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The influence of two cover crop species on the growth of *Zea mays* and *Cyperus esculentus*

by

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CONTENTS

DECLARATION

I, Suzette Renè Bezuidenhout, declare that the thesis, which I hereby submit for the degree PhD in Agronomy at the University of Pretoria is my own work and has not previously been submitted by my for a degree at this or any other tertiary institution.

S.R. Bezuidenhout February 2012

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Department: Plant Production and Soil Science

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ABSTRACT

Cover crops not only improve soil conditions, but can also suppress weed growth. In a field experiment the influence of two cover crops, *Secale cereale* (stooling rye), and *Lolium multiflorum* (annual ryegrass), on the growth of *Zea mays* (maize) and *C. esculentus* (yellow nutsedge) was compared to the latter crop and weed's growth at three control treatments which involved weed residues left on the soil surface, application of herbicides and weed control by hoeing. Maize emergence and growth were delayed in the presence of residues of both cover crop species, especially in annual ryegrass residues. *C. esculentus* growth was significantly inhibited in the area between the maize planting rows by the cover crops for the first 14 days after maize emergence, but this growth suppressing effect diminished after 28 days. In a controlled environment study, the influence of the same cover crops, together with *Avena sativa* (oats) and three cultivars of annual ryegrass were evaluated. Maize and *C. esculentus* growth were suppressed, especially by the root residues of the cover crops with the annual ryegrass cultivar 'Midmar' being the most suppressive. Chemical analysis of the leachate of root residues indicated the presence of phenolic acids and benzoxazolin-2(3*H*)-one (BOA). It is suggested that weed growth could be reduced by the allelochemicals leached from cover crop residues but in order to achieve prolonged, effective weed control the combination of mulch retained on the soil surface and the application of herbicides will required. In an integrated weed management approach a possible reduction in the type and number of herbicide applications required for effective weed control, could be implemented.

INTRODUCTION

One of the major constraints to food production is inadequate weed management (Buhler 2002). Management efforts are generally aimed at controlling weed seedlings prior to or shortly after crop establishment as it is easier to control than killing or removing more developed weed plants. However, those weeds than develop later in the growing season still produce seed that contributes to future weed populations. Chemical control is often seen as an easy option but it is essentially a short-term solution. More emphasis should be placed on preventing weed production and reduce weed densities rather than relying primarily on chemical management (Bastiaans *et al.*, 2008).

Incorporating cover crops as part of a cultural weed management approach has various advantages. Among others, it improves the soil characteristics, reduces soil erosion (Teasdale *et al.*, 2007) and can suppress weed growth (Hartwig & Ammon 2002). In areas where crops are mainly used for animal fodder, cover crops can, in addition to being environmentally beneficial, also serve as an important source of quality forage. Cover crops should, however, fulfil at least four requirements: (i) have low production costs, (ii) provide quality forage, (iii) enhance soil characteristics accompanied by providing good soil coverage and (iv) have no negative effects on the subsequent crop (Kramberger *et al.*, 2008). Strategies to use it as a weed management tool focus on the negative effect some cover crops have on weed growth through changes in the weed growth environment and the release of secondary metabolites known as allelochemicals. These metabolites can be exploited through the phenomenon known as allelopathy (Putnam *et al.*, 1983).

Research has focused mainly on the influence of cover crop root exudates and decomposition of cereal and leguminous cover crops residues (Weston 1990). At present it is clear that crop allelopathy cannot be solely used as a weed management strategy, as the specific identified allelochemicals are non-selective and merely suppress weed growth, not killing the weeds (Bhowmik & Inderjit

2003). In addition, the concept of allelopathy is still controversial and methodological limitations and a lack of knowledge about the phenomenon hampers the application thereof (Belz 2004).

Most of the work done previously focused on evaluating the different cover crops species used in various crop production systems, desiccating the cover crops at different times and determining the suppression of weed species dominant during the trial at different populations. Results obtained are inconsistent and contradictory. This raises the question: can cover crops successfully be incorporated in a weed management system to reduce the relative fitness of weeds in a conservation tillage system without inhibiting the growth of the subsequent crop?

No information is available on the effect of cover crops on weed growth in maize production in KwaZulu-Natal (KZN). Environmental conditions in KZN and the management capabilities differ from cover crop research done elsewhere in the world and results can therefore not be extrapolated to the use of cover crops in KZN. Only the principles regarding the use of the technology can be applied. This study was conducted to evaluate the suitability of cover crops to suppress *C. esculentus* growth in maize within the framework of conservation tillage practices and to determine what the effect will be on maize development and growth. In doing so, guidelines for the successful application of sustainable integrated weed management systems may be developed.

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