for 3 min and filtered through a Whatman # 2v filter paper (Fishers Scientific).

Total flavonoids were determined using a procedure described by Sari and Velioglu (2006), Xu and Chang, (2007) and Yim, et al. (2009) with modification by Abugri et al. (2012). A 250-µL of the digest was mixed with 1.25 mL deionized water, 75 µL of 5% $NaNO_2$ solution was added and incubated for 6 min at room temperature. 150 µL of $AlCl_3.6H_2O$ (10%) was added and the contents were re-incubated for an additional 5 min at room temperature. To the contents were added 0.5 mL of NaOH (1 *M*) and 2.5 mL of deionized water. The tube was vortexed and allowed to settle. Absorbance of the supernatant was determined at 510 nm by using a spectrophotometer (Hewlett Packard 8453 UV ï Visible). Concentrations of flavonoids were obtained from a standard curve developed using a catechin standard solution.

A procedure reported by Afify et al. (2012) was used with a slight modification. An aliquot (200µL) of each digest was pipetted into a test tube; 250 µL of Folin-Ciocalteus phenol reagent, 0.5 mL of Na_2CO_3 (2%) were added to the test tube and brought to 5mL volume with deionized water. The contents were mixed and incubated at room temperature for 30 min to develop a yellow colored complex solution. The absorbance of the solution was read at 725 nm by using a spectrophotometer (Hewlett Packard 8453 UV ï Visible). Concentrations of phenolics in the samples were determined from a standard curve developed using gallic acid.

Data were statistically analyzed using SAS computer software (SAS Inst. Inc., Cary, NC, USA).

RESULTS

Table 1. Contents of total flavonoids s in cover crops

Plant species	Concentration* in plant parts (µg/mL)		
	Above ground	Below ground	Whole plant
Black oat	4.50 a	1.27b	3.41b
Rye grass	2.29b	1.19 b	4.38a
Triticale	2.47ab	0.59 c	3.66b
Georgia gore	1.57b	1.57a	2.76c

Table 2. Concentration of phenols in cover crops

Plant species	Concentration* in plant parts (µg/mL)		
	Above ground	Bellow ground	Whole plant
Black oat	10.15a	3.32ab	9.52ab
Rye grass	7.22b	2.42 b	8.01b
Triticale	6.93b	3.11ab	10.03 a
Georgia gore	6.38b	3.90 a	7.55b

*, Means in a column followed by same letter are not different ($p < 0.05$

SUMMARY AND CONCLUSION

- Flavonoids and phenolics are among the groups with allelopathic compounds.
- These compounds were found in varying amounts in all cereal cover crops studied.
- Black oat had higher concentrations of both total flavonoids and phenolics than other three species.
- Findings indicate that all four cover crops have allelopathic potential but black oat may be more effective than other three cover crops in weed management due to higher concentrations of allelopathic compounds (flavonols and phenolics) in above ground parts

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