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Insect-Pest Management by Plant Nutrition

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Abstract

In the present scenario of agriculture, the most critical problem for increasing crop yield and developing sustainable agriculture is use of sufficient fertilizers and effective crop protection against diseases and herbivores. Plant nutrition status greatly impact on herbivores associated with plants. Best approach to deter insects is offense, especially for plants, it is keeping themselves healthy to sustaining their defenses.

Introduction

Insect pests are big menace which directly comes in the way of agricultural productivity by effecting crop yield and quality. Nutritional quality of plant is one of the main factors of host plant selection by phytophagous insects and also determines its resistance or susceptibility to pests (Bala *et al.*, 2018). Insect nutrition is the science that interprets the interaction of nutrients and other substances in food with relation to maintenance, growth and reproduction of an insect. It includes food intake, assimilation, biosynthesis, catabolism and excretion. Plant nutrition can be used as a preventive measure for pest management which has long lasting benefits. An inappropriate amount of nutrients results attracting insect populations instead of keeping them under check. Plant health also greatly influence the development of plant defenses like Systemic Acquired Resistance (SAR) against herbivores. Maintaining balanced plant nutrition along with Integrated Pest Management (IPM) adds in management of insect pests.

Nutritional Requirements of Insects

- **Carbohydrates:** Source of energy, e.g.: Hydrolyzing polysaccharides.
- **Proteins and Amino Acids:** Production of enzymes and morphogenesis, e.g.: Tyrosine (cuticular sclerotization), tryptophan (visual screening pigment).
- **Lipids:** Fatty acids, phospholipids and sterols are the components of cell wall.
- **Vitamins:** Necessary for fecundity, spermatogenesis and reproduction, e.g.: Vitamin E.
- **Minerals:** Aids in hardening the cuticle of mandibles in many insects, e.g.: Zn, Mn and Fe (Bala *et al.*, 2018).

Influence of Nutrients on Insects

Nutrients highly influence the survival, growth rate, fecundity, physiology, developmental time, longevity, population densities, intrinsic rate of increase, life expectancy and overall fitness of insects.

Pest Management through Nutrients

Excessive nitrogen application results in weak and succulent plants which are highly susceptible to attack of insects. Subsequently, less dose of Nitrogen increase the chlorogenic acid which acts as a resistance factor in chrysanthemum plants e.g., phenylpropanoids, chlorogenic acid and feruloylquinic acid present in higher amount in thrips resistant chrysanthemum varieties.

Phosphorus highly reduce the host suitability of various insect-pests in potato plants by altering secondary metabolites (phenolics and terpenes) followed by accumulation of phenolics (tannin, lignin), acts as barrier having anti-feedent effect or eventually have insecticidal effects on herbivores.

Potassium greatly reduces the nitrogen uptake and it adversely affects the biology, physiology and behavior of sucking insects. A high K: N ratio tends to reduce reproduction rate in aphids. It causes quantitative changes in nutrients and allelochemicals. Deficiency of potassium causes reduced synthesis of proteins, starch, and cellulose, and increased accumulation of low molecular weight compounds such as amino acids, nitrate, soluble sugars, and organic acids. These low molecular weight compounds are more easily utilized as nutrient sources by sucking insects. Hence, potassium should be applied in appropriate doses (Shah, 2017).

Among micronutrients, high silica content in leaves of cotton plant reduces the spiny bollworm (*Earias insulana*) and bollworm (*Helicoverpa armigera*) infestation. Similarly, high silica content in rice makes the plant resistance to stem borer (Sidhu, 2013). High level of accumulated silicon in shoots and leaves can discourage the attack by chewing insects by causing

dehydration and can able to block insect spiracles and declines oxygen levels required for respiration.

Sulphur plays an important role in insect pest control by inducing natural resistance and has a toxic effect on various species of mites. Similarly, many other nutrients present in plants also aid in imparting resistance to various insect pests species which are of economic importance.

Conclusion

Many herbivore resistance mechanisms are associated with plant nutrition and are sensitive to fluctuation in host plant nutrition. Nutrients have the potential to modify plant and insect relationships and aid in management of some herbivores. Therefore, optimum application of chemical fertilizers is essential for attaining sustainable crop production and managing herbivores.

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