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Recent advances in breeding for insect resistance in rice

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ABSTRACT

In the integrated pest management the insect resistance varieties have an ecologically viable importance against several biotic stresses. Various attempts have been made through conventional breeding for incorporating the resisetance to insect pest in rice. But due to the diversity in the population of insect pest, the gene pool of cultivated rice is lacking in resistance sources. Hence it favors the advanced molecular approach to cooperate with conventional breeding approaches for developing the resistance cultivars of rice. Hence this paper discusses the recent advances in breeding for insect resistance in rice.

Keywords- insect resistance, molecular approaches, conventional breeding.

INTRODUCTION

Rice is the most important staple food crop of the developing world. So, the production should be increased to meet the demand of the 7 billion plus people of the world. But the continuous attack of the insect pests affects production of rice. Around 15.1?% of the yield loss have been reported globally and in India about 32 million tone yield loss have been reported during the year 2008- 2009.the major insect pest which effects the yield are stem borer, planthopper and leaffolder. These insects affects the different parts of the rice plant at different stages (from seedling to maturity stage) Sharma S, Kooner R, Arora R (2017).

The most favorable option through which the yield losses due insect pest can be controlled by developing resistance in host plant .However the development of resistance cultivar of rice has been already done by conventional breeding approach but due to the diversity in the population of insect

pest, the gene pool of cultivated rice is lacking in resistance sources Dutta SS (2016). Hence, the advancement in the biotechnology helps in easy identification of resistant gene.

Chemical controls and pitfalls-

The chemical control is always the first preference of farmers for controlling the insect pest. However, it is reported that only 0.1% of pesticides kills the targeted organisms and remaining gets contaminated into environment. Hence, this approach is having several negative impacts on food and environment. And due to continuous use of chemicals the pest has developed high level of resistance to several classes of insecticides such as pyrethroids, carbamates, organophosphate, phenylphyrazoles etc Sparks TC (2015) . Hence, it leads to the development of some alternative control measures. In integrated pest management of rice, the host plant resistance has played an important role but the constant evolvement in insect population poses threat to the production of rice. Hence, necessary step should be taken for introduction and identification of new resistance gene into rice cultivars. Commonly, there are two main sources which enhance the host plant resistance .The first resistance source is present in the germplasm of the host plant and in their wildly relative species, this is the natural resistance system. The second source is available in the distant unrelated organism which is a heterologous resistance system Adang MJ (2013).

Molecular approach:- conventional breeding is supplemented by transgenic rice biotechnology and advanced molecular breeding. Genetic engineering breeding (GEB) and molecular resistance breeding (MAS) are mainly involved in the molecular resistance breeding. Basically four steps are involved in MAS.Designing the overall program, selection of parental materials and targeted gene, constructing breeding population, screening the breeding population Sharma HC, Sharma KK, Crouch JH (2004). Conventional breeding have almost similar breeding process. Former methods. it is important to understand the molecular level of the host plant resistance to insect pest for the development of the insect resistance cultivar. The recent advancement in biotechnology as developed the horizontal resistance. The IRGM insect resistance genetically modified rice varieties has been produced through transformation technologies Brar DS, Khush GS (2007). RNAi has also favors the development of high level of insect resistance ricecultivars. However, wild germplasm is an important source of resistance genes for varietal improvement.

RNA interference:-

RNA silencing helps in controlling the insect genes expression specially in the primary gene pool of the host plant, where the resistance sources are rare. Sometimes the silencing of targeted insect genes through RNAi leads in the reduced fecundity, development of aberrations or growth inhibition Wan P (2014).Through RNAi approach there are mainly two insect gnes i,e. amino peptidase N and cytochrome P450 which encodes for proteins/enzyme which are responsible for the effective insect control. Aminopeptidase attacks the midgut activities which causes an adverse effect on the growth and development of the larva and leads to larval mortality ZhaWJ(2011).

Proteinase inhibitor genes:-

The protease inhibitors are antimetabolites and the gene which encodes for these metabolites is an element of natural defense system of plants against pest damage Alfonso-Rubi J(2003). The transgenic rice has been tested with BTI-CMe which as a barley trypsin inhibitor against *Sitophilus oryzae* Bhutani S et al(2006).

Conclusion:-

It is important to find out a new stable source of resistance against the biotic stress of rice because host plant resistance is ecologically acceptable and easily accessible to the farmers with low income. With the use of advanced molecular approach resistance genes have been transferred from diverse germplasm of rice, this creates a selection pressure on the rice pests. Studies has shown that without deploying the Bt rice the resistance against cry toxin through high frequency of allel have been observed in the population of yellow stem borer. However, there is no specific approach which provides durable resistance against pest because there are several dynamics in the battle for survival which leads the buck and boost cycle.

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