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Performance of aerobic rice as influenced by different dates of sowing and varieties
I. Dry matter production, yield and water productivity

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ABSTRACT

Field experiments were conducted during *kharif* 2003 and 2004 at College farm, College of Agriculture, Rajendranagar, Hyderabad to study the effect of different dates of sowings and varieties on grain yield of aerobic rice. Significantly higher grain yield was obtained with crop sown on 16 June than 18 July in 2003 and 7 July in 2004. Higher water productivity was observed when crop was sown on 26 June during both the years. Among the varieties, higher grain yield and water productivity were obtained with short duration variety Erramallelu.

Key words : Aerobic rice, yield, water productivity, sowing dates

In Andhra Pradesh, 94 per cent of rice cropped area is transplanted under irrigation. During the rainy season, irrigated rice in Andhra Pradesh is subjected to water deficit resulting from inadequate irrigation supply. In recent years, the reservoirs and tanks in Andhra Pradesh are not receiving enough water or being filled late in the season. As a result, the transplanting of rice in the tail-end of canal, tankfed and well irrigated areas is delayed. The rice crop thus transplanted with aged seedlings results in poor yields. Under such circumstances, there is a scope to establish the rice crop with dry seeding and irrigating after 45 days after sowing (45 DAS). Irrigated rice requires about 3,000 – 5,000 L of water to produce 1 kg of grain (IRRI, 2001). Because of this high water requirement, the increasing water shortage threatens the sustainability of the irrigated rice system (Tuong and Bouman, 2002). To reduce the share of water in rice cultivation, it is imperative to develop alternate way of growing rice that uses less water, while maintaining high yields.

Aerobic rice is characterized by sowing of dry seed with the help of monsoon rains and subsequently irrigating the crop using tank, canal or ground water. Aerobic rice offers scope to advance crop establishment and to increase the effective use of early season rainfall (Tuong, 1999). The success of aerobic (Dry seeded irrigated) rice mainly depends on time of sowing which accounts for 23 per cent of yield variation (Singh *et al.*, 1990).

In aerobic rice system of cultivation, varieties should withstand moisture stress during the early growth and have higher translocation efficiency after flowering. Varieties need to have adequate tillering ability, early weed competitiveness, input responsiveness and decreased sensitivity to mild water (7-10 days without rainfall) deficit (Lafittee and Bennet, 2002). Water shortage for irrigation is necessitating the identification of suitable cultivars (Wang and Tang, 2000), which are critical in obtaining higher yields under aerobic system of rice cultivation. Very meagre information is available on performance of rice varieties under aerobic conditions. By keeping above facts in view a field investigation was carried out to study the performance of rice varieties under different dates of sowing under aerobic conditions.

MATERIALS AND METHODS

Field 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 on 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 seed rate of 400 seeds per square meter.

A fertilizer dose of 140 kg nitrogen as urea, 60 kg P_2O_5 as single super phosphate and 40 kg K_2O as muriate of potash was applied. A basal dose of 1/3rd nitrogen, entire P_2O_5 and K_2O was applied and the remaining nitrogen was applied in two equal splits at maximum tillering and panicle initiation stage. Crop was raised under rainfed conditions and 4 ± 1 cm depth of irrigation water was applied on every fourth day of previous irrigation from 45 days after emergence (DAE) till a week before maturity. The rainfall received during crop growth period was 810.2 mm and 577.7 mm during 2003 and 2004 seasons, respectively. Effective rainfall was calculated by adopting daily balance sheet method following Gupta *et al*. (1972). Crop was harvested at physiological maturity

RESULTS AND DISCUSSION

In 2003, effective rainfall decreased with the delay in sowing from 16 June (406.7 mm) to 18 July (208.1 mm) (Table 1). In 2004, higher effective rainfall was recorded when crop was sown on 26 June (389.1 mm) followed by 16 June (387.7 mm) and 18 July (352.5 mm). Crop sown on 7 July received lowest effective rainfall.

Crop sown on 16 June received higher irrigation water and it increased with delay in sowing upto 7 July. Further delay in sowing received less irrigation water (Table 1). Irrigation was withheld one week before harvesting during both the years. Maximum irrigation water was received on 16 June and 26 June sown crop during 2003 and 2004, respectively. During both the years, among varieties, medium duration

Table 1: Effective rainfall, irrigation water, growth,yield and water productivity in aerobic rice as influenced by dates of sowing and varietie.

Treatment	Effective rainfall (mm)		Total water used (mm)		No.of tillers at Panicle initiation		Dry matter production (g/m^2) at Panicle initiation		Dry matter production (g/m^2) at Harvest		Grain yield (t/ha)		Water productivity ($kg\ m^{-3}$)	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
Dates of sowing														
16-Jun	406.7	387.7	1011.7	1012.7	401	359	404	345	1226	1051	4.96	3.27	0.49	0.32
26-Jun	318.2	389.1	875.7	1026.6	399	357	390	341	1205	1021	4.88	3.27	0.56	0.32
7-Jul	296.5	331.6	876.5	1006.6	394	317	385	285	1199	883	4.81	2.76	0.55	0.27
18-Jul	208.1	352.5	770.6	1015	366	286	339	213	1032	703	4.11	1.87	0.53	0.18
SEm+	--	--	--	--	6	5	12	9	13	16	0.16	0.09	--	--
CD (P=0.05)	--	--	--	--	22	17	41	30	44	54	0.55	0.31	--	--
Varieties (V)														
Varaalu	264.8	353.6	709.8	728.6	358	318	155	142	959	788	3.86	2.45	0.54	0.34
Erramallelu	317.8	368	882.8	993	390	346	430	340	1265	982	5.28	3.08	0.6	0.31
Jagtiala Sannalu	322.9	369.7	940.4	1132.2	410	326	470	347	1199	941	4.94	2.8	0.53	0.25
Polasa Prabha	324.1	369.7	1001.6	1207.2	402	328	463	356	1216	947	4.68	2.83	0.47	0.23
SEm+	--	--	--	--	5	4	12	13	21	15	0.14	0.06	--	--
CD (P=0.05)	--	--	--	--	15	11	34	38	61	45	0.39	0.16	--	--
Interaction (DxV)														
SEm+	--	--	--	--	10	8	23	26	38	31	0.27	0.13	--	--
CD (P=0.05)	--	--	--	--	NS	NS	NS	NS	NS	NS	NS	NS	--	--

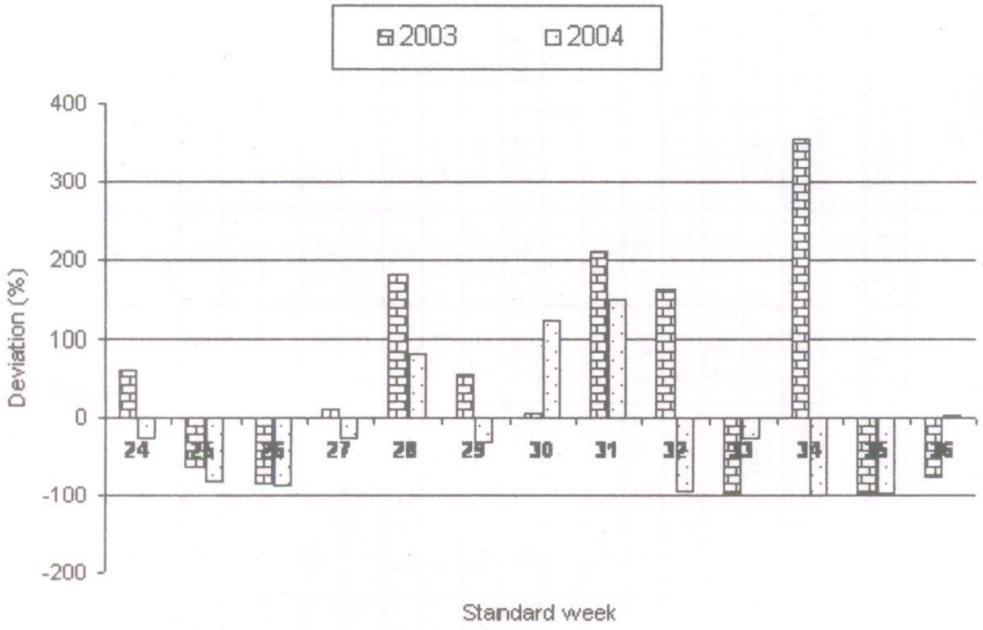

Fig. 1 : Rainfall deviation (%) from normal till starting of irrigation during 2003 and 2004

(135 days) cultivar Polasa Prabha received maximum water than short duration (120 -125 days) cultivars Jagtiala Sannalu and Erramallelu. Extra short duration (100 days) cultivar Varaalu received lower irrigation water. The variation in total amount of irrigation water was due to difference in duration of cultivars.

Significantly higher grain yield was observed with crop sown on 16 and 26 June and lowest with 18 July sown crop during both the years (Table 1).

The relatively higher grain yields recorded by 16 and 26 June sown crop were mainly due to higher effective rainfall received till 45 DAE, irrigation water and total water received. The grain yield decreased to the extent of 17.3 and 42.5 per cent in 2003 and 2004, respectively with decreasing effective rainfall till 45 DAE in 18 July sown crop (Table 2). Though the total water input (Effective rainfall + irrigation) was higher during 2004 than 2003, the grain yield was lower during 2004 than 2003 (Table 1). The reduction in grain yield in 2004 might be due to prolonged dry spell (Fig.1) before starting of irrigation. in the month of August (32-35 Std. weeks) which resulted in severe moisture stress and lower dry matter production (Fig. 1). Water stress during vegetative growth is known to be associated with leaf rolling, drying and pre-mature leaf death (Murthy and Ramakrishnayya, 1992). 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.

Since, the crop is raised under rainfed

Table 2: Effective rainfall (mm) upto 45 DAE and grain yield in dry seeded irrigated rice

Dates of sowing	2003		2004	
	Effective rainfall (mm)	Grain yield percent of 16 June sown crop	Effective rainfall (mm)	Grain yield percent of 16 June sown crop
16 June	325.1	100.0	306.2	100.0
26 June	226.8	97.8	306.2	100.0
07 July	203.6	96.9	191.6	84.4
18 July	124.6	82.7	209.0	57.5

conditions during early stages, the rainfall plays major role in crop growth and development, particularly plant height, tiller production and accumulation of dry matter at the end of vegetative phase. In 2003, the rainfall during vegetative phase was in the range of 463.2 – 590.4, 416.4 – 551.0, 436.4 – 481.4 and 327.0 – 396.0 mm, in 16 June, 26 June, 7 July and 18 July sown crops, respectively. In 2004, the rainfall was in the range of 300.0 – 406.2, 306 – 43.8, 191.6 – 384.8 and 254.0 – 401.9 mm, in 16 June, 26 June, 7 July and 18 July sown crops, respectively. Lower total rainfall received during vegetative phase in late sown crops especially 18 July in 2003 and 7 and 18 July in 2004, lowered the grain yield due to reduced tiller and dry matter production (Table 1) at the end of vegetative phase. In 2003, during vegetative phase, morning relative humidity ranges from 88 to 90 per cent compared to a range of 85 to 87 per cent during 2004. The higher morning relative humidity during vegetative phase helps plant to keep the stomata open for longer period, that may result in higher photosynthesis and more dry matter accumulation (Hsiao, 1973).

Among the varieties, significantly higher grain yield was recorded with short duration cultivars Erramallelu and Jagtiala Sannalu in 2003 and 2004, respectively (Table 1). The grain yield of Jagtiala Sannalu and Polasa Prabha was comparable with each other in both the years. Significantly lower grain yield was recorded with cultivar Varaalu.

During both the years, crop sown on 26 June recorded higher water productivity than all other sowings. In 2003, among the varieties, Erramallelu recorded higher water productivity followed by Varaalu and Jagtiala Sannalu (Table 1). In 2004, Varaalu recorded higher water productivity followed by Erramallelu and Jagtiala Sannalu. During both the years, Polasa Prabha recorded lowest water productivity.

It can be concluded that higher grain yield and water productivity can be obtained by sowing the aerobic rice on 26 June by

adopting short duration varieties under South Telangana agro-climatic zone.

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