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ALLELOPATHY : A REVIEW

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ABSTRACT:

All living things need certain resources to live and grow so as plants need sunlight, nutrients, water, and air. The roots bring nutrients and water from the soil for rest of the plant parts. The leaves absorb the sun's radiation for energy. When plants don't have enough space, they cannot meet their needs. So, the plants protect their resources by using process of allelopathy. Allelopathy is a chemical process that a plant uses to keep other plants from growing too close or away from it. Allelopathy refers to the chemical inhibition of one species by another. The "inhibitory" chemicals releases into the environment where it affects the development and growth of neighboring plants.

Keywords : Allelopathy, Chemical, Inhibition, Plants.

INTRODUCTION:

Molisch in 1937 first coined the term allelopathy, which refer to biochemical interactions between all types of plants including microorganisms. The term allelopathy was derived from Greek word, which means mutual harm. This term covers both the detrimental and beneficial reciprocal biochemical interactions. Rice in 1984 also defined allelopathy as any direct or indirect, harmful or beneficial effect of one plant on another plant through release of chemicals into the environment.

Allelopathic chemicals can be present in any part of the plant. They can be found in roots, stems, leaves, flowers or fruits. They can also be found in the surrounding soil. These toxins affect target species in many different ways. The toxic chemicals may inhibit root/shoot growth, they may inhibit nutrient uptake, or they may attack a naturally occurring symbiotic relationship thereby destroying the plant's usable source of a nutrient. Not all plants have

allelopathic tendencies. Some, though they exhibit these tendencies, may actually be displaying aggressive competition of a non-chemical form. There may be much of the controversy surrounding to identifying allelopathy in trying to distinguish the type of competition being displayed. In general, if it is of a chemical nature, then the plant is considered allelopathic. There have been some recent links to plant allelotoxins directed at animals, but data is scarce.

BRIEF HISTORY OF ALLELOPATHY:

Allelopathy is not a new subject, but terms used were different Theophrastus (ca. 300 B.C.E.), a student and successor to Aristotle, wrote about allelopathic reactions in his botanical works. He has been called the "father of Botany", and wrote of how chickpea "exhausts" the soil and destroys weeds. In 1 C.E., Gaius Plinius Secundus, also known as Pliny the Elder, a roman scholar and naturalist, wrote about how chick pea and barley "scorch up" cornland. He also mentioned that Walnut trees are toxic to other plants (Smith and Secoy, 1977). De Candole (1832) suggested that some plants excrete some substances from their roots, which are harmful to other plants. He noted the specific inhibition of Oat by thistles (*Cirsium*), flax by Euphorbs (*Euphorbia*) and *Scabiosa*and wheat by rye (*Lolium*) plants.

Most of the progress in this field occurred in the 19thcentury, farmers in America reported the loss of fertility in certain soils due to continued cropping of one crop over a long period and this lead to a revival of interest in excreted toxic substances. In early part of this century, Schreiner and his associates presented evidence that exhaustion of soil by single cropping is due to addition of growth inhibitors to the soils by certain crop plants (Schreiner and Reed, 1907a & b; Schreiner and Shorey, 1909; Schreiner and Sullivan, 1909; Schreiner and Lathrob, 1911).

Since the 1960's allelopathy has been increasingly recognized as an important ecological mechanism which influences plant dominance, succession, formation of plant communities climax vegetation and crop productivity. It has been related to the problems with weed: Crop interference (Bell and Koeppe, 1972), Phytotoxicity in stubble mulch farming (McCalla and Haskins, 1964) and

in certain type of crop rotations (Cornard, 1927). Rice (1984) indicated that allelopathy contributed to weed seed longevity problem through two mechanisms, (a) chemical inhibitors in the seed prevented their decay by microbes and (b) the inhibitors kept the seed dormant, although viable for many years.

The past reviews on allelopathy (Altieri and Doll, 1978; Bhandari and Sen, 1983; Lovett, 1983; Rice, 1984, 1985; Putnam, 1985, 1986; Waller, 1987 and Einhellig and Leather, 1988) have dealt with grasslands, forestry and weeds. Some of these reviews slightly mentioned the crop production but none dealt exclusively with these important aspects. However, the indications of allelopathy had been observed in crop science.

The production of phytotoxin substances and their potentiality in allelopathy is of utmost importance. Substances producing allelopathic effects are virtually universal in the plant world (Datta and Sinha-Roy, 1983).

Allelochemicals substances produced by plants and are released from the plants by four general routs.

1) **Weathering:** (Rice, 1964 and Overland, 1966).
2) **Leaching:** (Rice, 1974 and Turkey, 1964).
3) **Exudation:** (Woods, 1960 and Rovira, 1969)
4) **Volatilization:** (Muller, 1966).

Considerable evidences have been gathered during the past few decades, demonstrating the presence of inhibitory materials in a wide range of plant extracts and volatiles causing varying degree of inhibition. But the evidence concerning chemical nature of inhibitors or phytotoxins is insufficient. Moreover, it is not certain whether specific compounds are involved.

CHEMICAL NATURE OF ALLELOPATHIC COMPOUNDS:

There are thousands of compounds produce as secondary metabolites of plants. The categories of allelopathic agents reviewed by Rice (1984) in his book 'Allelopathy' are Water-soluble simple organic acids, Simple unsaturated lactones, Long-chain fatty acids and Polyacetylenes, Napthoquinones, Anthroquinones and complex quinines, Simple phenols, benzoic acid and

derivatives, Phloroglucinol and polyphlorogluicinols, Cinnamic acid derivatives, Coumarins, Flavonoids, Hydrolysable and Condensed tannins, Terpenoids and Steroids, Amino acids and polypeptides, Alkaloids and Cyanohydrins, Sulphides and Mustard oil glycosides, Purines and Nucleosides.

There are many other miscellaneous phytotoxins, e.g. Phenylacetic and 4-phenylbutyric acids; Phenethyl alcohol, Tryptophol, Ethylene etc. (Rice, 1984).

Plants do not produce allelochemicals at all times. Some are present at all times while some are produced after injuries or infection by pathogens. Plants protect themselves against herbivores and pathogens by producing defense chemicals (Poisons) but face a problem of 'autotoxicity' (c. f. Khose, 2006). The alleochemicals released in the surrounding environment may affect other organisms in different ways. They affect internal as well as external morphology, growth and physiological process such as uptake of nutrients, photosynthesis, respiration etc.

SCOPE AND FUTURE STRATEGIES:

Allelopathy offers a great scope to reduce the ill-effects of modern agriculture practices such as present pesticides causes environmental pollution, contamination of drinking water resources, human and animal health hazards, residues in food chain and development of pesticides resistant/ tolerant species of pests in agroecosystems. Allelopathy can be used in multidisciplinary areas of researchin several fields of Agroforestry and Forestry, Agronomy, Biochemistry, Biotechnology, Botany, Chemistry, Ecology, Entomology, Fresh Water Biology, Genetics and Plant Breeding, Horticulture, Limnology, Microbiology, Nematology, Plant Pathology, Soil Science, Vegetable Crops, Zoology etc.

RECENT DEVELOPMENTS:

a) In isolation, characterization, identification techniques of allelochemicals.
b) New techniques in biotechnology.
c) Use of allelochemicals to control pests (weeds, insects, nematocides, diseases) and to stimulate crop growth and yield.

d) New weed control practices using allelopathic crops may help in achieving this goal.
e) Useful in agriculture to increase yield.
f) Minimize some problems related to multiple cropping systems and
g) Soil productivity and availability of nutrients in soil.

Allelopathy is very young field of science; therefore research may be continued in all areas investigated in the past, allelopathic research will establish a boon in agricultural and forestry production (Narwal, 1994).

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