Journal of Advances in Science and Technology

Vol. VII, Issue No. XIII, May-2014, ISSN 2230-9659

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AN INTERNATIONALLY INDEXED PEER REVIEWED & REFEREED JOURNAL

Journal of Advances in Science and Technology
Vol. VII, Issue No. XIII, May-2014, ISSN 2230-9659

A Critical Study on Quality Traits in Rice

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Abstract – Rice is one of the chief grains of India. Moreover, this country has the biggest area under rice cultivation, as it is one of the principal food crops. It is in fact the dominant crop of the country. India is one of the leading producers of this crop. Rice is the basic food crop and being a tropical plant, it flourishes comfortably in hot and humid climate. Rice is mainly grown in rain fed areas that receive heavy annual rainfall. That is why it is fundamentally a kharif crop in India. It demands temperature of around 25^{0}C and above and rainfall of more than 100 cm. Rice is also grown through irrigation in those areas that receives comparatively less rainfall. Rice is the staple food of eastern and southern parts of India. The India's rice production reached to a record high of 104.32 million tonnes in 2011-2012 crop years (July-June) (FAO, 2012).

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INTRODUCTION

Rice is grown in Haryana in 18 districts. Out of which 14 districts are under high productivity group (yield more than 2,500 Kg/ha). Triennium average area of high productivity group comprising of 14 districts was 7.86 lakh hectares, which was 54.1% of triennium average area (14.51 lakh hectares) under rice in the state. Triennium average production was 23.73 lakh tonnes which was 64.9% of triennium average production (36.58 lakh tonnes) of rice in the state. Triennium average productivity of high productivity group comprising of 14 districts was 3,019 kg/ha as against 2,521 kg/ha triennium average productivity of the state (Anon, 2011).

Temperature is another climatic factor which has a favorable and in some cases unfavorable influence on the development, growth and yield of rice. Rice being a tropical and sub-tropical plant requires a fairly high temperature, ranging from 20° to 40 °C. The optimum temperature of 30°C during day time and 20°C during night time seems to be more favorable for the development and growth of rice crop. Sunlight is very essential for the development and growth of the plants. In fact, sunlight is the source of energy for plant life. The yield of rice is influenced by the solar radiation particularly during the last 35 to 45 days of its ripening period. The effect of solar radiation is more profound where water, temperature and nitrogenous nutrients are not limiting factors. Bright sunshine with low temperature during ripening period of the crop helps in the development of carbohydrates in the grains.

Rice is grown in almost all types of soils in India. The soils most suited for the cultivation of rice are clay, loam and dry soils. Such soils are capable of holding water for long period. The groups of soil under which rice can be successfully grown in India are alluvial, red soils, laterite and black soils.

In transplanting, the seedlings are first raised in nursery beds. These seedlings are uprooted from the nursery bed at the optimum age and transplanted in the main field. In wet or low land cultivation of rice, transplanting is advantageous for the following reasons. it enables the cultivator to have optimum plant population at desired spacing in the field, it enables the cultivator to have an opportunity to give a thorough cultivation and puddling operation which brings down the weed population; and since the nursery occupies only a small area of the field, the control of diseases and insect pests, irrigation, manuring, etc. of the young crop are easier and cheaper than a broadcast or direct sown crop.

In order to produce a higher yield, the rice must constantly stand in water. But it is wrong to flood the field always to the same depth of water. For the first 6 to 8 days after transplanting, leave the soil as a liquid mud. If the soil becomes dry, let in only a little water. About a week after transplanting, when the rice has begun to grow, flood the field with 2 to 3 cm of water and leave for 45 days. But, twice during these 45 days, drain the field in order to apply fertilizers. After 45 days, increase the depth of water to 10 cm.

REVIEW OF LITERATURE

Plant diseases are responsible for annual crop losses at a total value of more than 200 billion (Shivalingaiah and Umesh, 2012). Resistant plants and chemicals are often used to control plant diseases. Resistance does not exist against all diseases and the breeding of resistant plants takes many years. The use of microbes to control diseases, which is a form of biological control, is an eco-friendly approach. In contrast, the majority of molecules of agrochemicals do not reach the plant at all. Moreover, the molecules of biological origin are biodegradable compared with many agrochemicals that are designed to resist degradation by microbes. Bacteria that produce antibiotics, which kill pathogens, act via antagonism, if their mutants defective in structural genes in the synthesis of this antibiotic are biocontrol negative. For a bacterium to be suitable for biocontrol, it must not only synthesize and release the antibiotic, but also compete successfully with other organisms for nutrients from the root and for niches on the root to deliver the antibiotic along the whole root system. Also, the bacterium should escape in sufficient numbers from predators feeding on rhizosphere bacteria, so-called protozoan grazers (Jousset et al., 2006). Furthermore, the bacterium should produce the antibiotic in the right micro niche on the root surface (Pliego et al., 2008).

Plant growth in agricultural soils is influenced by many abiotic and biotic factors. There is a thin layer of soil immediately surrounding plant roots that is an extremely important and active area for root activity and metabolism which is known as rhizosphere. The rhizosphere describes the narrow zone of soil surrounding the roots where microbe populations are stimulated by root activities. The original concept has now been extended to include the soil surrounding a root in which physical, chemical and biological properties have been changed by root growth and activity (McCully, 2005).

A large number of microorganisms such as bacteria, fungi, protozoa and algae coexist in the rhizosphere. Bacteria are the most abundant among them. Plants select those bacteria contributing most to their fitness by releasing organic compounds through exudates (Lynch, 2010). Creating a very selective environment where diversity is low (Marilley and Aragno, 2009; García et al., 2011). Since bacteria are the most abundant microorganisms in the rhizosphere, it is highly probable that they influence the plants physiology to a greater extent, especially considering their competitiveness in root colonization (Antoun and Kloepper, 2011). Microorganisms that colonize the rhizosphere can be classified according to their effects on plants and the way they interact with roots, some being pathogens whereas other trigger beneficial effects. Rhizobacteria inhabit plant roots and exert a positive effect ranging from direct influence mechanisms to an indirect effect. So, the bacteria inhabiting the rhizosphere and beneficial to plants are termed plant growth prompting rhizobacteria (PGPR) (Kloepper et al., 2010). In the last few years, the number of PGPR that have been identified has seen a great increase, mainly because the role of the rhizosphere as an ecosystem has gained importance in the functioning of the biosphere. Various species of bacteria such as Pseudomonas, Azospirillum, Azotobacter, Klebsiella, Enterobacter, Alcaligenes, Arthrobacter, Burkholderia, Bacillus and Serratia have been reported to enhance the plant growth (Kloepper et al., 1989;Glick, 2012; Joseph et al., 2007). Pseudomonas spp. is ubiquitous bacteria in agricultural soils and has many traits that make them well suited as PGPR. The most effective strains of pseudomonas have been fluorescent pseudomonads. Considerable research is underway globally to exploit the potential of one group of bacteria that belong to Fluorescent pseudomonads (FLPs). FLPs help in the maintenance of soil health and are metabolically and functionally most diverse (Lugtenberg and Dekkers, 2009; Lata and tilak 2008). The presence of fluorescent pseudomonads inoculant in the combination of microbial fertilizer plays an effective role in stimulating yield and growth traits of chickpea (Rokhzadi et al., 2008). Isolates of FLPs from roots, shoots, and rhizosphere soil of sugarcane provides significant increases in fresh and dry masses (Mehnaz et al., 2009).

RESEARCH STUDY

Bacterial leaf blight caused by X. oryzae pv. oryzae is the most damaging disease of rice in south India, Japan, south East Asia and, particularly since introduction of dwarf high yield varieties. In Japan where figures are available up to 4 million ha may be affected annually with a loss of 20-30 % and 50 % still more in tropical regions severe infection results in poor grain development, broken rice and deterioration in chemical and nutritional composition (Ou, 2005a). The disease in its severe form is known to results in yield loss ranges from 74-81 % in susceptible cultivar (Shivalingaiah et al., 2013). In Africa, losses of 3-41 % in grain yield have been found (Awodera et al., 2011). It occurred in an epidemic form during 2008 in Palghat district of Kerala, India and destroyed the rice harvest (Gnananmanickem et al., 2009).

Yield losses due to bacterial leaf blight range from 74-81 % in India where it is epidemic. This loss is relatively higher than those reported in other parts of the world which is generally around 20-30 %, occasionally going up to 50 %. (Rangarajan et al., 2008). Yield losses due to bacterial leaf blight ranging from 50 to 90 % have been reported (Ou, 2005b, Sere et al., 2005). Reports from the Philippines, Indonesia and India estimate that losses due to the kresek syndrome of bacterial leaf blight, which affects 60–75 %, depending on weather, location and rice cultivar. In addition to reducing yield, bacterial leaf blight may also affect grain quality by interfering with maturation (Liu et al., 2006).

In India millions of hectare was severely infected with the disease causing yield loss up to 40 % (Pascuzzi and McCouch, 2007). The disease became prominent in the 1960s, when new high yielding cultivars were first developed and introduced yield loss ranging up to 26 % has been reported on susceptible rice cultivars. It is particularly destructive in Asian countries (Adhikari et al., 2012; Ghasemie et al., 2008). Yield losses due to this disease corresponds to the plant growth stages, infection at booting stages does not affect yield but results in poor quality and high proportion of broken kernels (Anon, 2009). Recent studies in West African countries such as Burkina Faso, Niger and Mali revealed the occurrence of bacterial leaf blight causing significant crop damages (Basso et al., 2011).

Recent survey reported the occurrence of bacterial leaf blight in most of rice growing eco zones of Togo with high incidence and severity, and the virulence of the pathogen was determined (Dewa et al., 2011). Losses due to bacterial leaf blight in tropical Asia vary from 2 to 74 % depending upon certain factors such as location, weather conditions, crop stage and cultivars. Similarly yield losses due to bacterial leaf blight disease range from 20 to 30 % though in severely infected fields the losses may reach up to 80 % (Chaudhary et al., 2012). Bacterial blight is reported to have reduced Asia's annual rice production by as much as 60 %. For example, in Japan, about 300,000 to 400,000 hectares of rice were affected by the disease in recent years. There was 20 % to 50 % yield loss reported in severely infected fields. In Indonesia, losses were higher than those reported in Japan. In India, millions of hectares were severely infected, causing yield losses from 6 % to 60 %. To develop rational and economical control measures, the extent of crop losses must be evaluated and related to the potential gain obtained from control practices. Disease severity and crop loss appraisal can be used to determine the economic impact.

DATA ANALYSIS

Rice is the staple food for more than three billion people worldwide. Over 600 million people derive more than half of their calories from rice. It is the third largest commercial crop behind wheat and corn. In the year 2005, 700 million metric tons were produced worldwide with a market value of US$ 120 billion. It is estimated that 50 % of the world rice crop is lost due to diseases caused by bacteria, fungi and viruses. In the year 2011, 300 million metric tons of rice was lost due to diseases. This important crop suffers from 40 different microbial diseases, with bacterial leaf blight the most devastating and harmful. One of the most serious bacterial diseases of rice in Africa and Asia is bacterial leaf blight caused by X. oryzae pv. oryzae. Bacterial leaf bight is one of the oldest recorded rice diseases and has been problematic for over a century. X. oryzae pv. oryzae spreads rapidly from diseased plant to healthy plant and from field to field in water droplets. Infected leaves develop yellow lesions, and wilt in a matter of days. In severely affected fields, bacterial blight can wipe out half a farmer’s rice crop. Bacterial leaf blight caused by X. oryzae pv. oryzae was worldwide in distribution particularly destructive in Asian countries during the heavy rains of monsoons. Bacterial leaf blight has become endemic on rice following repeated cultivation. It was first noticed by the farmers in Fukuokka area of Japan (Ishiyama, 2012) and the study of the disease commenced in Japan. In India it was first reported from Koloba district of Maharashtra by Srinivasan et al. The disease was considered to be of minor importance until it broke out in an epidemic form in Shahabad district of Bihar in 2009 (Srivastava and Rao, 2006).

The disease can affect rice plants at any plant growth stages (Jabeen et al., 2012). It is one of the most widespread and destructive diseases of rice in several countries in tropical rice-growing areas of Asia, Australia, United States, Latin America and Africa (Mew, 2011, 1989; Mew et al., 2008; Sere et al., 2005). Bacterial leaf blight was observed to occur in fields with high incidence of 70 to 80 % in several West African countries (Sere et al., 2005). Under tropical condition bacterial leaf blight is most prevalent in both tropical and temperate areas and endemic to much of Asia and west Africa (Liu et al., 2006). It is a typical vascular disease considered to be one of the destructive diseases in Asia including India, Nepal and Srilanka (Pasuezzi and McCouch, 2007). Bacterial leaf blight has the potential to become a destructive bacterial disease of rice in Pakistan, India and Haryana (Akhatar et al., 2008; Nayak et al., 2008; Shivalingaiah and Umesha, 2011). Recent studies in West African countries such as Burkina Faso, Niger and Mali revealed the occurrence of bacterial leaf blight causing significant crop damages (Basso et al., 2011). Recent survey reported the occurrence of bacterial leaf blight in most of rice growing ecozones of Togo with high incidence and severity, and the virulence of the pathogen was determined (Dewa et al., 2011). Bacterial blight was observed to occur in fields with high incidence of 70 to 80% in several West African countries (Banito et al., 2012). The X. oryzae pv. oryzae has been the most serious in South East Asia, particularly since the widespread cultivation of dwarf high yielding rice cultivars. It has caused huge yield loss during recent years. In Japan the yield loss reported were ranged between 20-30 %, occasionally increasing up to 80 %.

CONCLUSION

Management of bacterial leaf blight was undertaken using biotic and abiotic resistance inducer of host. The inducer enhances the host defense machinery to produce necessary compound to kill the pathogen soon after its entry into plant system. However there are many problems associated with controlling pathogens with long term persistent survival structure due to difficulties in reducing pathogen inoculum and lack of plant resistance. Plants have endogenous defense mechanisms that can be induced in response to attack of pathogens. It is well known that the defense genes are inducible genes and appropriate signals are needed to activate them. Inducing the plants own defense mechanisms by prior application of biotic or abiotic inducer is thought to be a novel plan protection strategy. The most promising and effective biological and chemical inducers were selected and attempted to manage this disease.

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