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Allelopathic Weed Management: A Future Aspects

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SUMMARY

A large number of plant & weed species produce secondary metabolites known as allelochemicals, & the process is known as allelopathy. Allelochemicals could be used to control weeds in agricultural systems by using allelopathic crops for intercropping or mulching. A few important examples of crop species with high allelopathic potential may include wheat, rice, sorghum, rye, barley, and sunflower. The naturally produced allelochemicals in these crops could be manipulated to suppress weeds and witness an environment friendly & sustainable agricultural production system.

INTRODUCTION

The term allelopathy was coined by a plant physiologist Molisch in 1937, consisting of two Greek words allelon meaning 'mutual' and pathos meaning 'to suffer', harmful effects on each other (Chon and Nelson, 2012).Allelopathy is a natural ecological phenomenon in which different organisms affect the functioning of other organisms in their vicinity, negatively or positively (Rice,1984). Allelopathy is the releasing of allelopathic compounds by one plant species that inhibit the growth and development of other neighbouring plants species (W eston and Duke, 2003). The release of allelopathic compounds from leaves, flowers, seeds, and stems and roots of living and decomposing plant materials can influence weed density and growth (Tesio and Ferrero, 2010). The term allelopathy refers to the production, by a plants, of chemicals (allelochemicals) which could influence the growth and development of another plant. Such an effect can be varied and could be negative (e.g. reduced germination) or positive (e.g. increased growth). For weed management we are interested in the inhibition of one plant (the weed or weeds) by other (usually the crop) through the production of allelochemicals. These allelochemicals may be actively produced by a growing plant or arise from the residues after die. The effects of the allelochemicals may be reduced or enhanced by microorganisms.

Allelopathic Approach

The use of allelochemicals as bio herbicides The allelochemicals have a mode of action similar to that of herbicides (Soltys et al., 2013).Most of the allelochemicals are partially or completely water soluble. Thus, it is easier to apply them without using surfactants (Dayan et al., 2009).This is different from the use of fungi as bio herbicides because the life span of the bio herbicides from fungi is shorter and specific environment application procedures are required e.g. some fungi need water and dew to react (Hoagland, 2001). Besides, allelochemicals are reported to have less halogen atoms, complex chemical structures and short half-life in the ecosystem (Duke et al., 2002).Allelochemicals are naturally produced compounds which are environmentally friendly and safer compared to chemically produced pesticides.

Allelopathy and Weed Management

Weeds are the most stubborn competitors of crops causing substantial reduction in yield by sharing light, air, water,nutrients and space. Allelopathic water extracts have been successfully used for organic weed management.Allelochemicals are diverse in nature and structure and thus lack common mode of action. When applied at high concentrations, these allelochemicals interfere with the cell division, hormone biosynthesis and mineral uptake and transport (Rizvi et al., 1992), membrane permeability (Harper and Balke, 1981), stomatal oscillations, photosynthesis (Einhellig and Rasmussen, 1979), respiration and protein metabolism (Kruse et al., 2000) and plant water relations(Rice, 1984), which may cause substantial growth reduction. The use of sunflower as green manure (Om et al., 2002) reduced the population of Phlaris minor by 42 and 100 percent under field and laboratory conditions, respectively. Annuionone isolated from aqueous extract of sunflower (cv.Suncross-42 leaves) reduced the growth of Phlaris minor,Chenopodiun album, Coronopsis didymus, Medicago polymorpha, Rumex dentatus (Anjum and Bajwa, 2005).Sunflower extracts completely inhibited seed germination of white mustard (Bogatek et al., 2006).However, the phytotoxins did not affect the seed viability (Kupidlowska et

al.,2006). Allelopathic chemicals from sunflower could influence the antioxidant system in target plants, causing cell membrane permeability and cellular damage, reducing the ability of the target plants to germinate and causing a gradual loss of seed vigour (Oracz et al., 2007). Weeds compete with crops for nutrients, water, space, and requirements for photosynthesis, which reduces crop yield. Synthetic herbicides can control weeds effectively and reduce labor in weeding but can cause numerous detriments to the environment and humans, and increase the occurrence of herbicide-resistant weeds. Since it is known that plants can self-regulate their densities and distribution in nature via allelopathic interactions, scientists have attempted to exploit these characteristics of crops and weeds in agriculture. The use of allelopathy for biological control of weeds in agriculture practice has attracted the interest of many agronomic scientists.

CONCLUSION

Weeds are a hidden foe for crop plants, interfering with their functions and suppressing their growth & development. Yield losses of 34% are caused by weeds among the major crops, which are grown worldwide. These yield losses are higher than the losses caused by other pests in the crops. Sustainable weed management is needed in the wake of a huge reduction in crop outputs due to weed pressure. A diversity in weed management tools ensures sustainable weed control & reduces chances of herbicide resistance development in weeds. Allelopathy as a tool, may be importantly used to combat the challenges of environmental pollution and herbicide resistance development. This article provides a recent update regarding the practical application of allelopathy for weed control in agriculture systems.

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