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Effect of Different Weather Parameters on the Growth and Yield Attributes and Yield of Rice *(Oryza sativa* L.*)*

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A field experiment was conducted during *Kharif* season of 2016-17 to study the effect of weather parameters on the growth, yield attributes and yield of rice. The rice crop sown on 23rd Meteorological Week (MW) recorded significantly higher grain yield (5.83 t ha^{-1}) and straw yield (6.99 t ha^{-1}) over delayed sowing on 24th MW and 25th MW. Hybrid rice Sahyadri-4 recorded the maximum grain yield (5.79 t ha^{-1}) as well as straw yield (6.94 t ha^{-1}) which was at par with Jaya, Swarna, Karjat-3, Karjat-7, Karjat-5, Palghar-1 and significantly higher over Ratnagiri-24 and Karjat-2. Under the changing climatic conditions, sowing of rice was found suitable during 23rd meteorological week with early duration variety Sahyadri-4 followed by conventional variety Jaya and Swarna.

*(**Key word:** Weather parameters, Varieties and Rice)*

Rice (*Oryza sativa* L.) is one of the most important staple food grain crops of the world, which constitute the principal food for 60 per cent of the world's population and 2/3rd of Indian population. India is the world's second largest rice producer and consumer next to China. Total area under rice in India is 45.05 million hectares with annual production of 103.27 million tonnes, how ever the per hectare yield is very low *i.e.*, 2.29 t ha^{-1}, as compared to other rice growing countries like Egypt (6.45 t ha^{-1}), USA (5.63 t ha^{-1}), Japan (4.73 t ha^{-1}) and China (4.74 t ha^{-1}) (Wailes and Chavez, 2012). In Maharashtra, rice is cultivated over an area of 15.13 lakh hectares with an annual production of about 28.43 lakh tonnes and a productivity of 1.88 t ha^{-1} (Anonymous, 2013). However, variations in rice productivity are governed by seasonal and spatial differences in climatic factors and their degree of influence on a particular phenophase of rice crop. The yields are highly variable due to aberrations in weather like late onset of monsoon, heavy continuous rains, intermittent dry spells and heavy rains at the time of harvesting, etc. Time of sowing is one of the most important factors influencing crop yield. Performance of a genotype entirely depends upon the time of planting. Delay in planting generally result in yield reduction which cannot be compensated by any other means. Studies on the effect of seeding date on rice grain yields have been sporadically conducted since very past. Despite numerous studies on rice seeding dates conducted in India, the rate of yield loss from delayed seeding has never been quantified. Specific information on the rate of yield decline of modern rice cultivars to seeding date in rice producing areas of *Konkan* region is needed to assist rice producers in making crop management decisions.

Thus, environmental conditions, as influenced by seeding date, may have a greater relative effect on rice grain yields. Delay in sowing results in reduction of plant height, productive tillers, filled grain panicle^{-1} and grain yield (Shah and Bhurer, 2005). Therefore, it is necessary to know the optimum sowing time, which is a critical aspect for rice cultivation in *Konkan*, as intensive and continuous rain occurs after regular onset of monsoon. In *Konkan* many promising, high yielding and widely cultivated varieties have been evolved by Dr. B.S.K.K.V., Dapoli through Agriculture Research Station, Karjat, Ratnagiri and Palghar. It is therefore, highly essential to study the response of popular varieties among the farmers to different climatic situations with respect to sowing times. With the above background an attempt has been made to investigate the "effect of weather parameters on the growth yield and yield attributes of rice" under agro-climatic conditions of *Konkan*.

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MATERIALS AND METHODS

A field experiment was conducted during *Kharif* season 2015-16 at Department of Agronomy Farm, College on Agriculture, Dapoli, Ratnagiri, to study the response of rice varieties to different sowing windows under *Konkan* conditions. The experiment was laid out in split plot design with three replications. The main plot treatments were three sowing windows, *viz*., 23rd Met Week (S_1), 24th Met Week (S_2), 25th Met Week (S_3). The sub plot treatments comprised nine rice varieties *viz*., Karjat-5 (V_1), Karjat-7 (V_2), Ratnagiri-24 (V_3), Karjat-2 (V_4), Palghar-1 (V_5), Karjat-3 (V_6), Swarna (V_7), Sahyadri-4 (V_8) and Jaya (V_9). Thus there were 81 treatment combinations. Twentyone days old nursery seedlings were was transplanted by following a spacing of 20 cm x 15 cm. At the time of transplanting 40% N and full doses of P and K were applied, 40% N was applied at maximum tillering (30 DAT) and remaining 20% N at panicle initiation stage (65 DAT). Other cultural practices and plant protection measures were followed as per the recommended package of practices.

RESULTS AND DISCUSSIONS

Data regarding the number of tillers per hill, no. of panicle per hill, length of panicle (cm), grain weight per panicle (g), test weight (1000 grain weight) (g), grain and straw yield (t ha^{-1}) of rice at harvest as influenced by different sowing times and varieties are presented in Table 1.

Effect of sowing time

Crop sown on 23rd Met Week recorded significantly more number of tillers per hill over the crop sown on 24th Met Week and 25th Met week. This may be due to availability of favourable soil and air temperature during growing cycle of the crop. Similar findings were also reported by Jagtap *et al*. (2016), Sharma *et al*. (2011) and Barun (2008). The crop sown on 23rd Met Week recorded significantly higher number of panicles per hill over the crop sown on 24th Met Week and 25th Met

Table 1. *Number of tillers $hill^{-1}$, no. of panicles $hill^{-1}$, length of panicle (cm), grain weight $panicle^{-1}$ (g), test weight [1000 grain weight (g)], grain and straw yield (t ha^{-1}) of rice as influenced by different sowing times and varieties*

Treatments	No. of tillers $hill^{-1}$	No. of panicles $hill^{-1}$	Length of Panicle (cm)	Grain weight $panicle^{-1}$ (g)	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Sowing Times							
S_1- 23rd Met. week	8.69	8.07	22.85	2.69	24.88	5.83	6.99
S_2- 24th Met. week	8.04	7.64	21.95	2.38	23.62	5.15	6.18
S_3- 25th Met. week	7.43	7.16	21.28	2.07	22.25	4.53	5.44
SE ±	0.15	0.14	0.15	0.04	0.35	0.14	0.17
CD at 5%	0.59	0.55	0.59	0.17	1.38	0.55	0.66
Varieties							
V_1 - Karjat-5	8.38	7.96	21.00	2.33	28.10	5.12	6.14
V_2 - Karjat-7	8.62	8.18	22.20	2.23	25.08	5.24	6.29
V_3 -Ratnagiri-24	6.64	6.82	21.31	2.17	19.61	4.98	5.97
V_4 - Karjat-2	9.11	8.42	21.16	1.91	21.86	4.26	5.11
V_5- Palghar-1	6.59	5.78	22.76	2.52	19.94	5.11	6.13
V_6 - Karjat-3	7.27	7.27	22.03	2.39	24.25	5.27	6.32
V_7 - Swarna	9.87	8.89	20.65	2.46	20.20	5.32	6.38
V_8 - Sahyadri-4	8.27	7.82	24.75	2.79	26.23	5.79	6.94
V_9 - Jaya	7.73	7.51	22.34	2.62	26.96	5.44	6.53
SE ±	0.30	0.29	0.35	0.10	0.43	0.27	0.33
CD at 5%	0.85	0.84	0.99	0.30	1.23	0.78	0.93
Interaction							
SE ±	0.51	0.51	0.60	0.18	0.75	0.47	0.57
CD at 5%	NS	NS	NS	NS	NS	NS	NS

Week. The crop sown on 23rd Met Week recorded the maximum panicle length (22.85 cm) which was significantly higher over all other sowing dates. The crop sown on 23rd Met Week recorded the maximum grain weight per panicle (2.69 g) which was significantly higher over all other sowing dates. The rice crop sown on 23rd Met Week recorded significantly more 1000 grain weight (24.88 g) over the delayed sown rice crop on 24th and 25th Met Week. This revealed that the environmental conditions like temperature, humidity were most favorable for grain development in early transplanting as compared to delayed transplanting. Same results have been reported by Jagtap *et al*. (2016) and Akbar *et al*. (2010).

Data presented in Table 1 revealed that, the rice crop sown on 23rd Met Week recorded significantly higher grain yield (5.83 t ha^{-1}) and straw yield (6.99 t ha^{-1}) over delayed sowing on 24th Met Week and 25th Met Week. The higher yield for early transplanting was mainly due to favorable climatic conditions especially at the time of tillering, flowering and grain filling. Crop transplanted beyond mid-June were exposed to low minimum and maximum temperature (12.5°C and 23.6°C, respectively) at flowering stage (from last week of August to first week of September), whereas early transplanted crops had already flowered when temperature were favorable for fertilization. Table 1 indicated that with delay in transplanting of rice, there was significant decrease in grain yield of rice. Similar results were reported by Jagtap *et al*. (2016), Mahajan *et al*. (2009) and Dhaliwal *et al*. (2006).

Effect of varieties

Rice variety Swarna recorded significantly maximum number of tillers per hill (9.87) over rest of rice varieties except Karjat-2 which was at par to Swarna. It is seen from the data presented in Table 1, that significantly maximum number of panicles was recorded by long duration variety Swarna over rest of the rice varieties except Karjat-2 and Karjat-7, which was at par with Swarna and minimum number of panicles was recorded by Ratnagiri-24 and Palghar-1 due to low number of tillers in these varieties. The panicle length was significantly varied among the different rice varieties. The rice variety Sahyadri-4 recorded significantly higher panicle length over rest of rice varieties, which was followed by medium duration variety Palghar-1 and Jaya. The rice variety Sahyadri-4 recorded significantly more grain weight $panicle^{-1}$ (2.79 g) over all the varieties except Palghar-1 (2.52 g) and Jaya (2.62 g) which was on par with each other. The hybrid rice variety Karjat-5, recorded significantly higher 1000 grain weight over all other rice varieties except variety Jaya, which was at par with Karjat-5. The results are in the conformity with the work done by Jagtap *et al*. (2016), Mahajan *et al*. (2009) and Padhi (1995). Short duration hybrid rice variety Sahyadri-4 recorded the maximum grain yield (5.79 t ha^{-1}) as well as straw yield (6.94 t ha^{-1}) which was at par with Jaya, Swarna, Karjat-3, Karjat-7, Karjat-5, Palghar-1 and significantly higher over Ratnagiri-24 and Karjat-2 varieties under study. Similar findings were also reported by Jagtap *et al*. (2016), Manjunath *et al*. (2012) and Reddy *et al*. (2012).

Table 2. *Correlation between growth and yield attributes and yield of rice with weather parameters at harvest*

Parameters	Dry matter	Height	No. of leaves	Tillers	No. of panicles	Length of panicle	Grain wt per panicle	Test weight	Grain yield
Tmax	0.46*	0.23	0.57**	0.47*	0.47*	-0.20	0.13	0.17	0.08
Tmin	0.00	0.06	-0.03	0.00	-0.03	0.39*	0.21	-0.11	0.33
RH-I	-0.65**	-0.51**	-0.63**	-0.48**	-0.48**	-0.08	-0.41*	-0.20	-0.43**
RH-II	-0.42*	-0.21	-0.44*	-0.35	-0.32	0.20	-0.13	-0.23	-0.03
Wind speed	-0.28	0.03	-0.47*	-0.39*	-0.33	0.38*	0.06	-0.08	0.18
Rainfall	0.69**	0.24	0.63**	0.57**	0.41*	0.16	0.45*	0.33	0.40*
Rainy Day	0.76**	0.37	0.67**	0.56**	0.41*	0.19	0.54**	0.30	0.51**
BSS	0.39*	0.10	0.52**	0.44*	0.40*	-0.29	0.04	0.15	-0.06
Epan	0.54**	0.21	0.63**	0.53**	0.46*	-0.17	0.20	0.21	0.12

** at 1% level of significance *at 5 % level of significance

Tmax: Maximum temperature, Tmin: Minimum Temperature, RH-I: Morning relative humidity, RH-II: Afternoon relative humidity, BSS: Bright sunshine hours, Epan: Pan evaporation.

Correlation with weather parameters

The correlation data with respect to biometric, yield attributes and yield with meteorological parameters are presented in Table 2. At harvest dry matter, tillers, number of panicles was positively correlated with maximum temperature and bright sunshine hours. Significantly positive correlation of rainfall and rainy day was found with dry matter, number of leaves, tillers, no. of panicles, grain weight and grain yield. While relative humidity had significantly negative, correlation with dry matter, height, no. of leaves, tillers, no. of panicles, grain weight per panicle and grain yield. The study revealed that there was significant impact of different weather parameters on growth and yield attributes and on yield of rice.

Under the changing climatic conditions sowing of rice was found suitable during 23rd meteorological week with early duration variety Sahyadri-4 followed by conventional variety Jaya and Swarna.

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