Advances in Environmental Biology, 5(7): 1559-1562, 2011
ISSN 1995-0756

This is a refereed journal and all articles are professionally screened and reviewed

ORIGINAL ARTICLE

Exploitation of Allelopathy in Agriculture

Omid alizadeh

Islamic azad university firoozabad branch. firoozabad, Iran.

Omid alizadeh, Exploitation of Allelopathy in Agriculture

ABSTRACT

Allelopathy involves the addition of a chemical compoundor several chemical compounds to the environment, while competition involves the removal or reduction of some factor in the environment, factors like water, minerals, food, and light. Several important agricultural plants are thought to interfere with crop growth at least in part though allelopathic mechanisms.Rigrous proofs, including isolation and identification of the chemical inhibitors, are required to document allelopathy. Although allelopathy has usually been considered a problem for agriculture, there is now considerable evidence to suggest that it might be exploited to help manage cropproblems in a variety of agroecosystems. Approaches that have been explored are selection for allelopathic types within the germplasm of crops,use of allelopathic rotational or companion plants in cropping systems, and biosynthesis of useful natural herbicides from higher plants and microorganisms. First approach involves screening for allelopathic types in germplasm collections of crops. Presumably, this characteristic could be incorporated into a cultivar by conventional plant breeding or other genetic recombination strategies. Second approach involves the idea of using strong interfering" smother crops" in rotation that has been practiced by farmers for centuries Residues of some plants, through production of chemical compounds. may selectively inhibit the germination of some weeds. Third approach involves the use or natural products from higher plants and microorganisms as herbicides. These products, if economical, may be useful in providing new herbicide chemistry.

Key words:

Introduction

The concept of deterimental effects of crop plant on the growth and development of other crop plants was known from early times.theopherastus observed the inhibitory effects of crop plants on other crops over 2000 years ago.but before theearly part of this century no research has been conducted in this area.[22]

Allelopathy and Allelochemicals:

Allelopathy is relatively new as a science, even though statements were made about the phenomenon over 2000 years ago . this term was coined by Molisch (1937) to refer to biochemical interactions between plants of all kinds including microorganisms.Allelpathy consists of every positive or negative reaction caxsed by produced chemical materials of a plant on another. Allelopaty has been formed of two Greek words meaning bilateral harm; but originally, it means harmful impacts of plants on germination and growth of other plant types [20].

The meaning of harmful impacts of a plant on another plant growth has been clear since past times, as Teofrastus, Greek historian, plants on other plants 2000 years age. [22]

Some scripts regarding toxic impact of some plants on others and soil written by Greek and Roman writers has been observed too. In the ninteenth Centrury, decondolle suggested crop rotation as a possibiltiy of decreasing harmful impacts os soil disease caused by toxic materials diffusion produced by some plants. [21,22]

Corresponding Author

Omid alizadeh, Islamic azad university firoozabad branch. firoozabad,Iran.
E-mail: omid_alizadeh2003@yahoo.com; Tel:+989177157434 fax:+987126224402

Chemicals that impose allelopathic influences are called allelochemicals or allelochemics. In a review of the potential use of allelochemicals as herbicides, Putnam (1988) listed 6 classes of allelochemicals namely alkaloids, benzoxazinones, cinnamic acid derivatives, cyanogenic compounds, ethylene and other seed germination stimulants, and flavonoids which had been isolated from over 30 families of terrestrial and aquatic plants.[21]

Maybe the first scientific paces of this question has been taken at the beginning of the present century, since according to that, Schreiner et al. analysed some phytotoxic materials from the crop residue and soil successfully. In that time, it was demonstrated that *Triticum aestivum* roots, oat and some other kinds of plants discharge materials out of their environment [22].

Some Alleopathic studies concerning crops included studies over analysis impacts of crop residue in soil. Benddict discovered that Bromus inermis roots can decrease the growth of its plantlets. Mccalla and Duelly discovered wheat stubble mulch decreased in som cases, the number and the growth of the next cron. The harmful impacts of plant residue on corn was considerable, especially in the humid and cold circumstances. Mccalla and Guenzi found the impact of wheat, soybean and Bromus inermis residue inhibition on wheat, corn and sorghum growth. The same researchers studied on harmful impacts of these materials on growth of wheat plant let as well as recognizing five types of phenolic acids in the residue of oat, corn and sorghum. [20,17,21]

Rainfall causes the leaching of allelopathic substances from leaves which fall to the ground during period of stress; leading to inhibition of growth and germination of crop plants [13].

In 1963, Norstdt and Mccalla distinguished a kind of fungi inhibited the growth of wheat plantlets seriously producing patxlin. These researchers' studies revealed the toxins produced by microbs as well as toxins coused by plant had formed and Alleopathic state.

Kimber (extracted from source 1) concluded both Nitrogene transfer in soil and toxins caused by crop residue could decrease performance, especially when the plant grows beside residueHe did it in 1973, while performing a series of precision experiments. Five texture forms a major part of soil enviroment while analysing plants and itself. Their analysis in soil causes formation of compounds which might have harmful effects on the coming plants[9,20].

Alleopathic materials may free by microbs through leaching or litters analysis. Freed compounds are infrluenced by crop residues or soil microbs population [19]. In most of Alleopathic reactions, it is not clear whether decrease of crop production is drivectly influenced by the freed toxins or toxic materials transfrom crop in such an extent that provide the conditions of microbic attack. [19&20] Discharged materials must be gathered enough to influence on plants or remain for some time. Prorided these materials discharge for a long time, may have longer impacts. It is clear that how much the environmental conditions are provided for faster analysis of phytotoxic materials; the ingfluence of harmful materials will be less on growth to the some extent.

For instance, hith temperature accelerating analysis most of the time; is not without and their harmful effects. [19&22]

Compounds which might have in hibition effects on plants in soil consist of a wide categories of paraffin. Hydrocarbonic materials, fat acids and other organic acids. Organic base, Esters and alchols, aldoids, phenols, kumarines, phleunoids, Tanens, Terpneuids, Alkaloids, cyanohydroids and other cellulose analysed products, lygnin and protein having plant origin. The type and amount of these materials differs in different plant types and different times [19,9,22]

At the tim of analysing these materials complicated changes and synthesis occurs and the soil environment possesses a different chemical compounds at any time influencing on plants differently.

It seems the most toxicity is around the materials being analysed [16,19]. Many of these materials one analysed quickly or inactivated and changed. Selection of allelopathic plants is a good and commonly used approach for identification of plants with biologically active natural products [7].

In cricumstances in which their analysis occur slowly for some reasons; they remain in soil for a longer time and put more harmful impacts on ther plants. [14,19,22]. Besides, the amount of materials in activated is in parallel to new materials production. So, their effect intenstity is subordinate to the amount of new analysis and productions. [19] In order to have any effect on the target plant the allelochemicals have to be released from the donor plant. This can happen in different ways:

1. Runoff and leachate from leaves and stem of plants. As for example, the allelochemicals in the leavesof black walnut,*Juglans nigra*, which are washed off with rain can inhibit the growth of the vegetationunder the walnut tree [3].
2. Volatile phytotoxic compounds from the green parts of a plant, e.g. *Salvia leucophylla* and *Artemisiacalifornica* [10].
3. Phytotoxic compounds from decomposing plant material, such as rye (*Secale cereale)* when used as amulching material. Apart from shading and keeping the soil moist, rye mulch also inhibits bothgermination and growth of weeds through release of phytotoxins [1]

4. Phytotoxic compounds released from the plant roots. Rice is an example, where living rice plants are able to suppress weed growth selectively [15,18]

Allelopathic Potentiality of Crop Residue:

The harmful effects of crop residue on the next plants creates important problems in stubble mulch farming that are under operation to preserve soil and water right now. Materials produced from stubble can cause poisoning of some present plants in rotations. Residue not only influences on the plant sprouting and growth and crop production; but also, it influences on growth of weeds.

In experiments regarding crop essence it was revealed that grasses influnence on sproxting less than legume [3]. Based on these experiments; produced materials from legume decrease plant lets growth and materials produced from shoots were more toxic than materials produced from roots. Concerning the degree of harmful materials influence in plants; respectively, *Medicago sativa,* lotus conrniculatus, Trifolium arundinaceae, Trifolium pratense, phalaris arundinaceae, phleum pratense and Dactylis glomerata were observed.

Chung *et al.* [12] described the effect of allelopathic potential of rice (*Oryza sativa* L.) residues against*Echinochloa crusgalli* P. Beauv. var. *oryzi-cola* Ohwi (barnyardgrass), an associated weed of paddy. Itwas found that average inhibition by the variety Duchungjong on *Echinochloa crusgalli* was 77.7% higherthan other 113 tested varieties.[3]

Oueslati examined the allelopathic effect of diluted extracts of roots, leaves and stems of twodurum wheat varieties viz., Karim and Om rabii on barley (variety Manel) and bread wheat (varietyAriana). Guenzi and McCalla [17] found phytotoxicity of phenolic acids, particularly *p*-coumaric acid,from residues of wheat and other cereals[4]

In other research, it was revealed that providing increasing chemical fertilizers could help the lack of plant growth; no Allelopathic mechanism appears. [12]

For instance, chandramohan et al., while analysing some chemical materials having inhibition state in rice plant lets in the southern India in 1973; found that adding fertilizer from the bottom causes an increase in rice yield ability and a decrease in density of phynel components in soil. In addition, it reveals that increase of Nitrogen, phosphor and other elements decreases phynel compounds in plants under experiment.

Caamal-Maldonado *et al.* [12] examined the toxic effect of four legumes velvetbean (*Mucuna deeringiana* (Bort) Merr.), jackbean (*Canavalia ensiformis* (L.) DC.), jumbiebean (*Leucaena leucocephala*(Lam.) de Wit), and wild tamarind (*Lysiloma latisiliquum* (L.) Benth.) on growth of three weeds viz.,barnyardgrass (*Echinochloa crusgalli* L. P. Beauv.), alegrيa and amaranth (*Amaranthus hypochondriacus*L.). The aqueous leachates (1%) of all four legumes exhibited strong phytotoxic effect on the radicle growth of the weeds. [4]

Increasing price of chemical fertilizers in recent years; consumption of legume in order to Nitrogen fixation in crop rotation has been increased; furthurmore, it has been revealed that most of legume have Allelopathic effects on ther plants. So, there must be an emphasis in selection and plant inbreeding compatible to mixed cultivations. [12].

There must also be more studies Concerning inbreeding plants which can face pests producing chemical materials.

In most of cases, herbicides produced by plant sources have respectively more systematic power and are analysed quicker. [6,10]. Again, toxins produced by some plants or pathogenes can be used in order to struggle weeds. [13]. Consequently, we can conclude that here have not been any considerable research concerning crop Allelopathic effects on weeds. [5,10,12].

Refrence

1. Barnes, J.P., A.R. Putnam, 1986. Evidence for allelopathy by residues and aqueous extracts of rye (*Secale cereale*). Weed Sci., 34: 384-390.
2. Benedict, H.M., 1941. The inhibitory effect of dead roots, on the growth of hromegrass. J.Am. Soc- Agron., 33: 1108 -109.
3. Bode, H.R., 1958. Beitrنge zur Kenntnis allelopatischer Ercheinungen bei einigen Juglandaceen. Planta, 51: 440-480.
4. Caamal-Maldonado, Jes's Arturo, Jiménez-Osornio, Juan José, Torres-Barragلn, Andrea and Anaya, Ana Luisa., 2001. The Use of Allelopathic Legume Cover and Mulch Species for Weed Control inCropping Systems. Agron. J. 93: 27-36.
5. Chung, I.M., K.H. Kim, J.K. Ahn, S.B. Lee, S.H. Kim, S.J. Hahn, 2003. Comparison of Allelopathic Potential of Rice Leaves, Straw, and Hull Extracts on Barnyardgrass. Agron. J. 95: 1063-1070.
6. Chandramohan, D., D. Purushothaman and R. Kothandarman, 1973. Soil phenolics and plant growth inhibition. Plant Soil., 39: 303-308.
7. Duke, S.O., F.E. Dayan, J.G. Romagni, A.M. Rimando, 2000. Natural products as sources ofherbicides: current status and future trends. Weed Res., 40: 99-111.
8. Grant, E.A and W.G. Salans, 1964. Influence of plant extract, on germination and growth of eight forage species- .1- Brit. Grassl. Soc., 19: 191-97.

9. Guenzi. W.D. and T.M. McCalla, 1962. Inhibition of germination and seedling development by crop residues. Soil Sci. Soc. Am- Proc., 26: 456-48.
10. Halligan, J.P., 1973. Bare areas associated with shrub stands in grasslands: the case of *Artemisia california*. Bioscience, 23: 429-432.
11. Kimber, R.W., 1977. Phytotoxicity from plant residues. III. The relative effect of toxins and nitrogen immobilization on germination and growth of wheat plant. Plant Soil., 38: 543-55.
12. Lockerman, R.H. and A.R. Putnam, 1978. Field evaluation of .Allelopathic cucumbers as an aid to weed control-Weed Sci., 27: 54.
13. Mann, J., 1987. Secondary Metabolism, 2nd Edition. Clarendon Press, Oxford, pp: 374.
14. McCalla, T.M. and F. Duley, 1949. Stubble mulch studies. III. Influence of soil microorganisms and crop residues on the germination. growth and direction of root growth of corn seedlings. Soil Soc :AM. Proc., 14: 196-99.
15. Navarez, D. and M. Olofsdotter, 1996. Relay seeding technique for screening allelopathic rice (*Oryza sativa*). Proc. 2nd Int. Weed Control Congr., Copenhagen, 1285-1290.
16. norstadt, f.a and T.M. Mccalla, 1963. Phytotoxic substance from a species of pencillium. science, 140: 410-11.
17. Oueslati, Oussama., 2003. Allelopathy in two durum wheat (*Triticum durum* L.) varieties. Agri. Ecosys. Env., 96: 161-163.
18. Olofsdotter, M., D. Navarez, M. Rebulanan, 1997. Rice allelopathy - where are we and how far can we get Brighton Crop Protect. Conf. Weeds, 1: 99-104.
19. Patrick, Z.A., T.A. Toussoun and l.w. Koch, 1964. Effect of crop residue decomposition products on plant roots. Ann. Rew. Phytopathology, 2: 267-93.
20. Putnam, A.R. and W.b. Duck, 1978. Allelopathy in agroecosystem.Ann.Rev.phytopatology, 16: 433-52.
21. Putnam, A.R., 1988. Allelopathy: problems and oppertunitis in weed anagement,in M.A. Altier, M. Liebman, pp: 77-89.
22. Rice, E.l., 1984. Allelopathy.Academic press, N.Y.
23. Tempelton, GE., D.O. Tebest and R.J. Smith, 1979. Biological weed with mycoherbicides. Ann.rev. Phytopathology, 17: 301-310.