Effect of drought at reproductive stage in different rice (Oryza sativa L.) genotypes

Garima Yadav*, Shambhoo Prasad, Shashi Devi, Sonam Singh and Atul Kumar Verma
Department of Plant Molecular Biology and Genetic Engineering, NDUA and T. Kumarganj Faizabad, India
*e-mail: yadav.garima169@gmail.com

(Received: November 06, 2015; Revised received: May 9, 2016; Accepted: May 11, 2016)

Abstract: This experiment was conducted in three set to evaluate the effect of drought stress on 5 rice (Oryza sativa L.) genotype/line (Nagina-22, NDR-97, Susk Samrat, Swarna sub-1 and NDR 9830102) to assess the drought tolerance. Drought stress was given at reproductive stage for 15 days. Exposure of 15 days drought significantly affects the growth and yield of rice genotypes. Sensitive genotype (swarna sub-1) more reduced in plant height (up to 35% reduction) and grain yield (up to 47% reduction) than for moderately tolerant NDR 9830102 (maximum reductions of height up to 13.03% and grain yield up to 23.94%) and tolerant genotypes Nagina-22, NDR-97, , Susk Samrat respectively. 50% flowering, and days of maturity were also delayed across genotype at the tolerance levels. Drought stress at reproductive stage severally affect yield of Swarna sub-1, but impact of drought was less on Nagonja-22, NDR-97, , and Susk Samrat and NDR 9830102 respectively.

Key Words: Drought, Submergence, Oryza sativa L.

Introduction

Rice (Oryza sativa L.) is the staple food for over half the world’s population (Singh et al., 2012). About 90% of the total rice grown in the world is produced by 200 million small farmers (Tonini and Cabrera, 2011), and rice is the major staple crop of nearly half of the world’s population. It is cultivated in at least 114 developing countries and it is the primary source of income and employment for more than 100 million house hold in Asia (Singh et al., 2015). Drought is the most significant limiting factor for plant, which can cause serious losses of yield and productivity in most crop plants in arid and sub-arid regions. Droughts and floods already cause widespread rice yield losses across the globe (Pandey et al., 2007), and the expected increase in drought and flood occurrence due to climate change would further add to rice production losses in the future. It is the major factor that limits crop productivity and subsequently determines the natural distribution of plant species (Saxe et al., 2001; Mpelasoka et al., 2008). Drought stress during the vegetative growth, flowering, and terminal stages of rice cultivation can cause spikelet sterility and unfilled grains (Kamoshita et al., 2004). Usually, water stress at grain filling process induces early senescence and shortens the grain filling period but increases remobilization of assimilates (are reserved in the stems and sheaths of rice and contribute 10-40% of the final grain weight) from the straw to the grains (Asseng et al., 2003). The effect of water stress on decreasing yield of rice is very pronounced during certain period of growth, called the moisture sensitive periods. The most sensitive periods to water deficits are flowering and head development. Water deficient characterized by other abiotic Stress by reduction of water content and gas exchange, closure of stomata. Keeping these points in view present study focuses on rice for effect of drought.

Material and Methods

This experiment was conducted in pot culture with 5 rice varieties, NDR-9830102, NDR-97, Nagina-22, Swarna sub-1, Susk Samrat to assess the drought tolerance in rice. Healthy nursery after 25 days transplanted in 5 earthen pots (30 X 20cm) filled with 10 kg well pulverized farm soil with recommended dose of N, P, and K (120:80:60). Pots were direct aligning with three time replication in two set according completely randomized design (CRD). At reproductive stage one set pot put drought condition for 15 days. Data related to physiological trait were recorded before and after drought condition.

Result and Discussions

This experiment was conducted in 2013 and 2014 in pot house in stress and control condition. Drought stress was given at reproductive stage for 15 days on 5 rice genotype (Nagina-22, NDR-9830102, NDR-97, Swarna sub-1, Susk Samrat). Variations in morphological characters were observed across genotype in drought and irrigated condition at each tolerant label.

Effect of drought on plant height, flag leaf Area: Under irrigated condition plant height and Flag leaf Area was higher in both sensitive and tolerant genotype but under drought condition plant height and flag leaf Area was more reduced in Swarna sub-1 (up to 35 % and 30.77% respectively) and less reduced in Nagina-22 (up to 10% and 14% respectively) than other genotype NDR-9830102 (13.03% and 20.08% respectively), NDR-97 (15.00% and 25.51% respectively) and Susk Samrat (63.60% and 16.05 respectively) (Table-1). Singh (2000) also reported that plant height reduced significantly due to drought in rice cultivars.

Effect of drought on 50% flowering, maturity and grain yield: Under control conditions, values for, flowering (start, 50%, and 100%), maturity and grain yield were significantly higher for sensitive genotypes than for tolerant genotypes. Under water deficit conditions, this traits flowering (start, 50%, and 100%), maturity and grain yield were delayed significantly but grain yield reduced as with the tolerant (Table-2). Pantuwan et al. (2002) made similar observations and concluded that under prolonged drought, flowering time is an important determinant of rice grain yield. The maturation stage, which is regarded as the period between anthesis and harvest, is also delayed as a result of delayed flowering or when drought appears after flowering. Maximum flowering delays (up to 9.05-9.47%) and reduction in grain yield (up to 7 %) were recorded in Swarna sub-1 and minimum flowering delays (up to 0.56 to 6.0%) and minimum grain yield reduction (13.09%) were recorded in Nagina-22 than other genotype NDR-
Effect of drought at reproductive stage in rice genotypes

In normal condition rice has early flowering and higher spikelet on every rice genotype. Grain usefully filled largest at irrigated condition than water deficit condition and grains become larger and heavier. Similar results on later-flowering inferior spikelets (grains), usually located 1000-grain weight under water stress had been on proximal secondary branches, are either sterile or fill reported by Venuprasad et al., 2006 and Castillo et al., 2007. Slowly and poorly to produce grains unsuitable for human Stress during different growth stages might decrease consumption (Ishimaru et al., 2005).

The present observation suggested the variation in among the genotypes for grain yield and yield contributing traits showed different response to drought stress at reproductive stage. Drought stress at reproductive stage significantly reduced plant height, grain yield, spikelet fertility, Flag leaf area, test weight, and increase in grain sterility percentage in rice genotypes. We identified 3 genotype as drought tolerant (Nagina-22, Susk Samrat, NDR-97), one moderately tolerant (NDR-9830102) and one susceptible (Swarna Sub-1). According to this experiment scientist can take these genotype for screening the drought tolerant genotype. So this drought tolerant genotype can successfully grow in water deficit’s areas.

References


