THE ALLELOPATHY RELATIONS' IMPORTANCE IN DEVELOPING TECHNOLOGIES FOR INTERCROPPING CULTIVATION SYSTEM

IMPORTANȚA RELAȚIILOR ALELOPATICE ÎN ELABORAREA TEHNOLOGIILOR DE CULTIVARE ÎN SISTEM INTERCROPPING

HAMBURDĂ Silvia Brîndușa[1], MUNTEANU N.[1], STOLERU V.[1], TELIBAN G.C.[1], GALEA (DELEANU)Florina-Maria[1], SAVA-PAVĂL Simona[1], COJOCARU Al.[1]

e-mail: silvia_hamburda@yahoo.com

Abstract. *This paper presents an overview of the knowledge of allelopathy relations based on a large Romanian and international bibliography. The species to which particular reference has been made is the runner bean (Phaseolus coccineus L.). There were highlighted both the companion plants as well as non-companion plants with runner bean species. Also, a range of plants that have allelopathy effects was presented. Allelopathy relations have a very important role in developing cultivation technologies, because the combination of improper species leads to crop compromise, respectively considerable financial losses.*

Key words: *allelopathy, companion plants, runner bean.*

Rezumat. *Lucrarea prezintă o sinteză asupra cunoştinţelor referitoare la relațiile alelopatice, pe baza unei ample bibliografii din țară şi străinătate. Specia la care au fost făcute referiri în special a fost fasolea mare (Phaseolus coccineus L.). Au fost puse în evidență atât plantele companion cât și plante non-companion cu această specie. De asemenea, au fost prezentate o serie de plante care prezintă proprietăți alelopatice. Relațiile alelopatice au un rol foarte important în elaborarea tehnologiilor, deoarece asocierea necorespunzătoare a unor specii duce la compromiterea culturilor, respectiv pierderi financiare considerabile.*

Cuvinte cheie: *alelopatie, plante companion, fasole mare.*

INTRODUCTION

Allelopathy is a natural phenomenon that belongs to a field of organic biochemistry and studying interrelationships between plants via chemical messages (signals) (Neamțu, 1983). Between different plant species, and between individuals within the same species, allelopathy effects occur.

Chemical compounds involved in the biochemical interactions between plants are generically called allelopathy substances. They are secondary products of plants, with low molecular weight, present in different organs of many plant

[1]University of Agricultural Sciences and Veterinary Medicine of Iasi, Romania

species such as leaves, flowers, fruits and seeds, but also in stems and roots, especially those which are perennial (Miró *et al.,* 1998; Delachiave, 1999). These allelochemical products have no role in primary metabolic processes, essential for plant survival, and are produced as consequences of primary metabolic pathways. In contrast to primary metabolism, which comprises several hundred molecular compounds, with low weight, tens of thousands of secondary products of metabolism are known, characteristic to plant species, but only a limited number of them are involved in allelochemical processes (Rice, 1984), at least at the current level of knowledge.

According to the literature review, there are reported both favourable associations among crops by intercalation or succession (Indrea, 1967; Aubert, 1975; Dumitrescu and Conea, 1986; Renaud and Dudouet, 1988; Stein, 1995; Toncea, 2002) and unfavourable associations (incompatibility) between related species (Stein, 1995; Toncea, 2002; Furnea, 2010).

The paper presents allelopathy relations' role in developing technologies for the intercropping cultivation system**.** The need for such research stems from the fact that allelopathy relations have a particular influence on crops and an improper association can ultimately lead to compromising crops or financial losses.

MATERIAL AND METHOD

The biological material to which assessments are made on allelopathy relations is runner bean (*Phaseolus coccineus* L.) species. Runner bean is an annual herbaceous species that usually multiplies by seeds, but in some cases by tuberizated roots (Munteanu, 1985). In this study we propose to consider companion and non-companion plants with bean, respectively a number of plants with allelopathy properties.

Reaching the goal and targets is carried out based on a literature review. As basic research methods we have used observation, case studies and statistics group.

RESULTS AND DISCUSSIONS

Allelopathy compounds affect cell division of competing plants, phytohormones' activity, operating efficiency of the chloroplasts and mitochondria, biomarkers, the functions of biomembranes, the plant-water relationship and various other plant processes (Einhellig, 2002; Blum *et al.,* 1999; Macias *et al.,* 1999). Other important aspects of allelopathy, in addition to the production and release into the environment of phytotoxic compounds to certain crop species, aim at the absorption and translocation of allelochemical substances in the recipient organism (Ferreira and Aquila, 2000).

Intensive scientific research for recognition and understanding of allelopathy has only been done in the last few decades, although the allelopathy phenomenon existed for thousands of years. In 1832, the idea of an influence exerted by certain chemical substances released into the environment by certain organisms to other neighboring bodies was issued by De Candolle (Harborne,

1977). De Candolle concluded that all the plants secrete, through the roots, certain substances that stimulate or inhibit the growth of other plants.

In 1937, a step forward was made by Molisch, when he published his research on ethylene action on some superior plants, a phenomenon that he called *"allelopathy"*. He is the one who has defined the term allelopathy for the first time (Molisch, 1937). Allelopathy meant, at that time, "biochemical relations established between all the plants", the same concept including both harmful interactions and those which are stimulative. The term "allelopathy" derives from the Greek words "*allelon*" = mutual and "*pathos*" = suffering. It rooted in literature, becoming one of the branches of the modern eco-physiological biology.

A real breakthrough in allelopathy was produced in 1974, with the publication of "Allelopathy" by Rice. It defined allelopathy as "detrimental effect exerted by a plant on another plant by producing chemicals that are released into the environment." Advances in chemistry, anatomy and physiology, in plant biotechnology and digital technology, as well as a better understanding of ecological processes, helped allelopathy research develop lately.

Contemporary researchers have tended to broaden the alelopathy context and also include in this phenomenon interactions between plants and animals (Rizvi and Rizvi, 1992), and suggested that allelopathy is a part of a whole network of chemical communication between plants, between plants and other organisms and that such communication may contribute to plant defense.

The commonly accepted definition of alelopathy is the production of biomolecules by plants; these molecules consist mainly of secondary metabolites that may beneficially affect another plant, or vice versa (Rizvi and Rizvi, 1992).

The over time accumulated data showed that allelopathy substances can have both an inhibitor or a stimulating role. Allelopathy substances with inhibitor character are widely distributed in nature, as highlighted in the desert plants, in the wetlands and forest ecosystems plants in temperate regions. Long studied allelopathy substances with a stimulating role are the vitamins.

The presence of weeds and debris into the soil in the early stages of germination and growth of vegetable plants may hamper crop through allelopathy phenomena, caused by the presence of toxic substances released from underground organs in the soil that come through volatilization and secretion or debris due to decomposition of residues thereof. These phenomena, poorly understood until now, of mutual influence can be destructive to crop plants, against some weed or to weeds among each other. Currently, allelopathy phenomena of species *Poa* (bluegrass) on crop of tomatoes, *Portulaca oleracea* (watergrass) on peas, *Artemisia vulgaris* (mugwort) on cucumbers are known (Indre *et al.,* 2009).

Also, there are other plant species with allelopathy properties, such as sorghum, poppy, mugwort, nut, etc.

The genus Sorghum (*sorghum*) includes sorghum plants, whose roots eliminate a poisonous substance that blocks respiration and photosynthesis of plants it comes in contact with.

For cereals, it is good to know that the seeds of poppy (*Papaver* sp.) do not germinate without the presence of wheat, while rye (Secale cereale) prevents certain types of weed germination.

Wormwood (*Artemisia absinthium* L.) inhibits the growth of plants such as lovage, cumin, basil, lemon balm and sage.

Black walnut (*Juglans nigra* L.) is one of the most famous plants with allelopathy properties. It secretes juglone, a substance that inhibits respiration in plants located in its vicinity. Since juglone is also present in the black walnut tree and roots, which can handle a generous area, the garden area affected by allelopathy could be quite large (http://gradina.acasa.ro/boli-si-daunatori-116/alelopatia-in-gradina-164583.html#ixzz2YiRTtP3T).

Given the above, in order to organize a garden, farm or agricultural land, association with optimal plants, in order to obtain maximum yield with minimum costs, if possible, and without the use of petrochemicals, with as little mechanization as possible should be considered (http://forum.softpedia.com/lofiversion/index.php/t752500.html).

The concept of "companion plants" is especially common in small and organic gardens, relying on the idea that plants can benefit from each others' company. This consists in the operation of interconnection, in order to ensure the growth and development of plants and to replace the use of chemical herbicides and insecticides, organically control and prevention of pests, attracting birds, insects and other useful animals (http://www.vegetalshapes.com/Romana/Plante CompanionI.html) (Fig. 1).

Fig. 1 - Associated crops
(https://gradinadeacasa2.wordpress.com/2013/08/29/cultura-asociata/)

Among the companion plants for runner bean we include: anise, asparagus, basil, potatoes, cucumbers, strawberries, zinnias, thyme, yarrow, coriander,

cosmos, chrysanthemums, bay leaves, pumpkin, squash, corn, spinach, rosemary, dill, carrots, celery, borage, lettuce, lovage, radishes, etc. (http://deepgreenpermaculture. com/companion-planting/companion-planting-table/) (Fig. 2).

Fig. 2 - Runner bean in an associated crop (http://www.vegetable-gardening-online.com/growing-runner-beans.html)

Among non-companion plants for runner bean we mention: peppers, chives, onions, cauliflower, garlic, leeks, tomatoes, chili peppers, fennel, gladiolas, beets etc. (http://deepgreenpermaculture.com/companion-planting/companion-planting-table/).

CONCLUSIONS

1. Allelopathy relations have a very important role in developing technologies for cultivation in intercropping system, as the combination of improper species leads to crop compromise, respectively financial losses.

2. Runner bean is a vegetable species that can be successfully associated with many species, but presents a number of non-companion plants, including chili peppers, onion, garlic etc.

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