Yield of Rice Affected by Meteorological Elements in Yeosu Area of Korea

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ABSTRACT

This study was conducted to investigate the relationships between yearly variations of meteorological elements and yearly variations of productivity in rice. In addition, correlation coefficients among yield and yield components were used to find out the relationships between meteorological elements and productivity. Yearly variation of the mean air temperature in May was large with coefficients of variation(C.V.) of 25.0%, but the variation of the duration of sunshine in May were relative small.

No. of panicles per hill and 1,000 grains wt. of brown rice were great with C.V. of 21.1, 19.7%, respectively, brown rice yield show more or less C.V. of 5.5% and milled rice show still less variation. Correlation coefficients between temperatures in period of cultivation from May and yield were positive correlations. Correlation Coefficients between precipitation in period of cultivation from Sep. to Oct. and yield are positive correlations. Correlation coefficients amount the panicle length, no. of panicles, no. of spikelets, ratio of ripened grains, 1,000 grains wt. of brown rice, milled rice yield, brown rice yield and milled rice yield were positively significant at the level of 1%, respectively.

Key words : Meteorological elements, Productivity of rice

INTRODUCTION

Crop has a close relation the environmental effects, especially weather condition. Many scholars reported(Kwon, 1993; Kwon *et al.*, 1986: Kwon *et al.*, 1982; Cho and Chung 1979; Choi *et al.*, 1993; Hyun, 1982; Lee *et al.*, 1977; Li, 1982; Rebert, 1982; Ryu *et al.*, 1977; Rhu *et al.*,1975; Won *et al.*, 1983) the results of research on weather and growth of crops and recently the research of meteorological effect evaluation and crop yield predicition has been developed.

This experiment develops the estimated equation of

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rice yield with a lot demands and analysis the relation of weather conditions to hot pepper growth and yield at Yeosu area, Chonnam in order to obtain the basic data of relation of crop to weather conditions and to develop safe cultivation and production techniques according to changes of meteorological environments and then the following results are reported.

We wish to show our thanks to related agencies and farm houses which cooperated to carry out this research.

MATERIALS AND METHOD

This experiment uses the rice yield of rice produced from 1,991 to 2,000 and meteorological data observed during the cultivation period as shown in Table 1, and induces the estimated equations of correlation among growth, yield and weather conditions, dispersions and yield.

Ilmibyo rice variety was grown at the experimental farm of Yousu local in Korea. Seeds were sown in box nursery bed on May 4 and seedlings were transplanted in the paddy field with 30 × 15cm distane with one plant per hill on June 10, every years.

The fertilizer was applied in the field at a ratio of 11-7-8kg/10a and the other cultural practices followed the conventional method in the southern region of korea.

RESULTS AND DISCUSSION

Variabilities of Meteorological Elements

The weather conditions from 1,991 to 2,000, rice growth, variability of yield character and the variabilities of meteorological elements during hot pepper growth period are shown in Table 2.

The greatest variation of meteorological elements is mean temperature of May. Coefficients of it's variability is 25.0%. It's appear that mean temperature of May is most flexible for transplanting day. However the coefficient variation of mean temperature of August was 6.6%, maximum temperature of August was 6.2% and minimum temperature of August was 6.9% and those were relatively stable meteorological elements during the growth and development of rice.

Considering the variabilities of yield character during the cultivation period in Table 3, while the standard deviation of 1,000 grains wt. of brown rice was very low as 4.03% and it is governed by genetic characters peculiar to variety, those of milled rice yield and brown rice yield were high as 47.35%, 32.12% and it is influenced by environmental factors in some degree and such a trend was shown as 28.50% in fresh weight of stem of rush(Kwon, 1993), 30.20% in soybean(Won et al., 1983) and 14.24% in barley(Kim et al., 1993) but in case of mat rush the fiber yield was 6.3%(Kwon et al., 1994) and it is considered that these results were due to the differences in character of crops.

Correlations among Meteorological Elements, Rice Growth and Yield.

As shown in Table 4. There are positive correlations between temperature of May, June, July, August, September, and October in mean, maximum and minimum air temperature and yield. It is found that high temperature condition from May, to October has a favorable influence on the yield.

In the Duration of sunshine, a negative correlation between the Duration of sunshine of all growth periods, May to October and yield is shown. and then it is found that the small precipitation for growth periods of May,

Table 1. Cultivated area and yield of rice in Yeosu area

Year	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000
Cultivated area(ha)	4,201	2,942	4,080	3,949	3,855	3,832	3,806	3,836	3,845	3,877
Total yield (kg/10a)	445	462	442	445	448	455	527	505	481	475

Table 2. Variabilities of meteorological factors for 10 experimental years (1,991-2,000)

Meteorological		Max	Min	Mean	Range	C.V.(%)	S.D
Air temperature (℃) Mean	May	18.8	16.6	17.7	2.2	25.0	4.43
	Jun.	22.0	20.2	21.1	1.8	7.3	1.53
	Jul.	27.8	22.4	13.9	5.4	8.9	1.24
	Aug.	27.6	23.4	25.5	4.2	6.6	1.68
	Sep.	23.7	21.3	22.5	2.4	7.0	1.58
	Oct.	19.1	16.6	17.9	2.5	7.9	1.45
Max.	May	22.5	20.9	21.7	1.6	7.1	1.55
	Jun.	25.8	22.6	24.2	3.2	6.8	1.64
	Jul.	32.0	25.1	28.6	6.9	6.2	1.78
	Aug.	30.8	26.4	28.6	4.4	6.2	1.78
	Sep.	27.8	24.3	26.1	3.5	6.5	1.70
	Oct.	22.4	20.4	21.4	2.0	7.2	1.54
Min.	May	15.6	13.0	14.3	2.6	8.8	1.26
	Jun.	18.9	16.8	17.9	2.1	7.9	1.41
	Jul.	24.9	20.2	22.6	4.7	7.0	1.58
	Aug.	25.0	20.7	22.9	4.3	6.9	1.60
	Sep.	21.3	18.3	19.8	3.0	7.5	1.48
	Oct.	16.2	14.0	15.1	2.2	8.5	12.9
Precipitation(mm)	May	250.1	46.1	148.1	204.0	2.7	4.06
	Jun.	381.9	31.9	206.9	350.0	2.3	4.80
	Jul.	546.6	112.5	329.6	434.1	1.8	6.05
	Aug.	603.0	129.9	244.3	473.1	2.1	5.21
	Sep.	246.2	21.9	134.1	224.3	11.1	14.9
	Oct.	201.0	18.8	110.0	182.2	3.2	3.50
Duration of sunshine	May	288.0	189.4	238.7	98.6	0.1	0.06
	Jun.	233.9	107.8	170.9	126.1	2.6	4.36
	Jul.	296.5	120.4	208.5	176.1	2.3	4.81
	Aug.	271.6	131.9	201.8	139.7	2.4	4.74
	Sep.	270.3	177.8	224.1	92.5	3.6	4.99
	Oct.	271.9	164.3	218.1	107.6	2.3	4.92

Table 3. Variabilities of agronomic characters for 10 experimental years

Characters	Max.	Min.	Mean	Range	C.V.(%)	S.D
Panicle length (cm)	21	19	20	2	17.3	3.46
No. of panicles per hill (cm)	22	18	20	4	21.1	4.21
No. of spikelets per panicle	101	80	91	21	14.6	13.31
Ratio of ripened grains (%)	89.2	73.7	81.5	15.5	9.6	7.81
1,000 grains wt. of brown rice	22.8	18.0	20.4	4.8	19.7	4.03
Brown rice yield(kg/10a)	885	847	866	38	5.5	47.35
Milled rice yield(kg/10a)	527	442	485	85	6.6	32.12

June, July, August, september, and October and yield is low and then rich precipitation for those of May, June, July, August and September, and October produced high yield.

Correlation between Growth and Yield characters, a highly significant positive correlation among all characters and Milled rice yield is shown and the more yield is, the more rice yield is shown and then rich

precipitation for those of May, June, July, August, September, and October produced high yield.

Correlation between Growth, Yield and Yield Characters

As shown in Table 5. in correlation between growth and yield characters, a highly significant positive correlation among all characters and milled rice yield is

Table 4. Correlation coefficients between agronomic characters and meteorological factors in each month

Meteorological elements	Month	Panicle length (cm)	No. of panicle /hill	No. of spikelets /panicle	Ratio of ripened grains (%)	1000 grains wt.of brown rice(g)	Brown rice yield yield(kg/10a)	Milled rice
Air Temperature (°C) Mean	May	0.431	0.531	0.463	0.566	0.487	0.525	0.556
	Jun.	0.618	0.350	0.233	0.270	0.367	0.211	0.409
	Jul.	0.034	0.006	0.031	0.017	0.019	0.006	0.051
	Aug.	0.089	0.247	0.273	0.255	0.108	0.196	0.169
	Sep.	0.074	0.124	0.273	0.250	0.247	0.324	0.233
	Oct.	0.146	0.343	0.426	0.388	0.244	0.349	0.299
Air Temperatuer (°C) Max.	May	0.177	0.333	0.330	0.416	0.388	0.443	0.336
	Jun.	0.288	0.058	0.029	0.009	0.099	0.008	0.102
	Jul.	0.119	0.156	0.116	0.149	0.163	0.156	0.117
	Aug.	0.059	0.119	0.164	0.116	0.028	0.067	0.016
	Sep.	0.088	0.052	0.053	0.004	0.018	0.058	0.071
	Oct.	0.084	0.114	0.165	0.078	0.082	0.035	0.071
Air Temperature (°C) Min	May	0.641*	0.642*	0.531	0.642*	0.632*	0.595	0.712*
	Jun.	0.589	0.393	0.328	0.364	0.449	0.310	0.409
	Jul.	0.033	0.001	0.079	0.030	0.009	0.009	0.037
	Aug.	0.128	0.267	0.339	0.300	0.160	0.245	0.189
	Sep.	0.193	0.198	0.420	0.367	0.404	0.452	0.279
	Oct.	0.200	0.364	0.460	0.436	0.329	0.408	0.317
Precipitation (mm)	May	0.199	0.091	0.083	0.002	0.050	0.071	0.187
	Jun.	0.574	0.632*	0.523	0.582	0.596	0.560	0.643*
	Jul.	0.271	0.226	0.406	0.323	0.291	0.305	0.166
	Aug.	0.013	0.240	0.483	0.325	0.247	0.384	0.159
	Sep.	0.185	0.186	0.438	0.361	0.421	0.443	0.197
	Oct.	0.059	0.020	0.115	0.124	0.041	0.083	0.009
Duration of sunshine(hr.)	May	-0.257	-0.223	-0.049	-0.092	-0.124	-0.051	-0.308
	Jun.	-0.125	-0.128	-0.035	-0.056	-0.007	-0.011	-0.100
	Jul.	-0.235	-0.229	-0.240	-0.219	-0.262	-0.236	-0.215
	Aug.	-0.221	-0.079	-0.037	-0.112	-0.228	-0.149	-0.165
	Sep.	-0.173	-0.202	-0.308	-0.276	0.321	-0.310	-0.114
	Oct.	-0.416	-0.457	-0.447	-0.538	0.488	-0.487	-0.403

shown and the more yield is, the more rice yield is.

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Table 5. Correlation of coefficients between yield components and yield

Characters	Panicle length (cm)	No. of panicle /hill	No. of spikelets /panicle	Ratio of ripened grains (%)	1,000 grains wt. of brown rice(g)	Brown rice yield (kg/10a)	Milled rice yield (kg/10a)
Panicle length (cm)							
No. of panicles / hill (cm)	0.951**						
No. of spikelets / panicle	0.779**	0.892**					
Ratio of ripened grains (%)	0.876**	0.967**	0.965**				
1,000 grains wt. of brown rice	0.888**	0.927**	0.944**	0.973**			
Brown rice yield (kg/10a)	0.797**	0.906**	0.976**	0.978**	0.976**		
Milled rice yield (kg/10a)	0.945**	0.979**	0.861**	0.942**	0.929**	0.894**	

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