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Screening of Rice Varieties under Deep Water Conditions

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Abstract: The field study was conducted at Rice Research Institute, Dokri, Larkana, Pakistan to assess the potential deep water rice cultivar. Five cultivars: Kanwal-95, IR-8, DR-82, IR-6 and DR-58 were screened. Kanwal-95 exhibited prolonged flowering and maturity days by recording elongated plants, more tillers and grain yield followed by IR-8 and IR-6 rice cultivars. The rest of cultivars were almost non-significant in growth and yield parameters. The study recommends Kanwal-95 as potential deep water rice cultivar in terms of elongation and grain yield.

Key words: Rice, deep water, cultivars, growth, yield

INTRODUCTION

In Asian countries, rice sector alone use over 80% fresh water and half of which is used in irrigated rice production (Guerra *et al*., 1998). There are five categories of agro-ecological diversity i.e., deep water, rianfed lowland, tidal wetlands, rainfed upland and irrigated rice (Khush, 1984). Dokri region of Sindh, Pakistan is placed under irrigated rice where rice is cultivated on leveled and bounded fields with water control. The productivity of this rice ecosystem situated at Indus valley in Pakistan is higher than in rainfed rice, due to better water control and higher solar radiation (Hundermark and Facon, 2004). An important element in effective water management in rice production is an adequate knowledge of crop water needs and irrigation requirements in the given climatic conditions (FAO, 1977). Solaimalai *et al*. (2000) in a review of the literature on the Indian subcontinent, confirmed the positive effects of various irrigation regimes on water consumption and yield. In some cases, however, yield levels were much reduced. More generally, it has been argued (FAO, 2002) that an important reason for field-level water management options remaining mostly in the research stations and not being adopted in the field. In Pakistan, where over-irrigation raised the water level closer to the surface, with salt subsequently accumulating in the root zone. Proposed salinity control options include: a marked reduction in water supplies to farmers; a substantial reduction in the area cultivated to rice and the introduction of a drainage system capable of controlling the water table at a depth where the capillary fringe remains below the root zone.

A current belief is that the real price of rice will continue to fall as per capita rice production increases (Newsweek, 1986) and that the cost of purchased inputs and labor, compared to rice, will continue to decrease. If this scenario is credible, then crop improvement techniques, such as exploration of varieties in different eco-systems will gain relevance as an option to plant paddy fields with such deep water varieties which can give better when the water availability become much higher than actual consumption. Deep water rice require water between 51 and 100 cm for more than half of the growth duration and some times there is complete submergence of the plant. Thus, in deep water rice growing areas the varietal selection is considered the best approach to obtain boosted yields. These varieties must have seedling vigor, ability to elongate with water levels, intermediate plant height when water levels become low or drought sets in, submergence tolerance, keening ability and photoperiod sensitivity (Vergera, 1977). Further, it was reported that depth of standing water in paddy fields is an important agronomic parameter in the management of irrigation-related problems. It was hypothesized that reductions in the yield of rice under salinity stress can be ameliorated by adjusting the water depth (Zeng *et al*., 2003). Wortman and Cummings (1978) made attention that research should be an important catalyst of rapid agricultural development and considerable research is needed to maintain the high yield levels and deep water areas must receive higher priorities than have been given in the past. Looking the facts of rice production and economic importance of rice exports in the country, the research emphases to explore new deep water rice varieties/strains suitable for achieving maximum yields.

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MATERIALS AND METHODS

The field experiment was conducted at agro-ecological conditions of Rice Research Institute, Dorki, Larkana, Pakistan. Five cultivars (Kanwal-95, IR-8, DR-82, IR-6 and DR-58) were tested in deep water conditions in Randomized Complete Block Design. The twenty days old seedlings were transplanted in well puddle soil. At seedling establishment, the 40-50 cm water depth was maintained whereas, 100 cm water depth was maintained after more than half of growth duration of crop. At physiological maturity, the water level was dropped for crop harvest.

RESULTS AND DISCUSSION

Flowering and maturity: Work on deep water rice improvement in Pakistan presumably started recently, few years ago and consisted of selection from existing indigenous deep water varieties. To improve varieties the needs of the region are kept in mind for water availability, varietal tillering capacity, tolerance ability combined with maturity, grain characters, disease and insect resistance in the agro-ecological situation. In the present study various rice varieties were screened under deep water conditions and results showed flowering and maturity days were not uniform in different varieties. Among the tested rice varieties, flowering appeared in the range of 81-113 days. Kawal-95 recorded maximum days for flowering and maturity followed by IR-8, IR-6, DR-82 and DR-58. The prolonged maturity days in Kanwal-95 were due to its genetic characteristic of growing this variety in the deep water conditions in the rice tracts, however, rest of varieties are being grown in the wet conditions (Table 1). It was reported that deep water rices have their earliest flowering dates in Bangladesh and similar rices had latest flowering in Thailand (Jackson *et al*., 1982). It was also noted that varieties under study flowers normally earlier in the normal sowing except Kanwal-95, which is cultured in deep water condition.

Elongation and tillering: Elongation is important character of deep water rices. Tallest plants were observed in Kanwal-95 followed by IR-6, IR-8, DR-82 and DR-58 (Table 1). Thus, Kanwal-95 proved outstanding in terms of elongation and tillering which are best characters of deep water rices. Vergera (1977) also reported deep water plant characters that essentially, a plant type of the high-yielding varieties is needed with the ability to elongate if the water level increases, which increases the submergence tolerance. Further, reports indicated that good seedling vigor is essential which support the tillering capacity of the plants.

Table 1: Plant characters of different rice varieties under deep water conditions

Varieties	Flowering (Days)	Maturity (Days)	Elongation (cm)	Tillers plant^{-1}	Grain yield (Kg ha^{-1})
Kanwal-95	113.00a	143.00a	154.67a	20.33a	4966.6a
IR-8	86.00bc	115.00bc	120.33b	14.33b	4120.0b
DR-82	82.00bc	112.00bc	118.00b	13.33b	3246.7c
IR-6	86.67b	116.70b	123.67b	16.33ab	4271.7b
DR-58	81.33c	111.33c	105.33c	12.33b	2890.0d
CV (%)	1.46	1.050	1.600	8.25	2.21
SE	0.75	0.722	1.152	0.73	49.84
LSD(5%)	2.97	2.830	4.520	2.86	195.7
LSD(1%)	4.92	4.700	7.520	4.75	324.5

Grain yield: The replicated trials critically assess the adaptability and yields of the screened cultivars. The yield data indicated superiority of Kanwal-95 deep water rice over the rest of cultivars, were maximum grain yield 4966.6 kg ha^{-1} was achieved (Table 1). IR-6 and IR-8 were also better yield performers but, significantly were ranked at the second place. The indigenous DR-82 and DR-58 could not compete and did not produced satisfactory seed yield. The increase in grain yield in Kanwal-95 was attributed to its maximum tiller production and elongation character. Until new improved varieties are released, efforts can be made to identify the best traditional varieties of each production zones and farmers should be encouraged to grow these varieties especially in the areas were water availability is not scare. Further, it is suggested that improving the water capturing capacity of its large and deep root system is required to stabilize the yield of rice in different areas. For the improvement of the root system through breeding and soil management, it is critical to understand the relative importance of genotypic and environmental effect and their interaction on the root development under various soil conditions and agronomic management (Kondo *et al*., 2003). The study recommends the Kanwal-95 rice variety as potential cultivar for recording satisfactory grain yield due to its elongation and tillering characters in the deep water.

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