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ALLELOPATHY : DEFINITION AND SCOPE

The word **Allelopathy** is derived from two Greek words ***'Allelon'*** means mutual and ***'Pathos'*** means harm and generally refers to the detrimental influence of higher plants, of one species (the donor) on the germination, growth, development and / or yield of plants of another species (the recipient). It can be separated from other mechanisms of plant inhibition because the detrimental caused is exerted by release of chemicals (allelochemicals) by the donor species into the plant through environment. It is, therefore, different from competition which involves the removal or reduction of some growth factors from the environment that is also required by some other plant sharing resources of same habitat such as water, nutrients and sunlight. Confusion surfaced because some biologist considered allelopathy to be a part of competition.

The impact of allelopathy in agriculture was recognized for the first time by Theophrastus in about 300 B.C. He stated, `chickpea (*Cicer arietinum*) does not reinvigorate the soil as other legumes do but exhausts it instead'. Further he pointed out also that *C. arietinum* destroys weeds.

In spite of the early observations pertaining to apparent allelopathic effect, no definite scientific evidence was obtained to support the suggestions until the present century. The term **allelopathy** was coined by **Molisch**, (1937) to refer biochemical interactions among all kind of plants, including microorganism. He referred that the term allelopathy meant to encompass both inhibitory and stimulatory biochemical interactions.

Since the beginning of research in this field, the scientists used different terms, *viz.* competition or allelospoly which created confusion. Therefore, to avoid this confusion the various scientists defined the term allelopathy. Some of the important definitions are as follows :

1. **Molisch,(1937)** coined the term allelopathy to describe all the biochemical interactions among plants (microbes and higher plants), stimulatory as well as inhibitory.
2. **Bonner, (1950)** describes that "It includes interspecific (antibiotic) as well as intraspecific (autotoxic) chemical coaction".
3. **Muller,(1969)** refers the allelopathy to deleterious effects that one higher plant has on another through the production of chemical retardants that release into the environment.
4. **Delmoral and Cates, (1971)** stated it as "inhibition

of germination, growth and metabolism of one plant due to the release of organic chemicals by another".

5. **According to Rice, (1974)** allelopathy refers to any direct or indirect inhibitory effec by one plant (including microorganisms) on another through the production of chemical compounds that escape into the environment.

6. **Tischler, (1975)** describe that "it is interspecific chemical co-action, while autoallelopathy is intraspecific chemical coaction."

7. **Putnam and Duke,(1978)** defined allelopathy as "detrimental effects of higher plants of one species (the donor) on the germination, growth and development of another (the recipient) plant species."

8. **International Allelopathy Society, (1996)** had proposed a new definition of allelopathy which refers to any process involving secondary metabolites produced by plants, microorganisms, viruses and fungi that influence the growth and development of agricultural and biological systems (excluding animals).

The aforesaid definition is the most acceptable because it covers all vistas of new science, which has a wide spectral role in agriculture, forestry and agroforestry.

SCOPE OF ALLELOPATHY

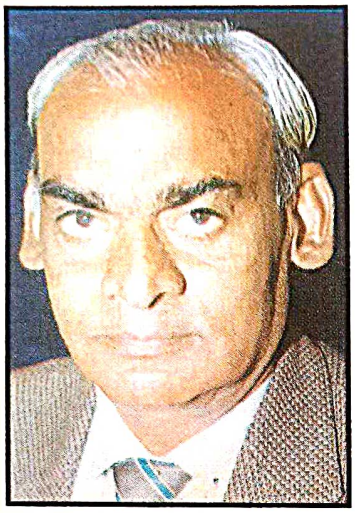
Allelopathy in agroforestry : It is well known that trees suppress the growth of certain understorey or neighbouring plant species. Allelopathy play a significant role in agroforestry, crop growth, development, productivity and horticulture. In crop production, it is related to problems of soil sickness, autotoxicity, predisposition of plants to disease, prevention of weeds seed decay, reduced biological nitrogen fixation in legumes and reduced uptake of nutrients. In trees, it causes autotoxicity, failure of budding/ grafting and suppression effect on understory species. The allelopathic effect is due to allelopathic compounds and secondary metabolites which are produced by trees, bacteria, fungi and algae under agroforestry system. *Leucaena leucocephala* is known to have allelopathic effect on the intercrops such as grasses, legumes and cereal crops.

Allelopathy in natural ecosystem : Probably allelopathic effects are of ecological significance affecting dispersion of plants and thus the patterning of vegetation. Various parts of red pine and soil under it were found to contain chemicals toxin to many understory plants. The allelopathy probably play an important role in retarding understory growth.

Allelopathy in forestry : Certain tree species such as *Betula pendula* and *Picea abies* fail to develop in association with heather (*Calluna vulgaris*). This apparently results from the production by heather of an allelochemical toxic to growth of mycorrihizae of *B.pendula* and *P.abies*. Fructicose soil lichens are often allelopathic to the growth of mycorrhizae and forest tree seedlings. Alder species are often important in forest because of the fixation of nitrogen by Frankia in nodules on their roots.

Allelopathy in agriculture : When some crop grow with the other crop and with tree they effect each other whether the effect is stimulatory or inhibitory. The rice - rice rotation is less than that of the first crop. Yield of soybean increased by burning the rice straw prior to planting the soybean. *Cassia uniflora* is a good biological control plant for *Parthenium hysterophorus* and has replaced that weed in some part of Indian state. The replacement has been due to a combination of allelopathy and

From The Director's Desk



Allelopathy, defined as the process involving the effect of secondary metabolites produced by one species on growth of other species, plays a decisive role in the overall productivity of any system. Information on allelopathic interaction, among trees, crops, weeds and microorganisms in agroforestry systems is meagre. However, these studies are of paramount significance in developing highly productive and sustainable agroforestry systems. This calls for the need to initiate/ expedite indepth research programmes to explore and elaborate the maximum possible utility of allelopathic interactions for increasing the total productivity of agroforestry systems.

(Dr. K. R. SOLANKI)
Director

competition. Over 100 species of weeds have been reported to have allelopathic potential.

Allelopathy in plant pathology : Parasitic plants occur in several families and seed germination appears to function as one level of chemical recognition in host selection. Several analogues of strigol were found as polateral stimulants of seed germination for species of both *Striga astiatica* and *Orobanche*. Stimulation of seed germination of parasites in soil even in absence of host plant may be a good control mechanism. The production of antibiotic is important in many of the reported cases of antagonism to various plant diseases.

Allelopathy in weed control : Presence of weeds in field crops significantly reduces the nutrient uptake by crops. Allelopathic interactions between crops and weeds are partly responsible for such crop losses. Allelopathy partly provides protection against decay and imparts dormancy to weed seeds present in the soil and thus they remain viable for several years. The weed seeds contain antimicrobial compounds and germination inhibitors. The weeds affect crop plants through release of phytotoxins from seeds, decomposing residues, exudates, leachates and volatile chemicals and weed residues are the major source of phytotoxin in the soil.

Chemical nature of allelopathic compounds : Allelopathic compounds exhibits a wide spectrum of chemical originated either through the acetate or shikimic acid pathway. These compounds ranges from very simple gases - aliphatic compounds to complex multi-ringed aromatic compounds.

Allelopathy play a decisive role in plant growth and development . In the near future allelopathic interactions may be used to increase productivity of agroecosystems, maintain soil productivity, reduce environmental pollution and to develop highly productive and sustainable agricultural, horticultural and agroforestry systems.

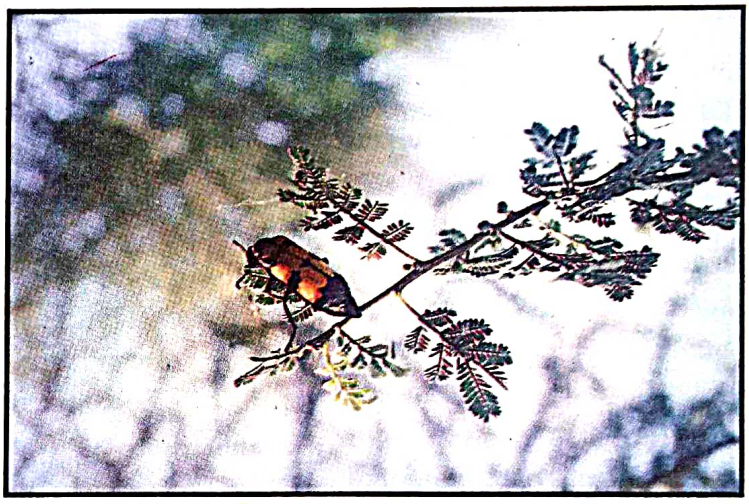
K.R. Solanki, A.K. Bisaria and Neelam Khare
National Research Centre for Agroforestry
Jhansi - 284003

BLISTER BEETLE DAMAGE IN AGROFORESTRY

Acacia torti lis is a fast growing tree suitable for the arid and semi arid regions. It is drought hardy and provides excellent firewood and charcoal; young shoots and pods are good fodder material. It is recommended for agroforestry as its thin canopy provides good potential for taking an under storey crop such as rain fed pulses during the brief rainy season or a dryland cereal crop such as sorghum or millet.

The tree comes to flowering in the month of June and continues up to August which coincides with the flowering of Kharif pulses such as mung (*Vigna radiata*) and urd (*Vigna mungo*). The flower beetle otherwise called the blister beetle, *Mylabris pustulata*, feeds voraciously on flowers of mung and urd. The beetle also feeds on the flowers of many trees found in association with crops such as *Acacia nilotica*, *A. tortilis*, *Luecaena luecocephala* etc. It has been observed that the association of *A. tortilis* with Kharif pulses is most harmful for the pulse crop in terms of damage by *M. pustulata*. The synchronised flowering of *A. tortilis* and the pulse crop attracts more number of beetles due to availability of more food and also tree shade for refuge. The beetle population increased 5 times more near a windbreak consisting of *A. tortilis* and *L. luecocephala* trees as compared to the area away from the wind break.

Therefore, it is necessary to take the following precautions :



* Avoid growing *Acacia tortilis* along with Kharif pulses.
* If grown, purning of branches in order to minimise the flowers available for feeding and reduce area for refuge.
* Hand picking the beetle as far as possible will help to limit the damage.
* Take up spraying at 15 days interval with endosulphan 0.05% or phosalone at 0.05% at the time of flowering.

Chitra Shanker, K.R. Solanki and Rajendra Singh
National Research Centre for Agroforestry, Jhansi-284003

SOIL BINDING FACTOR IS A GOOD INDICATOR IN SELECTING PLANT SPECIES FOR REVEGETATION OF MINESPOILS

Degraded limestone mine sites in north-west Himalaya of Uttar Pradesh are very poor in soil characteristics (pH 7.8, organic C 0.21%, available P_2O_5 4 kg ha^{-1}, available K_2O 40 kg ha^{-1}, bulk density 1.64 Mg m^{-3} and water holding capacity 16.0%) and devoid of vegetation (vegetal cover even less than 10% at places). Such sites require special conservation measures for rehabilitation with an immediate aim of providing carpet so that soil, nutrient and water losses are arrested. Therefore, to rehabilitate such problem sites, vegetation which can come up quickly, native, lime loving, fast growing having conservation and aesthetic values, economically and ecologically sound should be taken into account.

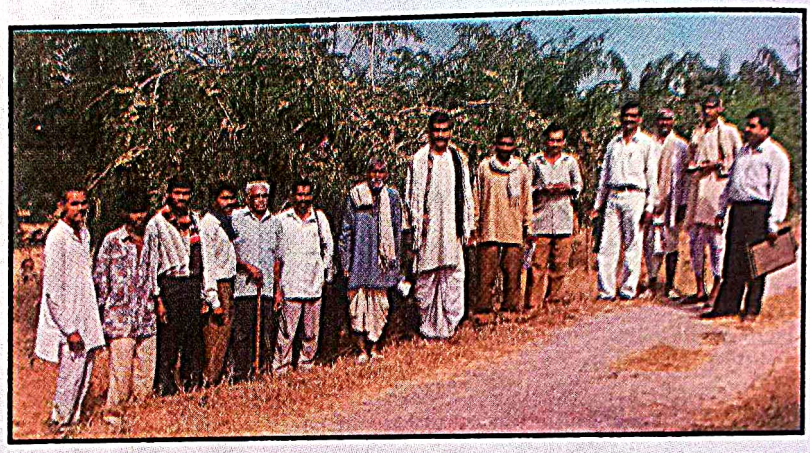
The role of length and thickness of plant roots in binding the soil particles is very important from conservation view point. In comparison to thick roots, fibrous roots have greater soil binding capacity. Bhimaya *et al.*, (1956) established a correlation between the degree of ramification of root systems, their weight and average thickness of roots, present in a known volume of soil in case of grasses which they termed it as a binding factor (F). It can be expressed as $F=W/r^2$, where W is the weight of roots and stolons (g) present in a unit volume of soil and 'r' is average radius (mm) of roots and stolons. But, in the present study, the factor suggested was slightly modified in which only fibrous roots (<0.5 mm) were taken into account for working out the SBF (F). The relative performance of twenty species of trees (*Eucalyptus hybrid, Grewia optiva, Bombax ceiba, Bauhinia retusa, Leucaena leucocephala, Erythrina suberosa, Salix tetrasperma, Toona ciliata*), shrubs (*Ipomoea carnea, Agave americana, Vitex negundo*) and grasses/climbers (*Chrysopogon fulvus, Arundo donax, Pennisetum purpureum, Brachiaria mutica, Eulaliopsis binata, Saccharum spontaneum, Eriophorum cosmosum, Thysanolaena maxima* and *Pueraria hirsuta*) was tested for root soil binding characteristics in minespoils of Mussoorie hills. Plant species were allowed to grow for 550 days and after that were carefully uprooted, washed with water and observations recorded on root biomass, specific root length (SRL), root radius (r) and soil binding factor (W/r^2).

Amongst tree species, highest soil binding factor (F) was recorded in *L.Leucocephala* (380) followed by *B. retusa* (170) and *S. tetrasperma* (168). *L. leucocephala* also possessed maximum SRL (292 m) and oven dry root biomass (70g). Tiny root nodules were also recorded on the roots of *L. leucocephala* which seems to be associated in the process of N-fixation. In case of shrubs, all performed equally well with respect to soil binding but the growth and root biomass was found more in *Ipomoea carnea*. Among grasses/climbers, *P. purpureum, E. binata, S. spontaneum* and *E. cosmosum* were found to have soil binding factors of 1550,990,887 and 880, respectively followed by *C. fulvus* (660). These observations suggest that in north-west Himalaya, *trees* (*L. leucocephala, B. retusa, S. tetrasperma*), shrubs (*I. carnea, A. americana* and *V. negundo*) and grasses (*P. purpureum, E. binata, S. spontaneum, E. cosmosum* and *C. fulvus*) are ideal plant species from soil conservation view point for rehabilitation of such degraded limestone mined sites.

K.S. Dadhwal
CSWCR&TI, Dehradun
Present Address:
National Research Centre for Agroforestry
Jhansi-284003

A REPORT ON AONLA WEEK

The Centre has organized aonla week from 7th to 12th December, 1998 in which 350 farmers and farm women visited the aonla based agri-horticultural system at the Centre. During this week, the various extension activities such as on-farm visit, demonstration trial visit, group discussion, question - answer session and scientist-farmer interactions were carried out. District information officer, Jhansi, officials from state department of agriculture, horticulture, forestry, KVK, Bharari, IFFDC, Sagar (MP) and media people from national and local dailies also attended the programme. There was a wide publicity of aonla based agroforestry system in the national and local dailies. The farmers have shown keen interst in aonla based agroforestry system and expressed their desire to have training on budding of aonla.



HUMAN RESOURCE DEVELOPMENT

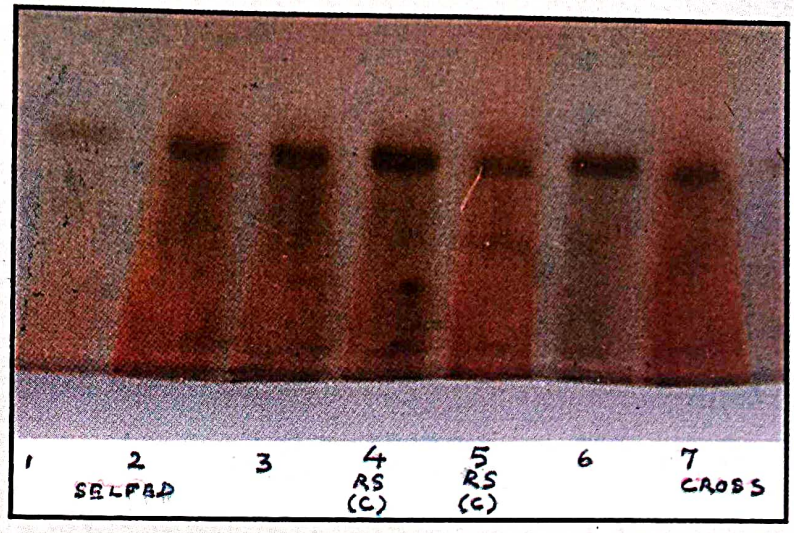
1. Dr. S.K. Shukla, Scientist (Horticulture) delivered lectures on 9.11.98, 19.11.98 and 28.11.98 in a training programme organized by Krishi Vigyan Kendra (KVK), Bharari (affiliated to C.S. Azad University of Agriculture and Technology, Kanpur).

2. Dr. P. Rai, Principal Scientist and Dr. Ram Newaj, Scientist (Sr. Scale) attended First International Agronomy Congress during 22-27 November, 1998 at IARI, New Delhi.

3. Dr. P. Rai and Dr. K. S. Dadhwal, (Principal Scientists) of the Centre attended the National Seminar on "Wasteland Development : Challenges & Opportunity" during 3-4 December, 1998 at CSAUA&T, Kanpur.

4. Dr. S.K. Shukla, Scientist (Horticulture) delivered a lecture on "In-situ planting in aonla and ber" on 28.12.98 in Udyan Gosthi organised by State department of Horticulture at Government Garden, Baruasagar, Jhansi.

STUDIES ON REPRODUCTIVE BEHAVIOR OF NEEM: AN ISOZYME CHARACTERIZATION APPROACH



Azadirachta indica A. Juss (neem) is widely grown in the Indian sub - continent and is known for its medicinal and pesticidal properties from time immemorial. Scanty information is available on the reproductive biology of neem and earlier reports based on preliminary studies have suggested cross pollinated behavior. In contrary to this, study at this Centre on selfing, seedling vigour of open pollinated Vs self pollinated progenies and dehiscence of anthers in closed flowers indicated that neem is predominantly self pollinated species. To confirm the contradictory result, isozyme characterization study was done through gel electrophoresis technique.Esterase, Acid phosphatase and Peroxidase were analysed in leaves of selfed as well as open pollinated progenies of same genotypes and open pollinated progeny of other genotype (Control). Uniform band pattern of isozyme profile was observed in selfed and open pollinated progenies of the same genotype whereas extra bands were observed in the progenies of other genotype (Control). These results further suggested that neem may be a self pollinated tree species. Further studies are underway on isozyme characterization of Catalase, Glutamine Oxaglutarate Amino Transferase and Alkaline phosphatase in leaves as well as in kernels to ascertain the extra breeding behavior of neem.

A.K. Shanker, V.K. Gupta, P.K. Mandal*, A.K. Handa and K.R. Solanki
National Research Centre for Agroforestry, Jhansi-284003
*Indian Grassland and Fodder Research Institute, Jhansi-284003

VISITS ABROAD :

Dr. K.R. Solanki, Director, NRCAF, Jhansi participated in International Expert Group (IEG) Meeting on the CCD Regional Action Programme (RAP) during 10-13 November, 1998 at ESCAP, Bangkok.

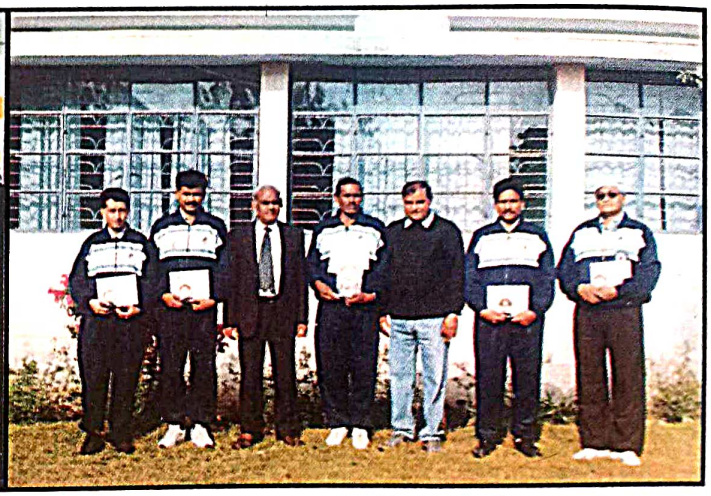
REGIONAL COMMITTEE (IV Meeting) :

Dr. K.R. Solanki, Director, NRCAF, Jhansi attended regional committee meeting during 18-19 December, 1998 at IISR, Lucknow.

IJSC MEETING :

A meeting of IJSC was held on 14th October, 1998 under the chairmanship of Dr. K.R. Solanki, Director, NRCAF, Jhansi.

भा. कृ. अनु. प. के मण्डल चतुर्थ खेलकूद में राष्ट्रीय कृषिवानिकी अनुसंधान केन्द्र का शानदार प्रदर्शन



भारतीय कृषि अनुसंधान परिषद के मण्डल चतुर्थ के 15 से 20 दिसम्बर 1998 देहरादून में सम्पन्न खेलकूद में राष्ट्रीय कृषिवानिकी अनुसंधान केन्द्र, झाँसी के श्री अतर सिंह, 5000 मीटर की साईकिल दौड़ में प्रथम रहे। यह दूरी उन्होंने 5.12 मिनट में पूरी की। ज्ञात रहे कि इससे पूर्व भी पिछले तीन वर्षो से श्री अतर सिंह साईकिल रेस में प्रथम आते रहे है। उधर दूसरी ओर टेबल टेनिस में इसी केन्द्र का प्रतिनिधित्व कर रहे डॉ० ए. के. हाँडा तथा डॉ० आर. वी. कुमार द्वितीय स्थान पर रहें। केन्द्र का प्रतिनिधित्व कर रहे 24 खिलाड़ियों के समूह ने 800 मीटर दौड़, भाला फैक, गोला फैंक, बैडमिंटन, वालीबाल शूटिंग तथा स्मशिंग तथा कबड्डी में भी अपना प्रतिनिधित्व प्रस्तुत किया है।

VISITORS

- Dr. Vivek Singh and Sh. Ravinder Kumar, Consultants, Agricultural Finance Corporation, Regional Centre for National Afforestation and Eco-development Board (RCNAEB), visited the Centre on 2.11.98.
- Dr. O.P. Gaur, Chief Executive, IFFDC, Farm Bhawan, Nehru Place, New Delhi alongwith a group from IFFDC, Sagar visited the Centre on 7.11.98.
- Sh. D.C. Gupta, Distt. Information Officer, Jhansi visited the Centre on 7.12.98
- Thirty five Farmers from Distt. Jalaun (U.P.) visited the Centre on 8.12.98
- Sixty Trainees from KVK, Bharari, Jhansi visited the Centre on 10.12.98
- Twenty six Trainees from CSWCR & TI, Dehradun visited the Centre on 19.12.98
- Dr. I. K. Thakur, Dr. Y. S. Parmar University of Horticulture and Forestry, Solan (H.P.) alongwith forty one Students (36 boys and 5 girls) visited the Centre on 26.12.98.

Supervision and Guidance : Dr. K.R. Solanki, Director, NRCAF, Jhansi

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A. K. Bisaria **P. Rai** **Ajit** **Rajeev Tiwari**	**Director** N.R.C.A.F., Jhansi Ph. : +91 - (0517) - 448213 Fax : +91 - (0517) - 442364 E.mail : nrcaf@x400.nicgw.nic.in	**Mini Printers** Antia Talab Road Jhansi-284002 ✆ : (0517) 446820