ejpmr, 2019,6(9), 345-350

SJIF Impact Factor 4.897

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

ALLELOPATHIC EFFECT OF *MYRISTICA FRAGRANS* ON *VIGNA RADIATA*

Vinitha S. Babu*

MPhil Scholar, Department of Botany, University of Kerala, Thiruvananthapuram.

***Corresponding Author: Vinitha S. Babu**

MPhil Scholar, Department of Botany, University of Kerala, Thiruvananthapuram.

Article Received on 23/06/2019 **Article Revised on 14/07/2019** **Article Accepted on 04/08/2019**

ABSTRACT

The present study aimed to evaluate the allelopathic potential of *Myristica fragrans* against *Vigna radiata*. The parameters selected for evaluation include germination, height of seedling, vigour index and phytotoxicity. Control group was also maintained. The germination along with the shoot and root length were found to be reduced by the effect of concentrations of the test solution. The phytotoxicity and vigour index were also found to be varying.

KEYWORDS: Allelopathy, *Myristica fragrans*, *Vigna radiata*, Phytotoxicity.

1. INTRODUCTION

Allelopathy is derived from two Greek words '*Allelon*' means each other and '*Pathos*' means to suffer i.e., the injurious effect of one upon another. However, allelopathy has also been coined as a term, which refers to all biochemical interactions (stimulatory and inhibitory) among plants, including microorganism.[1] The term allelopathy generally refers to the detrimental effects of one species (the donor) on the germination, growth or development of plants of another species (the recipient). It can be separated from other mechanisms of plant interference, because the detrimental effect is exerted through release of chemical inhibitors (allelochemicals) by the donor species to the plant environment. It is, therefore, different from competition which involves the removal or reduction of some growth factors from the environment that is required by some other plants sharing the same habitat e.g., water, minerals and sunlight. Confusion has arisen in the literature because some biologists consider allelopathy to be a part of competition. This confusion could be lessened by using the term 'allelopathy' to refer to the overall influence of one plant on another.[2] Allelopathy is of considerable importance for agroforestry systems and it involves ecological compatibility of trees with crops for higher productivity. However, possible allelopathy interactions between tree species and other plants grown in agroforestry systems have received little attention till 1970, but thereafter; the pace of research has accelerated. In 1996, the International Allelopathy Society defined allelopathy as follows: "Any process involving secondary metabolites produced by plants, micro-organisms, viruses, and fungi that influence the growth and development of agricultural and biological systems (excluding animals), including positive and negative effects".[3] Allelochemicals originating in foliage, leaching root products, leaf litter or mulches of crops woody plants may result in reduced productivity or even leading death of companion plants. Some plant species are widely known for their allelopathic interference with field crops. Agroforestry is a traditional method of farming that incorporates a mixture of woody perennial crops, annual crops and/ or livestock into an integrated production system. "Agroforestry is a collective term for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos etc.) are deliberately used on the same land-management unit as agricultural crops and / or animal, in some forms of spatial arrangement or temporal sequence''.[4] Agroforestry system has potential to increase the overall yield, it essentially creates competition among the components for resources in addition to presence of allelochemicals in either of the component which has impact on productivity. Therefore, detailed studies on the effect of tree allelochemicals on seed germination, growth and metabolism of crop plants need to be conducted prior to recommending any tree species for agroforestry programme. These compounds are often referred to as 'natural herbicides' from the agronomic point of view, the research in allelopathy provides perspectives of a reduced reliance on traditional herbicides if weeds control can be achieved by the release of allelochemicals from the crop. Also, in cropping systems where herbicides are not used, for example in organic farming, crop cultivars with enhanced allelopathic activities could be part of the weed management strategy. Weed control mediated by allelopathy – either as natural herbicides or through the release of allelopathic compounds from a living crop cultivar or from plant residues – is often assumed to be advantageous from the environment compared to traditional herbicides. Due to their origin from natural sources, some authors suggest that the allelopathic components will be biodegradable and less polluting than

traditional herbicides. However, even though most compounds derived from natural sources appear to have short half-lives compared to synthetic pesticides, some of those products also have toxicologically undesirable target effects.[5]

Investigations of allelopathic activities have often been initialized by field observations mainly related to changes in agricultural, horticultural or silvicultural productivity or change in vegetation patterns in natural habitats. Problems of growing the same crop in succeeding years because of poor establishment and stunted growth has led to investigations of possible causes, including allelopathy. Allelopathy occurring among individuals of the same spices is termed auto toxicity. The role of allelopathy in the interactions between forest trees and their understory species is also of current interests. For example, inadequate natural regeneration and reduced growth of planted seedlings has been attributed to the release of allelochemicals by herbaceous vegetation. Especially ericaceous shrubs have been investigated for their effect on seed germination, rooting ability and seedling growth of conifers.[6]

Allelopathic effect and tree-crop interaction of *Myristica fragrans* and *Vigna radiata* is not available; hence the present investigation was designed with the following objectives.

1. To study the allelopathic effect of *Myristica fragrans* with different extracts (leaves, pericarp aril and seeds) on germination and seedling growth of *Vigna radiata*.
2. To study the vigour index and phytotoxicity of *Vigna radiata.*

2. MATERIALS AND METHOD

2.1. Allelopathic Factor

The allelopathic factors for this investigation was *Myristica fragrans* and the test crop was *Vigna radiata*. The descriptions of the allelopathic factor and test crop are as under:

2.2. *Myristica fragrans*

Myristica fragrans is an evergreen tree indigenous to the Moluccas (or the Spice Islands) of Indonesia. It is important as the main source of the spices nutmeg and mace. It is widely grown across the tropics including Guangdong and Yunnan in China, Taiwan, Indonesia, Malaysia, Grenada in the Caribbean, Kerala in India, Sri Lanka and South America. *Myristica fragrans* is an evergreen tree, usually 5–15 m (16–49 ft) tall, but occasionally reaching 20 m (66 ft) and rarely reaching up to 30 m (98 ft) find only in Tidore. The alternately arranged leaves are dark green, 5–15 cm (2.0–5.9 in) long by 2–7 cm (0.8–2.8 in) wide with petiolesabout 1 cm (0.4 in) long. The species is dioecious, i.e. "male" or staminate flowers and "female" or carpellate flowers are borne on different plants, although occasional individuals produce both kinds of flower. The flowers are bell-shaped, pale yellow and somewhat waxy and fleshy. Staminate flowers are arranged in groups of one to ten, each 5–7 mm (0.2–0.3 in) long; carpellate flowers are in smaller groups, one to three, and somewhat longer, up to 10 mm (0.4 in) long.Carpellate trees produce smooth yellow ovoid or pear-shaped fruits, 6–9 cm (2.4–3.5 in) long with a diameter of 3.5–5 cm (1.4–2.0 in). The fruit has a fleshy husk. When ripe the husk splits into two halves along a ridge running the length of the fruit. Inside is a purple-brown shiny seed, 2–3 cm (0.8–1.2 in) long by about 2 cm (0.8 in) across, with a red or crimson covering (an aril). The seed is the source of nutmeg, the aril the source of mace.

Systematic Position
Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Magnoliales
Family: Myristicaceae
Genus: Myristica
Species: *M. fragrans*

2.3. *Vigna radiata* L. wilczek (Green gram)

Green gram is small, herbaceous and annual having a twining habitat and height of 45-90 cm. The stem is ridged and succulent having 6-9 branches on them. The leaves are trifoliate, ovate, entire and arranged in alternate and opposite position on the stem. Third and central leaflet use to bear a long petiole (stalk) and the leaves and stem are covered with small hairs. The flowers appear in axillary raceme in clusters of 10-20 in numbers. They are self -pollinated and develop into 6-10 cm long hairy pods which are round, slender and use to bear about 7-11 seeds in them. The seeds are small, globular normally green in color.

Systematic Position
Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Fabales
Family: Fabaceae
Genus: Vigna
Species: *V. radiata*

2.4. Preparation of Extracts

For the experiment fresh leaves, seeds, aril and pericarpof *Myristica fragrans* were collected during the month of October 2018 from the Department of Botany, Deva Matha College, Kuravilangad. The material from each clones were air dried under shade for 3 days, then grained and passed through a mesh sieve to remove the visible plant residues. The aqueous extract of each parts were prepared by soaking 5 g of powder in 100 ml distilled water for 24 hours, at room temperature for the preparation of 2%, 4%, 6% and 8% concentrations. The solution was firstly passed through the cotton cloth and then further filtered through Whatman No.1 filter paper.

Ten seeds of *Vigna radiata* were placed in each of the concentrations for 48 hours in petridishes lined with moist filter paper. Moisture in the petridishes was maintained by adding the respective concentration of the test solutions. Water, free from the test ingredient served as the control.

2.5. Observations

Observations on seed germination and other growth parameters were recorded in the following manner:

2.5.1. Seed Germination (%)

On the third day after sowing the germination was recorded daily up to the 15th day. After the completion of germination in all replication, the germination per cent was calculated for each treatment.

$$\text{Germination \%} = \frac{No.of\ seeds\ germinated}{Total\ no.of\ seeds} \times 100$$

Protrusion of radical as well as emergence of cotyledons through the seed coat was taken as the criterion for germination.Percentage of germination was expressed on the basis of the total number of seeds tried for germination.

2.5.2. Length of radicle (cm): The root length was measured with the help of scale from collar region to the tip of the longest root, after removing the seedling from the petri plates/ polythene bags. It was the average length of five roots recorded per seedling.

2.5.3. Length of plumule (cm): The plumule length was measured with the help of scale, and the average length of five roots recorded per seedling.

2.5.4. Vigour index: Vigour index was calculated using the formula

$$\text{Vigour index} = Germination\ percentage \times Length\ of\ the\ Axis$$

2.5.5. Phytotoxicity (%): The percent phytotoxicity was calculated using the formula:

$$Phytotoxicity\ (\%) = \frac{Radicle\ length\ of\ Control - Radicle\ length\ of\ Test}{Radicle\ length\ of\ Control} \times 100$$

3. RESULTS AND DISCUSSION

Improvement of allelopathic properties of crop cultivars can be achieved by traditional breeding or by genetic manipulation. So far, no crop with strong allelopathic activity has apparently been developed, but research in this area is receiving attention. At least for barley and wheat, some of the genes involved in the production of allelochemicals have been located. Apart from genotype, the production and/or release of allelochemicals from crops, e.g. rye, wheat, barley and rice, typically depend on the developmental stage of the plant and/or on external factors such as temperature, nutrient status and herbivory,[7]

From an agronomic point of view, allelopathic weed management seems immediately advantageous as an alternative or a supplement to other weed management practices in crop production. Reduced reliance on traditional herbicides via the use of allelopathy has frequently been mentioned as environmentally favourable.[8]

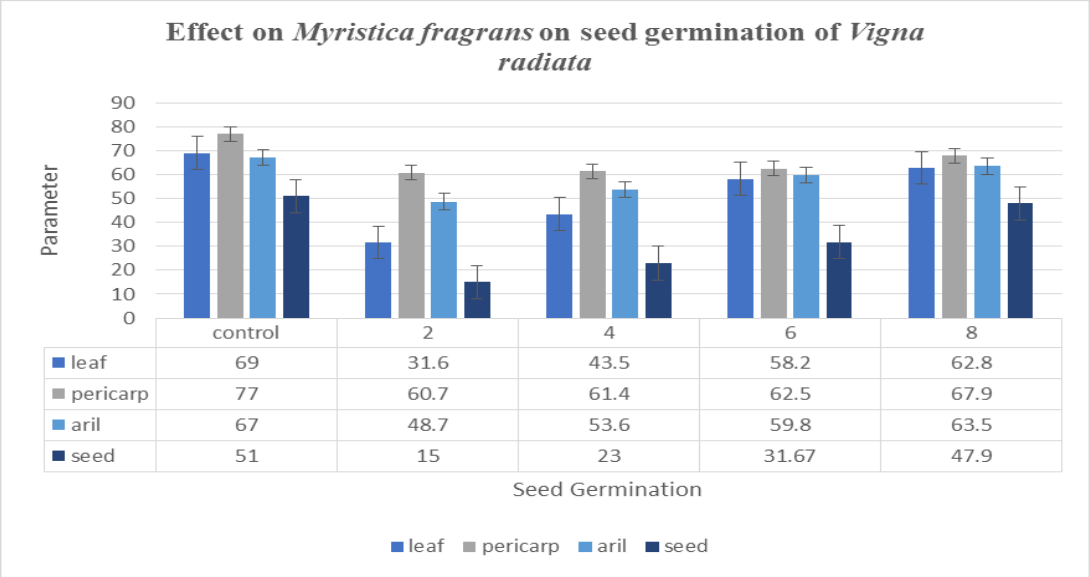
Germination percentage was 90 percent in control on day after germination and no further increase in germination percentage was noted. In treated population all the concentrations tried showed inhibitory effect on germination. But in some cases like 6 and 8 percent it showed delaying effect on germination. In 2 and 4 percent i.e. the lower concentration treated, the inhibitory effect is much prominent than the higher concentration treated. As a whole no dose dependency was observed among the concentration for the inhibitory effect (Graph.1).

Growth after germination was noted as the length of radicle increased. It was found some of the concentration (lower concentration) exhibits a negative relation to radicle length while others (higher concentration tried) showed a positive relation to length of radicle. As far as aril was concerned, no further increase was observed for 6 and 8 percent. (Graph. 2).

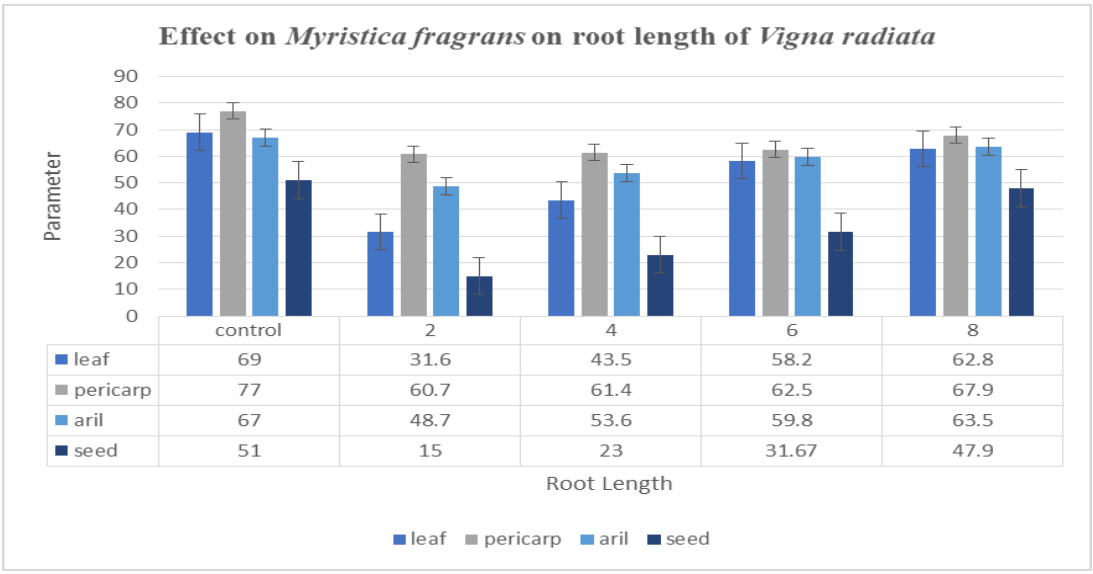
Effect on plumule length was also recorded. Similar to the radicle length plumule length also showed that, some of the concentration (lower concentration) exhibits a negative relation to radicle length while others (higher concentration tried) showed a positive relation to length of radicle. As far as aril was concerned, no further increase was observed for 6 and 8 percent. (Graph. 3).

Phytotoxicity and vigour index were presented in Graph 4 and 5 respectively. Phytotoxicityand vigour index showed an increase in both values as far as seeds, pericarp, leaves and aril were concerned.

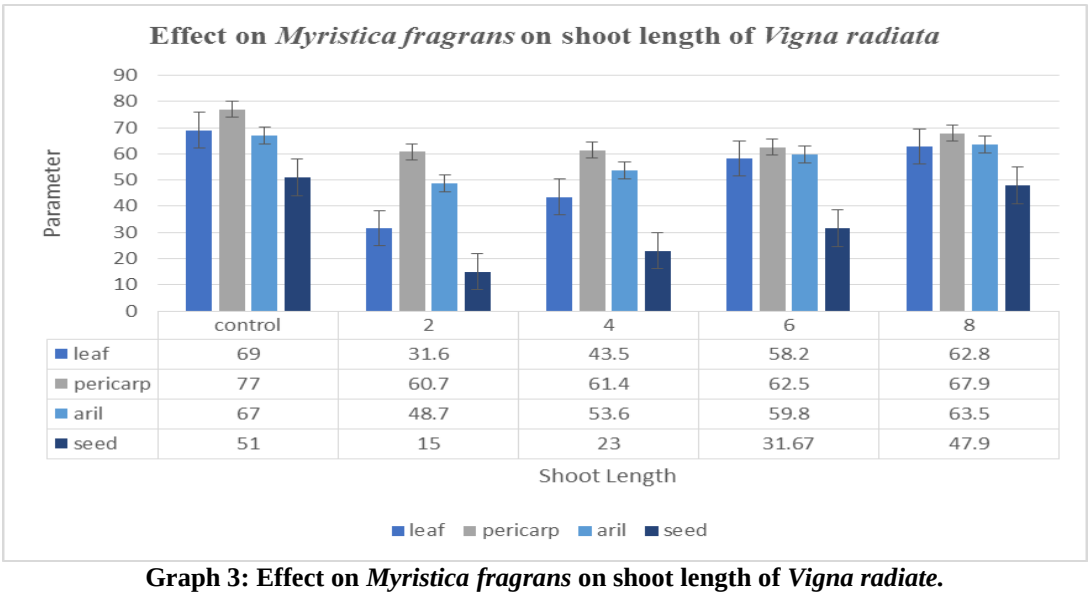
In the present study the germination was found to be reduced by the effect of all concentrations of the test solutions. When the seedlings become older the shoot and root length was found to be less affected by the extract. Thus, the phytotoxicity and vigour also varying. When coming to the biomass and chlorophyll content the variation was found to be less. In some cases the lower concentration has slight promotive effect also. These indicate that the auxin content or other fractions of growth hormones present in the extract especially in the fresh condition stimulate the growth of the seedlings. When the seedlings become older they get natural recovery from the damage caused by the extract.[9]



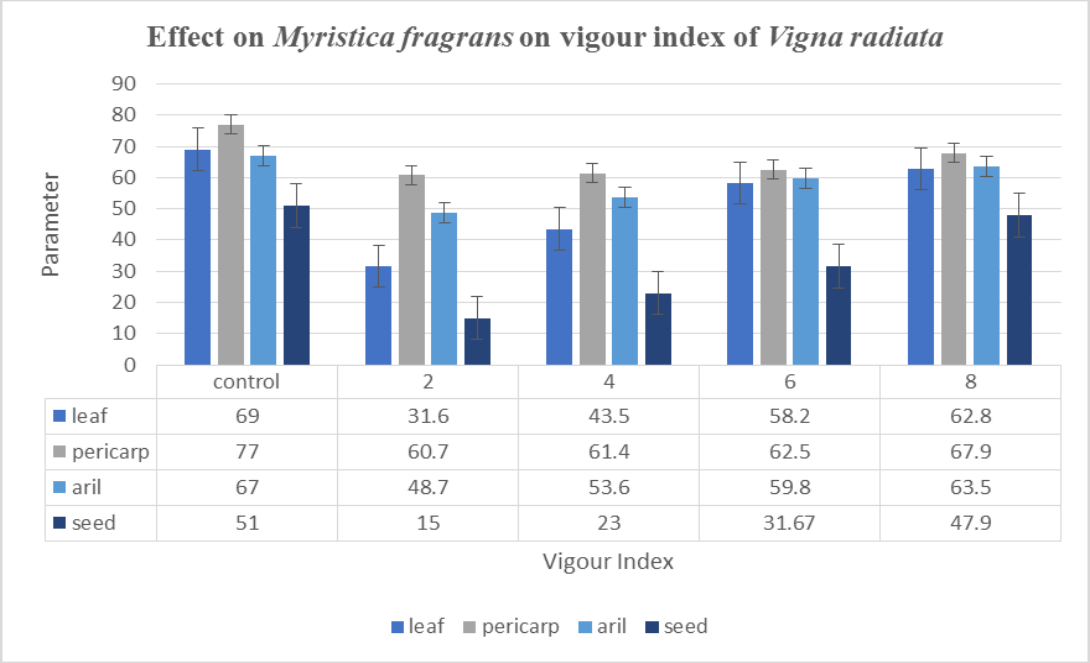
Graph 1: Effect on *Myristica fragrans* on seed germination of *Vigna radiate.*



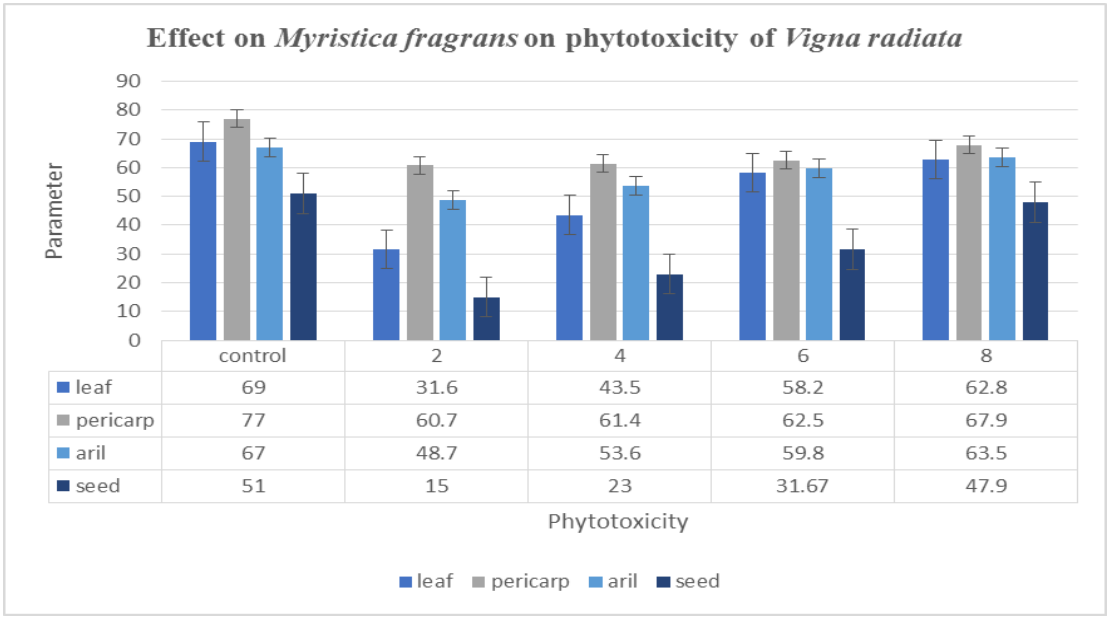
Graph 2. Effect on *Myristica fragrans* on root length of *Vigna radiate.*



Graph 3: Effect on *Myristica fragrans* on shoot length of *Vigna radiate.*



Graph 4: Effect on *Myristica fragrans* on vigour index of *Vigna radiate.*



Graph 5: Effect on *Myristica fragrans* on phytotoxicity of *Vigna radiate.*

The present investigation reveal that the allelochemicals or chemicals that responsible for the induction of variation in the seedling as well as germination of Solanum.[10,11] The following sites or processes are known targets for allelochemicals: cell division, production of plant hormones and their balance, membrane stability and permeability, germination of pollen, mineral uptake, movement of stomata, pigment synthesis, photosynthesis, respiration, amino acid syntheses, nitrogen fixation, specific enzyme activities and conduction tissue.

The inhibitory activity against the seedling growth of several testing plant species mainly corresponded to the anthraquinone compounds which are potent allelopathic substances. In the present investigation also, these kinds of allelochemicals present in the leaf extract may contribute to the inhibitory effect on germination and growth. It is suggested that the genotypes sensitive to the allelochemicals have been removed from the gene pool of the proximal population by selection,[12]

4. CONCLUSION

The present study explains the luxuriant growth of *Myristica fragrans* in all along the lands due to its allellopathic potential. It also estimated the seedling damage caused by the plants. Several parameters selected for evaluation are germination, length of radicle, length of plumule vigour index and phytotoxicity etc. The comparison done with the control group can be used

to determine the level of changes that has been occurred to the plant due to its allelopathic effects.

5. REFERENCES

1. Molisch H, Der Einfluss einer Pflanze auf die andere, Allelopathie. Fischer Jena, 1937.
2. Muller G, Index of geoaccumulation in sediments of the Rhine River, Geojournal, 1969; 2(1): 108-118.
3. Caamal-Maldonado JA, Jiménez-Osornio JJ, Torres-Barragán A, Anaya AL. The use of allelopathic legume cover and mulch species for weed control in cropping systems. Agronomy Journal, 2001; 93(1): 27-36.
4. Raintree JB. A diagnostic approach to agroforestry design. Strategies and designs for afforestation, reforestation and tree planting, 1984; 252-273.
5. Duke JA, The green pharmacy: New discoveries in herbal remedies for common diseases and conditions from the world's foremost authority on healing herbs. Rodale, 1997.
6. Mallik AU, Allelopathy and competition in coniferous forests. In Environmental Forest Science Springer, Dordrecht, 1998; 309-315.
7. Krishnan G, Holshouser DL, Nissen SJ. Weed control in soybean (*Glycine max*) with green manure crops. Weed Technology, 1998; 12(1): 97-102.
8. Macias FA. Allelopathy in the search for natural herbicide models. ACS Publications, 1995.
9. Narwal SS, Sarmah MK, Tamak, JC. Allelopathic strategies for weed management in the rice-wheat rotation in northwestern India. In Workshop on allelopathy in rice (Manila, Philippines, 25-27 November 1996. IRRI, Los Banos, Philippines. 1998; 117-131.
10. Rizvi SJH, Haque H, Singh VK, Rizvi V. A discipline called allelopathy. In Allelopathy. Springer, Dordrecht, 1992; 1-10.
11. Foy CL, Understanding the role of allelopathy in weed interference and declining plant diversity. Weed Technology, 2001; 15(4): 873-878.
12. Lawrence JG, Colwell A, Sexton OJ. The ecological impact of allelopathy in *Ailanthus altissima* (Simaroubaceae). American journal of Botany, 1991; 78(7): 948-958.