Extended Abstract | Insights in Aquaculture and Biotechnology | 2018 Vol.2 No.2

Biotic stress resistance in Brassica

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Mainly fungi, viruses, bacteria, nematodes and insects instigate biotic stress during production of crops. Plants possess their own mechanisms to fight against these pathogens. Numerous pathogenesis related genes are known in Brassicas a lot of them have been characterized and cloned on the molecular level. This article summarizes the current status of knowledge on biotic stress resistance in Brassica.

Keywords: Biotic stress; resistance; Insects, Fungi, PR-Proteins

Introduction:

Biotic stress usually caused by living organisms, distinctively fungi, viruses, nematodes, bacteria, insects etc. Biotic stress agents uninterruptedly start degrading their host by taking away its nutrients resulting in dwindled plant vigor. In agriculture biotic stress significantly affects growth and development of crop resulting in major pre- and postharvest losses. Now-a-days, research has been generally consolidated on figuring out the plant responses against biotic stresses and to understand plant pathogen interaction mechanism (Nejat *et al*., 2017). Plants usually lack an adaptive immune system, or the capability to acclimatize to new diseases and memorize previous infections. Thus plants have evolved additional strategies to counteract biotic stresses. Plant's genetic code contains of the genetic basis of these defense mechanisms.

Brassica is an economically important crop which includes rapeseed (*Brassica napus* L.), mustard (*Brassica juncea* L.), cabbage (*Brassica oleracea* L.), and turnip rape (*Brassica rapa* L.) that are mainly cultivated for oil, vegetables, fodder, condiments etc. (McVetty *et* al., 2016). These crops are severely challenged by biotic and abiotic stresses causing yield losses. *Alternaria spp.*, *Fusarium oxysporum*, *Albuga candia*, *Leptosphaeria maculans* are the fungal pathogens which devastate the oilseed brasicasnthe most (Fitt *et al*. 2006).

Brassica vegetables are extremely susceptible to bacterial rot disease which causes serious damage and economic losses all across the members of Brassica. Biotic stresses could be managed in two possible ways in Brassica crops 1. Crop management 2. Biotechnological approaches.

Crop management

The selection of methods and strategies for inducing and improving resistance in crop plant against biotic stresses mostly depends upon the accessibility of sources of resistance. The conventional plant breeding methods plays an important role in the raising biotic stress resistant cultivars and the various methods used for this objective are:

i. Establishment of exotic lines: Introduction of new type of plant which contained a special character or gene that can help in developing hybrid variety which possess high yielding potential and vigor thereby providing disease resistance to that plant (St. Clair *et al*., 2016).

ii. Hybridization and cultivar development

Hybridization is employed by breeders to make disease resistant hybrids and cultivars. Hybridization combines the genes of higher yield and stress resistance from various sources.

iii. Backcross breeding

Backcross breeding is one of the frequently used techniques to introduce single disease or insect resistant genes into a susceptible high yielding cultivar. The recipient is the high yielding cultivar and the the donor is the resistant cultivar. The high yielding cultivar is crossed with the resistant cultivar in first year. The ensuing progeny is then called backcross 1 and possess 50% genetic content of both the cultivars. To retrieve high yielding genes of recipient cultivars, the recipient cultivar is again backcrossed with back cross generations in consequent years until 99% genes of recipient cultivar are recovered. This strategy has been employed by plant breeders to generate disease resistance in in most of the cultivar.

Biotechnological approach

In Biotechnological approach disease resistance is developed when candidate genes are involved in plant microbe interaction and restrict the virulence traits of the pathogens, e.g., pathogen cell wall degrading enzymes and toxins. These genes are inserted into the plant which enhances the production of plant defense proteins like PR-Proteins, ROS, phytoalexin, saponins, antimicrobial peptides etc. These proteins then provide resistance to the plants against pathogens by attacking their virulence factors (Tian *et al*., 2016). Introductions of such gene in the plant genome confer resistance to the plants against different diseases, insects and pathogens. At times combination of two or more gene can be used which is known as gene pyramiding or gene stacking which provide broad spectrum resistance against the pathogen.

Conclusions:

Growth and development of crop are hampered by environmental stresses and various types of pathogens. The majority of crops are vulnerable to those stresses. The cellular metabolic components calcium, protein kinase, ROS, protein phosphatase are activated and instigate the signal transduction pathways inside cells during stress and convey the stress signal that are necessary to regulate transcription factors. Biotic stress signals are responded by the plants through initiation of ROS, callogen, tyloses, etc. in the signal transduction pathways. External signal of each stress are received by plant cells which consequently turn on the response to produce particular molecules to overpower such stress. A number of molecules are involved in the defense response to the specific stress that contributes to defend the plant and express its resistance/tolerance to that particular stress. The mol
ecular engineering is a new approach which is used to transform a gene coding and introduction specific genes in crop plants causing to elevate tolerance against stresses. Functions or mechanisms of the stress responsive candidate genes must be extensively studied. Thereafter, introgression of those particular genes via traditional breeding or marker assisted back crossing or genetic transformation will result in development of resistant or tolerant cultivar of *Brassica*.

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