ALLELOPATHY

DR. SUMEET KAUR

PG DEPT. OF BOTANY

GOVT. COLLEGE FOR GIRLS, LUDHIANA, PUNJAB

Allelopathy Meaning -

Allelopathy is a biological phenomenon by which an organism produces one or more biochemical's that influence the germination, growth, survival, and reproduction of other organisms.

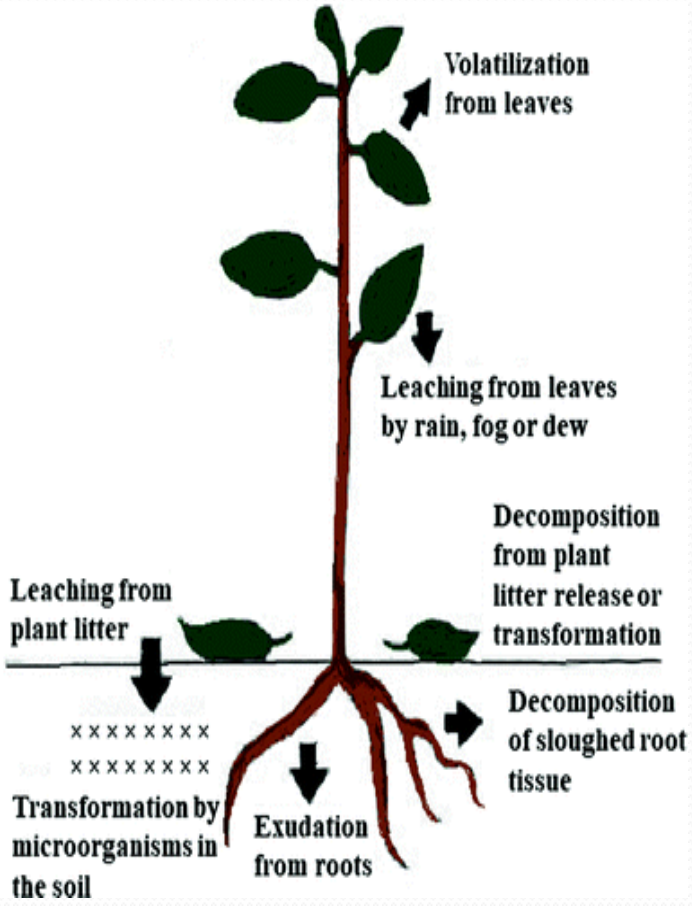
Allelopathy is derived from two Greek words “allelon or allele” that mean mutual or each other and “pathons” that means suffering or to suffer.

INTRODUCTION -

- Hans Molisch (1973) – The plant physiologist, university of Vienna, Austria coined the term Allelopathy.
- It was first reported in alfa-alfa and the first allelochemical was extracted from Walnut.
- It is the process involving secondary metabolites, produced by algae, bacteria, plants, which influences the growth of the other or same species.

PRINCIPLE OF ALLELOPATHY-

The central principle of Allelopathy arises from the fact that plants and microorganisms collectively produce thousands of chemicals and many of these chemicals are released from the producing organism by leaching, exudation, volatilization or decomposition process. Subsequently some of these compounds known as allelochemicals alter the growth or physiological functions of organisms that encounter them during growth.



ALLELOCHEMICALS -

- Allelochemicals are mostly so-called 'secondary metabolites' produced by organisms such as plants, animals, or microorganisms, and which are not needed for basic (primary) metabolism. Rather, they have ecological functions to counterbalance abiotic and biotic stressors. Allelochemicals affect other organisms, either in their physiology, growth, and behavior or life history.

Some of the common allelochemicals are –

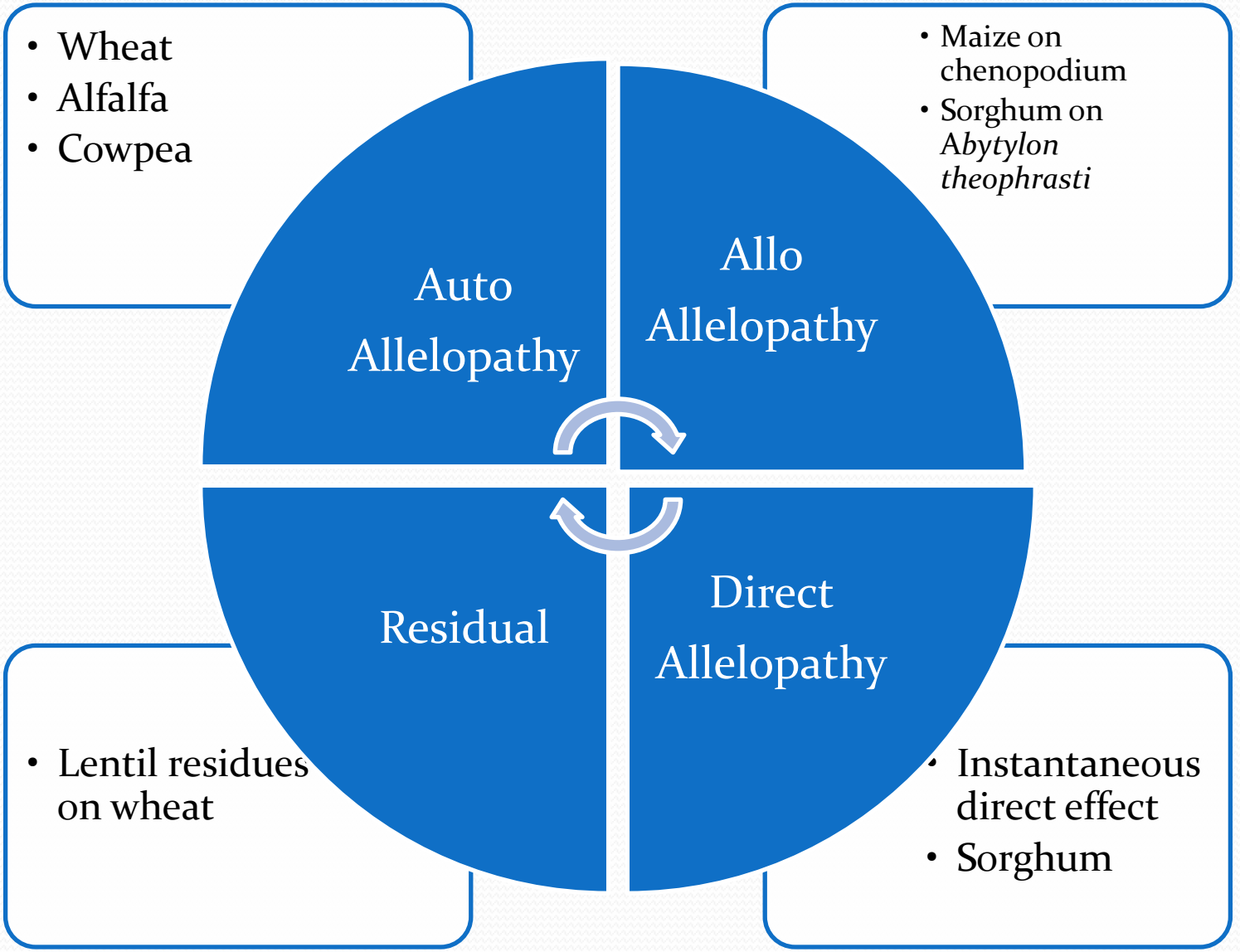
- Cinnamic and Benzoic acid
- Flavonoids
- Terpenes

TYPES OF ALLELOPATHY

There are basically two types of Allelopathy-

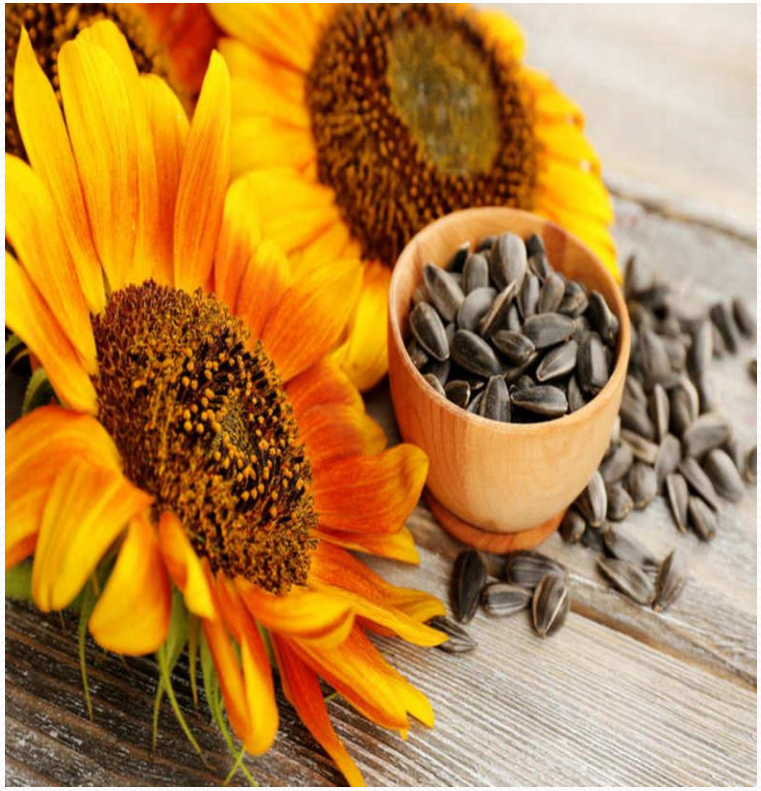
- TRUE TPYE – the release into the environment of compounds that are toxic in the form in which they are produced

- FUNCTIONAL TYPE – the release into the environment of a substance that is toxic as a result of transformation by micro-organisms.


Wheat
Alfalfa
Cowpea
Maize on chenopodium
Sorghum on *Abytylon theophrasti*
Auto Allelopathy
Allo Allelopathy
Residual
Direct Allelopathy
Lentil residues on wheat
Instantaneous direct effect
Sorghum

FORMS OF ALLELOPATHIC INTERACTIONS -

- Crop against other crops –
- Sunflower has been found allelopathic to groundnut under intercropping situation.
- Tree crops like Eucalyptus also shows some allelopathic interactions to vegetables and some field crops grown as intercrop with it.
- Crop residues of lentil are phytotoxic to wheat and of sunflower and mustard to several crops.
- Sorghum is allelopathic to wheat and sweet potato to cow pea
- Mung/green gram and cowpea are stimulatory to growth of wheat.



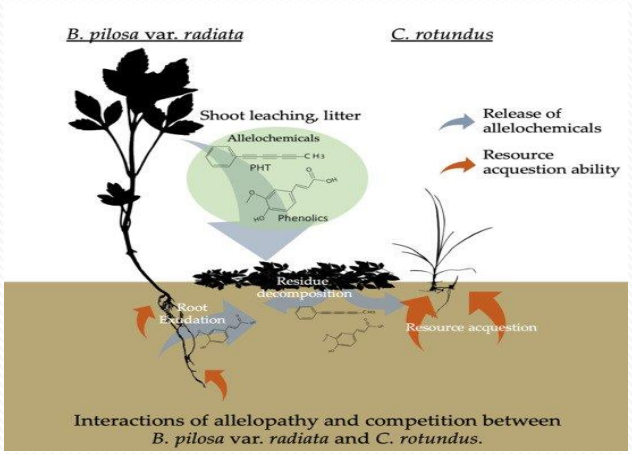
Crop Against Weeds -

- Sorghum releases hydrocynic acid (HCN) and suppresses many weeds growing in vicinity.
- Barley produces “gramine” an alkaloid, which inhibits weed growth.

S.NO	CROPS	WEED SPECIES
1	MAIZE	*Chenopodium album, Amaranthus retroflexux*
2	SORGHUM	*Setaris virdis, Bromus pectinatus,Amaranthus hybridus*
3	CUCUMBER	*Echinochloa crusgalli*
4	SWEET POTATO	*Cyperus rotundus, Cyperus esculentus*

Weed Against Crops -

S.NO	WEEDS	CROPS
1	*Cyperus rotundus*	Sorghum, Soybean
2	*Imperata cylindrica*	Several crops
3	*Chinopodium album*	Alfalfa, cucumber, oat, maize
4	*Cirsium arvense*	Several crops
5	*Avena fatua*	Several crops



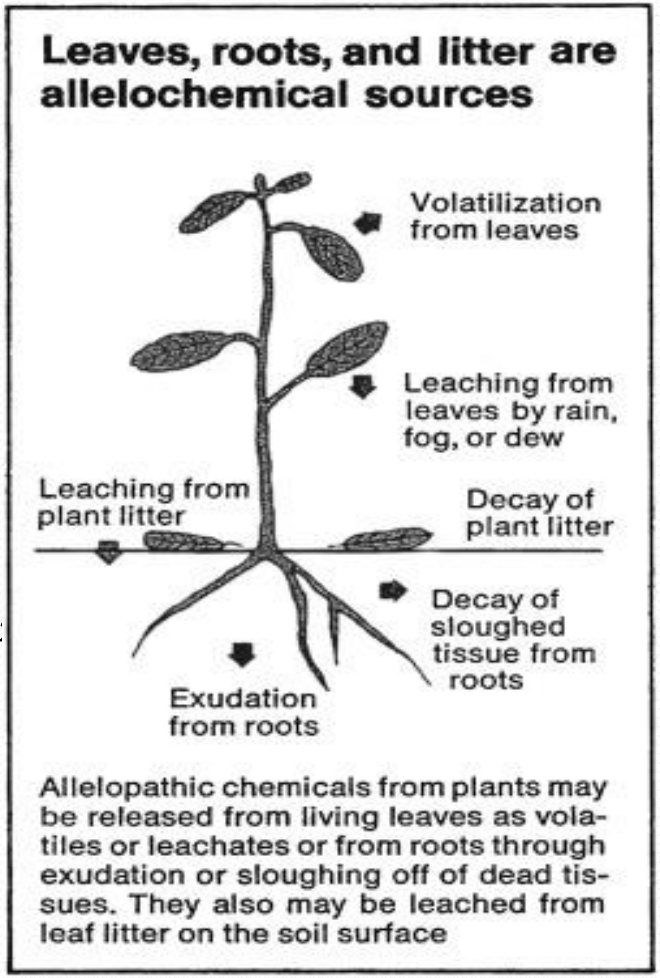
Interactions of allelopathy and competition between *B. pilosa* var. *radiata* and *C. rotundus*.

Weed Against Other Weeds -

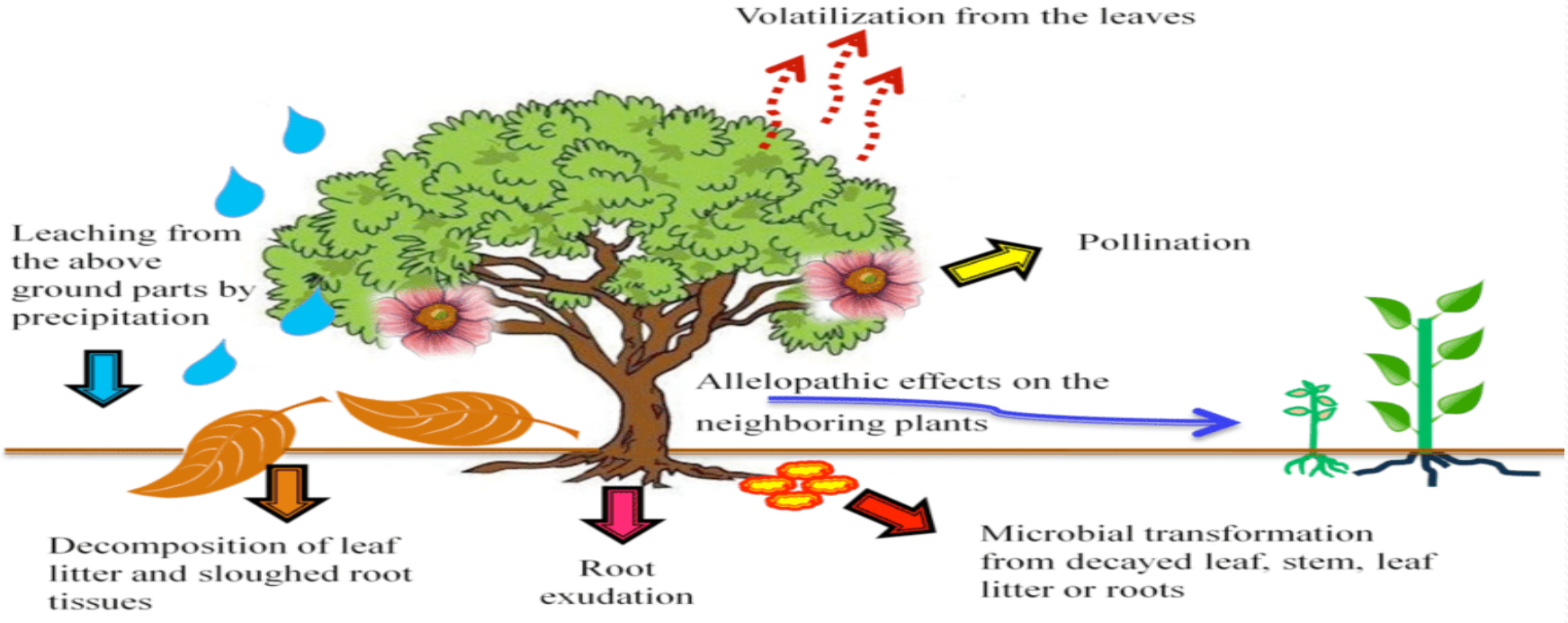
- Cassi Sericea, has shown encouraging result to oust Parthenium in Karnataka state

Sources -

- Allelopathy occurs when **one plant species releases chemical compounds**, either directly or indirectly through microbial decomposition of residues, that affect another plant species.
- Production of allelochemicals varies with environment and associated environmental stresses. It can occur in any plant organ (Rice, 1974), but **roots, seeds, and leaves** are the most common sources. Source becomes important for exploitation of allelochemicals for weed control.

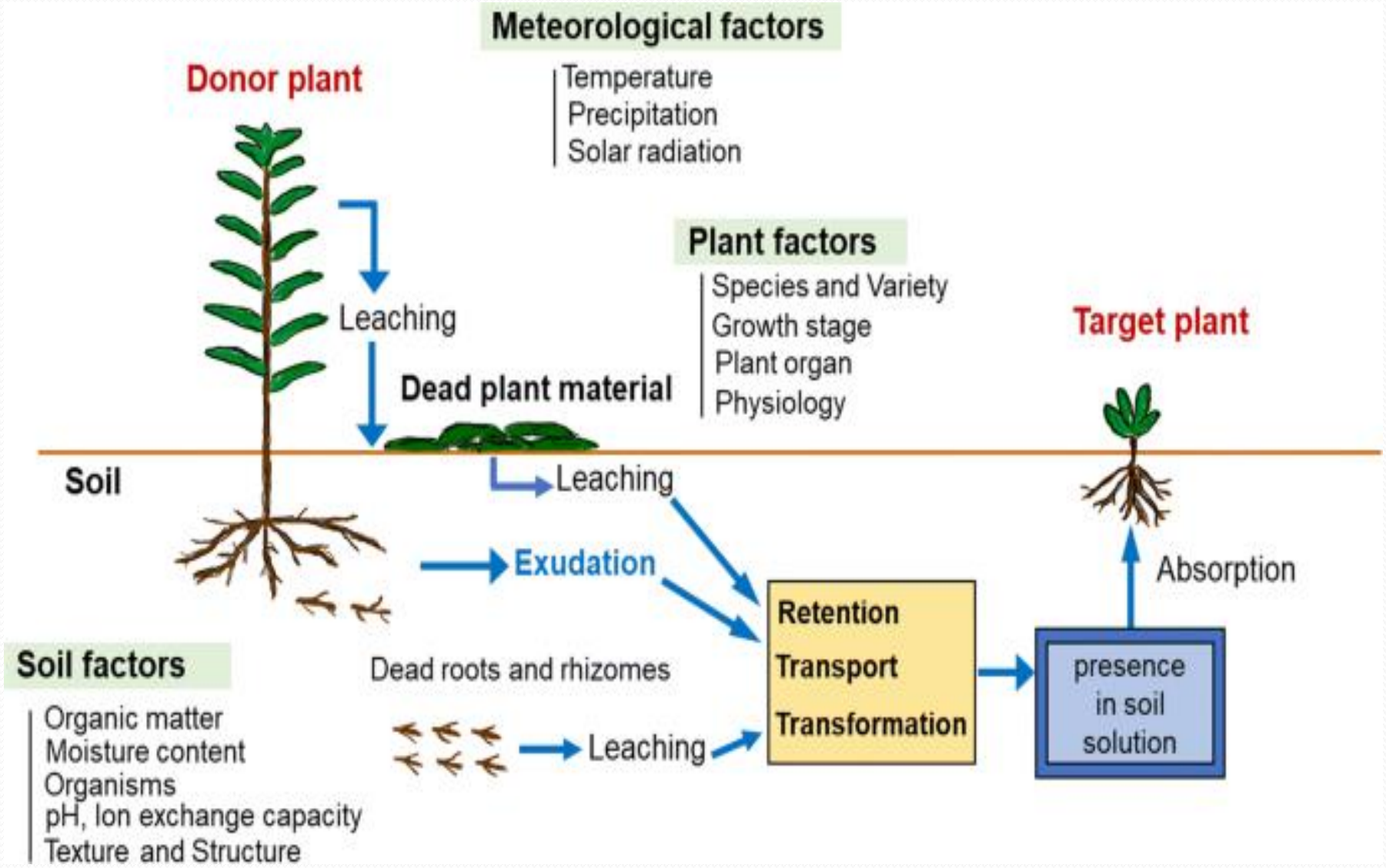


VOLATALIZATION	LEACHING	EXUDATION	WEATHERING
Arid and semiarid environment Mostly terpinoid group Released from special glands on stem or leaves	Through aqueous solution (rain,dew) Mature leaves are more susceptible	Metabolites exuded from roots to surrounding atmosphere Potential source of allelopathic effect	Leaves and Stubbles By weathering and microorganisms



Allelochemicals

- Donor plants release allelochemicals into the environment through volatilization from living parts of the plant, leaching from plant foliage, decomposition of plant material and root exudation . Except for volatilization, the other pathways release allelopathic compounds into the soil. Once released by the donor plant, allelochemicals enter into a complex plant-soil system in which different factors affect their availability and, consequently, their effective influence on target plants. This plant-soil system, is in turn influenced by several meteorological factors, demonstrating the complexity of this phenomenon. In addition to the chemical nature of the allelochemical produced, the phytotoxic activity of allelochemicals in the soil is affected by climatic conditions (e.g. solar radiation, temperature, rainfall), soil factors (e.g. texture, pH, ion-exchange capacity, organic matter content, nutrient dynamics, moisture content and microbial ecology) and plant factors of both the donor and target plants (e.g. species, botanical variety, growth stages, plant parts, etc.). Since the pathways of release of allelochemicals into the environment, as well as plant and meteorological factors affecting their production, have already been reviewed in depth this article addresses root exudation, which is the most important pathway of release of such secondary metabolites into the soil, and soil factors (physical, chemical and biological) interacting with allelochemicals.

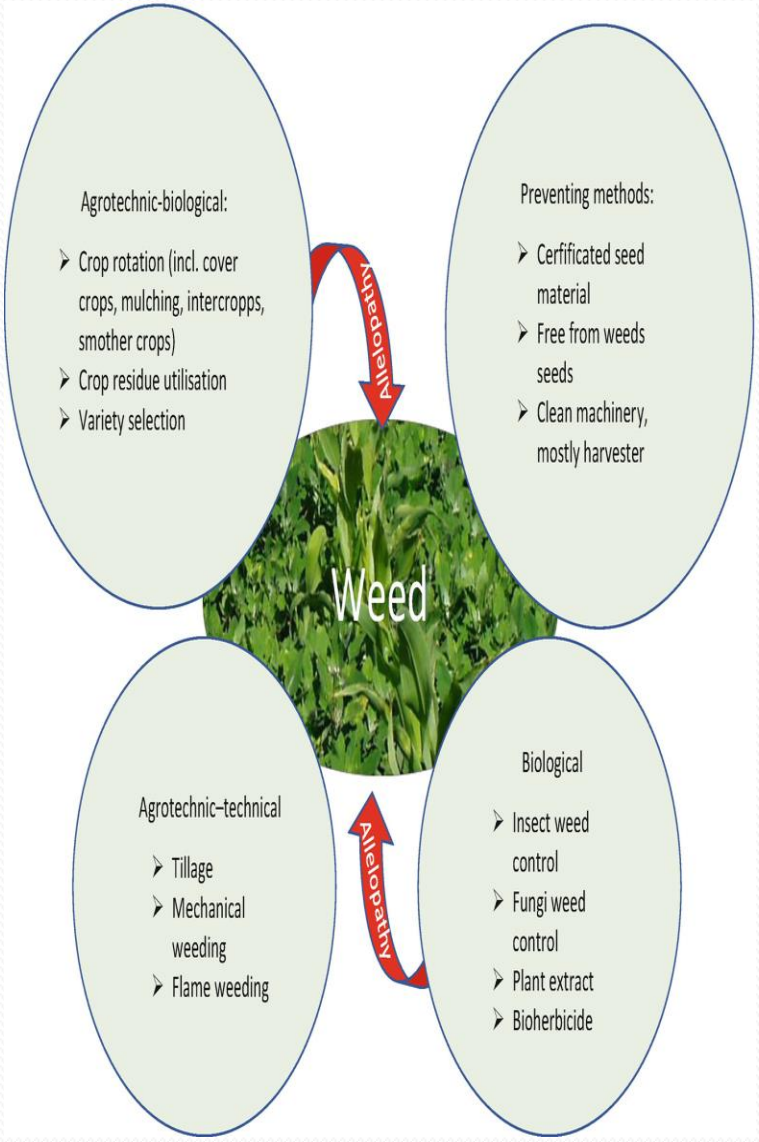

Meteorological factors
Temperature
Precipitation
Solar radiation
Donor plant
Leaching
Plant factors
Species and Variety
Growth stage
Plant organ
Physiology
Target plant
Dead plant material
Soil
Leaching
Exudation
Absorption
Retention
Transport
Transformation
presence in soil solution
Soil factors
Organic matter
Moisture content
Organisms
pH, Ion exchange capacity
Texture and Structure
Dead roots and rhizomes
Leaching

APPLICATIONS

WEED MANAGEMENT-

- Weeds are unwanted plants and can out-compete intended crop growth by using up valuable resources like nutrients, minerals, water, space, and sunlight. Chemicals traditionally used to control weed growth can be toxic to the environment and humans. Extended use of such herbicides can also create herbicide-resistant weed species. Thus, allelopathy provides a more natural alternative.
- Some crops have been already shown to have weed suppressing allelopathic chemicals. For example, rye, wheat, sorghum and winter legumes have all been shown to have weed suppressing activity. These crops can be used as cover crops, or processed and spread as green manure or smother.

- Allelopathic crops can also be used in rotation to keep weeds at bay. For example, rotations of rye in the fall have been shown to suppress weed growth for weeks after the crop has been terminated. The effects can last longer if the rye plant material is left on the soil as green manure.
- Rice is another important crop that has allelopathic tendencies. In rice farming, the use of herbicides to control weeds is extremely common. However, herbicide-resistant weed strains are increasing due to excessive use. Some studies are screening rice strains for allelopathy to use in place of herbicides. Increasing the use of allelopathic rice strains could improve sustainable farming in the rice industry.
- However, some allelopathic chemicals can be so strong that they have **autotoxicity**, meaning they inhibit the growth of plants of the same species. For example, although alfalfa exhibited allelopathy that inhibited weeds, it can also create autotoxicity if it's used in high dosages. When alfalfa is used in low doses, it can promote plant growth.



INSECT MANAGEMENT

- Insects are another huge problem for agriculture and forestry. Synthetic chemicals have been used as insecticides but with their increased use the insects are becoming resistant to these chemicals.
- Thus the allelopathic chemicals can be used as a natural defense against insect attacks on plants or forest.
- For eg. Neem tree produces different compounds that inhibit pest such as green Cicadellid, whitefly and strawberry aphids. These compounds can be isolated and applied to crops like an insecticide grow in rotation or used as green manure.

MANAGEMENT OF PLANT ALLELOPATHY

- Arrangement of cropping systems

1. Crop allelopathy can be effectively used to control weeds in the field.
2. By intercropping those field crops that can supress the weeds of the next crops.

STRAW MULCHING –

It provides the sustainable weed management.

The allelochemicals from decomposed straw can supress weed growth in

ADVANTAGES OF ALLELOPATHY

- Limit competition for space, light, nutrients and water.
- Autotoxity (chemical produced inhibits germination of it's own seeds)
- Allelopathic weed supression through the use of cover crops.

Mode Of Action Of Allelchemicals

- Donor – Aspergillus japonicus
- Released Alleochemicals Secalonic acid F (SAF)
- Decrease of SOD and POD activity
- Free radicle increased
- Lipid in membrane be preoxidised
- Membranes are destroyed
- Cell structure destroyed
- Then two phases occur-

1. Acuumulation of MDA – Leads to increased electronic conductivity and finally inhibit root growth and root activity.
2. Destruction of structure of Chloroplast and Mitochondrian that leads to decreased photosynthesis and respiration and leads to inhibition of seedling ,growth, yellowish and parietal death.

THANK YOU