



# ALLELOPATHY : ALLELOCHEMICALS A BRIEF REVIEW

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## Abstract

Allelopathy is a singularity where secondary metabolites created by plants, fungi, viruses and microorganisms, effect biological and agricultural, which may be either “stimulatory or inhibitory” from the release of compound known as “Allelochemicals” are released to the environment from all plant organs roots, leaves, stems etc. The review included (an introduction, discussions of allelochemicals, Factors affecting in production of allelochemicals, Mode of action of allelochemicals,, and Fate of allelochemicals. We hope that it will inspire researchers to start research into this memorable new field.

**Key words:** Allelopathy, Allelochemicals, Factors affecting, Mode action

## Introduction

Allelopathy :known as: “Inhibiting the growth of one type of plant by chemicals produced by other types” Or more widely: (Biochemical interactions between all kinds of plants, as well as microorganisms) (Rice, 1984; Yang *et al.*, 2011). The Allelopathy is a chemical war between plants; which is carry out by one plant to prevent the latter from benefiting from oppression. The word allelopathy is rooted in allélon, which means “from each other”; pathetic, which means “suffering.” Molisch (1937).

Thus, it appears to us in the phenomenon of agricultural biochemical opposites that “biochemical plants” work to generate adverse environments for neighboring plants by decreasing seed germination and growth of biochemical plant initiators, which are known as natural inhibitors so that they have a very effective role in inhibiting the growth of plants and weeds (Waseem *et al.*, 2020).

All living things need certain resources to live and grow and plants need sunlight, nutrients, water and air, The roots provide nutrients and soil water for the plant. The leaves absorb energy from sunlight, Plants need enough space to meet their needs, and many use allelopathic defenses to protect the space around them.

### The production and composition of allelochemicals

“Allelopathy” can be considered to be a form of

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communication among plants (Bais *et al.*, 2004, Yoneya & Takabayashi 2014), Plants synthesize a many compounds from secondary metabolism, Production of these compounds depends on the activation of specialized genes and existence of precursor molecules, (Croteau *et al.*, 2000).

### Nature of Allelopathic Compounds

Allelopathic compounds are secondary metabolites synthesized by fungi, viruses, microorganisms and plants influence biological and agricultural systems (Prince and Pohnert, 2010). Variability in the activity and concentration of the allelochemicals and its derivatives are known to occur in various parts of the plants such leaves, stem, flowers, roots, pollen at the growing season (Qasem & Foy, 2001; Macias *et al.*, 2007; Gatti *et al.*, 2010). Volatilization and leaching serve the two means for the release of allelochemicals into the atmosphere or rhizosphere. In order to have any effect on the target plant the allelochemicals have to be released from the donor plant.

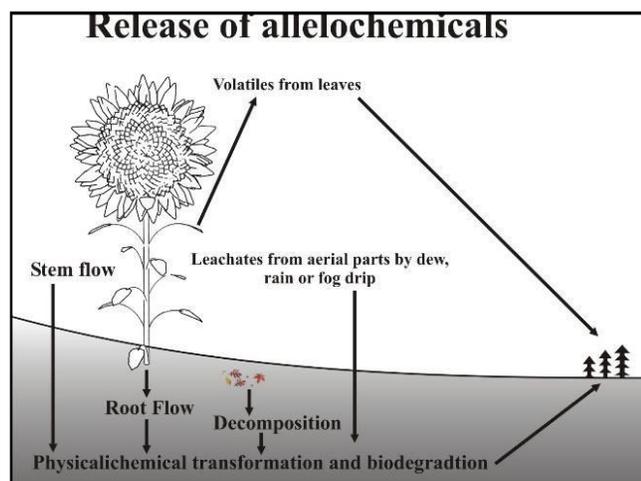
### Released into environment through four methods:

1. Leaching: from leaves and stem of plants. for example, the allelochemicals in the leaves of *Black walnut*, *Juglans nigra*, which are washed off with rain can inhibit the growth of the vegetation under the walnut tree (Bertin *et al.*, 2003).

2. Volatilization compounds from the leaves and stem of a plant, e.g. *Salvia leucophylla* (Bertin *et al.*, 2003).

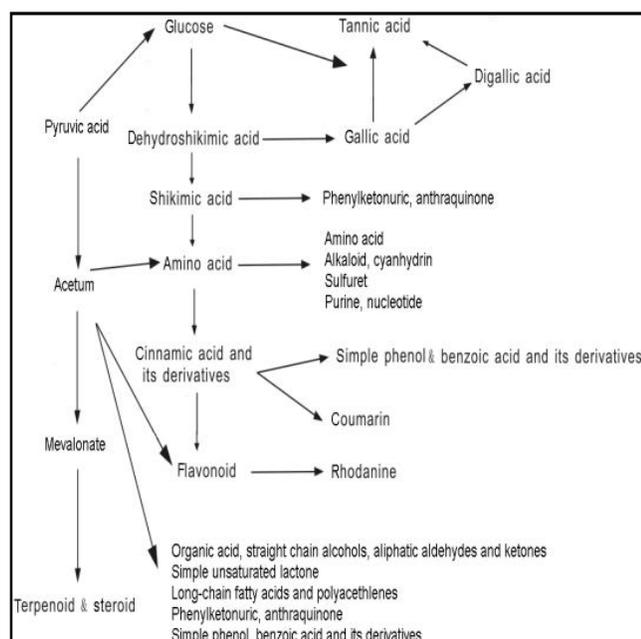
3. Phytotoxic compounds from decomposing plant material, The decomposing plant residue releases a number of allelochemicals such as Rye (*Secale cereale*) when used as a mulching material. Apart from shading and keeping the soil moist, rye mulch also inhibits both germination and growth of weeds through release of phytotoxins (Barnes and Putnam, 1986). In maize field were allelopathic effect on *Setaria verticillata* L. (Dhima, *et al.*, 2006).

4. Root exudation : compounds released from the plant roots, Rice is an example, where living Rice plants are able to suppress weed growth selectively (Olofsdotter *et al.*, 1997).



### Allelochemicals

Allelochemicals are secondary substances, biosynthesized from the metabolism of carbohydrates, fats and amino acids and arise from acetate or the shikimic acid pathway.



These are biosynthesized and stored in the plant cells and do not affect in the cell activities. However, after their release from the plant cells (through volatilization, leaching root exudates and decomposition of biomass), these allelochemicals start influencing the organisms (plants, pathogens, insect, etc.), when they come in contact.

### Nature of Allelochemicals

Rice (1984) has divided these compounds into 14 chemical categories: (a) cinnamic acid derivatives, (b) coumarins, (c) simple phenols, benzoic acid derivatives, gallic acid and protocatechuic acid, (d) flavonoids, (e) Tannins, (f) Terpenoids and steroids, (g) water soluble organic acids, straight chain alcohols, aliphatic aldehydes and ketones, (h) simple unsaturated lactones, (i) long chain fatty acids, (j) naphthoquinones, anthraquinones and complex quinones, (k) amino acids and polypeptides, (l) alkaloids and cyanohydrins, (m) sulfides and mustard oil glycosides and (n) purines and nucleotides. However, Putnam and Tang (1986) grouped these chemicals into 11 classes: (a) toxic gases, (b) organic acids and aldehydes, (c) aromatic acids, (d) simple unsaturated lactones, (e) coumarins, (f) quinines, (g) flavonoids, (h) tannins, (i) alkaloids, (j) terpenoids and steroids and (k) miscellaneous and unknown. Allelochemicals based on their structural differences and properties (Li *et al.*, 2010).

### Factors affecting in production of allelochemicals

1. Amount of produced allelochemicals compounds influence by long-day photoperiods, Growing seasons, plant growth stage (Al-Jobori & Ali, 2014).
2. Mineral deficiency: Mineral deficiency leads to increases in allelochemicals.
3. Drought stress: enhanced the production of allelochemicals under these conditions.
4. Temperature: allelochemicals are production in larger amounts in Cooler temperatures (Ali, 2008).
5. Plant tissue type and the age: allelochemicals production different within species and between species, a result of the unequal spreading of compounds in plants.
6. Plant diseases, predator can influence allelopathy.

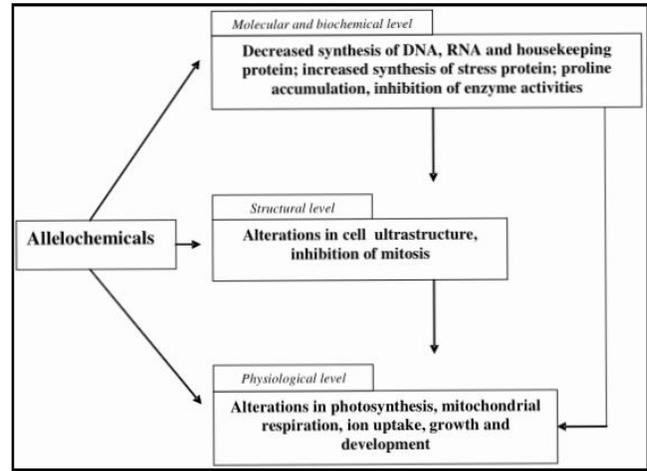
As well as there are many factors affect on allelochemicals amount produced that: radiation, water stress, temperature, Allelopathic agents and age of plant organs Rice (1984).

### Mode action of allelochemicals

Allelopathic effect in plant growth (Rice, 1984) by effect in physiological processes: division and elongation cell A L-Jehaishy (2017) Cytology and ultrastructure: in

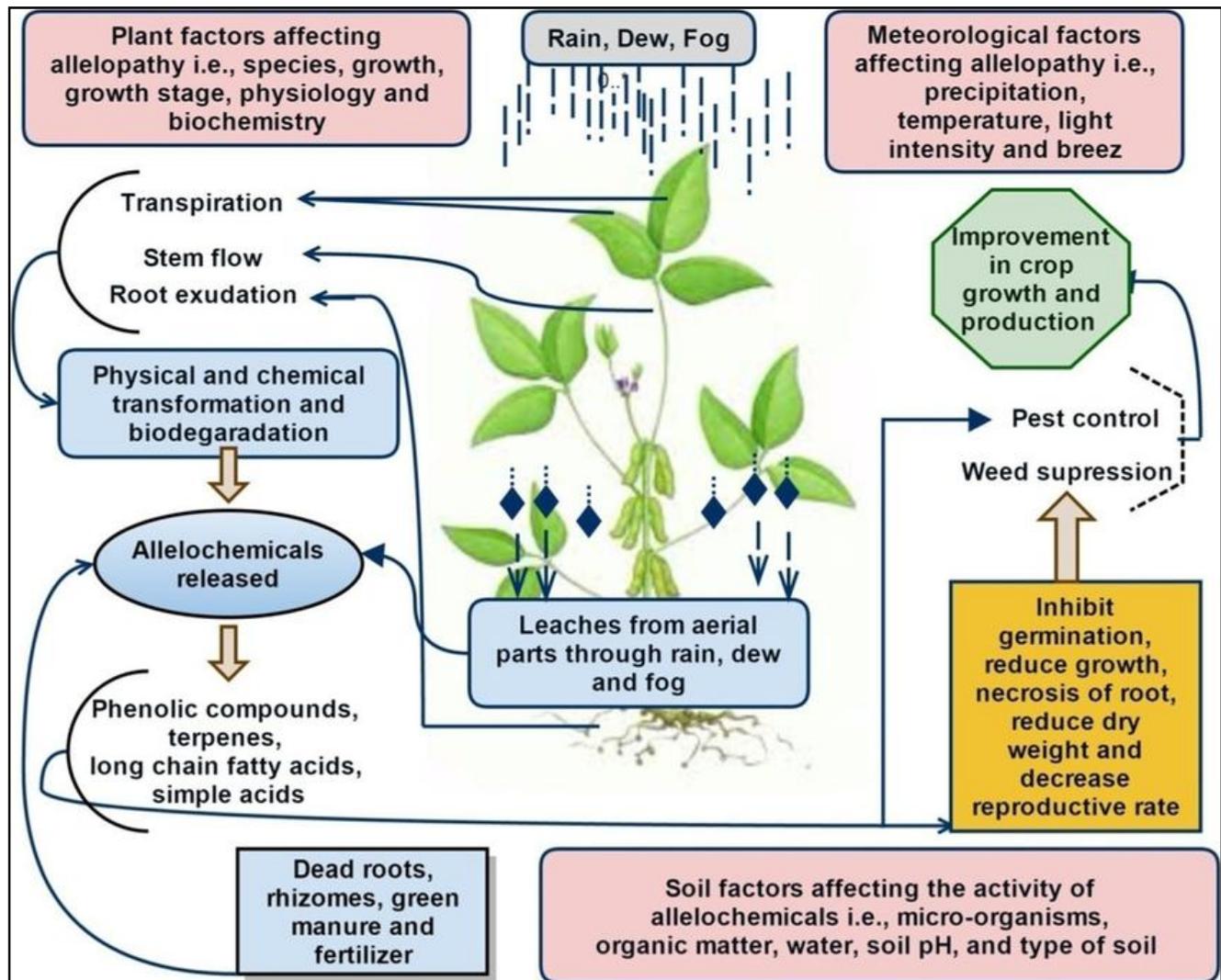
roots of plant (Celik & Aslanturk, 2010; Gulzar *et al.*, 2016; Mohamadi & Rajaie, 2009; Mushtaq *et al.*, 2019), Phytohormone : the plant hormones, (IAA) and gibberellins (GA) control cell expansion in plants, IAA-oxidase is repressed by allelochemicals (Chou, 1980), allelopathy stress increased production of Ethylene and abscisic acid (ABA) (BogatekOracz, & Gniazdowska, 2005); permeability of membrane (Galindo *et al.*, 1999),; mineral uptake allelochemicals can change in the amount of ion absorption in plants (Baar *et al.*, 1994). Phenolic acids decrease the uptake of (macronutrients and micronutrients) (Akemo *et al.*, 2000). Obtainability of soil phosphorus and potash., photosynthesis, respiration, protein synthesis; enzymes; elements(Kamal, 2020) plant anatomy (stem, Root, Leaves) (Hussain *et al.*, 2018), Conducting tissue (Gniazdowska & Bogatek, 2005). Plant- balance of water (Sheteawi & Tawfik, 2007), Genetic material (Baziramakenga *et al.*, 1997; Jensen *et al.*, 2001).

**Fate of allelochemicals**



Mode action of Allelopathic compounds.

When allelochemicals released to enviroment by volatilization that absorbed by plants on or after the air or as leachates “by rain, mist, dew”, all other allelopathic reactions occur in the soil. And they can released to the soil by decomposition of plant residues or Root exudation.



Fate of allelochemical in the soil based on their interface between the soil complex, soil micro-organism and soil chemical situation. Adsorbed allelochemicals may stay biologically active or be reduced sedentary dependent on the nature of the adsorbing surface (Kamal. 2020). Allelochemicals potential stay vigorous in the soil to have an allelopathic influence.

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