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Allelopathic effects of different weed species on crop

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ABSTRACT:

The unwanted unintentionally propagated plant species with crops, called as weeds may have inhibitory effect on bothersome weeds. Part of plant as whole or their extract or their metabolite can be used as Allelopathic plant. Although any of these parts have which kind of effect on any selected plant; is matter of study. In current study such phenomenon has been explained in brief. The study shows that almost every plant has some allelopathic effect by any way on any other plant. the mechanism of action may be Volatilization, Leaching, Root exudation, Decomposition and act as herbicide for other plant.

KEY WORDS: Weed, Allelopathy, Allwlopathic species, Mechanisam of inhibition

INTRODUCTION

Weeds are out of place plants and not intentionally propagated. Weeds are naturally strong competitors and those weeds that can best compete always tend to dominate. There are approximately 250,000 species of plants worldwide; of those, about 3% or 8000 species behave as weeds . Weeds are also known as invasive plants. The weeds typically produce huge amounts of kernels, assisting their spread and are exceptional at surviving and germinate in disturbed environments. It can be an unusual species or a native species that settles and persists in an ecosystem in which it did not previously exist. Weeds can inhabit all environments; from our towns and cities through to our oceans, deserts and alpine areas. Some weeds are of particular concern and, as a result, have been listed for priority management or in legislation.

Australia has identified thirty two Weeds of National Significance (WONS) because of their invasiveness, impacts on primary production and the environment, potential for spread and socioeconomic impacts. Throughout Australia, weeds are spreading faster than they can be controlled and management of them is consuming an enormous amount of resources. Climate change poses an additional challenge to our ability to manage weeds [1].

Allelopathy is grouping of two greek words one is ‘allele’ and other ‘pithy’. Allelo means mutual or one another. Pathy means suffering. In nature many plant secrets secondary metabolites or phytotoxins that may constrain the growth of diverse other plant. This phenomenon of nature is called allelopathy and the produce effect may be directly by alive plant or indirectly through the process of plant decomposition. If the metabolite or phytotoxin produces inhibitory, effect they are known as allele-chemicals. Allelopathy may be beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms and the community [2]. Austrian scientist Hans Molisch during his study about forestry systems first ever use term ‘allelopathy’. Initially, many of the forestry species evaluated had negative allelopathic effects on food and fodder crops, but in the 1980s research was begun to identify species that had beneficial, neutral, or selective effects on companion crop plants[3].

allelopathy can affect many aspects of plant ecology, including occurrence, growth, plant succession, the structure of plant communities, dominance, diversity, and plant productivity.

The maximum number of research and publication shows that reduction in seed germination and seedling growth are most common allelopathy effects. The resource shows that Like chemical herbicides, there is no physiological target site or common mode of action for any allelochemicals. However, sites known for action for some allelochemicals include pollen germination, cell division, nutrient uptake, specific enzyme function and photosynthesis[4].

MECHANISMS OF ALLELOPATHY

Inhibitory effect of allelopathy is complex process. Different classes of chemicals involved in allelopathy such as flavonoids, phenolic compounds, terpenoids, steroids, alkaloids, amino acids and carbohydrates alone or with mixtures and may involve the interaction of different compounds. The mixture sometimes having a greater allelopathic effect than individual compounds alone[5]. Furthermore, environmental and physiological stresses, diseases, pests, solar radiation, herbicides, and less optimal nutrient, moisture, and temperature levels can also affect allelopathic weed effect. Allelopathic activity can be found on different plant parts, including leaves, flowers, leaf mulch and leaf litter stems, bark, roots, soil, and soil leachates and their derived compounds. These chemicals are released by four different ways[6, 7].

I. Volatilization: release of chemicals into the atmosphere. These chemicals may be diluted orabsorbed in vapour by surrounding plants or directly can be condensate in dew or may reach the soil and be taken up by the roots;

II. b) Leaching: Chemicals may leach with dew or rainfall, irrigation from the superficial parts of plants that are deposited on the soil or on other plants. Leaching may also occur through plant residues laied on earth.

III. c) Root exudation: from plant roots, bark into the soil environment or on other plant parts. sheding off the roots is not clearly understood whether these compounds are actively exuded, leaked or arise from dead cells

IV. d) Decomposition: plant residues decomposition is difficult to determine whether produced by microorganisms or toxic substances are contained in residues and simply released upon decomposition.

Allelochemicals can be present in soil and can affect crop plant beside it and those to be plant in succession. Further the effect can varies over a growing season. Although allelochemicals may be more biodegradable than traditional herbicides, they may have undesirable effects on non-target species, necessitating ecological studies before widespread use.

Allelochemicals of crops and plants may also have selective activity. For example, Leucaena leucocephala, the miracle tree helps for water and soil conservation, revegetation, and livestock nutrition; The toxic amino acid (non-protein) present in this tree leaves inhibit the growth of other trees but not its own seedlings. Leucaena species have also been shown to reduce the yield of wheat but increase the yield of rice[8].

The allelopathic effects of fresh shoot aqueous extract of Tithonia diversifolia showed that the radicle and plumule lengths of the maize (Zea mays L.)seedlings were sign ificantly inhibited further the same significantly stimulate the growth of older plants of two weeks old and above [9]

POTENTIAL ALLELOPATHIC EFFECT

The department of chemistry involved in isolation and identification of allelochemicals is called as allelochemistry. In the laboratory, leachates and plant extracts are usually screened for their effects on seed germination with further isolation & identification of allelochemicals from greenhouse tests and field soil, confirming laboratory results. Interactions among host crops, allelopathic plants, and other non-target organisms must also be considered. Furthermore, allelochemistry may provide templates or basic structures for developing new synthetic herbicides. Various studies have elucidated specific allelochemicals involved in weed suppression, including diterpenoid momilactones in rice; benzoxanoids in rye; alkaloids and flavonoids in fescue; tabanone in cogongrass; naphthotectone and anthratectone in teak (Tectona grandis); abscisic acid beta-d-glucopyranosyl ester in red pine; cyanamide in hairy vetch; and a fatty acid (cyclopropene) in hazel sterculia (Sterculia foetida).

The allelopathic traits from wild or genatic combination of cultivated plants into crop plants or combination through traditional breeding methods could also enhance the biosynthesis and release of allelochemicals. Genetic basis of allelopathy has now been demonstrated in winter wheat and rice. Specific cultivars with increased allelopathic potential are known in both these crops.

An allelopathic weed can effectively be used to control bothersome weeds near crop by planting a variety with allelopathic qualities, either as a smother crop, when left as a residue mulch or , in a rotational sequence, or, especially in low-till systems, to control subsequent weed growth. For instances, in one study, rye mulch had no effects on common lambsquarters and velvetleaf but had suppressive effects on common purslane and pigweed. A fall cover crop of forage radish had weed suppression effects on the following season's crop. In a multiseason field study, when applied as a soil amendment, mustard seed meal derived from white mustard (Sinapis alba) was effective for weed suppression in organic sweet onion, but crop injury was also significant.

Alternatively, application of allelopathic compounds along with, before, or after synthetic herbicides could increase the total effect of both materials, thereby reducing application rates of synthetic herbicides. The attempts also have been made and reported here on spray of allelopathic plants' aqueous extracts on crops for suppression of weed. One of the studies, an extract of brassica (Brassica napus), sunflower, and sorghum was used on rain-fed wheat to successfully controll weed pressure. When an allelopathic plant water extract was tank-mixed with atrazine, a significant degree of weed control was achieved in wheat with a reduced dose of herbicide. Sunflower residues with a preplant herbicide (Treflan®) enhanced weed suppression in broad bean.

The reported study about allelopathic effect of some weeds on the germination of seeds of selected crops showed that six dominant weeds often used for mulching and green manuring, were evaluated on the germination of the seeds of six commonly grown crops. Extracts from 500g of finely chopped shoots and roots each of Aspilia africana (Pers) C. D. Adams, Crotalaria retusa L, Emilia sonchifolia (L) DC, Chromolaena odorata(L) King & Robinson, Cyperus esculentus L., and Panicum maximum L., were obtained with one litre of distilled water. These were applied to seeds of Zea mays L., Abelmoschus esculentus (L) Moench,Citrullus lanatus Thunb, Vigna unguiculata (L) Walp, Arachis hypogaea L., and Glycine max (L) Merr in petri dishes. The decomposing mulches showed varied but less inhibitory effects on the seeds with a trend toward increasing inhibitory power with increasing mulch level and decreasing seed size. The results revealed that a possible relationship between the low seed germination and poor seedling growths often observed in the area. However, further studies are needed to confirm the findings. [10]

Table 1 Influence of weed plant extract on the root and shoot length of rice weeds [11]

Allelopathic plant	*T. portulacastrum*	*E. colona*	*E. crus-galli*	*C. rotundus*	*C. iria*
			Shoot length (cm)		
Control	28.53 cd** ± 1.99	36.07 b ± 1.93	46.73 a ± 3.01	36.93 b ± 1.30	28.00 c-e ± 1.83
Sorghum AE*	19.80 f-m ± 2.27	23.47 d-h ± 1.74	30.20 c ± 1.68	20.93 f-k ± 0.84	13.13 n ± 0.50
Sunflower AE	19.67 g-m ± 3.37	28.47 cd ± 0.25	27.50 c-e ± 1.53	18.33 h-n ± 2.08	16.73 j-n ± 1.07
Brassica AE	20.67 f-l ± 1.12	20.13 f-l ± 0.64	27.00 c-e ± 2.18	20.00 f-l ± 1.31	15.47 l-n ± 0.12
Mulberry AE	21.53 f-j ± 1.86	22.87 e-i ± 1.15	24.40 d-g ± 2.21	21.13 f-k ± 1.29	17.73 i-n ± 1.07
Eucalyptus AE	18.20 i-n ± 1.39	24.27 d-g ± 1.64	24.73 d-g ± 1.83	14.67 mn ± 0.75	16.93 j-n ± 1.20
Winter cherry AE	24.60 d-g ± 1.74	24.90 d-f ± 1.17	27.67 c-e ± 1.17	16.30 k-n ± 0.80	21.53 f-j ± 0.46
LSD P ≤ 0.05			Interaction=5.229		
			Root length (cm)		
Control	10.00 c-g ± 1.50	14.33 b ± 0.76	17.80 a ± 1.42	11.00 c-f ± 0.50	5.77 k-n ± 0.34
Sorghum AE	9.33 e-I ± 1.26	9.67 d-h ± 0.76	10.13 c-g ± 1.81	8.67 f-j ± 0.76	3.33 no ± 0.76
Sunflower AE	9.33 e-i ± 1.53	11.00 c-f ± 0.66	11.33 c-e ± 1.28	7.33 h-k ± 1.04	3.83 no ± 0.14
Brassica AE	10.00 c-g ± 0.87	12.33 bc ± 0.58	12.00 b-d ± 1.53	4.85 l-n ± 0.07	3.50 no ± 0.90
Mulberry AE	12.33 bc ± 0.29	12.00 b-d ± 0.50	11.40 c-e ± 1.02	7.00 i-l ± 1.32	4.60 l-n ± 0.26
Eucalyptus AE	8.00 g-k ± 1.50	12.17 bc ± 0.72	11.03 c-f ± 1.61	6.83 j-m ± 0.88	2.10 o ± 0.09
Winter cherry AE	12.40 bc ± 0.72	12.17 bc ± 1.42	12.27 bc ± 1.45	5.67 k-n ± 1.04	4.50 m-o ± 0.75
LSD P ≤ 0.05			Interaction=2.441		

*Aqueous extract; ** Means with different letters differ significantly at the 5% level of probability by an LSD test.

Allelopathic plant	Impact
Rows of black walnut interplanted with corn in an alley cropping system	Reduced corn yield attributed to production of juglone, an allelopathic compound from black walnut, found 4.25 m (~14 ft) from trees
Rows of Leucaena interplanted with crops in an alley cropping system	Reduced the yield of wheat and turmeric but increased the yield of maize and rice
Lantana, a perennial woody weed pest in Florida citrus	Lantana roots and shoots incorporated into soil reduced germination and growth of milkweed vine, another weed
Sour orange, a widely used citrus rootstock in the past, now avoided because of susceptibility to citrus tristeza virus	Leaf extracts and volatile compounds inhibited seed germination and root growth of pigweed, bermudagrass, and lambsquarters
Red maple, swamp chestnut oak, sweet bay, and red cedar	Wood extracts inhibited lettuce seed as much as or more than black walnut extracts
Eucalyptus and neem trees	A spatial allelopathic relationship if wheat was grown within 5 m (~16.5 ft)
Chaste tree or box elder	Leachates retarded the growth of pangolagrass, a pasture grass, but stimulated the growth of bluestem, another grass species
Mango	Dried mango leaf powder completely inhibited sprouting of purple nutsedge tubers.
Tree of heaven	Ailanthone, isolated from the tree of heaven, has been reported to possess non-selective postemergence herbicidal activity similar to glyphosate and paraquat
Rye, fescue, and wheat	Allelopathic suppression of weeds when used as cover crops or when crop residues are retained as mulch
Broccoli	Broccoli residue interferes with growth of other cruciferous crops that follow
Jungle rice	Inhibition of rice crop
Forage radish	Cover crop residue suppression of weeds in the season following the cover crop
Jerusalem artichoke	Residual effects on weed species
Sunflower and buckwheat	Cover crop residues reduced weed pressure in fava bean crop
Tifton burclover	Growth inhibition in wheat and autotoxicity in burclover
Sunn hemp	Growth inhibition of smooth pigweed and lettuce and inhibition of vegetable seed germination
Desert horsepurslane (*Trianthema portulacastrum*)	Growth promotion of slender amaranth (*Amaranthus viridis*)
Rhazya stricta	Growth inhibition of corn
Rough cocklebur (*Xanthium strumarium*)	Growth inhibition of mungbean

Garlic mustard	Inhibition of arbuscular mycorrhizal fungi colonizing on sugar maple
Barbados nut (*Jatropha curcas*)	Extracts of leaves and roots inhibited corn and tobacco
Chicory	Inhibition of *Echinochloa crusgalli* and *Amaranthus retroflexus*
Swallow-worts	Invasive species in northeastern United States and southeastern Canada; inhibited several weed species
Vogel's tephrosia (*Tephrosia vogelii*)	Growth inhibition of corn and three narrow-leaf weed species
Green spurge	Inhibition of chickpea
Crabgrass	Inhibition of corn and sunflower but no inhibition of triticale when dry crabgrass residue was incorporated into soil
Silver wattle (*Acacia dealbata*)	Inhibition of native understory species in northwest Spain
Sticky snakeroot (*Ageratina adenophora*)	Volatiles were inhibitory to plants in non-native ranges but not inhibitory to plants in the native range

REFERENCES:

1. Weeds in Australia, Department of environment, http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/index.html

2. Stamp, Nancy Out of the quagmire of plant defense hypotheses, The Quarterly Review of Biology. March 2003, 78 (1): 23–55

3. Willis, R. J. 2010. The History of Allelopathy. Dordrecht, The Netherlands: Springer.

4. Cheng F, Cheng Z. Research Progress on the use of Plant Allelopathy in Agriculture and the Physiological and Ecological Mechanisms of Allelopathy. Frontiers in Plant Science. 2015;6:1020.

5. Faravani, M., H. B. Baki, and A. Khalij. "Assessment of Allelopathic Potential of Melastoma malabathricum L. on Radish raphanus sativus L. and Barnyard Grass (Echinochloacrus-galli)." Notulae Botanicae Horti Agrobotanici Cluj-Napoca 36.2 (2008): 54.

6. Putnam, A.R. 1985. Weed allelopathy. In: S.O. Duke (ed.). Weed physiology volume 1: Reproduction and Ecophysiology. CRCPress.131-155.

7. Rice , E. L. 1984 . "Allelopathy." 2nd Ed . Academic Press , New York , pp. 421.

8. Yeung, Patrick K. K., Francis T. W. Wong, and Joseph T. Y. Wong. "Mimosine, the Allelochemical from the Leguminous Tree Leucaena Leucocephala, Selectively Enhances Cell Proliferation in Dinoflagellates." Applied and Environmental Microbiology 68.10 (2002): 5160–5163.

9. Oyerinde R. O., Otusanya O. O. and Akpor O. B. "Allelopathic effect of Tithonia diversifolia on the germination, growth and chlorophyll contents of maize (Zea mays L.)" Scientific Research and Essay 2009; Vol.4 (12), pp. 1553-1558.

10. Usuah, P.E., G. N. Udom, and I.D. Edem. "Allelopathic Effect of some Weeds on the Germination of Seeds of Selected Crops Grown in Akwa Ibom State, Nigeria." World Journal of Agricultural Research 1.4 (2013): 59-64.

11. Khaliq, A; Matloob, A; Khan, M.B and Tanveer, A. Differential suppression of rice weeds by allelopathic plant aqueous extracts. Planta daninha . 2013, vol.31, n.1

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