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EFFECT OF WEATHER ON YIELD AND YIELD ATTRIBUTES OF TWO RICE VARIETIES

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Abstract: *Field experiments were conducted by Department of Agricultural Meteorology, Kerala Agricultural University at Agricultural Research Station Mannuthy, to analyze the impact of different weather variables on yield and yield attributes of rice such as number of panicles per unit area, number of spikelets per panicle, number of filled grains per panicle and thousand grain weight. Experiments were carried out from 2013 to 2017 during kharifseason. It was laid out in split plot design with five dates of planting as main plot treatments and two varieties; Jyothi and Kanchana as subplot treatments. Correlation studies revealed that the yield and yield attributes of these varieties are influenced by different weather parameters either positively or negatively during different growth stages.*

Key words*: Weather, yield, yield attributes, varieties Rice.*

Introduction

Rice is one of the dominant food of people in Kerala and the main produce of the state. It rich in carbohydrates, calcium, iron, thiamine, folate and vitamin E and relatively a good source of energy. The growth, development and yield of rice is highly influenced by the prevalent weather. Rice productivity can be increased by the influence of weather parameters like temperature, sunshine hours and rainfall. High maximum temperature which ranged from 29 to 31.5°Cand total sunshine hours three weeks after flowering positively influences panicle number and grain weight (Ghosh *et al*., 1973). Rainfall, number of rainy days and length of rainy season showed significant correlation with yield of rice (Gupta et al., 2000). Significant correlation was observed between number of sunshine hours and yield of rice (Nigam and Mishra, 2003).

Materials and Methods

Field experiments were conducted during 2013-2017 (May– November) at Agricultural Research Station, Mannuthy, Kerala Agricultural University, Thrissur. The study was conducted using two most popular varieties among farmers, Jyothi and Kanchana. The experimental design used was split plot design with five dates of planting (from 5th June to 5th August) as the main plot treatments and two varieties Jyothi and Kanchana as sub plot treatments. It was replicated four times.The field was divided into 40 plots of 5x4 m^{2}size each. A spacing of 15x10 cm was maintained.Number of panicles per plant, number of spikelets per panicle and number of filled grains per panicle were counted randomly from 5 plants at the time of harvest. One thousand grains were counted from the cleaned dried produce from each plot and the weight was recorded in grams.The produce from each plot was threshed, properly winnowed and dried to 14 percent moisture, weighed and expressed as kgha^{-1}. These observations were correlated with the weather experienced by the crop during the experimental period.

Results

The results of correlation are shown in Table 1 to Table 6. Afternoon relative humidity, rainfall and number of rainy days during transplanting to active tillering stage showed a significant positive correlation with yield while maximum temperature and bright sunshine hours showed significant negative correlation in the case of Jyothi. Forenoon relative humidity, afternoon relative humidity, and number of rainy days during 50% flowering to physiological maturity stage exhibited a significant

positive correlation whereas maximum temperature, minimum temperatureshowed a significant negative correlation in Jyothi.

Afternoon relative humidity and rainfall during transplanting to active tillering stage exhibited a positive correlation with yield whereas bright sunshine hours showed a negative correlation in Kanchana. Forenoon relative humidity, afternoon relative humidity, mean rainfall, and number of rainy days during 50% flowering to physiological maturity stage exhibited positive correlation with yield while maximum temperature, minimum temperature, and bright sunshine hours showed a significant negative correlation with yield in Kanchana.

Correlation between weather variables and thousand grain weight in Jyothi

Forenoon and afternoon vapour pressure deficit during transplanting to active tillering stage showed significant positive influence on thousand-grain weight of Jyothi while minimum temperature during the same phenophases showed significant negative influence on it. Forenoon relative humidity, forenoon vapour pressure deficit and pan evaporation during 50% flowering to physiological maturity stage exhibited a significant positive effect on thousand grain weight while maximum temperature, rainfall and number of rainy days had a significant negative effect.

Correlation between weather variables and number of panicles per m^2 in Jyothi

Significant positive correlation was exhibited by forenoon, afternoon and mean relative humidity, rainfall, number of rainy days and wind speed during transplanting to active tillering and panicle initiation to booting stages while significant negative correlation was exhibited by maximum and minimum temperatures, diurnal temperature range and forenoon vapour pressure deficit during panicle initiation to booting and booting to heading stages with number of panicles per m^2. Significant positive influence of rainfall and number of rainy days during booting to heading stage on number of filled grains was obtained while significant negative influence of bright sunshine hours during transplanting to active tillering and panicle initiation to booting stage was noticed through correlation analysis.

Correlation between weather variables and number of spikelets per panicle in Jyothi

Significant positive influence was exhibited by forenoon, afternoon and mean relative humidity, rainfall and number of rainy days during panicle initiation to booting, booting to heading, heading to 50% flowering and 50% flowering to physiological maturity stages on number of spikelets per panicle whereas maximum, minimum and mean temperatures, and forenoon vapour pressure deficit during active tillering to panicle initiation, panicle initiation to booting, booting to heading and 50% flowering to physiological maturity exhibited significant negative influence on number of spikelets per panicle.

Correlation between weather variables and filled grains per panicle in Jyothi

Significant positive correlation was observed between forenoon relative humidity, afternoon relative humidity and mean relative humidity of transplanting to active tillering and panicle initiation to booting stage and number of filled grains per panicle while significant negative correlation was obtained for maximum temperature, minimum temperature, mean temperature and forenoon vapour pressure deficit of phenophases transplanting to active tillering, active tillering to panicle initiation, panicle initiation to booting and 50% flowering to physiological maturity with number of filled grains.

Correlation between weather variables and thousand grain weight in Kanchana

Significant positive correlation was shown by forenoon vapour pressure deficit, afternoon vapour pressure deficit and number of rainy days on thousand-gram weight while significant negative correlation was shown by minimum temperature and pan evaporation during transplanting stage to active tillering stage. Significant positive influence of forenoon vapour pressure deficit and pan evaporation was observed during 50% flowering to

physiological maturity stage while significant negative influence of diurnal temperature range, rainfall and number of rainy days was found during the same stage.

Correlation between weather variables and number of panicles per m² in Kanchana

Panicles per m^2 was positively influenced by forenoon relative humidity, afternoon relative humidity and mean relative humidity and wind speed during active tillering to panicle initiation, panicle initiation to booting, booting to heading and 50% flowering to physiological maturity stages. Significant negative influence of minimum temperature during active tillering to panicle initiation and panicle initiation to booting stage and of diurnal temperature range during panicle initiation to booting, booting to heading, 50% flowering to Physiological Maturity was noticed by correlation analysis. Pan evaporation during Transplanting stage to active tillering stage also influenced these yield at transplanting stage negative.

Correlation between weather variables and number of spikelets per panicle in Kanchana

A significant positive correlation was shown by forenoon relative humidity, afternoon relative humidity and mean relative humidity, rainfall, number of rainy days and wind speed during panicle initiation to booting, booting to heading, heading to 50% flowering, and 50% flowering to physiological maturity with number of spikelets per panicle. Number of rainy days during transplanting stage to active tillering stage, forenoon vapour pressure deficit during active tillering to panicle initiation and diurnal temperature range during panicle initiation to booting stage also showed a significant influence on number of spikelets per panicle.

Correlation between weather variables and filled grains per panicle in Kanchana

Wind speed during active tillering to panicle initiation stage, panicle initiation to booting and 50% flowering to physiological maturity exhibited a significant positive correlation with filled grains per panicle while maximum temperature, minimum temperature, forenoon vapour pressure deficit and afternoon vapour pressure deficit during transplanting stage to active tillering, active tillering to panicle initiation, panicle initiation to booting and 50% flowering to physiological maturity showed a significant negative correlation with filled grains per panicle Forenoon vapour pressure deficit during heading to 50% flowering and diurnal temperature range during 50% flowering to physiological maturity also influenced filled grains per panicle negatively.

Table 1: Correlation between weather and thousand grain weight in Jyothi worked out using 5 years' experimental data

Crop stages	Tmax	Tmin	RHI	RHII	VPI	VPII	RF	RD	BSS	WS	Epan
P1	-0.024	-0.268**	0.07	0.163	0.293**	0.331**	-0.071	0.186	-0.16	0.042	-0.136
P2	0.072	-0.267**	0.033	-0.14	-0.008	-0.026	-0.164	-0.071	-0.082	0.104	-0.022
P3	-0.024	0.013	-0.061	-0.189	0.142	-0.214*	-0.198*	-0.025	0.005	0.14	-0.065
P4	-0.211*	0.223*	0.146	0.108	0.198*	-0.138	-0.011	-0.118	-0.079	0.214*	0.082
P5	-0.111	0.173	0.07	-0.14	0.024	-0.368**	-0.045	-0.059	0.108	0.207*	0.165
P6	-0.216*	0.104	0.270**	-0.045	0.292**	-0.07	-0.377**	-0.206*	-0.042	-0.009	0.282**

Table 2: Correlation between weather and filled grains per panicle in Jyothi worked out using 5 years' experimental data

Crop stages	Tmax	Tmin	RHI	RHII	VPI	VPII	RF	RD	BSS	WS	Epan
P1	-0.419**	-0.246*	0.345**	0.375**	-0.327**	-0.195	0.218*	0.147	-0.312**	0.176	-0.253*
P2	-0.247*	-0.324**	0.139	0.124	-0.262**	-0.275**	0.069	-0.127	0.01	0.248*	-0.012
P3	-0.419**	-0.439**	0.338**	0.248*	-0.397**	-0.224*	0.056	0.103	-0.295**	0.207*	-0.231*
P4	-0.083	-0.396**	0.145	-0.144	-0.229*	-0.279**	0.146	0.286**	0.09	0.362**	-0.066
P5	-0.119	-0.112	0.051	0.147	-0.123	-0.034	0.182	0.377**	0.045	0.349**	0.115
P6	-0.490**	-0.407**	0.374**	0.16	-0.374**	-0.487**	0.036	0	-0.236*	0.239*	-0.243*

Table 3: Correlation between weather and number of panicles per m2 in Jyothi worked out using 5 years' experimental data

Crop stages	Tmax	Tmin	RHI	RHII	VPI	VPII	RF	RD	BSS	WS	Epan
P1	-0.352**	0.027	0.394**	0.426**	-0.042	0.055	0.407**	0.355**	-0.441**	0.407**	-0.149
P2	-0.232*	-0.124	0.137	0.172	-0.186	-0.074	0.161	0.153	-0.136	0.479**	0.012
P3	-0.549**	-0.173	0.467**	0.373**	-0.378**	-0.189	0.336**	0.321**	-0.405**	0.480**	-0.174
P4	-0.275**	-0.136	0.267**	-0.062	-0.206*	-0.207*	0.235*	0.215*	-0.086	0.565**	0.066
P5	-0.184	0.101	0.197*	0.132	-0.091	-0.077	-0.095	0.115	0.031	0.462**	0.205*
P6	-0.265**	-0.058	0.273**	0.07	0.015	-0.114	0.142	0.15	-0.182	0.405**	0.14

Table 4: Correlation between weather and number of spikelets per panicle in Jyothi worked out using 5 years' experimental data

Crop stages	Tmax	Tmin	RHI	RHII	VPI	VPII	RF	RD	BSS	WS	Epan
P1	-0.198*	-0.019	0.069	0.311**	-0.257**	-0.063	0.279**	0.111	-0.218*	0.016	-0.144
P2	-0.285**	-0.220*	0.107	0.384**	-0.348**	-0.106	0.284**	0.19	-0.163	0.384**	0.125
P3	-0.470**	-0.438**	0.310**	0.550**	-0.424**	0.134	0.354**	0.277**	-0.516**	0.244*	-0.435**
P4	-0.239*	-0.577**	0.382**	0.098	-0.402**	-0.154	0.291**	0.342**	-0.176	0.281**	-0.103
P5	-0.239*	-0.158	0.300**	0.404**	0.102	0.184	0.419**	0.398**	-0.191	0.232*	-0.072
P6	-0.477**	-0.533**	0.509**	0.516**	-0.277**	-0.12	0.501**	0.392**	-0.441**	0.184	-0.301**

Table 5: Correlation between weather and thousand grain weight in Kanchana worked out using 5 years' experimental data

Crop stages	Tmax	Tmin	RHI	RHII	VPI	VPII	RF	RD	BSS	WS	Epan
P1	0.129	-0.322**	-0.009	-0.004	0.358**	0.350**	-0.069	0.460**	0.004	-0.178	-0.233*
P2	-0.095	-0.277**	0.081	0.072	-0.08	0.006	0.058	0.189	-0.277**	-0.057	-0.127
P3	-0.09	0.082	0.052	-0.107	0.230*	-0.246*	-0.111	0.083	-0.062	0.178	-0.174
P4	-0.102	0.346**	0.104	-0.11	0.186	-0.059	-0.192	-0.247*	0.041	0.175	0.071
P5	0.025	0.290**	-0.132	-0.214*	0.052	-0.184	-0.212*	-0.211*	0.069	0.123	0.218*
P6	-0.193	0.169	0.189	-0.126	0.292**	-0.162	-0.470**	-0.310**	0.069	0.055	0.309**

Table 6: Correlation between weather and filled grains per panicle in Kanchana worked out using 5 years' experimental data

Crop stages	Tmax	Tmin	RHI	RHII	VPI	VPII	RF	RD	BSS	WS	Epan
P1	-0.400**	-0.372**	0.209*	0.298**	-0.374**	-0.202*	0.207*	-0.384**	-0.216*	0.132	-0.414**
P2	-0.329**	-0.361**	0.174	0.244*	-0.249*	-0.230*	0.207*	0.119	-0.195	0.215*	-0.118
P3	-0.475**	-0.411**	0.372**	0.191	-0.429**	-0.339**	0.074	0.129	-0.300**	0.289**	-0.169
P4	-0.236*	-0.232*	0.186	0.019	-0.159	-0.256*	0.165	0.241*	0.052	0.528**	-0.114
P5	-0.063	-0.093	-0.149	-0.138	-0.202*	-0.206*	-0.124	0.229*	0.292**	0.430**	0.241*
P6	-0.465**	-0.332**	0.334**	0.083	-0.348**	-0.451**	-0.103	-0.114	-0.181	0.263**	-0.105

Conclusion

From the correlation analysis, it is evident that the yield and yield attributes such as yield attributes of rice such as number of panicles per unit area, number of spikelets per panicle, number of filled grains per panicle and thousand grain weight of rice varieties Jyothi and Kanchana are influenced by different weather parameters such as maximum and minimum temperatures, forenoon and afternoon relative humidity, forenoon and afternoon vapour pressure deficit, rainfall and number of rainy days, bright sunshine hours, wind speed and evaporation either positively or negatively. This relationship of weather parameters with yield can be made use in the area of crop yield forecasting using different techniques.

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