International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(4): 892-897

Received: 03-05-2017
Accepted: 04-06-2017

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Weather in relation to yield of different rice (*Oryza Sativa* L.) varieties under *konkan* agro: climatic condition of maharashtra

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Abstract
A field experiment was conducted at Department of Agronomy, College of Agriculture, Dr. B.S. Konkan Krishi Vidyapeeth (Agricultural University), Dapoli, Maharashtra, India during rainy season of 2013 and 2014 to examine effect of weather on yield of different rice varieties under *Konkan* climatic condition of Maharashtra state. The experiment was laid out in split plot design with three main plot treatments consisting sowing times and nine sub plot treatments having varieties. Results in the pooled data revealed that the rice crop sown during 23rd meteorological week recorded significantly higher grain and straw yield over all other sowing times *viz*., 24th and 25th meteorological week in descending order respectively. The mean agroclimatic indices *viz*., growing degree days and hydrothermal units were numerically higher due to sowing during 23rd meteorological week in all the physiological stages as well as in the total duration of the crop as compared to remaining delayed sowings. Whereas, the numerical higher heliothermal unit was recorded in sowing during 25th meteorological week in all the physiological stages as well as in the total duration of the crop. While in case of varieties, the short duration hybrid Sahydri-4 recorded significantly the highest grain yield over rest of the varieties followed by the medium duration Jaya. However, significantly the highest straw yield was recorded by tall medium duration Karjat-5 as compared to rest of the varieties followed by short duration hybrid Sahydri-4 and medium duration variety Jaya. The correlation studies between agroclimatic indices and yield of different varieties revealed that growing degree days showed significantly positive correlation with grain yield of all the varieties studied. While, hydrothermal units showed significantly positive correlation with the grain yield of short duration varieties and the heliothermal units with that of long duration varieties.

Keywords: Sowing times, rice varieties, GDD, Hydrothermal unit and heliothermal unit

Introduction
Rice based agriculture is the largest source of livelihood of majority of rural mass in *Konkan*, which lies along the Arabian seacoast at the extreme western part of the Indian peninsula. The rice crop is adopted to a greater range of climatic conditions, As such, cultivated lands ranges from coastal lowlands, floodplains and deltas to forested hills and mountains. Among the wet season crops in *Konkan*, rice alone occupies an area about 3.83 lakh hectares with production of 10.59 lakh tonnes and per hectare yield of 2.76 tonnes [1]. 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. In *Konkan* region of Maharashtra about 80 per cent of rice crop is a low land, spreading over a 40-60 km in width and stretching to a length of 700 km all along the west-coast. 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.
World food security is a major issue with ever increasing population. The situation is worsened by variability in climate that has become predominant in recent years. Among the natural conditions, climatic factors have a profound influence on crop productivity. Since yield is the overall result of growth, the relationship between environmental factors and rice yield is very complex. Prediction of phenophases helps in farm operations like fertilizer application, irrigation management and harvesting etc. in recent years predicting crop development under field condition has gained importance [2]. Duration of phenophases in rice shows a wide range of diversity, depending on the genotype and environment and has significant effect on seed yield.

Changes in ambient temperature during both the vegetative and reproductive phase affect the onset and duration of phonological development can be inferred by way of plants have definite temperature requirement before they attain certain phonological stage [3]. The optimum temperature for a given phenophase is of paramount importance in relation to favourable growth of the crop. Continuous cloudy weather, low sunshine hours, intermittent dry spells, high humidity, heavy and continuous rains are the climatic features of *Konkan* region of Maharashtra. The rice varieties having higher photosynthetic efficiency under low diffused light during growth phases can give the potential yield under agro climatic situation of *Konkan*. With the above background in view, an attempt has been made to investigate such experiment.

2. Materials and Methods

A field experiment was conducted at Department of Agronomy, College of Agriculture, Dr. B.S. Konkan Krishi Vidyapeeth (Agricultural University), Dapoli, Maharashtra, India during rainy season of 2013 and 2014. The climate is sub-tropical which is characterized by warm and humid atmosphere. The experiment was conducted in lateritic soil of *Konkan* and laid in split plot design with three main plot treatments consisting sowing times and nine sub plot treatments having varieties. Rice were sown at different sowing time as per treatments and transplanted after 21` DAS `of respective sowing time, Weather data during the crop growing season were collected from meteorological laboratory, AICRPM, Dapoli, located 50 m away from experimental field.

The agroclimatic indices, namely, growing degree days, heliothermal units and hydrothermal units were worked out as follows.

$$\text{Growing Degree Day} = \frac{T_{max} + T_{min}\ min}{2} - T_{base}$$

Where,

T_{max} = Daily maximum temperature (oC)

T_{min} = Daily minimum temperature (oC)

T_{base} = Base temperature of 10oC

The hydrothermal unit for a given day represents the product of GDD and average relative humidity percent. As an equation:

Hydrothermal unit = GDD × N

Where,

GDD = Growing degree days.

N = Daily average relative humidity.

The heliothermal unit for a given day represents the product of GDD and the actual bright sunshine hours. As an equation:

Heliothermal unit = GDD × n

Where,

GDD = Growing degree days

N = Actual sunshine hour.

3. Result and Discussion

3.1 Weather effect

Weather is the most important factor governing the performance of any crop. The weather parameters during *Kharif* season of 2013 and 2014 (Table 1) were critically studied. The different weather parameters namely maximum and minimum temperature, relative humidity, rainfall, number of rainy days and sunshine hours showed distinct variation during the individual years. Among these, maximum temperature, minimum temperature as well as sunshine hours were at higher side during *Kharif* season of 2014 than 2013, however, regarding the relative humidity, rainfall and number of rainy days, it were higher in the year of 2013 than 2014. (Fig. 1)

Weather data clearly showed that comparatively much higher sunshine hours were recorded during 2014 than 2013. This might have resulted in the optimum growth of crop during 2014 and resulted into production of more sink. Whereas in the year of 2013 comparatively less shine hours exhibited more competition for sunshine and resulted in more vegetative growth *viz*., more plant height, leaves, tillers and dry matter as compared to 2014. On the other hand, crop experienced more rainfall and more number of rainy days in the most of crop growing period of rice during the year of 2013 as compared to 2014. Predominantly more rainfall during the flowering and maturity stage of most of the varieties were experienced in the year of 2013, which resulted the washing out of pollens and subsequently poor grain filling (more number of chaffy grains) in most of the varieties. Similarly [4], reported panicles have a large number of blank florets under condition of very high rainfall. Whereas in the year of 2014, comparatively even distribution and comparatively less rainfall during the flowering and maturity stage was experienced. This is the reason behind the yield of rice was higher during 2014, although the more growth was associated in the year of 2013. Similar results was reported by [5].

3.2 Effect of sowing time

The mean agroclimatic indices during different physiological stages of rice were presented in the Table 2. The sowing during 23rd meteorological week accumulated maximum growing degree days and hydrothermal units in most of the growth stages of rice as well as in the total duration of the crop. While, the values of these agroclimatic indices were decreased gradually with delay in each week sowing i.e. during 24th and 25th meteorological week sowing in descending order. This is largely due to longer duration of the flowering and grain filling stage and maturity stage for early-sown crop *i.e.* during 23rd meteorological week. The reduction in duration of flowering and grain filling stage and maturity stage for late sown conditions i.e. during 24th and 25th meteorological week occurred in descending trend because of increased temperatures in delayed sowing coincides with grain development and resulting in enforced maturity in such sowings as compared to early sowing [6]. Revealed that number of days required for completion of flowering and maturity decreased with delayed planting and accumulated growing degree days also decreased with delayed sowings.

Whereas the maximum heliothermal unit were accumulated by late sowing of 25th meteorological week and gained decreased value with comparatively early sowings of. 23rd and 24th meteorological week in descending order in most of the physiological stages as well as in the total duration of the crop [7]. Inferred from data that higher growing degree days, higher hydrothermal units and lower heliothermal units are optimum weather conditions for obtaining high rice yield.

Data shown in Table 3 revealed that the sowing during 23rd meteorological week recorded significantly higher grain yield ha^{-1} as compared to 25th meteorological week and found

statistically at par with sowing during 24th meteorological week sowing during both the years of study. Whereas in pooled data, sowing during 23rd meteorological week recorded significantly more grain yield over rest of the sowing times. The mean increase in grain yield due to sowing during 23rd meteorological week over sowing during 24th and 25th meteorological week was to the tune of 7.65 and 21.98 per cent respectively. The increased yield contributes might be due to result of optimum growth and development parameters associated with 23rd meteorological week, which associated with favourable weather condition due to more accumulation of agroclimatic indices. Similar results was reported by [8].

However, higher straw yield was recorded by the sowing during 23rd meteorological week and was at par with the 24th meteorological week sowing but found to be significantly superior over the 25th meteorological week sowing during both the years of study. Whereas in the pooled data, the sowing during 23rd meteorological week proved its significant superiority over remaining sowing times in terms of straw yield ha^{-1}. Magnitude of increase in mean straw yield under the 23rd meteorological week sowing over 24th and 25th meteorological week sowing was to the tune of 5.67 and 16.72 per cent, respectively. This might be due to increased morphological characters observed in the 23rd meteorological week sowing. Similar findings were also reported by [9].

The foregone discussion suggests that second year environmental condition was much better for grain production than first year which was good for vegetative growth. Delay in sowing significantly reduced the grain and straw yield but it was more pronounced in second year. The production of above ground biomass a straw yield was more in first year and grain yield in second year. Maximum straw yield (54.24 q ha^{-1}) was obtained during first year where as highest grain yield (48.42 q ha^{-1}) was recorded in second year at early date of seeding. Similar results were reported by [5].

3.3 Effect of varieties

Agroclimatic indices gained by the different varieties between all the phenological stages were variable (Table 2). Longer duration genotype Swarna and Karjat-2 experienced more growing degree days, hydrothermal units and heliothermal units between all phenological stages as well as in the total duration of the crop than rest of the medium and short duration varieties. This is largely due to longer duration of Swarna (136-142 days) and Karjat-2 (132-138 days). Whereas the lowest agroclimatic indices were recorded with the shorter duration variety Ratnagiri-24 (103-109 days) during all the phenological stages as well as in the total duration of the crop. Similar findings was also reported by [5].

Short duration hybrid Sahyari-4 was remunerative and produced significantly the highest grain yield than rest of the varieties and followed by medium duration Jaya within level of significance (Table 3). The hybrid Sahydari-4 significantly outyielded all the varieties during both the years and in the pooled mean and produced the grain yield of 52.55, 56.72 and 54.64 q ha^{-1} respectively, which was higher than the other tested varieties. The mean increase in the grain yield of the short duration hybrid Sahyadri-4 over medium duration Jaya, short duration Karjat-7, long duration Swarna and Karjat-2, short duration Karjat-3, medium duration Palghar-1 and Karjat-5 and short duration Ratnagiri-24 was to the tune of 3.00, 11.92, 13.31, 14.55, 19.67, 23.87, 30.13 and 43.15 per cent, respectively. Hybrid Sahyadri-4 and conventional variety Jaya performed better due to more conversion of photosynthates into economic produce, which resulted in higher yield contributing characters in the respective varieties. Similar results was reported by [10].

Medium duration variety Karjat-5 produced significantly higher straw yield during both the years and in the pooled data to the tune of 66.07, 63.26 and 64.67 q ha^{-1} respectively, in comparison to the other tested varieties. The increase in the mean straw yield under medium duration variety Karjat-5 over the short duration Sahyadri-4, late duration Swarna, medium duration Jaya, late duration Karjat-2, early duration Karjat-7 and Karjat-3, medium duration Palghar-1 and early duration Ratnagiri-24 was to the tune of 13.10, 15.19, 17.84, 19.63, 28.98, 30.15, 30.86 and 39.55 per cent, respectively. This was due to the increased morphological characters *viz*., plant height and dry matter production $hill^{-1}$ observed in the Karjat-5. Similar results was reported by [6].

3.4 Correlation studies

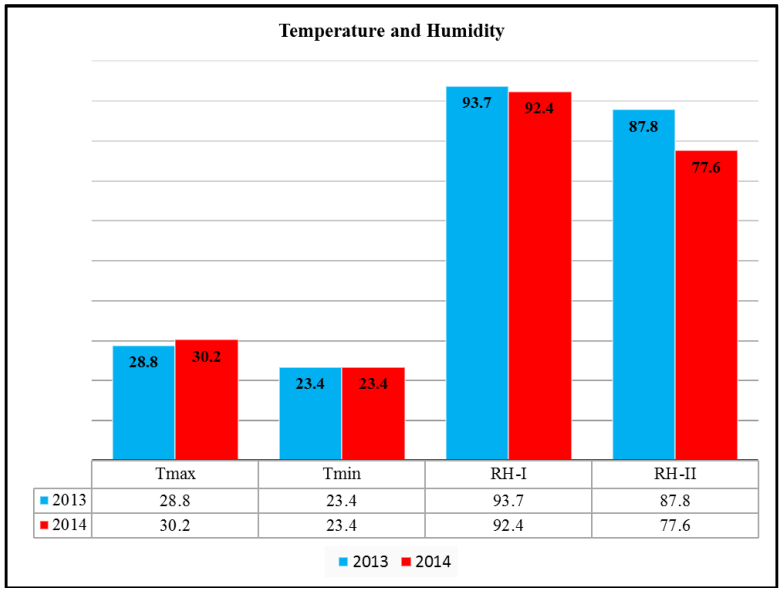
Short duration hybrid Sahyari-4 was remunerative and produced significantly the highest grain yield than rest of the varieties and followed by medium duration Jaya within level of significance. The hybrid Sahydari-4 significantly outyielded all the varieties in the pooled mean. The correlation studies (Table 2) revealed that all the varieties under study recorded significantly positive correlation with total accumulated growing degree days. Whereas, the short duration varieties *viz*., Karjat-7, Ratnagiri-24, Karjat-3 and Sahyadri-4 showed significantly positive correlation with hydrothermal unit. In case of heliothermal unit, long duration variety Swarna (r=0.740) showed significant positive correlation followed by long duration Karjat-2 (r=0.384). Thus it is confirmed that growing degree days is an important factor responsible for increasing the grain yield in all the varieties. Whereas, more humidity (hydrothermal units = GDD*mean relative humidity) responsible for higher yield in short duration varieties. More bright sunshine hours (heliothermal units = GDD*bright sunshine hours) considerably increased the yield of long duration varieties. Similar results was reported by [11].

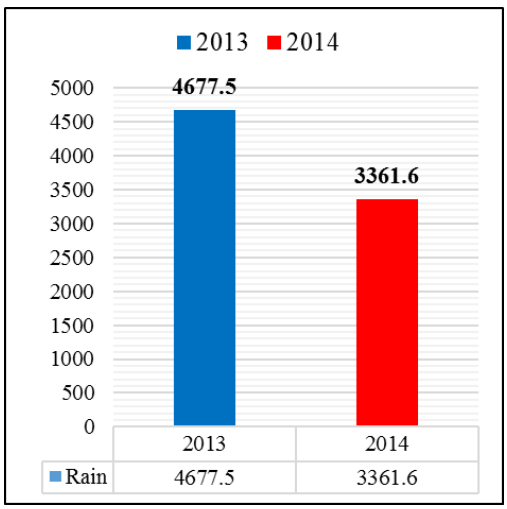
4. Conclusion

Based on present study results, it can be concluded that *Kharif* rice in *Konkan* be sown during 23rd meteorological week with hybrid Sahyadri-4 or conventional variety Jaya, so as to obtained higher yield and economic returns due to congenial environment associated, as it accumulated higher agroclimatic indices *viz*., growing degree days, hydrothermal units and heliothermal units.

Table 1: Meteorological data during the crop growth period (*Kharif* 2013 and 2014)

Met. week	Period	Temperature (ºC)				Relative humidity %				Rainfall (mm)		No. of Rainy days		Sunshine (hr/day)	
		Max.		Min.		RH-I		RH-II							
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
23	04.06 - 10.06	30.3	34.3	24.1	26.3	95	85	98	58	471.8	0.0	4.00	0.00	3.8	5.4
24	11.06 - 17.06	28.0	32.6	23.9	24.4	95	91	94	68	769.2	257.4	6.00	5.00	0.4	5.3
25	18.06 - 24.06	28.1	30.3	23.5	25.2	94	88	95	81	250.2	86.0	6.00	5.00	3.0	4.0
26	25.06 - 01.07	28.2	30.8	23.9	25.4	94	86	92	73	213.2	2.5	7.00	1.00	2.5	7.5
27	02.07 - 08.07	27.6	30.8	24.2	23.5	93.9	95	94	79	305.8	121.2	6.00	5.00	0.9	4.1
28	09.07 - 15.07	26.6	27.8	23.2	22.1	97	98	95	99	498.9	579.9	7.00	7.00	0.2	0.6
29	16.07 - 22.07	26.4	28.2	23.3	24.7	97	95	93	91	495.8	395.7	7.00	7.00	0.2	0.4
30	23.07 - 29.07	26.5	27.7	23.3	24.0	96	92	93	90	388.4	301.2	7.00	7.00	0.0	2.8
31	30.07 - 05.08	27.1	27.4	23.7	24.2	95	96	92	89	253.4	402.8	7.00	7.00	2.4	1.3
32	06.08 - 12.08	28.1	28.1	23.9	23.7	92	95	85	86	98.0	132.2	7.00	7.00	4.1	3.4
33	13.08 - 19.08	27.8	28.7	24.0	24.1	96	92	87	83	138.4	39.3	7.00	5.00	2.2	5.3
34	20.08 - 26.08	28.3	29.9	23.8	24.4	91	93	87	78	106.4	20.2	6.00	3.00	4.3	3.7
35	27.08 - 02.09	28.7	26.5	22.9	23.3	93	99	86	92	41.2	545.9	4.00	7.00	6.0	0.7
36	03.09 - 09.09	29.4	28.3	23.1	23.8	91	97	87	93	18.4	351.3	3.00	7.00	5.8	3.6
37	10.09 - 16.09	29.9	28.9	23.2	23.1	94	94	88	83	71.4	95.8	5.00	5.00	2.9	3.4
38	17.09 - 23.09	28.2	29.9	23.7	22.7	94	89	92	71	78.0	7.0	4.00	1.00	1.9	4.2
39	24.09 - 30.09	28.1	31.6	23.0	24.1	96	91	90	66	113.6	0.8	6.00	0.00	3.6	6.0
40	01.10 - 07.10	28.9	32.4	23.4	22.4	95	92	85	71	306.4	12.0	5.00	2.00	4.0	6.3
41	08.10 - 14.10	29.8	32.1	22.4	22.9	91	91	84	67	39.8	0.0	1.00	0.00	4.6	7.0
42	15.10 - 21.10	32.3	33.9	23.4	22.5	90	91	74	62	8.8	1.8	1.00	0.00	6.1	8.2
43	22.10 – 28.10	32.9	31.2	22.7	21.0	91	94	76	67	10.4	8.6	2.00	1.00	7.3	4.3
44	29.10 – 04.11	32.3	33.3	21.5	17.5	91	89	66	60	0.0	0.0	0.00	0.00	8.1	8.3
Mean/ Total		28.8	30.2	23.4	23.4	93.7	92.4	87.9	77.6	4677.5	3361.6	108.0	82.0	74.3	95.8





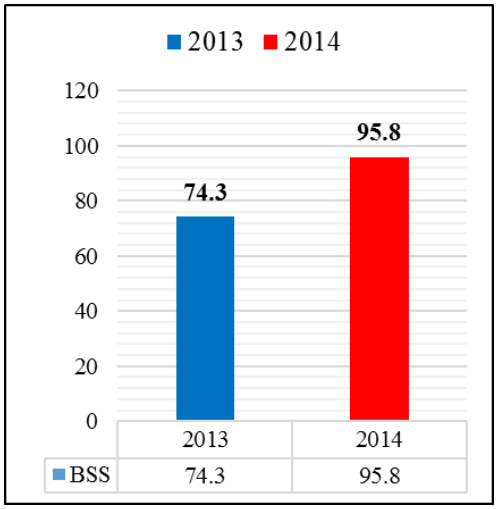


Fig 1: Comparison among the different weather parameters between *Kharif* 2013 and 2014.

Table 2: Influence of sowing times on phenology, accumulated growing degree days (°C day), hydrothermal units and heliothermal units of different rice varieties.

Physiological Stages	Karjat-5			Karjat-7			Ratnagiri-24			Karjat-2			Palghar-1			Karjat-3				Swarna			Sahyadri-4			Jaya	
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
Duration (Days)																											
Germination	5	5	6	5	5	6	5	5	6	6	6	7	5	5	6	5	5	6	6	6	6	5	5	6	6	6	7
Seedling	25	25	25	23	23	23	21	21	21	28	28	28	25	25	25	23	23	23	28	28	28	23	23	23	25	25	25
Tillering	29	28	27	26	26	25	26	26	25	35	34	33	30	29	28	25	25	24	36	35	34	27	27	26	30	29	28
Panicle development	14	14	13	15	14	14	14	13	12	20	20	19	14	13	13	14	13	12	21	21	20	15	15	14	15	14	14
Flowering and grain filling	34	33	33	26	25	24	24	24	23	35	34	33	35	35	34	24	23	23	36	35	34	27	26	26	36	36	35
Maturity	19	18	17	24	24	23	21	20	19	16	15	15	19	18	17	24	23	23	16	15	15	25	24	23	19	18	17
Total duration	125	122	118	118	116	112	109	107	103	138	135	132	127	124	120	114	112	109	142	139	136	120	118	115	130	127	123
Growing degree days (Cumulative) = Mean temp. - Base temp.																											
Germination	82	74	70	82	74	70	82	74	70	100	90	87	82	74	70	82	74	70	100	90	87	82	74	70	100	90	87
Seedling	415	403	394	382	375	363	358	344	331	469	456	447	415	403	394	382	376	363	469	456	447	382	376	363	420	410	401
Tillering	448	436	424	404	400	390	399	391	382	536	528	518	456	444	432	389	384	375	552	544	535	412	408	398	457	445	433
Panicle development	225	219	211	238	225	220	213	201	194	322	313	302	225	211	203	221	209	196	337	329	318	238	225	220	241	229	226
Flowering and grain filling	548	538	522	409	400	386	386	377	361	564	559	548	564	562	550	385	385	366	582	571	563	434	417	416	579	571	560
Maturity	316	303	287	394	389	379	340	326	313	280	268	252	316	305	290	392	388	381	294	271	260	412	388	376	312	308	296
Total duration	2032	1972	1907	1907	1863	1806	1775	1712	1648	2269	2213	2153	2056	1998	1937	1849	1837	1749	2333	2242	2208	1933	1888	1842	2100	2052	2001
Hydrothermal units (Cumulative) = GDD * Mean relative humidity																											
Germination	6665	6744	6269	6665	6744	6269	6665	6744	6269	8100	8162	7652	6665	6744	6269	7362	6744	6269	8100	7492	7652	6665	6744	6269	8100	8162	7652
Seedling	36404	36210	36772	33371	33480	33059	31145	31092	30037	41764	41344	41100	36404	36210	35942	35671	34885	33059	41764	42015	41100	33371	33480	33059	37178	36947	36767
Hydrothermal units (Cumulative) = GDD * Mean relative humidity																											
Germination	6665	6744	6269	6665	6744	6269	6665	6744	6269	8100	8162	7652	6665	6744	6269	7362	6744	6269	8100	7492	7652	6665	6744	6269	8100	8162	7652
Seedling	36404	36210	36772	33371	33480	33059	31145	31092	30037	41764	41344	41100	36404	36210	35942	35671	34885	33059	41764	42015	41100	33371	33480	33059	37178	36947	36767
Tillering	42059	40364	39408	37941	37450	35918	37192	36831	35336	49688	48263	46717	42806	41040	39587	35696	35005	34484	51132	48972	48121	38680	38150	36594	42787	41116	39561
Panicle development	20230	19466	19446	21640	20097	19470	19402	18136	17331	28688	28202	27621	20194	18790	17899	20777	20136	17370	30181	29788	29089	21596	20089	19499	21590	20210	20015
Flowering and grain filling	49198	48199	48107	36121	36231	34943	34515	33891	32697	49624	48463	46749	50635	50342	48923	35562	35670	33240	50883	48973	47469	39203	37755	37717	51837	50976	49622
Maturity	26736	24835	24037	34234	33426	32448	30397	28589	26967	22688	21531	20120	26772	25518	24064	32095	31867	32775	23718	21003	20692	35736	33154	31757	26235	25571	24126
Total duration	181290	175816	175437	169970	167426	162105	159314	155281	148635	200551	195964	189957	183474	178641	172682	167163	165305	157196	205777	198242	194122	172919	169370	164894	187018	182981	177741
Heliothermal units (Cumulative) = GDD * Bright sunshine hours																											
Germination	266	166	402	266	166	402	266	166	402	337	199	474	266	166	402	337	166	402	337	199	474	266	166	402	337	199	474
Seedling	1566	1389	872	1524	1389	920	1414	1350	907	1659	1373	872	1566	1389	931	1537	1389	920	1659	1373	872	1524	1389	920	1525	1356	872
Tillering	475	483	1099	417	432	757	480	532	641	896	1267	1607	524	743	1036	331	467	740	961	1322	1673	454	483	807	657	835	1077
Panicle development	823	1361	720	747	859	851	568	717	746	1321	1324	1157	796	769	755	801	817	681	1397	1296	1204	712	825	819	873	832	910
Flowering and grain filling	1993	1469	2437	1599	1527	1449	1511	1600	1342	2322	2355	2621	2061	2118	2190	1451	1531	1398	2451	2538	2824	1723	1579	1477	2120	2200	2210
Maturity	1669	1605	1811	1473	1712	1835	1170	1115	1266	1863	1890	1763	1700	1659	1649	1451	1543	1695	2037	1801	1893	1654	1814	1986	1642	1798	1940
Total duration	6791	6688	7341	6024	6086	6212	5406	5278	5303	8397	8407	8494	6913	6843	6961	5908	5913	5835	8841	8528	8940	6262	6256	6410	7100	7219	7482

Table 3: Mean yield of grain (q ha^{-1}) and straw (q ha^{-1}) of rice as influenced by different treatments.

Sym.	Sowing Dates	Grain yield (q ha^{-1})			Straw yield (q ha^{-1})		
		2013	2014	Pooled mean	2013	2014	Pooled mean
Sowing time							
S_1	23rd Met. Week (4th to 10th June)	50.22	52.22	51.22	57.86	56.90	57.38
S_2	24th Met. Week (11th to 17th June)	45.92	48.24	47.08	55.15	53.43	54.30
S_3	25th Met. Week (18th to 24th June)	40.19	44.79	42.49	49.71	48.62	49.16
	S.E.±	1.35	1.33	0.95	0.93	0.97	0.67
	C.D. at 5%	5.28	5.22	3.08	3.67	3.82	2.20
Varieties							
V_1	Karjat – 5	41.43	42.55	41.99	66.07	63.26	64.67
V_2	Karjat – 7	47.66	49.99	48.82	49.56	50.71	50.14
V_3	Ratnagiri – 24	39.19	37.16	38.17	47.66	45.03	46.34
V_4	Karjat – 2	46.55	48.84	47.70	55.37	52.76	54.06
V_5	Palghar – 1	43.45	44.73	44.11	51.83	47.01	49.42
V_6	Karjat – 3	44.45	46.87	45.66	50.29	49.10	49.69
V_7	Swarna	43.17	53.28	48.22	54.73	57.54	56.14
V_8	Sahyadri -4	52.55	56.72	54.64	57.26	57.11	57.18
V_9	Jaya	50.48	55.63	53.05	55.39	54.37	54.88
	S.E.±	0.73	0.78	0.53	1.23	0.95	0.77
	C.D. at 5%	2.07	2.22	1.48	3.49	2.71	2.16
Interaction Effect							
	S.E.±	1.26	1.35	1.30	2.124	1.65	1.88
	C.D. at 5%	3.59	3.85	3.64	N.S.	4.70	5.29
General Mean		45.44	48.42	46.93	54.24	52.99	53.61

Table 4: Correlation studies between total accumulated agro-climatic indices and grain yield of different rice varieties

Varieties	Pooled grain yield (q ha^{-1})	Growing degree-days	Hydrothermal Units	Heliothermal Units
Karjat-5	41.99	0.845*	0.326	-0.044
Karjat-7	48.82	0.734*	0.679*	0.148
Ratnagiri-24	38.17	0.598*	0.934*	-0.253
Karjat-2	47.70	0.643*	0.129	0.384
Palghar-1	44.11	0.802*	0.467	0.094
Karjat-3	45.66	0.617*	0.687*	0.266
Swarna	48.22	0.926*	0.155	0.740*
Sahyadri-4	54.64	0.747*	0.849*	0.283
Jaya	53.05	0.797*	0.238	0.294

N= 18 *Table r value= 0.468 at 5%

5. Acknowledgement

First author is sincerely acknowledge the Department of Science and Technology, Ministry of Science and Technology, Government of India, New Delhi, for providing financial assistance by availing Inspire Fellowship for Ph.D. programme, which buttressed me to perform my work comfortably. He is also thankful to Head of Department for their cooperation and moral spot.

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