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Effect of Meteorological Element on Growth and Yield of Sesame

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ABSTRACT

This study was conducted to investigate the relationships between yearly variations of climatic elements and yearly variations of productivity in sesame. In addition, correlation coefficients among yield and yield components were estimated. The data of yield and yield components were investigated for 10 years from 1992 to 2001.

The meteorological data gathered at the Yeosu Weather Station for the same period were used to find out the relationships between climatic elements and productivity. Yearly variation of the amount of precipitation in July and September were large with coefficients of variation(c.v.) of 64.59, 92.47%, respectively, but the variation of the average temperature in June and August were relative small.

Yield and plant height greatly with c.v. of 26.24, 23.41%, respectively, 1,000 grain weights show more or less c.v. of 3.83% and length capsule setting show still less variation.

Correlation coefficients between maximun temperature in period of cultivation(from June to September) and yield are positively significant at the level of 5.1%, respectively.

Correlation coefficients amount the plant height, length capsule setting, number of capsules per plant, weight of 1,000 grains and seed yield were positively significant at the level of 1%, respectively.

Simple linear regression equations by the least square method are estimated for number of capsules per plant(Y_1) and the maximun temperature in August(X) as Y_1=10.1255+0.1725X, and for yield(Y_2) and the maximun temperature in August(X) as Y_2=21.6151+1.3724X.

Key Words : Climatic elements, productivity, sesame, climatic elements

INTRODUCTION

Crop has a close relation to the environmental effects, especially weather condition. Many scholars reported(Kwon, 1993; Kwon *et al.*, 1986; Kwon *et al.*, 1994; Cho *et al.*, 1982; Cho and Chung 1979; Choi *et al.*, 1979; Kim *et al.*, 1993; Hyun, 1982; Lee *et al.*,

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

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
cultivation(ha)	574	431	214	253	212	245	233	184	178	178
Yield(kg/10a)	51	51	196	43	60	60	70	69	61	61

Table 2. Variabilities of meteorological elements for ten(1992-2001) experimental years

Meteorological elements	Month	Max.	Min.	Mean±SD	Range	c.v.(%)
Air temperature (℃)Mean	June	23.20	21.20	20.25±0.52	2.00	2.56
	July	29.30	22.80	25.21±1.24	6.50	4.92
	Aug.	25.50	22.30	25.15±0.75	3.20	2.98
	Sep.	22.40	19.00	20.15±1.03	3.40	5.12
Air temperature (℃)Max	June	34.50	26.20	29.20±2.88	8.30	9.86
	July	38.80	27.10	31.80±3.65	11.70	11.48
	Aug.	35.40	27.70	32.10±2.58	7.70	8.04
	Sep.	34.20	25.30	28.20±3.44	8.90	12.21
Air temperature (℃)Min.	June	18.10	8.40	14.12±3.47	9.70	24.58
	July	22.70	14.20	19.85±2.54	8.50	12.80
	Aug.	22.50	16.10	19.26±2.12	6.40	11.01
	Sep.	17.30	5.80	12.57±3.59	11.50	28.56
Precipitation (mm)	June	360.50	19.00	191.30±113.21	341.50	59.18
	July	667.20	28.20	312.50±201.85	639.00	64.59
	Aug.	510.10	95.30	301.01±158.15	414.80	52.54
	Sep.	282.50	9.80	115.70±112.77	272.70	97.47
Duration of sunshine(hr)	June	245.60	98.20	164.60±43.13	147.30	26.20
	July	278.30	94.30	152.30±38.85	184.00	25.50
	Aug.	245.50	98.30	175.30±26.63	147.20	15.19
	Sep.	221.30	111.20	117.10±25.13	110.10	21.46

1977; Li, 1982; Rebert, 1982; Ryu *et al.*, 1977; Rhu *et al.*, 1982; Park, 1975; Won *et al.*, 1983) the results of research on weather and growth of crops and recently the research of meteorological effect evaluation and yield predicition has been developed.

This experiment develops the estimated equation of sesame yield with a lot of demands and analysis the relation of weather conditions to sesame 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 yield produced from 1992 to 2001 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.

Table 3. Variabilities of agronomic characters for ten experimental years

Characters	Max.	Min.	Mean±SD	Range	c.v.(%)
Plant height(cm)	88	67	76.2±17.83	21	23.41
Length capsule setting(cm)	63	56	58.8±2.59	7	4.37
No. of capsules per plant	67	51	57.2±10.36	16	18.12
Weight of 1,000 grains(g)	2.50	2.23	2.15±0.23	0.27	3.83
Seed yield(kg/10a)	73	50	59.6±15.6	23	26.24

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

Meteorological elements	Month	Plant height(cm)	Length capsule setting(cm)	No. of capsules per plant	Weight of 1,000 grains(g)	Seed yield (kg/10a)
Air	June	0.0521	0.2121	0.2440	0.2117	0.1515
temperature	July	0.2125	0.0325	0.0621	0.0303	0.1306
(℃)Mean	Aug.	0.2815*	0.1314	0.3187*	0.1521	0.2521*
	Sep.	0.2487*	0.2125*	0.2832*	0.2483*	0.3171*
Air	June	0.2636*	0.2860*	0.2977*	0.4393**	0.3914**
temperature	July	0.5356**	0.5012**	0.5018**	0.4955**	0.5296**
(℃)Max.	Aug.	0.9494**	0.9576**	0.9872**	0.9265**	0.9337**
	Sep.	0.5836**	0.6846**	0.6272**	0.5466**	0.6632**
Air	June	-0.3854**	-0.6261**	-0.4877**	-0.3855**	-0.5532**
temperature	July	-0.4825**	-0.6687**	-0.5731	-0.6351**	-0.5525**
(℃)Min.	Aug.	-0.5665**	-0.7129**	-0.5625**	-0.6177**	-0.6361**
	Sep.	-0.3612**	-0.5663**	-0.4126**	-0.5034**	-0.3838**
Precipitation	June	0.0808	-0.1963	-0.2810*	-0.0334	-0.0310
(mm)	July	0.6448**	-0.4524**	-0.5252**	-0.5657**	-0.6963**
	Aug.	-0.3823**	-0.4624**	-0.5837**	-0.4235**	-0.4307**
	Sep.	-0.3921**	-0.5835**	-0.6060**	-0.4121**	-0.5724**
Duration of	June	0.1371	0.0264	0.1327	0.2216	0.1832
sunshine(hr)	July	0.1735	0.2412*	0.4843**	0.5514**	0.6238**
	Aug.	0.9393**	0.9525**	0.9313**	0.9216**	0.9211**
	Sep.	0.2757*	0.4780**	0.6812**	0.7217**	0.8185**

RESULTS AND DISCUSSION

1. Variabilities of Meteorological Elements

The weather conditions from 1992 to 2001, sesame growth, variability of yield character and the variabilities of meteorological elements during sesame growth period are shown in Table 2.

The greatest variabilities of meteorological elements are precipitation of July and September their variability coefficients reach 64.59% and 97.47% respectively, the greatest temperature change during cultivation period was occurred in September and variabilities coefficients were mean temperature 28.56% to the contrary, the mean temperature of August was 2.98%, maximum temperature 8.04% and minimum temperature 11.01% and it has relatively stable meteorological elements.

Table 5. Correlation coefficients between yield conponents and yield

Characters	2)	3)	4)	5)
Plant height(cm)	0.8124**	0.8934**	0.8821**	0.9337**
Length capsule setting(cm)		0.9291**	0.9505**	0.9431**
No. of capsules per plant			0.9124**	0.9665**
Weight of 1,000 grains(g)				0.9437**
Seed yield(kg/10a)				0.8984**

Table 6. Analysis of variance and regressive equation on number of capsules per plant and yield

Characters	F value	Regressive equation
No. of capsules per plant	7.567**	Y=10.1255+0.1725X
Observed yield(1g/10a)	2.914*	Y=21.6151+1.3724X

Table 7. Major meteorological elements, observed and theoretical yields

Year	Max. temperature in Aug.	No. of capsules per plant	Observed yield(O)	Theoretical yield(T)	Differences (O-T)	O/T(%)
1992	34.1	43	51	55	-4	93
1993	29.8	43	51	48	3	106
1994	33.0	44	52	53	-1	98
1995	32.8	40	43	44	-1	98
1996	35.4	45	60	58	2	103
1997	32.8	45	60	56	4	107
1998	35.7	49	70	67	3	104
1999	34.9	48	69	63	6	109
2000	33.1	47	61	65	-4	94
2001	33.1	47	61	60	1	102

Considering the variabilities of yield character during the cultivation period in Table 3, while the variability coefficient of length capsule setting was very low as 4.37% and it is governed by genetic characters peculiar to variety, those of yield and plant height were high as 23.4%, 26.24% 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.*, 1993) and it is considered that these results were due to the differences in character of crops.

2. Correlations among Meteorological Elements, Sesame Growth and Yield.

As shown in Table 4. There are highly significant negative correlations between temperature of June, July, August and September in minimum air temperature and yield, positive correlations between temperature of June, July, August and September in mean and maximum air temperature and yield and then it is found that high temperature condition in June, July, August and September has a favorable influence on the yield.

In the precipitation, a negative correlation between the precipitation of all growth periods, June, July, August and September and yield is shown and then it is found that the small precipitation for growth periods of June, July, August and September has a profitable influence on the yield.

In the duration of sunshine, a positive correlation between duration of sunshine in June, July, August and September and yield is shown and then rich sunshine for those of June, July, August and September produced high yield.

3. Correlation between Growth and Yield Characters

As shown in Table 5. in correlation between growth and yield characters, a highly significant positive correlation among plant height, length capsule setting, number of capsules per plant, weight of 1,000 grains and seed yield is shown and the more yield is, the more sesame yield is.

4. Estimation of Yield and Number of Capsules per Plant Using Meteorological Elements

Kwon and others(1994) made estimated equation of *Alisma plantago* using the maximum temperature in November and Kim and others(1993) made the estimated equation of barley yield with the maximum and minimum temperature of March, but this experiment compares the stream of estimated equations by all meteorological Elements and characters in order to make the estimated equation of yield and since the estimated equation of maximum temperature in August was most effective, the equation for the number of capsules per plant using it in Table 6, $7(Y_1)=10.1255+0.1725X$ was obtained and its significance was acknowledged as shown in Table 6 and yield equation $(Y_2)=21.6151+1.3724X$ was obtained and its significance was recognized as shown also in Table 6 and observed yield and theoretical yield are shown in Table 7 by means of regressive equation.

There is no difference between practical and estimated yields in general.

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