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Effect of Sowing Times on the Yield and Yield Attributes of Rice (*Oryza sativa* L.) Varieties

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A field experiment was conducted during *Kharif* season of 2015-16 to study the effect of sowing times on the growth and yield of different rice varieties. The experiment was laid out in split plot design with three replications. The main plot treatments were three sowing times, viz., 23rd meteorological week, 24th meteorological week and 25th meteorological week. The sub-plot treatments comprised nine rice varieties viz., Karjat-5, Karjat-7, Ratnagiri-24, Karjat-2, Palghar-1, Karjat-3, Swarna, Sahyadri-4 and Jaya. Thus there were 27 treatment combinations. From the present investigation it is concluded that *Kharif* rice in *Konkan* can be sown during 23rd meteorological week with hybrid Sahyadri-4 followed by conventional variety Jaya and Swarna, so as to obtain higher yield and economic returns.

(***Key words:*** *Sowing times, Varieties and Rice*)

Rice (*Oryza sativa* L.) is one of the most important staple food grain crops of the world, which constitute the principle 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, though production is large, the per hectare yield is very poor i.e. 2.29 tonnes ha^{-1}, as compared to other rice growing countries like Egypt (6.45 t ha^{-1}), USA (5.63 tonnes ha^{-1}), Japan (4.73 tonnes ha^{-1}) and China (4.74 tonnes ha^{-1}) (Wailes and Chavez, 2012). In Maharashtra, rice is cultivated over an area of 15.13 lakh hectares and an annual production of about 28.43 lakh tonnes with a productivity of 1879 kg 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. But the yields are highly variable due to aberration in weather like late onset of monsoon, heavy continuous rains, intermittent dry spell and heavy rains at the time of harvesting, etc. Time of sowing is the most important factors influencing the 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 investigating the effect of seedling date on rice grain yields have been sporadically conducted since very past. Despite numerous studies on rice seedling dates conducted in India, the rate of yield loss from delayed seedling has never been quantified. Specific information on the rate of yield decline of modern rice cultivars to seedling date in rice producing areas of *Konkan* region is needed to assist rice producers in making crop management decisions.

Rice yields are closer to reaching their genetic yield potential due to improved management and pest control. Thus, environmental conditions, as influenced by seedling date, may have a greater relative effect on rice grain yields. In context to this genetic advance, optimum sowing time is even more relevant and non-monetary input, since varieties are comparatively more sowing time responsive. Sowing of rice during the optimum period of time resulted in high grain yield. However, optimum rice planting dates are region specific and vary with the location and varieties. 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

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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 in view, an attempt has been made to investigate the "Effect of sowing time on the yield and yield attributes of different rice varieties" under agro climatic conditions of *Konkan*.

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 (S1), 24th Met Week (S2), 25th Met Week (S3). 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. 21 days of old nursery seedling was transplanted by following a spacing of 20 cm x 15 cm. In RDF, 40% N and full dose of P and K were applied at the time of transplanting. Remaining 40% N was applied at maximum tillering (30 DAT) and 20% at panicle initiation stage (65 DAT) as per treatments. 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 (Kg ha^{-1}) of rice at harvest as influenced by different sowing times and varieties are presented in Table 1.

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 (kg 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	9.11	8.54	24.69	2.38	24.53	5.66	6.79
S_2- 24th Met. week	7.96	7.69	23.71	2.31	23.16	4.95	5.45
S_3- 25th Met. week	7.28	6.95	23.09	2.10	22.27	4.44	4.66
SE ±	0.34	0.21	0.27	0.05	0.13	0.13	0.14
CD at 5%	1.35	0.82	1.07	0.20	0.51	0.52	0.56
Varieties							
V_1- Karjat-5	8.38	7.99	21.65	2.55	27.78	4.50	5.06
V_2- Karjat-7	8.63	8.26	24.33	1.94	25.41	5.10	5.72
V_3-Ratnagiri-24	6.78	6.55	24.48	2.10	17.59	4.17	4.69
V_4- Karjat-2	8.96	8.59	22.05	1.97	22.83	4.82	5.41
V_5- Palghar-1	6.86	6.49	25.62	2.27	19.58	4.75	5.35
V_6- Karjat-3	7.57	7.26	22.25	1.87	23.06	4.44	5.01
V_7- Swarna	9.83	9.46	22.58	2.33	21.77	5.78	6.46
V_8- Sahyadri-4	8.16	7.37	26.94	2.74	24.23	6.13	6.86
V_9- Jaya	7.89	7.53	24.55	2.67	27.61	5.51	6.17
SE ±	0.53	0.42	0.43	0.16	0.31	0.17	0.18
CD at 5%	1.51	1.20	1.23	0.44	0.87	0.48	0.53
Interaction							
SE ±	0.92	0.73	0.75	0.27	0.53	0.29	0.32
CD at 5%	NS	NS	NS	NS	NS	NS	NS

Effect of Sowing times

At harvest stage, crop sown on 23rd met week recorded significantly more number of tillers hill^{-1} over the crop sown on 25th met week, However, this was statistically at par to crop sown on 24th met week. This may be due to availability of favourable soil and air temperature during growing cycle of the crop. Similarly these findings were supported by Sharma *et al*. (2011) and Barun (2008). The crop sown on 23rd met week recorded significantly higher number of panicles hill^{-1} over the crop sown on 24th met week and 25th met week. The crop sown on 23rd met week recorded the maximum length panicle^{-1} (24.69 cm) which was significantly higher over the crop sown on 25th met week, however this was statistically at par to crop sown on 24th met week. The rice sown during 23rd Met Week and 24th met week were at par with each other in case of grain weight panicle^{-1} and both of these sowing times recorded significantly higher over sowing on 25th met week. The rice crop sown on 23rd met week recorded significantly more 1000 grain weight (24.53 g) over the delayed sown rice crop on 24th and 25th met week. This show that the environmental condition likes temperature, humidity are most favorable for grain development in early transplanting as compared to delay transplanting (Akbar *et al*., 2010). Data presented in Table 1 revealed that, the rice crop sown on 23rd met week recorded significantly higher grain yield (5.66 t ha^{-1}) and straw yield (6.79 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^{o}C and 23.6^{o}C, respectively) at flowering stage (from last week of August to first week of September), whereas early transplanted crops were flowered when temperature were favorable for fertilization. Table 2 indicated that with each delay in transplanting of rice, there was significant decrease in grain yield of rice during the crop seasons. Similar results were reported by Dhaliwal *et al.* (2006) and Mahajan *et al.* (2009).

Effect of Varieties

At harvest stage, rice variety Swarna recorded maximum number of tillers per hill (9.83) over all other rice varieties except Karjat-5, Karjat-2 and Karjat-7 which were on par with Swarna. It is seen from the data presented in Table 1, 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 panicle was recorded by Ratnagiri-24 and Palghar-1 due to low number of tillers in this variety. The length of panicle was significantly influenced by the different rice varieties. The rice variety Sahyadri-4 recorded significantly more panicle length over rest of rice varieties, which was followed by medium duration variety Palghar-1 and Jaya. The different panicle lengths were observed due to different genotype of the varieties. The rice variety Sahyadri-4 recorded significantly more grain weight panicle^{-1} over all the varieties except Karjat-5, Swarna and Jaya, which was on par with it. The hybrid rice variety Karjat-5, recorded significantly higher test weight (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 Padhi (1995) and Mahajan *et al*. (2009). Short duration hybrid rice variety Sahyadri-4 recorded the maximum grain yield (6130 kg ha^{-1}) as well as straw yield (6857 kg ha^{-1}), which was at par with Swarna and significantly higher over all other varieties in case of grain and straw yield under study. Similar findings were reported by Manjunath *et al*. (2012) and Reddy *et al*. (2012). Under abiotic stress situation like flooding, tolerant varieties responded better to improved management practices like balanced fertilizer dose with organic manure, optimum number of seedling and spacing (Sarangi *et al.*, 2016).

From the present investigation it can be concluded that *Kharif* rice in *Konkan* can be sown during 23rd meteorological week with hybrid Sahyadri-4 followed by conventional variety Jaya and Swarna, so as to obtain higher yield and economic returns.

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