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Bitter gourd – A hidden treasure that serves as promising insecticide

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Abstract: -

Bitter gourd is a cucurbitaceous vegetable highly potent with biochemical compounds that serves the purpose of pest control. These are ecofriendly compounds that provides resistance to the host for a wide range of pest. Bitter gourd is highly susceptible to pests like melon fruit fly (Bactrocera cucurbitae), fall armyworm (Spodoptera frugiperda), & Helicoverpa armigera that cause immense threat to its production and productivity. This article provides the evidence of compounds present in bitter gourd that can act as resistance to multiple pest. Terpenoids and ascorbic acid in various parts of the plant including leaf, seed and fruit of bitter gourd are the main constituents that serves the purpose keeping in view the rising concerns for environmental sustainability with less reliance on chemical pesticides.

Introduction:

Vegetables are any edible part of a plant that we consume in our day to day life. It constitutes as one of the major components of Indian horticulture. Among the cucurbitaceous vegetables that contribute to the largest number of summer-grown or rainy season vegetables,bitter gourd is one among them. Coming from the Cucurbitaceae family, with the botanical name Momordica charantia ,locally called karela is grown extensively in Southeast Asia. Bitter gourd stands first among all cucurbits in regards to its nutritive value being rich in ascorbic acid, iron & phosphorus. It also holds chemical properties of insulin & hence is recommended for diabetics (Kedar & Chakraborti, 1982).

Like other crops, bitter gourd is also infested by various insect-pests that bring constraints to its increasing production & productivity. Among several insect-pests, the melon fruit fly (Bactrocera cucurbitae), fall armyworm (Spodoptera frugiperda), red pumpkin beetle, (Aulacophora foevicollis)are economically concerned throughout the tropics

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& sub tropics.Although application of chemical insecticides can effectively control the losses of pest attack, the rising global concerns for environmental pollution & health risks associated with it proves to be a red flag for adopting chemical control.

However, the Environmental Protection Agency has made commendable efforts in reducing the use of harmful insecticides especially organophosphates, organochlorines, some carbamates & pyrethroids. And as a result, the trend has now diverted towards Integrated Pest Management(IPM). IPM is a combination of chemical, biological & cultural control tactics where chemical insecticides are also prevelant.But the application of chemical insecticides on fruit zones where maggots feed internally or pupa which remains under the soil is less effective since they come in less contact with the chemical applied. Therefore to ensure alternative methods of pest control for increasing production of bitter gourd is of paramount significance. This has led to the rise of the concept of host plant resistance, i.e. the mechanism of the host against the pest's invasion and identification of the sources of resistance in bitter gourd & its influence on pest multiplication. The mechanism of resistance may be antibiosis, tolerance & antixenosis. Identifying the biochemical factors in bitter gourd that govern resistance can be used for transferring in commercially acceptable varieties. Biochemical studies can help successful discovery of resistance sources. It is well known that chemical stimuli in a plant play a major role in the selection of host plant by the pest.With this aim,various potent traits , characteristics and biochemical behaviour in bitter gourd has been identified that contribute towards resistance to various pests.

Biochemical resistance towards fruit fly (Bactrocera cucurbitae)

One among the notorious pests of cucurbits, the fruit fly pupates under soil and maggots feeds internally in bitter gourd providing lesser scope for chemical control. Hence the biochemical basis of resistance in bitter gourd against the infestation of fruit fly comes into limelight.

On determining the biochemical constituents of resistant varieties ,it was found that moisture content of the varieties are postively correlated with the percentage of fruit fly infestation or no. of larvae per fruit, i.e. resistant varieties show lower moisture content, whereas the moisture content in susceptible bitter gourd varieties are higher. In addition, the total sugars, reducing sugars, and non-reducing sugars are higher in resistant varieties.Moreover, higher amounts of tannins, flavonol, total phenol and other contents in fruits for resistant varieties are responsible for imparting pest resistance of bitter gourd.The

ascorbic acid content in bitter gourd fruits also has significant impact on the fruit damage showing negative correlation with the pest attack.

Bitter gourd seed extracts against Helicoverpa armigera

The seeds of bitter gourd are found to have proteinase inhibitors that act as strong inhibitors for the gut proteinases of Helicoverpa armigera. Biochemical investigations showed inhibition of more than 80% of the proteinase activity in the pest. 2 major proteins namely bitter gourd proteinase inhibitor-1 (BGPI-1) & BGPI-2 and 2 minor proteins BGPI-3 & BGPI-4 in the seeds, showing inhibitory action were discovered resulting in immediate decline of larval feeding. BGPI's also resulted in retarding the growth, development, fecundity and longevity of Helicoverpa armigera & other lepidopteran pest as well. Thus, most of BGPIs can be effectively used to introduce insect resistance in susceptible plants.

Bitter gourd extracts for control of Fall armyworm (Spodoptera frugiperda):

It has been found that extracts of bitter gourd has promising potential in the control of fall armyworm as highly effective bio insecticide. These botanical extracts of bitter gourd also could be proposed as one of the significant component of IPM strategies. It can be easily adopted by small & marginal farmers across India.

The fall armyworm known for its complex high destructive biological traits such as high reproductive capacity, strong migratory behaviour marks immense threat to Indian agriculture. Thus locally available bitter gourd extracts more specifically using the seed, leaf & pulp can cause significant efficiency in larval mortality within 72 hours of application.

Control of other phytophagous insects

Bitter gourd leaves primarily contain terpenoids, that act as fungicides, nematicides& insecticides. Terpenoids protect plants by repelling or killing the pests & sometimes attract them too. The amount of terpenoids present in leaf determines its effectiveness against the pest. Addition to bittergourd another such another example is Chrysothamnus nauseosus plants which are protected from insect attack due to high terpenoid activity. Moreover 2 active compounds found in bitter gourd namely momordisin I & momordisim II inhibits pest feeding & egg laying in various pests like Liriomyza trifolii, Plutella xylostella & Pseudoplusia separata.

Conclusion

The Momordica charantia botanicals & extracts obtained can be potentially used as promising insecticide against various pest of

bitter gourd as well as other crops. Moreover the biochemical traits of bitter gourd contributing to the pest resistance of the crop demands further research and study. Adequate information on the sources of plant biochemical & morphological traits associated with resistance to pest infestations is required.This shall assist in developing plant varieties that serves as resistant to infestation of pest with less reliance on chemical pesticide.

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