

Phytotonic Action of Insecticides and Its Effects

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Introduction

Insecticides are the chemical that are formulated to kill, harm, repel or mitigate one or more species of insect. But, in relation to effect of insecticides on plant, we mostly come across the term known as Phytotoxicity. It refers to toxic effect by a compound on plant growth.

In contrast to that, the term “Phytotonic effect” is defined as the additional positive advantages in growth and development other than the direct effect for which the input/or the process has been used. Here, the additional advantage refers to increasing in plant growth and development. Because the main purpose we use pesticides or Insecticides is to control/ manage the pest. But it also providing an additional positive advantage by stimulating plant growth.

First report on phytotonic effects of insecticides reported on increase in vegetative growth of brinjal and okra plants treated with DDT.

Causes For Phytotonic Action Of Insecticides

- 1. Alter the plant physiological and metabolic responses:-** Neonicotinoids induce the expression of salicylic acid pathway, plays a key role in production of pathogenesis related proteins, which increases the disease resistance in *Arabidopsis thaliana* leads to increase in plant growth.
- 2. By increasing the enzyme activity:-** Urease activity is enhanced by monocrotophos, fenvalerate, cypermethrin. Thereby, it catalyses the hydrolysis of urea into ammonium which involved in nitrogen cycle.
- 3. By enhancing nutrient uptake.-I** Incorporation of insecticides like Phorate and Fenvalerate stimulates the mineralization and availability of organic Carbon, Nitrogen and Potassium in the soil.

4. **Acts as Bio activators:-** Bio activators are complex organic substances, that modify the morphology and physiology of plants and are capable of acting in the synthesis and action of endogenous hormones, leading to increase in productivity. In this class some insecticides fit, such as aldicarb and thiamethoxam, besides of the hydrogen cyanamide.
5. **Alter the gene expression:-** Thiomethaxom affect genes regulating cell wall biosynthesis in soybean. Some insecticides may induce effects that are still unknown.

Insecticides Showing Phytotonic Effects

There are some insecticides which are showing phytotonic effects

1. Neonicotinoids- Thiamethoxam , Imidacloprid, Acetamiprid Imidacloprid the first commercilaized neonicotinoid insecticide known to possess some growth regulating properties also in rice and cotton
2. Carbamates – Carbofuran, Aldicarb, Phorate
3. Synthecticpyrethroids- Lamdacyahalothrin ,Deltamethrin
4. 4.Cyantraniliprole
5. 5.Spinosad

Phytotonic Action of Thiamethoxam

Thiamethoxam is a second generation neonicotinoid insecticide and possess unique chemical properties. It plays the role of a growth regulator by altering plant physiology and shows potential to increase production.

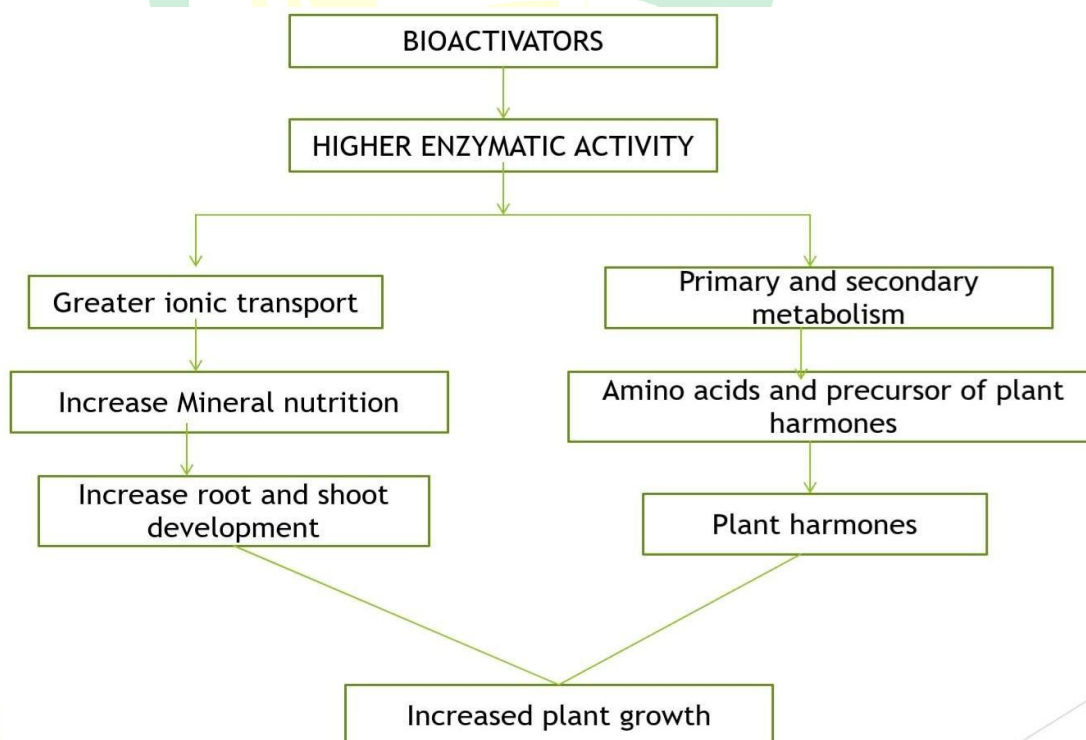
Mechanism behind the Thiamethoxam Vigour effect

- Thiamethoxam helps to reduce the nitrate reductase activity. Thereby it helps the plant to readily absorb nitrate form of nitrogen from soil.
- Increased phenylalanine ammonia-lyase activity, helps in salicyclic acid pathway. So, this salicyclic acid pathway helps in production of pathogenesis related proteins.
- It can increase mineral nutrition of the plant, which promotes positive responses in plant development and productivity.
- Thiamethoxam application improved biometric parameters, especially stalk yield in sugarcane.

- It also results in higher enzymatic activity caused by thiamethoxam, which increases both primary and secondary metabolism, due to the fact that some treatments such as thiamethoxam might have an activating effect, thus increasing the size of roots and shoots.
- Thiamethoxam positively affects the plant through its ability to increase the biosynthesis of functional proteins resulting in more effective defense against numerous environmental stress conditions. (Drought, Low pH, Protein degradation resulting from heat stress, High soil salinity).
- It can acts as bioactivators in two ways:

The first one, is to enable transport proteins from the cell membranes allowing a greater ionic transport, increasing the mineral nutrition of the plant. This increase in the availability of mineral salts promotes positive responses in the development and plant productivity.

The second one is related to the higher enzymatic activity caused by thiamethoxam, as the seed level or as the plant one. The highest enzymatic activity would increase both the primary and the secondary metabolism. It would increase the synthesis of amino acids, precursors of new proteins. The plant response to these proteins and hormone biosynthesis could be related to important increases in production.



Do these effects apply to foliar and soil application of thiamethoxam?

Syngenta researchers have determined that the Thiamethoxam effect is more pronounced when thiamethoxam is applied as a seed treatment or soil application. This helps the plant defend itself against stress factors in the critical youth development stage, providing a robust start for more vigorous growth throughout the season.

Do the other neonicotinoids such as imidacloprid and clothianidin provide the same effect?

Although other neonicotinoid products may claim increased plant vigor, years of laboratory and field research prove that thiamethoxam delivers more vigorous plant growth and higher yields in direct comparisons versus competitive products.

Phytotonic Effect of Carbamates

- The phytotonic effects of carbofuran and phorate on rice works by triggering the root activity of the crop could be related to an increase in the ability of plant to take up nutrients due to stimulation in growth.
- The stimulating effect of carbofuran on germination and growth reveals that the physiological activity of carbofuran operated via the oxidative metabolism, than this could be associated with the auxin- induced growth response in plants, thus causing the plant to increase its uptake of nutrients.
- Some reports also showed that phytotonic effect on plants which might be attributed to greater colonization of a plant growth promoting rhizobacteria. Induced systemic resistance by fluorescent *Pseudomonas* against various pests is considered as the most desirable approach in crop protection.
- An increased accumulation of defence molecule such as chitinase and proteinase inhibitors due to fluorescent *Pseudomonas* (combined strain Pf1, TDK1 and PY15) was also reported earlier which can play a vital role in management of *Cnaphalocrocismedinalis* in rice.
- Aldicarb has been reported to enhance growth, promote earliness, and increase the number of bolls and squares on cotton plants.

Other Insecticides Showing Phytotonic Effects

- The neonicotinoid insecticides showed an increase in the soluble protein content of cotton and okra. An increase in soluble protein content is reported to increase the ability of plants to fix carbon dioxide (CO₂) effectively and thus increase photosynthesis.

- Chlorantraniliprole, which showed a better performance against insect pests had favoured a greater colonization of bacteria compared to that of cartap and fipronil.
- It was found that methyl parathion had a little or no effect on the maturity of cotton plants but Roark *et al.* (1963) concluded that methyl parathion biochemically alters the morphological nature of a branch by determining if the branch will be vegetative or reproductive by affecting plant metabolism.
- Acetamiprid recorded a gradual increase in total chlorophyll content of okra leaves
- Insecticide Guthion, when applied in cotton under insect- free conditions was found to increase the flower and boll production and allowed for a longer maturation period. Increased boll production and a longer maturation period provide the potential for higher lint yields.
- Chlordimeform- It is an acaricide used as an ovicide in cotton, has physiological activity similar to zeatin, a naturally occurring cytokinin. It was also reported that chlordimeform increased physiologic activity, as measured by radish (*Raphanussativus*) cotyledon expansion.

How insecticide induced plant growth affect Insect population

1. Resurgence of the brown planthopper, *Nilaparvatalugens* (Stål) on rice was induced by applications of deltamethrin, methyl parathion, and diazinon.

Factors Affecting Insecticide-Induced Resurgence in BPH

- ✚ It is reported that foliar application of deltamethrin and methyl parathion resulted in increased number of tillers and leaves and increased plant height increased feeding and stimulation of reproduction of the hopper, either by contact action of the insecticides or through increased plant growth.
- ✚ Reduction in the length of the nymphal stage and increased adult longevity resulting in a shortened life cycle and longer oviposition period respectively, were additional factors contributing to resurgence.

2. Resurgence induced in Cotton aphid and spider mite in cotton fields treated with insecticides.

- ✚ Because, the increased level of sugars, especially monosaccharide and oligosaccharides in leaves and other vegetative and generative organs and increased level of soluble

proteins which are considered to be food niche for aphid and mites. Researches gave evidence that, there is a link between the amount of total sugars and aphids and mites quantity.

- ✚ The other reason for the increased level of insects is expected to be the lower activity of PR proteins having insecticidal property such as chitinase and glucanase.

Conclusions

Some insecticides apart from keeping the crop free of pest damage they promote growth also. However reports in literature on effects of insecticides on plant growth is are limited.. These topics are thought to be of less importance in the world of insecticides, but it is not so. Therefore, there is need to conduct proper research on this topic to know how this insecticides will promote plant growth and its mechanism behind that.

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