THE IMPORTANCE OF RESEARCH ON THE MOLECULAR LEVEL APPROACH ON PLANT DEFENSE AGAINST PHYTOPHAGUS

IMPORTANȚA ABORDĂRII CERCETĂRILOR LA NIVEL MOLECULAR PRIVIND APĂRAREA PLANTELOR ÎMPOTRIVA FITOFAGILOR

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Abstract: *To deal with at the biotic stress produced by the attack of phytophagous insects and pathogens have developed mechanisms (signaling molecular, such as phytohormones - jasmonate) to alert all of the plant via a ion transmission, fast, like the nervous system of animals organisms to trigger the some defensive defense. These triggered as a result of complex interactions, many plant hormones, transcription of many genes and sensitive to these signals. The following presents the research carried out in recent decades that have revolutionized knowledge of plant defense mechanisms against fotofage species through the discovery of the role of phytophagous jasmonate. Jasmonates (JAS) are the main signals for adjusting resistance to phytophagous insects, representing new weapons and quick responses against insect attack produced. The relationship trophic plant-fitofagus (insect in this case) -entomophagus, attacked plants increasingly volatile launches more, as the plant is attacked and attract the entomophagous parasitoids. Although ethylene, salicylic acid and other plant hormones play an important role in plant-insect interaction and contribution to the emergence of resistance to these signals what appears to be minor in comparison with jasmonic acid . Using the sequenced genomes plant, as Arabidopsis thaliana, tomatoes, tobacco etc, the mutant gene silencing may clarifies the of chain signals and biotic stresses preparedness measures and inducing defense.*
Key words*: the entomophagous, parasitoids, jasmonates*

Rezumat: *Pentru a face față la stresul biotic produs de atacul unor insecte fitofage şi patogeni, s-au dezvoltat mecanisme (semnalizare moleculară, cum ar fi fitohormonii – jasmonați) care alertează toată planta, printr-o transmisie ionică, rapidă, asemănătoare sistemului nervos din organismele animale, în vederea declanşării unor apărări defensive. Acestea declanşate în urma interacțiuni complexe, a multor fitohormoni, şi a transcripției a numeroase gene sensibile la aceste semnale.În cele ce urmează prezentăm cercetări realizate în ultimele decenii, care au revoluționat cunoaşterea mecanismelor de apărare a plantelor împotriva speciilor fitofage, prin*

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descoperirea rolului fitohormonilor jasmonați. Jasmonații (JAs) sunt principalele semnale pentru reglarea rezistenței la insectele fitofage, constituind arme noi şi răspunsuri rapide împotriva atacului produs de insecte. Prin relația trofică plantă-fitofag (insectă în cazul de față) –entomofagi, plantele atacate lansează volatile din ce în ce mai multe, cu cât planta este atacată şi atrag speciile de entomofagi parazitoizi. Deşi etilena, acidul salicilic şi alți fitohormoni au un rol important în interacțiunea plantă-insectă, contribuția acestor semnale în apariția rezistenței apare să fie minoră în comparație cu a acidului jasmonic. Utilizarea plantelor cu genomurile secvenționate, ca Arabidopsis thaliana, tomate, tutun etc, prin mutante cu gene silențiate sau în superexpresie pot aduce clarificări în lanțul semnalizărilor stresurilor biotice şi măsurile de pregătire şi de inducere a apărărilor.
***Cuvinte cheie**: entomofagi, parazitoizi, jasmonati.*

INTRODUCTION

Particularly prolific through a stage in the development of basic and applied research at the molecular level. Technology developed in recent decades gives us another dimension on the phenomenology that takes place at the microcosmic level of ultrastructural cellular chromatography, HPLC site and PCR - site, highlighting the nano-molecules, enzymes, metabolites, and transcription of the genes by microarray technology.

These modern means of investigation have created a tumult in the scholarly world and move on from experimentation aimed at biological activities at macro level intrusion in the privacy of phenomena vital, so that the plant be seen as a body extremely complex, with activities very coordinated by various plant hormones. There are new branches of science dealing Molecular, ending with the "omic" such as genomics, proteonomica, metabolomics, transcriptomics, lipidonomica etc preoccupied research all phenomena that occur at the molecular level, factors coordinators outbreak these biological processes. For these achievements in the development of various branches of science and research in the area have benefited entomological, fundamental research and management of insects in different ecosystems, especially agriculture and forestry.

To deal with the stress biotic produced by the attack of phytophagous insects and pathogens have developed mechanisms (signaling molecular, such as phytohormones - jasmonate) to alert all of the plant via a transmission ion, fast, like the nervous system of organisms animals to trigger some defensive defense.

The use of modern equipment would not have the desired success if it would not use plants with genomes sequenced as Arabidopsis thaliana, tomato, tobacco, mutant gene silencing or overexpressing, who clarified the chain of signs stress biotic and measures training and induction of defense.

The following presents the research carried out in recent decades that have revolutionized knowledge of plant defense mechanisms against fotofage species through the discovery role of jasmonate plant hormones.

MATERIAL AND METHOD

The evolution of research on jasmonate (JA).

Not long ago, in 1962, it was isolated Jasmonic acid methyl ester (Meja) Jasminum grandiflorum volatile oils L. (Demo *et al.,* 1962), *Rosmarinus officinalis* L. He then there was a long period of time up to jasmonatul determined that acid and methyl Jasmonic are omnipresent, they are superior plant growth regulators, responding to external stimuli by the expression of genes.

A beneficial step in characterizing the role jasmonaților mutants of *Arabidopsis* was used thaliana, then tomato and tobacco, acid biosynthesis study Jasmonic phases, the transduction of injury, signaling pathways, etc. using mutants in overexpressing or silencing of genes dependent JA sets.

It was established that the enzymes that converge 12th OPDA acid (12-oxo Phytodienoic) and dnOPDA (dinor-OPDA), also called octadecanoizi are acid precursors acid Jasmonic and present in many plants, indicating that it may be a metabolic pathway general plants (Vick and Zimmerman, 1984). Jasmonații are oxilipine, signaling molecules derived from oxygen and polyunsaturated fatty acids are widespread in living organisms. In 1990, Farmer and Ryan, that as a result of injuries caused by a fitofagus by methyl-jasmonatului activity (Meja) in tomato plants occurs accumulation of protease inhibitors (PIN2) that disrupts digestion in the stomach of insects. The same phenomenon is happening and applying air treatment with Jasmonic acid methyl ester (Meja). Subsecvențional, we studied gene expression and induction changing pattern JA metabolites (fig. 1), the study of protein deposits accumulate in vegetative (Staswick *et al.,* 1992) and alkaloids (Gundlach *et al.,* 1992).

Another study phase is cloned enzyme biosynthesis acid Jasmonic, alenoxid synthase (AOS), laboratory Brash (Song *et al.,* 1993) and the isolation of the first mutant insensitive to JA (from the plant Arabidopsis thaliana) in the laboratory of Turner (Feys *et al.,* 1994). Further investigations were performed, using the mutants for determining the factors receiving signals injury and transcription of the genes for the synthesis of jasmonaților and other plant hormones that act ethylene and salicylic acid and, finally, transcription factors, gene-dependent jasmonate, role in inducing defense and "preparation" (priming) plants.

In the last 20 years the Jasmonic acid (JA) and its metabolites, such as its methyl ester (Meja) and acids conjugated acid Jasmonic were included under the term jasmonate, recognized as the first signs of an injury and the defense against biotic (Wasternack, 2006).

Following the attacks occur defensive answers - through induction of resistance: the synthesis of proteins, such as PIN, which are harmful to insect feeding; fitoalexine synthesis, such as nicotine or other alkaloids; synthesis and release of volatile compounds (VOCs) that attract parazitoizii and predators (tritrofice relations plant-plant feeder-parasite); the formation and release of green leaf volatiles (GLVs); formation of honeydew nectar (EFN); mechanical strategies to increase the cell walls (Wasternack, 2006). Also launching volatile place and preparation (priming) or being prepared (primed state) organs are not challenged or neighboring plants.

Unlike defenses that have a genetic component, ie the production of toxic alkaloids, which is produced by continuously energy consumption of the plant, preparation is the most inexpensive, metabolic energy and thus allocated for growth and multiplication and maintaining populations as numerous .

Fig. 1 - Relationship-parasite trophic plant-plant feeder. The attack of thentredinid of the *Pteronidea melanopsis* who attract ichneumonids entomophagus *Bassus* sp. (original).

Unit living organisms, plant and animal, is highlighted by the presence oxilipinelor, signaling molecules derived polyunsaturated fatty acids and oxygen. In the animal world, eicosanoids are similar jasmonaților and function as signaling molecules in vertebrates, invertebrates and eukaryotic microbes.

Answers defensive ways Jasmonic acid constituent is a conserved mechanism for promoting defense responses in many phytophagous arthropods (Howe and Jander, 2008). Although ethylene, salicylic acid and other plant hormones play an important role in plant-insect interaction, the contribution of these signals the emergence of resistance appears to be minor in comparison with acid Jasmonic (Koornneef and Pieterse, 2008; Zheng and Dicke, 2008). Many experiments reveal that jasmonații (JAS) are the main signals for adjusting resistance to phytophagous insects. After Browse and Howe (2008), jasmonații (JAS) are new weapons, with quick responses against insect attack produced.

RESULTS AND DISCUSSIONS

As primary metabolites and defensive signals.

Protection of plants against phytophagous triggers changes both in the primary and secondary metabolism. Basically there is a channeling of resources and energy in reducing attack produced, and the possibilities that have resources and to ensure multiplication of the population. The responses of plant resistance to insect feeding is coordinated by various signaling pathways that depend on primary metabolism. In addition, the integration of different signals induced by insect injury and provocateurs specific results from a complex of primary and secondary metabolism rearranged (Schwachtje and Baldwin, 2008). JA has a key role in signaling kinases defensive and

calls WIPK and WRKYs Sipka and transcription factors.

Recently, the role of sugar signaling is assessed, as they have found many resistance genes induced by sucrose. For example, sucrose (Suc), glucose (Glc) and fructose (Fru) plays role in inducing the expression of specific regulatory signals of injury Glycine max; storing a probable role of defensive proteins sucrose it is also induced by Jasmonic acid. Moreover, transcripționarea of hexokinases that can function as a sensor or repressor photosynthetic is induced injury, and is responsive to threalozе-6-P, which itself is involved in the regulation feedback photosynthesis transitions development (Ramon and Roland, 2007). Trehalozele proteins SnRK kinases have been shown to interact, as they have sugar and lectin-induced JA, suggesting that lectins play a role in signal transduction.

Many metabolites that play a role in primary metabolism has thoroughly studied defensive positions. Dual functions of them have been discovered due to the accumulation in plants at high levels or patterns that their induction by herbivores attacks, are similar defensive secondary metabolites. For example threonine deaminase, an enzyme that works to degrade threonine, leading to the hypothesis that operates in essential amino acids degrade insect stomach, causing hunger amino acids. Two isoforms are known threonine, one stable insect stomach and the S. lycopersicum N. attenuator with double functions in primary and secondary metabolism.

High levels of oxalate, calcium (Ca), a primary metabolite, is accumulated in the plant (more than 80% of the dry matter), some synthesis is induced by herbivores. Adjusts the size of the calcium oxalate Ca levels, which are involved in cell signaling and in various biochemical processes. Crystals can be placed around the tissues, eg vascular bundles, producing a physical barrier against insects sucking the abrasive effect of blunting the mandibles. TAC defensive role play and anti-nutritive intake by decreasing feed conversion efficiency. Also, proteins and lectins stored vegetative has a dual role in primary metabolism and resistance, some acid-induced Jasmonic (Zhu *et al.,* 2008).

The knowledge of the molecular phenomena can not be achieved without the use of proper laboratory techniques, improved in recent decades, supported by bioinformatics. Observations at the macro level, biometric evaluations, size, weight etc can not satisfy us. Using the genomes sequenced plant, *Arabidopsis thaliana* as tomatoes, tobacco etc, the mutant gene silencing or overexpressing may clarify the signaling chain and biotic stresses preparedness measures and inducing defense. Research present and future to establish signaling pathways of the biotic environment of receptor proteins stimulated the factors connecting the nodes of interference of various plant hormones, to decision makers in triggering transcripts (activation sets genes dependent on plant hormones, plant defense default) in the production of secondary metabolites involved in defense.

In preparing students during the license, but especially by masters must increase the proportion of subjects with levels of molecular genetic approaches, biochemical, environmental, etc., for a real knowledge of the phenomena of life.

CONCLUSIONS

1. Entry into the molecular size is the only way to develop fundamental research and practical interest insect management.

2. Jasmonații (JAS) are the main signals for adjusting resistance to phytophagous insects, representing new weapons and rapid responses against insect attack produced.

3. Biotic receptors signals by connecting factors mediating or regulating plant hormones biosynthesis genes and their expansion biosynthesis of secondary metabolites mediate transcription. These events include a reconfiguration transcriptomic with changes in gene transcription levels of defensive and growth; release of volatile organic compounds (VOCs) that functions as an indirect defense and disturbing accumulation of secondary metabolites herbivores or pests nicotine, trypsin and protease inhibitors (TPIs).

4. Jasmonates plays an important role in the production of protease inhibitors (PIN2), resulting in overproduction of digestive proteases in the insect stomach, and reducing the growth of essential amino acids exhausted. Reducing combinations increase may be due to toxic effects of anti-nutritive or antifeedant.

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