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INFLUENCE OF WEATHER ON THE YIELD OF PEPPER CV. PANNIYUR *1 (PIPER NIGRUM* L.)

T. Pradeepkumar, K. Kumaran. K, C. Aipe and T. P. Manomohandas
Regional Agricultural Research Station, Ambalavayal 673 593. Kerala, India

Abstract : Influence of weather on the yield of black pepper variety Panniyur 1 was studied by resorting correlation and regression analysis. Among the different weather variables. mean maximum temperature in March first fortnight and June second fortnight, total sunshine hours received during February first fortnight, March first fortnight and April second fortnight, total rainfall during March second fortnight and September second fortnight mean maximum relative humidity during March first and mean minimum relative humidity during March second fortnight and July first fortnight were found to be significantly correlated with the pepper yield of succeeding year. By combining three weather variables viz., mean maximum temperature during March first fortnight, maximum temperature during June second fortnight and mean minimum relative humidity during July first fortnight, a regression equation was derived with an R^2 value of 9 can be used in predicting the pepper yield at the end of July first fortnight

Key words : Panniyur 1, *Pipernigrum*, regression eq weather, yield

INTRODUCTION

Black pepper is a weather sensitive crop and the environment influences the yield considerably (Pillai *el al.*. 1987). Early work at the Pepper Research Station, Panniyur has shown that flowering process in pepper plant is initiated by the application of water equivalent to 70 mm or more rainfall within a period of three weeks, following a dry spell (Anon., 1954). According to Pillai *et al.* (1985) pepper requires a short spell of drought during summer months preceding to flowering in **June-July,** Pillai *et al.* (1987) reported that a break in rainfall occurring during any part of the critical period of reproductive phase would affect the pepper yield considerably. Kannan *et at.* (1987) reported that a dry spell from February to April should prevail for satisfactory spiking in **pepper** They observed a low yield in Panniyur1 on occurrence of summer showers. An understanding of the weather effects on yield will be **helpful** in developing prediction models which facilitate the **early** forecasting of pepper yields. Hence a study was **undertaken** at the Regional Agricultural Research Station, Ambalavayal, Wayanad to find out the effect of weather variables on the yield in pepper cv. Panniyur 1.

MATERIALS AND METHODS

Yield data of 20 year old Panniyur 1 pepper garden in an area of 4 ha recorded at the **Regional** Agricultural Research Station, Ambalavayal in the submountainous region of Wayanad, Kerala were analysed against the weather variables. An understanding of the weather effects on yield **will** be helpful in developing prediction models for the early forecasting of pepper yields. The statistical analysis was carried out with the **stabilised** yield data of 11 years starting from 1988 converting block data into per hectare basis Two node cuttings were used for planting as a pure crop at a spacing of 3.6 x 3.6 m. The crop was raised under rainfed **condition.** The soil of the cropped area is deep forest loam, acidic (pH 5.6). moderate in organic matter (organic C 3.65%), medium in available P (10 ppm) and high in K (333 ppm) as reported by Sreekumaran, 1998) The fertilizer and crop protection measures were followed as per the package of practice recommendations of the Kerala Agricultural University (KAU. 1978). The green spike yield was used ' for deriving regression equation with the weather variables. Fortnightly mean weather data (maximum and minimum temperature, maximum and minimum relative humidity, rainfall, number of rainy days and sunshine hours) recorded at the meteriological observatory of the Regional Agricultural Research Station. Ambalavayal were used for analysis. The method of analysis involved two steps. At first, all the weather variables were correlated with yield. Then the variables with significant correlation coefficients were

selected for regression analysis. The harvest data from January to March-April were correlated with the weather data of previous year starting from January. The correlation coefficients obtained were tested for significance at 5 and 1 per cent level of probability and

Table 1. **The weather variables** showing significant correlation coefficients with pepper yield.

Variable	Period	Correlation	Probability
Maximum temperature	March first fort night	0.640	0.032
	June second fortnight	**-0.739**	0.008
Sunshine hours	February first fortnight	**-0.573**	0062
	March first fortnight	**0.521**	0.097
	April second fortnight	**-0.648**	0029
Rainfall	March second fortnight	**-0.632**	0.034
	September second fortnight	0.685	**0.018**
Maximum relative humidity	March first fortnight	-0.787	0.003
Minimum relative humidity	March second fortnight	-0.666	0.023
	July first fortnight	-0.810	0.002

significant ones selected for deriving regression equations.

RESULTS AND DISCUSSION

The yield of Panniyur 1 was correlated with different weather variables and significant coefficients are given in Table 1. The yield was found to be positively correlated with the maximum temperature (r = 0.64) and sunshine hours (r = 0.521) received during March first fortnight. The maximum relative humidity during March first half (r= -0.787) and rainfall during March second fortnight are having negative effect on the yield. Based on a preliminary analysis of rainfall received during March-April. Kannan *et al.* (1987) observed a similar trend in the yield of pepper intercropped with coffee in Wayanad. The present findings revealed that the temperature and sunshine hours received during the first half of March has a significant positive effect on the yield of pepper in Wayanad. The summer rainfall during March thus indirectly reduces the yield of pepper cv. Panniyur 1. Among the other weather variables, the mean minimum relative humidity of July first fortnight (r = -0.810). total sunshine hours received during February first fortnight (r = -0.573) and April second fortnight (r = -0.648) and mean maximum temperature during June second fortnight (r = -0.739) are found to have a negative correlation on yield.

The values of the significant weather variables along with the mean and standard deviation are given in Table 2. Pepper yield was highest during 1993 (9242.5 kg ha^{-1}) and lowest in 1989 (226.5 kg ha^{-1}) and showed an irregular bearing pattern in successive years. The present studies show the triggering effect of weather elements in inducing the irregular bearing habit in Panniyur 1. The weather during March has a significant effect on the yield of pepper. High temperature and sunshine hours during March stimulate the production of more number of spikes in pepper grown in highrangcs. Rainfall and humidity during March offset the drought effect and cause a reduction in pepper yield of succeeding year.

Stepwise regression analysis was carried out for arriving a regression equation by including significant weather variables. By combining three weather variables viz. maximum temperature during March first fortnight (x_1), maximum temperature during June second fortnight (x_2) and minimum relative humidity during July first fortnight (x_3), final regression equation was obtained with an R of 0.926.

$Y = 42658.04 + 1021.3x_1 \bullet - 2032.1x_2 - 232.91x_3$, where Y is yield in kg, XI = maximum temperature during March first fortnight, \2 = maximum temperature during June second fortnight, and x_3 = minimum relative humidity during July first fortnight.

Table 2. Yield and relevant weather variables (mean fortnight values for the year 1988-1998)

Year	Yield, kg ha^{-1}	Max. temp., °C		Sunshine, h			Rainfall, mm		Max. RH%	Min. RH%	
		March I fort-night	June II fort-night	Feb. I fort-night	March I fort-night	April II fart-night	March II fort-night	Sept. II fort-night	March I fort-night	March II fort-night	July 1 fort-night
1988	7221.0	29.96	21.30	156.80	157.1	111.9	11.40	163.0	84.93	33.43	80.93
1989	226.5	29.78	25.60	140.15	125.4	105.2	17.20	88.40	90.37	53.52	91.46
1990	7168.3	30.40	24.86	137.18	117.9	85.1	14.80	130.4	83.66	42.06	70.93
1991	1578.8	29.92	25.10	148.60	129.9	110.9	18.80	22.80	86.13	47.27	8666
1992	3657.0	30.11	24.88	142.90	126.9	114.2	7.00	29.40	90.20	39.12	7900
1993	9242.5	31.98	23.54	113.20	139.9	97.7	0.00	145.6	77.53	.15.00	76.53
1994	602.8	30.00	26.07	149.20	127.0	120.0	39.00	26.20	85.66	56.50	82.13
1995	7528.5	31.39	25.12	106.00	146.6	98.6	15.80	37.60	81.00	48.00	77.93
1996	2511.0	30.61	25.66	139.70	120.5	102.1	0.00	20.80	88.20	35.62	86.73
1997	7372.8	32.34	23.18	124.80	145.9	100.9	0.00	169.it	85.66	42.75	70.66
1998	756.5	30.84	25.62	138.80	137.2	119.8	53.80	52.59	91.06	55.00	86.73
Mean	4351.4	30.66	24.99	136.13	134.0	106.0	15.16	80.59	85.85	44.38	80.88
SD	3389.1	0.880	0.862	15.44	12.28	10.53	17.47	60.53	4.13	8.27	6.70

Table 3. Observed and predicted yield for the period 1988-1998 based on the regression equation

Year	Yield, kg ha^{-1}		Residual
	Observed	Predicted	
1988	7221.0	7060.16	160 83
1989	226.50	-250.00	476.50
1990	7168.25	6668.58	499.66
1991	1 578.80	2026.98	-448.18
1992	3657.00	4452 18	-795. 18
1993	9242.50	9660.34	-417.84
1994	602.88	1192.64	-589.76
1995	7528.30	5520.99	2007.30
19%	2511.00	1577.43	933.56
1997	7372.80	8062.58	-689.78
1998	756.50	1893.61	-1137.11

(Durbin-watson statistic 1.4099)

The beneficial effect drought in pepper preceding flowering in June-July is already established by Pillai *et al.* (1985) High temperature during June second fortnight is found to reduce the yield. June-July is the flowering period in pepper and a continuously drizzling and wet atmosphere throughout the flowering period seems lo be the optimum condition for maximum productivity in pepper (Nalini. 1983). The maximum temperature during monsoon season is greatly dependant upon the quantity and distribution of rniu£aJ] and the influence of temperature can be explained as a consequence of high or low rainfall pattern. The high temperature during this period may also cause spike shedding which results in poor yield. The minimum relative humidity during July first fortnight is found to have a negative effecton the yield. A rise in mean minimum relative humidity causes a reduction in yield compared lo lower humidity. The effect of low minimum relative humidity can be explained on basis of rainfall and high temperature. The rate and quantity of photosynthesis during rainy season is highly influenced by these factors and a low minimum relative humidity thus indirectly contributes lo the high photosynthetic rate in pepper.

Above regression equation can be used in predicting the current year crop yield in the end of July firs) fortnight. The actual yield and predicted yield based on (he regression equation are given in the Table 3. The equation is more effective in predicting the yield of high yielding years Con") compared to low crop (`off') year. The present study clearly establishes that the weather during March and June-July is critical in determining the yield of Panniyur 1. The pepper production of the current year can be forecasted with a high degree of precision using the above regression equation. However, the

rale of weather in inducing irregular bearing habit in Panniyur I along with other physiological and genetic factors needs to bc investigated for developing a yield prediction model.

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