Research note
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GROWTH AND DRY MATTER PRODUCTION ON YIELD OF RICE (*Oryza sativa* L.) VARIETIES UNDER ALTERNATE WETTING AND DRYING IN PUDDLED SOIL

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Food security in Asia is challenged by increasing food demand and threatened water availability. Geometric growth of population and arithmetic increase in food grain production leave a vast gap in food supply. In India and Telangana, rice occupies an area of 44.10 M ha and 14.15 lakh ha, respectively during 2014-2015 (DoES, 2015). As per the concepts of water foot print and virtual water to produce one kg of rice 3000-5000 liters of water is required. Being a water-intensive crop, cultivation of paddy has been a big drain on water resources. Rice is a heavy water consumer but water for rice production is becoming scarce and expensive due to the increased demand for water from the ever growing population and industries (Chowdhury *et al*. 2014). Irrigated lowland rice not only consumes more water but also causes wastage of water resulting in degradation of land. In recent years to tackle this problem, many methods of cultivation have been developed. Among the different methods of water-saving irrigation, the most widely adopted is Alternate Wetting and Drying (AWD) irrigation method (Li and Barker, 2004).

A field experiment was conducted on sandy clay soil at Agricultural College farm, Rajendranagar, Hyderabad during *kharif,* 2016 in a split plot design with three replications**.** The treatments comprised of three irrigation regimes (AWD irrigation of 5 cm when water level falls below 5 cm from soil surface in field water tube, AWD irrigation of 5 cm, at one day after disappearance of water on the surface of the soil and recommended submergence of 2-5 cm water level as per crop stage) as main plot treatments and four rice varieties (Telangana sona, Kunnaram sannalu, Bathukamma and Sheethal) as sub plots treatments. The seedlings of different rice varieties at 21days age were transplanted by adopting a spacing of 15 × 15 cm. The recommended dose of 120:60:40 N, P_2O_5 and K_2O kg ha^{-1} was applied. The experimental soil was sandy clay in texture, moderately alkaline in reaction, non-saline, low in organic carbon content, low in available nitrogen (N), medium in available phosphorous (P_2O_5) and potassium (K_2O). The data generated was statistically analysed by adopting standard methods.

Results of the experiment indicated that the plant height was not significantly influenced by irrigation regimes and interaction between varieties and irrigation. Among varieties, Sheethal recorded significantly higher mean plant height (67.1, 102.7, 122.4 and 122.8 cm) than Bathukamma (51.0, 77.5, 96.7 and 97.0 cm), Kunaram Sannalu (50.0, 80.5, 101.1 and 101.5 cm) and Telangana Sona (45.5, 72.7, 91.7 and 92.1 cm) at different growth stages of crop (30, 60, 90 DAT and harvest). However, Bathukamma and Kunaram Sannalu were at par with each other. Significantly lower plant height was recorded with Telangana Sona at different growth stages of crop (30, 60, 90 DAT and harvest) (Table 1). The variation in plant height may be due to genetically inherent character of these varieties.

Number of tillers $hill^{-1}$ at various crop growth sub-periods of rice was significantly influenced by different rice varieties and irrigation regimes except at 30 DAT (Table 2). Among the different irrigation regimes, the number of tillers $hill^{-1}$ did not differ significantly at different stages except at 90 DAT and harvest. Recommended submergence of 2-5 cm water level as per crop stage (I_3) recorded significantly higher average number of tillers $hill^{-1}$ (16.9 and 13.7) than AWDI of 5 cm irrigation when water level falls 5 cm (I_1) below in the field water tube (15.6 and 12.0) and was on par with AWDI of 5 cm one day after

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disappearance (I_2) of ponded water (16.0 and 13.0) at 90 DAT and harvest. Significantly lower average number of tillers hill^{-1} was obtained with AWDI of 5 cm submergence when water level falls 5 cm below in the field water tube (I_1) (12.0). However, AWDI of 5 cm irrigation when water level falls 5 cm below in the field water tube (I_1) and AWDI of 5 cm one day after disappearance of ponded water (I_2) were at par with each other. Lower number of tillers under delayed irrigation could be due to development of water stress in plants which resulted in reduced cellular growth and lower leaf water potential (Begg and Turner, 1976). Frequent irrigations and maintenance of 2-5 cm submergence created favourable moisture regimes enabled the crop to grow lavishly by providing conducive micro climate and increase absorption, translocation and assimilation of nutrients by the plant for various physiological process (Dass and Chandra, 2012) and in turn helped the plants to boost their growth through supply of more photosynthates towards reproductive sinks which caused to produce more number of tillers plant^{-1}. Similar results were reported by Pandey *et al*. (2010) and Kumar *et al*. (2014).

Among the varieties, Telangana Sona recorded higher average number of tillers hill^{-1} at different growth stages of crop than rest of the varieties (Table 2). At 60 DAT, average number of tillers hill^{-1} were significantly higher in Telangana Sona (12.3) than Bathukamma (11.4) and was on par with Kunaram Sannalu (12.0) and Sheethal (11.6). Telangana Sona recorded significantly higher average number of tillers hill^{-1} (17.0) than Kunaram Sannalu (15.9), Bathukamma (15.9) and Sheethal (15.9) at 90 DAT. At harvest, Telangana Sona recorded significantly higher average number of tillers hill^{-1} (13.5) than Bathukamma (12.6) and Sheethal (12.3) and was on par with Kunaram Sannalu (13.0), though number of tillers hill^{-1} of Kunaram Sannalu, Bathukamma and Sheethal were at par at 90 DAT and harvest. Significantly lower number of tillers hill^{-1} was recorded with Sheethal than rest of the varieties. The variation in number of tillers hill^{-1} among varieties was due to genetically inherent character of the varieties.

Dry matter production (kg m^{-2}) at various crop growth sub-periods of rice was significantly influenced by differed irrigation regimes except at 30 DAT (Table 3) and among the different irrigation regimes, recommended submergence of 2-5 cm water level as per crop stage (I_3) recorded significantly higher dry matter production (0.88 kg m^{-2}) than AWDI of 5 cm irrigation when water level falls 5 cm below in the field water tube (I_1) and was on par with AWDI of 5 cm one day after disappearance of ponded water (I_2). However lower dry matter production were obtained with AWDI of 5 cm submergence water level falls 5 cm below in the field water tube (I_1, 0.79 kg m^{-2}) and was on par with the AWDI of 5 cm one day after disappearance of ponded water (I_2, 0.83 kg m^{-2}) at 60 DAT. Significantly higher dry matter production (1.38 and 1.50 kg m^{-2}) registered under recommended submergence of 2-5 cm water level as per crop stage (I_3) than AWDI of 5 cm at one day after disappearance of ponded water (I_2, 1.26 and 1.35 kg m^{-2} respectively) and AWDI of 5 cm irrigation when water level falls 5 cm below in the field water tube (I_1) at 90 DAT and harvest. Significantly lower drymatter was obtained with AWDI of 5 cm submergence water level falls 5 cm below in the field water tube (I_1, 1.08 and 1.18 kg m^{-2} respectively) at 90 DAT and harvest. In the present investigation, consequence of favorable growing environment, better uptake of nutrients helped the plants to boost their growth leading to produce more tillers (Table 2) and pronounced plant height (Table1) through supply of more photosynthates towards sink lead to production of higher dry matter under AWDI of 5cm one day after disappearance of ponded water and recommended submergence of 2-5 cm water level as per crop stage compared to AWDI of 5 cm submergence depth when 5 cm drop of water level in the field tube. Similar results of increased dry matter under AWDI of 5cm at one day after disappearance of ponded water and recommended submergence of 2-5 cm water level as per crop stage were reported Kumar *et al.*(2014) and Chowdhury *et al.* (2014).

Among the varieties, Bathukamma (0.26, 0.85 and 1.30 kg m^{-2} respectively), Kunaram Sannalu (0.26, 0.87 and 1.25 kg m^{-2} respectively) and Sheethal (0.28, 0.84 and 1.23 kg m^{-2} respectively) recorded on par dry matter production at 30, 60 and 90 DAT, and were significantly higher dry matter production than Telangana Sona. At 30 DAT Sheethal recorded significantly higher dry matter than Telangana Sona, though on par with other two varieties of Bathukamma and Kunaram Sannalu. Bathukamma recorded

significantly higher dry matter at 90 DAT than Telangana Sona and was on par with Kunaram Sannalu. At harvest, Bathukamma recorded significantly higher dry matter production (1.42 kg m^{-2}) than rest of the varieties *viz*., Kunaram Sannalu (1.35 kg m^{-2}), Sheethal (1.32 kg m^{-2}) and Telangana Sona (1.27 kg m^{-2}). Lower dry matter production was recorded with Telangana Sona at 30,60,90 DAT and harvest than other varieties and was significantly lower than all other varieties at 60 DAT, than Bathukamma at 90 DAT and harvest though on par with the same at 30 DAT. Telangana Sona was on par in dry matter production with Kunaram Sannalu at 30 DAT and 90 DAT and with Sheethal at 90 DAT and harvest. Variation in dry matter production among varieties and lower dry weight of Telangana Sona might be due to genetically inherent character of the varieties.

Based on the research results, it can be concluded that recommended submergence of 2-5 cm water level as per crop stage recorded higher dry matter, tillers $hill^{-1}$ followed by one day disappearance of ponded water. Among varieties sheethal recorded higher plant height, Telangana Sona was with higher tillers $hill^{-1}$ and Bathukamma produced higher dry matter production, grain yield and straw yield compared to Kunaram Sannalu, Sheethal and Telangana Sona.

Table 1. Plant height (cm) of rice varieties at different growth intervals as influenced by different irrigation regimes.

Treatment	30 DAT	60 DAT	90 DAT	At harvest
Main plot- (Irrigation regimes)				
I_1: AWDI of 5 cm, when water level falls below 5 cm from soil surface in perforated pipe	53.5	81.9	102.3	102.5
I_2: AWDI of 5 cm, one day after disappearance of ponded water on the surface of the soil	52.4	81.9	102.8	103.2
I_3: Recommended submergence of 2-5 cm water level as per crop stage.	54.3	86.4	103.9	104.4
SEm±	0.6	1.2	0.7	0.7
C.D (P=0.05)	NS	NS	NS	NS
Sub plot- (Varieties)				
V_1 – RNR 15048 (Telangana sona)	45.5	72.7	91.7	92.1
V_2– KNM 118 (Kunaram sannalu)	50.0	80.5	101.1	101.5
V_3– JGL 18047 (Bathukamma)	51.0	77.5	96.7	97.0
V_4– WGL 283 (Sheethal)	67.1	102.7	122.4	122.8
SEm±	1.1	1.4	0.7	0.7
C.D (P=0.05)	3.3	4.1	2.1	2.1
Interaction				
Rice varieties at same level of Irrigation regimes				
SEm±	1.9	2.4	1.2	1.2
C.D (P=0.05)	NS	NS	NS	NS
Irrigation regimes at same or different rice varieties				
SEm±	1.8	2.4	1.3	1.2
C.D (P=0.05)	NS	NS	NS	NS

DAT: Days After Transplanting, AWDI: Alternate Wetting and Drying Irrigation NS: Non Significant

Table 2. Number of tillers hill^{-1} of rice varieties at different growth intervals as influenced by different irrigation regimes

Treatment	30 DAT	60 DAT	90 DAT	At harvest
Main plot - (Irrigation regimes)				
I_1: AWDI of 5 cm, when water level falls below 5 cm from soil surface in perforated pipe.	6.3	11.6	15.6	12.0
I_2: AWDI of 5 cm, one day after disappearance of ponded water on the surface of the soil.	6.4	11.9	16.0	13.0
I_3: Recommended submergence of 2-5 cm water level as per crop stage.	6.3	11.9	16.9	13.7
SEm±	0.2	0.2	0.2	0.3
C.D (P=0.05)	NS	NS	1.0	1.2
Sub plot - (Varieties)				
V_1 – RNR 15048 (Telangana sona)	6.6	12.3	17.0	13.5
V_2– KNM 118 (Kunaram sannalu)	6.4	12.0	15.9	13.0
V_3– JGL 18047 (Bathukamma)	6.2	11.4	15.9	12.6
V_4– WGL 283 (Sheethal)	6.2	11.6	15.9	12.3
SEm±	0.3	0.2	0.3	0.2
C.D (P=0.05)	NS	0.7	0.8	0.7
Interaction				
Rice varieties at same level of Irrigation regimes				
SEm±	0.6	0.4	0.5	0.4
C.D (P=0.05)	NS	NS	NS	NS
Irrigation regimes at same or different rice varieties				
SEm±	0.6	0.4	0.5	0.4
C.D (P=0.05)	NS	NS	NS	NS

DAT: Days After Transplanting, AWDI: Alternate Wetting and Drying Irrigation NS: Non Significant

Table 3. Dry matter accumulation of rice varieties (kg m^{-2}) at different growth intervals as influenced by different irrigation regimes.

Treatment	30 DAT	60 DAT	90 DAT	At harvest
Main plot - (Irrigation regimes)				
I_1: AWDI of 5 cm, when water level falls below 5 cm from soil surface in perforated pipe.	0.25	0.79	1.08	1.18
I_2: AWDI of 5 cm, one day after disappearance of ponded water on the surface of the soil.	0.26	0.83	1.26	1.35
I_3: Recommended submergence of 2-5 cm water level as per crop stage.	0.27	0.88	1.38	1.50
SEm±	0.01	0.01	0.03	0.02
C.D (P=0.05)	NS	0.06	0.11	0.09

Treatment	30 DAT	60 DAT	90 DAT	At harvest
Sub plot- (Varieties)				
V_1 – RNR 15048 (Telangana sona)	0.23	0.78	1.17	1.27
V_2– KNM 118 (Kunaram sannalu)	0.26	0.87	1.25	1.35
V_3– JGL 18047 (Bathukamma)	0.26	0.85	1.30	1.42
V_4– WGL 283 (Sheethal)	0.28	0.84	1.23	1.32
SEm±	0.01	0.02	0.03	0.02
C.D (P=0.05)	0.03	0.05	0.08	0.05
Interaction				
Rice varieties at same level of Irrigation regimes				
SEm±	0.02	0.03	0.05	0.03
C.D (P=0.05)	NS	NS	NS	NS
Irrigation regimes at same or different rice varieties				
SEm±	0.02	0.03	0.05	0.03
C.D (P=0.05)	NS	NS	NS	NS

DAT: Days After Transplanting, AWDI: Alternate Wetting and Drying Irrigation NS: Non Significant

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