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Duration to and height at the time of flowering in relation to selected weather parameters : A study in the case of ragi over Bangalore

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सार — बंगलूर में किए गए क्षेत्रीय प्रयोग के आधार पर, रागी के मामले में पुष्पन के समय, उसकी अवधि और उंचाई पर, चयनीय मौसम प्राचलों के प्रभाव का पता लगाया गया है। यह पाया गया है कि रागी के मामले में पुष्पन की अवधि औसत तापमानों और औसत वाष्पन के साथ धनात्मक रूप में संबंधित है। पुष्पन के समय की ऊंचाई का मौसम प्राचलों के साथ कोई सार्थक सहसंबंध नहीं है।

ABSTRACT. On the basis of field experiments conducted at Bangalore, the influence of selected weather parameters on the duration to and the height at the time of flowering in the case of ragi has been made. It has been found that the duration to flowering in the case of ragi is positively correlated with average temperatures and average evaporation. The height at the time of flowering does not have any significant correlation with the weather parameters.

1. Introduction

Flowering in plant species represents one of the most important stages of development. It represents the beginning of the reproductive stage of development. Therefore, several workers have studied the influence of weather parameters on this important phenophase. Francis (1970), Hunter (1974), Bonaparte and Brawn (1976), Bruer *et al.* (1976) have all examined the influence of different environmental factors like photoperiod, temperature etc, on the duration from emergence to tassel initiation and also on the total stem length at the time of tassel initiation in respect of selected corn hybrids. Troyer and Larkins (1985) pointed out that flowering date is one of the important measures of maturity in species like corn. Campbell and Read (1968) studied the influence of environmental conditions on the stem length of Chinook wheat during the vegetative stage. Larry White (1979) presented relationships between flowering dates of 53 plant species and accumulation of temperature, solar radiation etc, through a study of four years near Sydney. This is, because as he said, agriculturists need advance knowledge of a plant when it will reach a specific developmental stage to plan the application of herbicides, to begin grazing season etc. Upendra Shanker and Gupta (1981) treated height as an important measure of growth and made a correlation study between the heights of two varieties of paddy crops and weather elements. Rao (1980) attempted a similar study in respect of jute.

It would be appreciated that (a) flowering stage being an important phenophase, the influence of weather parameters on this stage merits a close study and (b) the duration to flowering and the height at the time of flowering are two important parameters that characterise this phenophase. Hence the present study.

2. Material and method

The variety sown is ragi (*Eleusine coracana*) Indaf 5. The experiments were conducted in the fields of Gandhi Krishi Vignana Kendra, Bangalore. The period under study was from 1982 to 1985 when 24 sowings of ragi on different dates were made. The cultural practices were kept the same for all the different sowings. In each case biological observations were taken by random sampling and their averages were calculated as follows :

(*a*) The duration from the date of sowing to flowering,

(*b*) The heights at the time of flowering.

The daily maximum and minimum temperatures, the average daily temperature above 10°C level $(T_{max}+T_{min})/2-10°C$ (called heat unit), the evaporation in mm from the class A open pan evaporimeter, the rainfall in mm, the daily sunshine hours and the mean wind speeds in kmph for each period under consideration, *i.e.*, from the date of sowing to the time of flowering were obtained from the daily

TABLE 1

Correlation matrix : Number of days from sowing to flowering of ragi and accumulated weather parameters

	X_2	X_3	X_4	X_5	X_6	X_7	Y
X_1	0.8430**	0.8743**	0.9128**	—0.6324**	0.8802**	—0.7533**	0.8400**
X_2		0.7214**	0.8580**	—0.3037	0.5955**	—0.4900*	0.8547**
X_3			0.7920**	—0.4765*	0.7402**	—0.6074**	0.6815**
X_4				—0.4076*	0.7663**	—0.6568**	0.8324**
X_5					—0.8221**	0.8104**	—0.2813
X_6						—0.9223**	0.5364**
X_7							—0.3849

Meaning of the symbols :

X_1—Maximum temperature (°C), X_2—Minimum temperature (°C), X_3—Heat unit (°C) day, X_4—Evaporation (in mm), X_5—Rainfall (in mm), X_6—Sunshine (in hr), X_7—Wind speed (in kmph), Y=Duration in days

*Significant at 5% level, **Significant at 1% level

observational records of the meteorological observatory located nearby. Accumulated values of the above parameters also for the entire duration from sowing to flowering, for each experiment were calculated. Also the average daily values of the above parameters were calculated.

3. Discussion

Table 1 gives the simple correlation matrix of the duration to flowering of ragi from the date of sowing, with different accumulated weather parameters and of the different accumulated parameters among themselves.

In this case of ragi positive significant correlation coefficients have been found with cumulative maximum, cumulative minimum, cumulative heat unit, cumulative evaporation and cumulative sunshine hours. As can be seen from Table 1, these values are very significant and are ranging from 0.5364 to 0.8547, 0.8547 being for cumulative minimum. The individual equations also are provided in Table 2. The multiple correlation coefficients of the duration to flowering from the date of sowing with various combinations of cumulative maximum, cumulative heat unit etc, are presented in the Table 4. The highest value is 0.9512 for multiple correlation of the duration with cumulative maximum, cumulative heat unit, cumulative evaporation and cumulative sunshine hours. The corresponding regression equation is $Y=32.5457+0.0270X_1 -0.0073\,X_3 + 0.0084\,X_4 - 0.0228\,X_6$. It would, therefore, appear that higher accumulated values would increase the duration to flowering of ragi. With the accumulated values of heat units the duration will increase in the case of ragi as can be seen from the Table 1. But the higher accumulated values may be due to larger duration itself. Therefore, it was proposed to examine the correlation of duration with respect to the average values of heat unit and other elements as can be seen from Tables 3, 5 and 6.

TABLE 2

Individual regression equations connecting the duration to flowering from the date of sowing of ragi with various accumulated weather parameters

Variables considered	Individual regression equations
X_1	$Y = 50.8064 + 0.0128\,X_1$
X_2	$Y = 39.1884 + 0.0277\,X_2$
X_3	$Y = 64.4644 + 0.0149\,X_3$
X_4	$Y = 60.2698 + 0.0381\,X_4$
X_5	$Y = 86.3705 - 0.0129\,X_5$
X_6	$Y = 75.7535 + 0.0134\,X_6$
X_7	$Y = 89.4032 - 0.0104\,X_7$

$X_1, X_2, \ldots, X_7$ have the same meaning as in Table 1

TABLE 3

Individual regression equations connecting the duration to flowering from the date of sowing of ragi with various average weather parameters

Variables considered	Individual regression equations
X_1	$Y = 51.5318 + 1.0586\,X_1$
X_2	$Y = 48.9950 + 1.9292\,X_2$
X_3	$Y = 69.3994 + 0.9415\,X_3$
X_4	$Y = 58.8862 + 3.4012\,X_4$
X_5	$Y = 86.9157 - 1.3379\,X_5$
X_6	$Y = 78.1132 + 0.8109\,X_6$
X_7	$Y = 90.4204 - 0.0269\,X_7$

Meanings of the symbols as in Table 1

TABLE 4

Multiple regression equation of duration to flowering from the date of sowing of ragi with various combinations of accumulated weather parameters

The variables considered	Multiple regression equations	*R* adj	d.f.	*F* value
X_1, X_2, X_3, X_4, X_5, X_6 and X_7	$Y=29.7509+0.0268X_1-0.0012X_2-0.0076X_3+0.0103X_4-0.0010X_5-0.0190X_6+0.0001X_7$	0.9446**	16, 7	28 3323
X_1, X_2, X_3, X_4, X_6 and X_7	$Y=29.4513+0.0270X_1-0.0012X_2-0.0077X_3+0.0096X_4-0.0187X_6+0.0001X_7$	0.9481**	17, 6	35.0814
X_1, X_3, X_4, X_6 and X_7	$Y=28.9858+0.2064X_1-0.0075X_3+0.0039X_4-0.0180X_6+0.0001X_7$	0.9508**	18, 5	44.4258
X_1, X_3, X_4, X_6	$Y=32.5457+0.0270X_1-0.0073X_3+0.0084X_4-0.0228X_6$	0.9512**	19, 4	55.6323
X_1, X_3, X_6	$Y=30.5012+0.0301X_1-0.0075X_3-0.0236X_6$	0.9505**	20, 3	72.6729

$X_1, X_2, \ldots, X_7$ have the same meanings as in Table 1

TABLE 5

Correlation matrix : Mean number of days from sowing to flowering of ragi and average weather parameters

	X_2	X_3	X_4	X_5	X_6	X_7	Y
X_1	0.5602**	0.8040**	0.7977**	—0.7927**	0.9304**	—0.8573**	0.5328**
X_2		0.4641*	0.6155**	—0.2757	0.4161*	—0.4744*	0.3869
X_3			0.6493**	—0.4936*	0.6565**	—0.6067**	0.4102*
X_4				—0.4555*	0.7103**	—0.7501**	0.6337**
X_5					—0.8452**	0.8162**	—0.3454
X_6						—0.9219**	—0.3509
X_7							—0.4784*

Meanings of the symbols as in Table 1

TABLE 6

Multiple regression equation of duration to flowering from the date of sowing of ragi with various combinations of average weather parameters

The variables considered	Multiple regression equations	*R* adj	d.f.	*F* value
X_1, X_2, X_3, X_4, X_5, X_6 and X_7	$Y = 35.2542+2.8390X_1-0.9806X_2-0.6388X_3+3.4884X_4-1.2391X_5-3.9509X_6-0.0161X_7$	0.6844*	16, 7	3.8950
X_1, X_2, X_3, X_4, X_5 and X_6	$Y = 24.3623+2.9392X_1-0.9370X_2-0.7166X_3+3.8472X_4-1.4905X_5-3.6442X_6$	0.6982**	17, 6	4.6466
X_1, X_3, X_4, X_5 and X_6	$Y = 20.1456+2.4526X_1-0.6178X_3+3.5284X_4-1.6252X_5-3.3335X_6$	0.7015**	18, 5	5.4568
X_1, X_4, X_5, X_6	$Y = 34.2451+1.5742X_1+3.7953X_4-1.9842X_5-3.0504X_6$	0.7040**	19, 4	6.6506
X_4, X_5, X_6	$Y = 66.2393+5.2054X_4-2.5676X_5-2.0758X_6$	0.6764*	20, 3	7.4652

Meanings of the symbols as in Table 1

It can be seen from the Table 5 that in the case of ragi, the simple correlation coefficient of duration to flowering with average maximum temperature, (r=0.5326), average minimum temperature (r=0.3869), average heat unit (r=0.4102) and average evaporation (r=0.6337) are positive and significant. Table 3 gives linear regression equation of duration with each of the average weather parameters in the case of ragi.

Table 6 gives multiple regression equation of duration of ragi with average weather parameters. The highest multiple correlation coefficient of 0.7040 was obtained when average maximum, average evaporation, average rainfall and average sunshine are considered. In the case of wheat Mallik and Subramanian (1956) suggested that the minimum temperature is primarily responsible in determining the length of the time taken to flowering. According to them warmer winter nights tend to induce early flowering. From the Tables 5 and 6 it will be seen that the duration to flowering in the case of ragi is positively correlated with temperatures.

In the case of ragi, height at the time of flowering does not have any significant correlation coefficient either with cumulative parameters or average weather parameters. Upendra Shanker and Gupta (1981) have shown that in the case of paddy the heights are negatively correlated with temperatures. But in the case of ragi the response in terms of height is not correlated with weather parameters.

4. Conclusions

(*i*) The duration of flowering is positively correlated with average temperatures and average evaporation in the case of ragi.

(*ii*) The height at the time of flowering does not have any significant correlation either with cumulative or mean weather parameters in the case of ragi.

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References

Bonaparte, E.E.W.A., 1975, *Annals of Bot.*, **39**, pp. 853-855.

Bonaparte, E.E.W.A. and Brawn, R.J., 1976, *Can. J. of Pl. Sci.*, **56**, p. 699.

Breur, C.M. *et al.*, 1976, *Can. J. of Pl. Sci.*, **56**, pp. 795-798.

Campbell, C.A. and Read, W.W.L., 1968, *Can. J. of Pl. Sci.*, **48**, p. 299.

Francis *et al.*, 1970, *Crop Sci.*, **10**, pp. 465-468.

Hunter, R.B. *et al.*, 1974, *Can. J. of Pl. Sci.*, **54**, pp. 71-78.

Larry M. White, 1979, *Agri.Met.*, **20**, pp. 189-204.

Mallik, A.K. and Subramanian, V.K., 1956, *Indian J. Met. Geophys.*, **7**, pp. 173-178.

Rao., P.V. 1980, *Agri. Met.*, **22**, pp. 45-52.

Troyer, A.F. and Larkins, J.R., 1985, *Crop Sci.*, **25**, p. 695.

Upendra Shanker and Gupta, B.R.D., 1981, *Agri. and Forest Met.*, **23**, pp. 137-142.