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Performance of aerobic rice as influenced by different dates of sowing and varieties
II. Plant water relations and yield

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ABSTRACT

A field experiment was conducted during *kharif* 2003 and 2004 at College farm, College of Agriculture, Rajendranagar, Hyderabad to study the influence of different dates of sowing on plant water relations and grain yield of aerobic rice. Higher grain yield, relative leaf water content, lower leaf temperature and leaf diffusion resistance (LDR) were recorded on 16 and 26 June sown crop. Grain yield had significant positive correlation with RLWC (0.72**), and negative correlation with leaf temperature (0.67**) and leaf diffusion resistance (0.70**) recorded at 45 DAE in aerobic rice.

Keywords: Aerobic rice, RLWC, LDR, leaf temperature and grain yield

Aerobic rice culture is a system of cultivating rice that requires less water than low land rice. It entails the growing of rice in aerobic soil, with the use of supplementary irrigation. Aerobic rice is characterized by sowing of dry seeded rice with the help of monsoon rains and subsequently irrigating it by using tank, canal or ground water. Dry seeded rice offers scope to advance crop establishment and to increase the effective use of early season rainfall (Tuong, 1999). The success of aerobic rice mainly depends on time of sowing which accounts for 23 per cent of yield variation (Singh *et al.*, 1990). As most of the rice is being grown in *kharif* season, the sowing time is very important to avoid possible water stress. Information is meagre on influence of dates of sowings on plant water stress indices before starting of irrigation and grain yield in aerobic rice. The present investigation was carried out to find out the performance of rice varieties in relation to plant water status and grain yield under aerobic conditions. The total water used, dry matter and water productivity were reported in a companion paper (Sreenivas *et al.*, 2007).

MATERIALS AND METHODS

The experiment was conducted during *kharif* seasons of 2003 and 2004 at College farm, College of Agriculture, Rajendranagar, Hyderabad. The experimental site was sandy clay loam in texture with pH 7.7, low in available N (275.9 kg ha^{-1}), P_2O_5 (10.8 kg ha^{-1}) and K_2O (128.9 kg ha^{-1}). Crop was

sown in four different dates *viz.*, 16 June, 26 June, 07 July and 18 July as main plots and four varieties *viz.*, Varaalu, Erramallelu, Jagtiala Sannalu and Polasa Prabha as sub-plots in split plot design and replicated thrice. Crop was sown in rows at 20 cm interval using 400 seeds per square meter in plot size of 25 m^{-2}. Fertilizer and irrigation application were the same as reported earlier (Sreenivas *et al.*, 2007).

Physiological parameters using the youngest fully expanded leaf of plant's main shoot were measured between 1300-1400 h one day before converting to wet system (45 DAE). Relative leaf water content (RLWC) was estimated as per the procedure laid out by Turner (1981). Leaf diffusion resistance and leaf were measured using Steady State Porometer (Model LI-1600) one day before start of irrigation (45 DAE) in each treatment.

RESULTS AND DISCUSSION

During both the years, crop sown on 16 and 26 June recorded higher relative leaf water content, lower leaf temperature and leaf diffusion resistance at 45 DAE (Fig.1). The higher RLWC in early sown crop might be due to higher amount of effective rainfall received in early sowings than that of delay in sowing *viz.*, 7 and 18 July (Table 1). In 2003, the RLWC was higher compared to 2004. Similarly the leaf temperature and leaf diffusion resistance were lower in 2003 compared to 2004. This might be due to high amount of effective rainfall received before starting of irrigation in 2003. Among the varieties, Erramallelu maintained higher RLWC, lower leaf temperature and leaf diffusion resistance compared to all other three varieties (Fig. 1).

Significantly higher grain yield was observed with crop sown on 16 June than 18 July in 2003 and 7 July in 2004. Crop sown on 7 July recorded significantly higher grain yield than that of 18 July in 2004 (Table 1). Higher RLWC lower leaf temperature and leaf diffusion resistance at 45 DAE might have favoured higher tiller number and dry matter production and yield at harvest of the crop sown on 16 and 26 June. The drastic reduction in grain yield in 7 and 18 July sown crops in 2004 might be due to prolonged dry spell in the month of August (32-35 Std. weeks) which resulted in moisture stress and lead to lower RLWC at 45 DAS. Water stress during vegetative growth is associated with leaf rolling, drying and pre-mature leaf death (Murthy and Ramakrishnayya, 1992). Soil moisture deficit reduces plant height and tiller production (Ramakrishnayya and Murthy, 1991). Ingram and Yambao (1988) reported yield reduction due to water stress from 25-45 per cent for 5-10 days of water deficit, and 88 percent for 15 days moisture stress. Thus, rice yields were affected more by the duration of drought. The decrease in RLWC due to deficit soil moisture reduces photosynthates (Shaw and Laing, 1966) mainly through reduced flow of CO_2 due to stomatal closure (Turner, 1969). Under water deficit conditions, leaf stomatal conductance decreases markedly and the effect on net photosynthesis gradually weakens (Wang *et al.*, 2001).

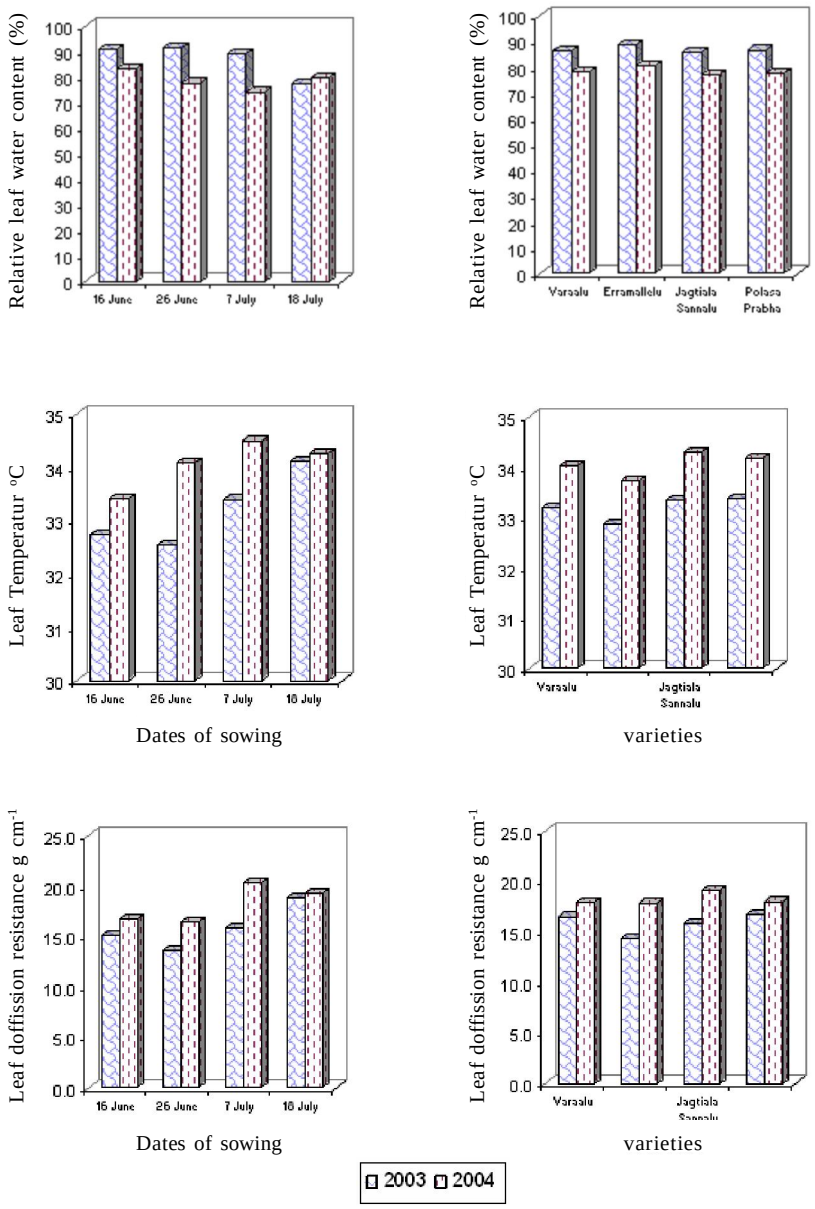

Fig.1: Relative leaf water content (%), leaf temperature (^{0}C) and leaf diffusive resistance (s cm^{-1}) at 45 DAE as influenced by dated of sowing and varieties under aerobic conditions

Table 1: Effective rainfall (mm) upto 45 DAE, growth and yield as influenced by dates of sowing and varieties in aerobic rice

Treatments	Effective rainfall upto 45 DAE (mm)		Grain yield (t ha^{-1})	
Date of sowing (D)	2003	2004	2003	2004
16 June	325.1	306.2	4.96	3.27
26 June	226.8	306.2	4.88	3.27
7 July	203.6	191.6	4.81	2.76
18 July	124.6	209	4.11	1.87
S.Em±	-	-	0.16	0.09
CD(P=0.05)	-	-	0.55	0.31
Varieties (V)				
Varaalu	-	-	3.86	2.45
Erramallelu	-	-	5.28	3.08
Jagtiala Sannalu	-	-	4.94	2.80
Polasa Prabha	-	-	4.68	2.83
S.Em±	-	-	0.14	0.06
CD(P=0.05)	-	-	0.39	0.16
Interaction (DxV)				
S.Em±	-	-	0.27	0.13
CD(P=0.05)	-	-	NS	NS

Among the varieties, significantly higher grain yield was recorded with Erramallelu than Polasa Prabha in 2003 and Jagtiala Sannalu in 2004 (Table 1). Significantly lower grain yield was recorded with Varaalu. Higher RLWC and lower leaf temperature and leaf diffusion resistance at 45 DAE favoured higher tiller number and dry matter production at the end of vegetative stage and at maturity which might have helped in higher grain yield of Erramallelu.

Correlation analysis between plant water stress indices recorded one day before start of irrigation (45 DAE) and grain yield of aerobic rice revealed that grain yield had significant positive correlation with RLWC (r =0.72**) and negative correlation with leaf temperature (r = -0.67**) and leaf diffusive resistance (r = -0.70**).

It is concluded that the higher grain yield can be obtained in aerobic rice by sowing the crop from 16-26 June by selecting the varieties which maintains higher RLWC, and lower leaf temperature

and leaf diffusion resistance. Overall study indicated that any impact on plant water stresses indices during initial stages *i.e.,* upto 45 DAS will affect the final grain yield and hence an in-depth study in these aspects is of paramount importance.

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