

# New trends in phytopharmacy in urban gardening conditions

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A number of past studies, gaining increasing popularity today, show that plants are not inert objects requiring continuous care for their protection. They are a complete living system, possessing highly evolutionarily developed self-defense mechanisms in a hostile environment. Besides various mechanical morphological adaptations - thorns, unpleasant smell, specific colors, etc., they also exhibit a specific system for forming various biochemical substances with which they defend themselves against attacks from insects, phytopathogens, and non-insect pests. Precisely these biochemical substances can be used to carry out environmentally friendly plant protection in urban gardening conditions.

In plants under stress situations, mainly two types of defense are formed:

A) non-specific - pre-infectious defense mechanisms, and

B) specific - after the onset of the infectious process.

Non-specific defense is carried out by substances of various types, structures, and biochemistries present in plant tissues, regardless of whether they are exposed to a pest or not. These can include: various proteins; cyanogenic glycosides; glucosinolates; alkaloids; phenols and saponins (Nikolov, 2017)

These substances, and many others of different compositions, are called **phytoncides**. They are also known as plant antibiotics, and are most often terpenes by composition, highly volatile compounds forming a spatial protective barrier around plant tissues (Stancheva, 2004). Recently, work on this problem in organic farming, and especially the application of phytoncides, has found increasingly widespread use in practice. (Ayzerman et al., 1984; Grainge & Ahmed, 1987; Regnault-Roger et al., 2008). It is accepted that phytoncides participate in both non-specific and specific plant defense against pests. The connection here is close, and the boundary cannot be defined; that is, upon penetration of pathogens into the host, the synthesis of pre-infectious protective substances progressively increases.

Upon penetration of pests into the plant, a process known as „**Systemic Acquired Resistance**” (**SAR, SDH**) arises. This was first reported in 1961 by Ross, who found that a localized infection could lead to resistance not only against a subsequent attack by the specific causal agent of the primary infection but also against a wide range of other pests. This resistance initially manifests locally - at the site of infection - and subsequently spreads systemically throughout plant tissues. Overall, SAR can be compared to immunization in humans, although the underlying mechanisms are different. In nature, plants are subjected to a continuous threat from pests, which is why SAR almost always provides plants with mechanisms for evolutionary advantage. For example, in cucumbers infected with anthracnose, SAR induction is observed against a number of other pests (fungi and bacteria). The time it takes to develop depends on the plant and the pest. For instance, in cucumbers, resistance was observed about 7 hours after infection with *Pseudomonas syringae*, while in tobacco attacked by *Peronospora parasitica*, SAR-type resistance is observed 2 to 3 weeks after the onset of the infectious process. Once developed, this type of resistance can last up to several weeks. The development of SAR in tissues distant from the infection site is due to a specific, in some cases unknown, signaling substance produced at the infection site, activating the plant's defense mechanisms against future attacks. SAR has also been demonstrated through the use of rhizobacteria colonized in the rhizosphere - resistance is induced in the foliage and stems. This shows that rhizobacteria can protect plants comprehensively without causing any harm. This method is called „Induced Systemic Resistance” - ISR. According to recent studies (Bhawsar, 2014), these are

two different phenomena with specific plant reactions after pest attack, with ISR being a hypersensitive response, and SAR being a system of developing plant immunity.

An important element in the system is also the synthesis of so-called **phytoalexins**. They were first studied by Müller and Börger in 1940, with the first isolated phytoalexin from pea leaves being named pisatin. The term phytoalexin was chosen to denote molecules that the plant releases or produces as a result of pest attack or under the influence of abiotic environmental factors. Today, this concept is defined as plant antibiotics produced in plants under the influence of biotic (microorganisms, fungi, bacteria, viruses) and abiotic factors (Ingham, 1973). To date, over 350 phytoalexins from more than 30 botanical families have been isolated and their structures established (Ahuja et al., 2012). Phytoalexins themselves are specific to the plant, and each of them can exhibit pesticidal action against a number of pathogens. It has been established that, depending on the concentration, their action can be fungicidal or fungistatic. Phytoalexins have been isolated from almost all parts of the plant - leaves, stems, roots, fruits. Most of them are phenolic compounds synthesized via the shikimic acid pathway, others via the synthesis pathway of acetate-mevalonic and acetyl-malonic acids (Benhamou, 2009). A typical example of phytoalexins is the so-called stilbene (3,4,5 dihydroxystilbene) - resveratrol. In vineyards, as a result of attack by *Botrytis cinerea*, *Plasmopara*, or under stress, transferase enzymes synthesize this phytoalexin and block the development of phytopathogens. Resveratrol itself, when additionally applied through treatment, blocks cytochrome reductase and monooxygenase enzymes (Martinez, 2012).

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