Comparative Study Of Performance In Between Submergence Tolerant Rice (*Oryza sativa*) Cultivars And Their Non-tolerant Counterparts Under Both Submerged And Controlled Condition

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Abstract: *Flash flood or submergence is a frequent observable fact in rice budding rain fed lowland regions all the way through drenched (kharif) time of year with the intention of gravely affects harvest establishment leading to ruthless yield hammering. A small number of submergence-tolerant rice cultivars have been build up by introgressing Sub1 gene into mega rice cultivars through marker-assisted backcrossing. Some of them are IR64-Sub1, Swarna-Sub1 and BR11-Sub1 which was generated from their parental non-tolerant corresponding species, such as IR64, Swarna and BR11. BR11and BR11-Sub1 was circulated in Bangladesh. IR64 and IR64-Sub1 were made public in the Philippines. Swarna and Swarna-Sub1 were released in India .These cultivars were analyzed and tested for agronomic presentations under in cooperation with submerged and controlled circumstance in many diverse situates of dissimilar countries. Subsequent to analyzing those information my aspire was to establish the association linking to shoot extension capability of rice cultivars and submergence, to set up the affiliation flanked by submergence tolerance and Alcohol dehydrogenase (ADH) activity, to perceive the most advantageous and optimal level of ADH activity in Sub1 rice cultivars and their counterparts for the duration of both condition, to identify the finest rice cultivar among them on the foundation of their endurance score achieved in both submergence and controlled state. Plant elevation did not boost to a great extent in Sub1 introgressed cultivars, resulted momentously minor elongation contrasted to supplementary non-tolerant cultivars. A brawny negative and unenthusiastic intercommunion amid percent survival and stem tendril outgrowth is usually evident. The submergence liberal rice cultivars can stay alive normally up to 2 weeks for the period of absolute submergence. The optimal ADH enzyme activity illustrates merely at forty eight hours all through submergence in both tolerant and non-tolerant cultivars. ADH enzyme activity is persuaded by Sub1 gene during submergence strain which is accountable for underneath water energy supply and undoubtedly provide evidence of the imperative function of Sub1 in improving endurance during flash flood. The submergence tolerance cultivars have revealed that superior quantity of ADH enzyme synthesis than non-tolerant cultivars. Survival rate and inundation tolerant during submergence is unswervingly proportional with the ADH activity among the rice cultivars. The submergence tolerant rice cultivars shows enhanced agronomic performance than the non-tolerant equivalents and IR64-Sub1 is concluded as paramount cultivar among the other rice cultivars owing to its tremendous lucrative agronomic performance.*

Key Words: *Rice cultivar, Bio-morphological parameters, ADH activity, Sub1 gene, Flash flood and submergence, Kharif season.*

1. INTRODUCTION:

Rice is the staple food of most of the parts of Asia continent. It is also a source of income for more than 50 million households. After India and Bangladesh, the other three major rice growing countries in South Asia are Pakistan, Nepal and Sri Lanka which together have little more than 5 million [1]. Rice is the seed of the grass species *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice), belongs to the Family: *Poaceae*, Genus: *Oryza*. It is grown at an angular distance above the horizon or can say at an elevated geographical formation. Autumn (Aus), Winter (Aman) and Summer (Boro) are the three seasonal paddy crops cultivated in India. As per as the time of harvest these crops are named, such as - November/December to April/May Boro is cultivated which is 28% of the total rice area and Boro production of rice is 34% of total rice production. Again from July/August to October/November Aman is grown. Aman / Kharif area is the predominant of three (68%) of the total rice area and production of rice is 63% of total rice production. From May/June to September/October Aus is harvested, Aus is only 4% of the total rice area along with production of 3% of the total rice production [2]. The king growing rice is thus Aman. In main rice harvesting season Aman is grown both as rain-fed and irrigated crop. The most fragile ecosystem is nothing but the Rain fed lowland. Low land ecosystem is divided into three land situation: a. shallow (20-40cm of water dept), b. semi-deep (40-75cm), c. deep (75-100cm).

2. LITERATURE REVIEW:

1) The Challenges In Rice Breeding For Excess Water Environments

Floods are common in India and Bangladesh due to its heavy rainfall and rivers. Every year farmers experience losses because of flood. Flash floods (a flash flood is generally defined as a rapid onset flood of short duration with a relatively high peak discharge) affect 24% of rain fed low land, generally in Aman rice areas mostly at the seedlings condition, which is generally defined as a rapid onset flood of short duration with a relatively high peak discharge. The key factor limiting yield of low land rice which creates of proportional affects to the grain yield of rice crop because of submergence due to flash flood [3]. On the whole, improved submergence tolerance is an essential triat for rice growing in rain fed low land areas. Therefore, efforts are taken for improving submergence tolerance without harming the rain yield. Flash floods regularly affect near about 30 million ha of paddy areas (Largest areas: India, Bangladesh, Thailand; others: Cambodia, Laos, Indonesia) [4]. Rice is the only crop plant adapted to aquatic environments as it have well-developed aerenchyma tissues that facilitate oxygen diffusion through continuous air spaces from shoot to root and avoid anoxia development in roots. A milestone was the identification in near mid 1990s of the major quantitative trait locus (QTL) Sub1 is the primary contributor for tolerance. Rice breeder David Mackill (University of California, Davis) in 1990's along with a graduate student Kenong Xu (University of California, Davis) found that tolerance to complete submergence mapped to the submergence tolerance-1 (Sub1) quantitative trait locus (QTL) on chromosome 9. These discoveries and the molecular marker technology have accelerated the breeders to develop submergence-tolerant varieties by a fast-track marker-assisted backcrossing (MABC) strategy to introgress Sub1 using grand varieties as recurrent parents [5]. After that several submergence tolerant mega varieties were developed, such as Swarna-Sub1 was released in India, Indonesia and Bangladesh; BR11-Sub1 was circulated in Bangladesh; and IR64-Sub1 in the Philippines and Indonesia. With the Sub1 mega-varieties, dissemination and adoption is more straight forward, because the main aim is the replacement of the original mega variety with an improved submergence tolerant version [6-13]. Under short term flooding extension growth is harmful because it accelerates energy depletion and augments mortality. Tall crops also tend to have shelter when the water level secedes resulting in additional yield hampered losses with very poor rain quality. Mechanisms associated with such tolerance were recently reviewed [14, 15].

2) Bio-morphological Parameters

Rice is the compulsory food for more than half of the world population. In Asia it is produced and consumed almost 90% of the whole. South and South-East Asia being the most flood- prone areas cultivates and intake rice as their staple food. Within South Asia, India and Bangladesh both are the king rice growing countries [1-3, 16-18]. Submergence is a regular event in principally flat down regions, focusing on monsoon rainfalls, fatally distressing crop [4, 19] establishment along with endurance, leading to extreme yield hamper. It compels a multifarious abiotic pressure in flood-prone bionetwork, since it significantly diminishes crop stand, in particular if it arises at some stage in early vegetative stage and extends for further than a week [14-16]. Most obtainable rice cultivars are vastly injured or decreases in value if they are entirely inundated for more than 3 days in a row; on the other hand, a small number of tolerant cultivars can cumber or resist complete submergence for 10 to 14 days [20]. Consequently numerous submergence tolerant mega varieties namely IR64-Sub1, Swrna-Sub1 and BR11-Sub1 were built up in a string [6, 13]. Swarna-Sub1 was on the rampage in India, Indonesia and Bangladesh; IR64-Sub1 in the Philippines and Indonesia was released; and BR11-Sub1 was circulated in Bangladesh. Dissemination and implementation is further uncomplicated, in the midst of the Sub1 mega-varieties for the reason that the core aim is the substitution of the original mega variety with an enhanced submergence liberal version [7, 10, 11, 13]. To produce submergence tolerant rice cultivars, it is done a cross between an *Indica* submergence tolerance line (IR 40931-26) with susceptible *Japonica* line (PI543851) through QTL mapping at chromosome-9, entitled as Sub1, having the ability to give complete submergence of paddy crop for two weeks [8, 9]. Under the controlled (non-submergence) condition, there is no significant difference ADH activity, agronomic performance-survivility [21-23]. During submergence the tolerant varieties have the ability to maintain their metabolic energy in anaerobic condition, so they can survive upto twelve to fourteen days [24-29]. In many cases Swarna-Sub1 alives upto seventeen days in field trial [19]. Under flash flood condition, the tolerant cultivars' stems are not elongated and not showing noticeable growth due to have Sub1 gene for food energy conservation, but the non-tolerant cultivars shows much stem elongation and growth than the tolerant cultivars. Thus the non-tolerant cultivars die generally under submergence within two to three days [6, 7, 16, 21, 23, 25, 28, 30-35]. Some field experiments were shown that in submerge condition IR64-Sub1 showed the highest survival rate and Swarna-Sub1 showed less tolerant from IR64-Sub1 and the lowest shown in BR11-Su1. In case of non-tolerant cultivars, IR64 showed highest survival rate and Swarna in some les from it but more than BR11 [16]. At Bangladesh Rice research institute, Gazipur, a field trial showed the survival percentage of IR64-Sub1 was 92.6%, Swarna-Sub1 was 89.6%, BR11-Sub1 was 79.6%, IR64 was 32%, Swarna was 31.2%, BR11 was 30.6% but there submerge tolerance difference was negligible among the cultivars under controlled condition [13].

3) Alcohol Dehydrogenase (adh) Activity

During O_2 deficiency, the level of ADH activity increases [21, 28, 36-39]. Due to have Sub1 gene, the tolerant cultivars utilize the ADH enzyme activity for better survival under submergence but the susceptible non-tolerant cultivars are not [30, 40, 41]. During submergence the highest ADH activity was shown by IR64-Sub1 and the lowest was shown by BR11-Sub1 but the difference of ADH activity under controlled condition in between submerge tolerant and non-tolerant cultivars was negligible. In many cases it was shown that those cultivars showed highest survival percentage, showed also the highest ADH activity [13, 42]. The optimum ADH activity was shown by both submergence tolerant and non-tolerant cultivars at the 48 hours during both submerge and control condition [35, 43] and in case of submergence tolerant cultivars ADH activity graph showed towards the plateau after 15 days in absolute submerge condition [44] but the ADH activity of non-tolerant cultivars totally finished after 3 to 4 days during submergence [34, 45, 46].

3. CONCLUSION:

In many parts of the nation, flash floods and heavy rain-falls habitually have an effect on rain-fed low land of rice ecosystem where the flood water lingers for two weeks. Submergence is one of the most vital abiotic limitations in India as well as Bangladesh and Philippines, which accounts for in close proximity to entirety yield loss of rice. Survival subsequent to submergence seems to be robustly reliant on rations reserves left over in the shoot later than submergence, which is in revolve likewise dependent on the amount of stem elongation throughout submergence. Plant elevation or height did not augment greatly in Sub1 introgressed cultivars, resulted appreciably minor elongation contrast to other non-tolerant cultivars. Maintenance and safeguarding of high levels of stocked up victuals in the paddy seedlings prior to submergence coupled with bare minimum shoot elongation are enviable qualities for submergence tolerance. Wide-ranging shoot elongation is not preferred in flash flood conditions as it fatigues energy storage and eventually be inclined to lodge, which diminishes equally productivity/output and grain eminence. A hefty negative intercommunion involving percent of survival and stem elongation augmentation is usually notable. The submergence tolerant rice cultivars can subsist or endure in the gross up to two weeks during absolute submergence. The most favorable and optimal ADH enzyme activity shows barely at forty eight hours for the duration of submergence in mutually tolerant and non-tolerant cultivars. ADH enzyme activity is persuaded by Sub1 gene throughout submergence strain which is accountable for below water energy supply and evidently proved the imperative function of Sub1 in flourishing continued existence for the period of flash flood. The introgression of sub1 gene in cultivars has revealed with the aim of higher amount ADH enzyme synthesis than non-tolerant cultivars. Survival rate and inundation tolerant during submergence is directly proportional with the ADH activity amongst the rice cultivars. The submerge tolerant rice cultivars shows healthier agronomic performance than the non-tolerant counterparts and IR64-Sub1 is accomplished as most excellent cultivar among the other rice cultivars due to its brilliant agronomic performance.

4. FINANCIAL DISCLOSURE:

We declare that we have no conflict of interest.

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