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INFLUENCE OF WEATHER ON YIELD OF RICE

Association of weather elements with crop growth and yields is well known. Although there are numerous studies (Fisher, 1924, Cole 1938; Mallik, 1964, 1966; Inoue *et al.*, 1965; Gangopadhyay and Sarker, 1965; Lomas and Shashoud, 1970; Lomas, 1971, 1973, 1985; Sreenivasan and Banerjee, 1973; Chowdhury and Gore, 1991) regarding crop-weather relationships, our present knowledge is still insufficient and we do not know the exact manner in which various weather elements influence and control the crops, crop phases and the resulting yield. It is, therefore, desirable to have more such studies on as many growth aspects, crops and weather elements as possible.

In spite of the importance of the rice crop as one of the three basic cereals feeding the world's population relatively little research work has been carried out on weather-yield relationships, especially for India where rice is grown as a major crop. Sreenivasan and Banerjee (1973) applied Fisher's technique to find out effect of rainfall on rice crop at Karjat. Adopting this technique, Sreenivasan and Banerjee (1978) found that additional rainfall above the normal, exerts negative influence during sowing, tillering and flowering stages of rice at Aduthurai and Coimbatore. All the studies cited above used Fisher's technique except by Chowdhury and Gore (1991) who have used curvilinear technique for rice crop in Bhandara district and observed that a combination of maximum temperature of 30.5° C, 81% relative humidity and rainfall of 1000 mm during physiological growth phases is ideally suited to give optimum rice yield. This paper analyses rice production at Pattambi (10 48′ N 76 12′E) in Kerala and investigates the relationship between weather and rice yield by using curvilinear technique. The study was carried out with the kharif rice (Jaya). Yield data were obtained from the Regional Agricultural Research Station (Kerala Agricultural University) Pattambi. In this station, the paddy is normally transplanted between end of June to middle of July and harvested in September-October. Twelve years rice yield data during the period 1974-1990 were considered for this study. For some of the years, data could not be considered as it was missing or unreliable. Total rainfall, total sunshine hours and average maximum and minimum temperatures for the growing period were collected from the crop weather observatory at Pattambi. Curvilinear technique as described by Ezekiel and Fox (1959) and Samui and Chowdhury (1994) was used for analysis.

Comparison between residual Z'' and Z''' (Table 1) show that the new residuals decreased in eight cases and increased in four cases. Apparently the third estimates are nearer the actuals than the second estimates. The approximation was terminated at this stage, since the decrease in sum of squares of Z''' is marginal than that of Z" and was felt that the curves have approached the underlying true curves.

The curves shown in Fig 1(a) to (d) represent the net relation between the rice yield and maximum and minimum temperature, bright sunshine hours and rainfall. The inferences are:

(i) Yield of rice (Jaya) at Pattambi increases as the average daily minimum temperature increases from 21.5° C. The optimum value of the minimum temperature is 23.5° C.

(ii) Yield of rice (Jaya) at Pattambi decreases as the average daily maximum temperature increases from 29.1 C. The optimum value of the maximum temperature is less than or equal to 29.1 C. High temperature induces sterile spikelets and hence reduction in yield.

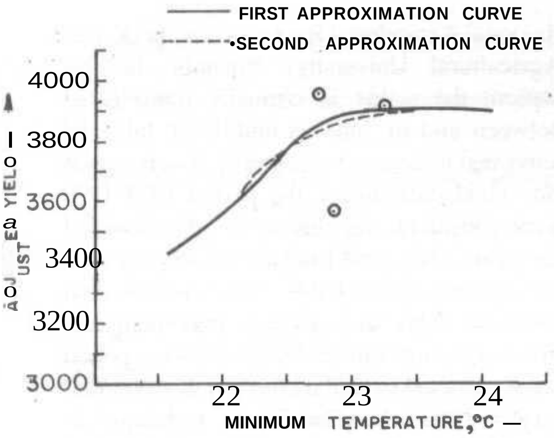

Fig 1(a). Apparent relation of rice yield (Jaya) to minimum temperature adjusted to maximum temperature, sunshine hours and rainfall

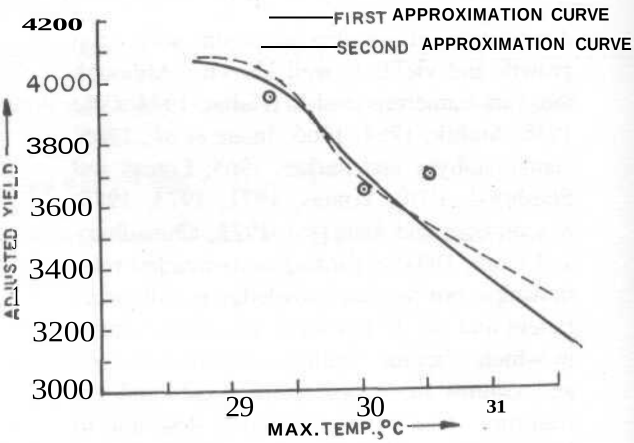

Fig 1(b). Maximum temperature and yield of rice (Jaya) adjusted to minimum temperature, sunshine hours and rainfall

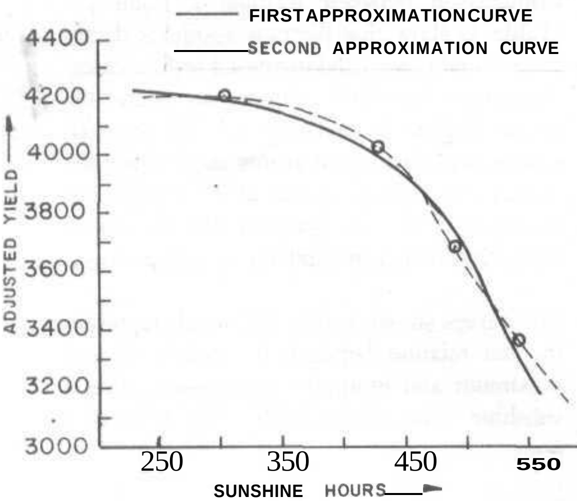

Fig l(c). Sunshine hours and yield of rice (Jaya) adjusted to maximum and minimum temperatures and rainfall

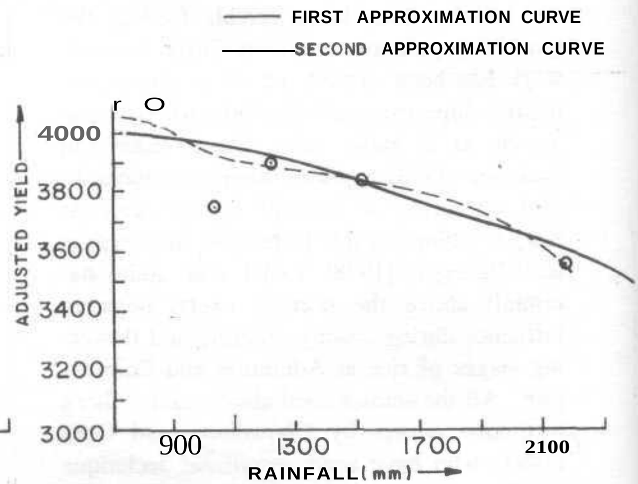

Fig l(d). Rainfall and yield of rice (Jaya) adjusted to maximum and minimum temperatures and sunshine hours

(iii) Yield slowly decreases as the total bright sunshine (BSS) hours during planting to harvesting increases from 300 hours to 450 hours. Beyond 450 hours of BSS, the fall is rapid. The optimum value of the total bright sunshine hours is less than or equal to 300 hours.

(iv) Yield decreases with increase in total amount rainfall during planting to maturity from 900 to 1100 mm. Yield appears to remain more or less stationary so long the total rainfall remains within 900 mm and decreases as the total rainfall exceeds 900 mm.

The optimum value of the total rainfall is 900 mm. The present study thus illustrates the ability of the curvilinear analysis both to bring out a series of crop weather relationships which are not observable on the surface and to provide a basis for estimating the probable effect of new combinations of independent factors upon the dependent one.

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REFERENCES

Chowdhury, A. and Gore, P. G. 1991. Effect of weather on rice crop in Bhandara districts : A curvilinear approach. *Mausam* 41(3) : 279-286

Cole, J. S. 1938. Correlation between annual precipitation and the yield of wheat in the Great Plains. *U.S. Dept. Agric. Tech. Bull.* 636 : 40

Ezekiel, M. and Fox, K. A. 1959. *Methods of Correlation and Regression Analysis.* John Wiley and Sons, New York, pp. 204-248

Fisher, R. A. 1924. The influence of rainfall distribution on the yield of wheat at Rothamsted Philos. *Trans. R. Soc. London* 213 : 89-412

Gangopadhyay, M. and Sarker, R. P. 1965. Influence of rainfall distribution on the yield of wheat crop. *Agric. Meteorol.* 2 : 331-350

Inoue, E., Mihara, Y. and Tsu Boi, Y. 1965. Agrometeorological studies on rice growth in Japan. *Agric. Meteorol. 2* : 85-107

Lomas, J. 1973. Forecasting wheat yields from rainfall data in Iran. Report presented to WMO, Sept. 1971

Lomas, J. 1973. Forecasting wheat yield from rainfall data in Iran, Report presented to WMO, Jan. 1973

Lomas, J. 1985. Weather and rice yield relationships in Tropical Costa Rica. *Agric. For. Meteorol.* 35 : 133-151

Lomas, J. and Shashoud, Y. 1970. The effect of rainfall on wheat yield in an arid region : Plant responses to climatic factors. *Proc. Uppsala Symp. Nat. Resour. Res.*, UNESCO

Mallik, A. K. 1964. Climatology of the crop seasons of India: 1. Rice. *Indian J. Meteorol. Geophys.* 15 : 555-564

Mallik, A. K. 1966. Climatology of the crop seasons of India: 2. Rice. *Indian J. Meteorol. Geophys.* 17 : 39-48

Samui, R. P. and Chowdhury, A. 1994. Studies on effect of weather on traditional photosensitive PTB-1 and high yielding Jaya varieties by curvilinear technique at Pattambi, Kerala. *Mausam* 45(4) : 351-360

Sreenivasan, P. S. and Banerjee, J. R. 1973. The influence of rainfall on yield of rainfed rice of Karjat (Colaba District). *Agric. Meteorol.* 11 : 283-292

Sreenivasan, P. S. and Banerjee, J. R. 1978. Behaviour of Co-25 variety of unirrigated rice under two environments. *Agric. Meteorol.* 19 : 189-202