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Climate in the raising of Paddy at Tirurkuppam (Chingleput District) *

by

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Synopsis : The result of a study of crop weather relationships in different crops of paddy grown in Chingleput district, Madras State are dealt with in this article. It is interesting that paddy is grown as the main crop in 75 per cent of the area under cultivation in this district which is devoid of any dependable major irrigational facilities.

Introduction : The tract, where the Rice Research Station at Tirurkuppam is situated in Chingleput district, is mainly fed by tanks, which get filled up during the north-east monsoon period of October to December. The peculiarity of this tract is that it has a large number of wells to supplement the tank irrigation. Paddy is the main crop in this tract practically occupying three-fourths of the area under cultivation.

There are four systems of paddy cultivation in this tract and they are wet, semi-wet, garden land and dry cultivation of paddy. The main paddy seasons are i. Hot weather or *swarnavari* season : May to September, ii. Main *samba* season : August to February and iii. Cold weather or *navarai* season : December to May.

In consideration of the large area occupied by paddy crop in this tract, that is devoid of dependable major irrigational facilities, a study of crop-weather relationship in different crops of paddy grown in this tract was taken up.

MATERIALS AND METHODS :

Materials : The data on the dates of sowing, flowering and harvest and the yields of grain of *swarnavari*, *samba* (G.E.B. 24) and *Navarai* (Co. 18) paddy crops, raised at the Agricultural Research Station at Tirurkuppam were compiled from the Station Reports for the period 1942–'43 to 1959–'60. For the *swarnavari* crop the data were available for Co. 13 paddy for ten years from 1943–'44 to 1952–'53 and for T.K.M. 6 paddy for seven years from 1953–'54 to 1959–'60. As the duration and normal yields of Co. 13 and T.K.M.6. are identical, both the varieties were taken together for this study for the *swarnavari* season. For *navarai* paddy data on Co. 18 were available for all the 17 years from 1943–'44 to 1959–'60.

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The daily rainfall data were also compiled for the various corresponding periods. In addition, the daily data on maximum temperature and mean relative humidity were compiled for the years 1956 to 1960 for the periods representing the different life phases of the three crops of paddy. In the case of *navarai* crop only six years data were available (1955 to 1960).

Methods: The duration of the nursery period, growth period, maturity period and entire life period, taking the flowering period for each crop as nine days, were worked out together with the data on rainfall and number of rainy days (a day with 5 cents and above of rain being taken as a rainy day) for these periods. These data were compiled separately for each crop. The effect of these various durations on the grain yield of each crop was statistically assessed. Likewise the effect of rainfall and number of rainy days in these various periods on the grain yield of the crop was established. The rainfall pattern in these periods seems to have no significant effect on the grain yield of everyone of these three crops of paddy. Hence only the correlations worked out with the durations of the various periods and the grain yield of each crop are given in Table I.

For each crop the period from the date of planting to the day prior to the date of harvest was divided into weekly intervals and the total rainfall and number of rainy days for each of these weekly intervals were computed. The influence of rainfall and number of rainy days in these various weekly periods on the grain yield of the crop was statistically determined separately for each crop. The simple correlations worked out in this connection for every one of these three crops of paddy together with the nature of significance are presented in Tables II and III.

The standard deviation of the grain yield per acre of each crop was worked out. The limits of Mean $\pm \frac{1}{2}$ S. D. were established for each crop. If the yield in a particular year is above Mean plus $\frac{1}{2}$ S.D. it is taken as good yield and marked as A. In case the yield in a particular year is less than Mean minus $\frac{1}{2}$ S. D. it is taken as poor yield and indicated as B. If the yield is in the range of Mean $\pm \frac{1}{2}$ S. D. it is shown as C. The details compiled on this principle are furnished in Table IV.

The cyclic nature of variations in the grain yields of each of these three crops was statistically established by working out S.D., C.V. and S.E. by the Centre Shift Average method for periods of 1 year, 2 years, etc., upto 8 years as the total number of years is only 17 in *swarnavari* and *navarai* crops and 18 in *samba* crop. The concerned data are presented in Table V.

The totals of maximum temperature in the different phases of growth of each crop from the date of sowing to the day prior to the date of harvest were computed to assess the nature of thermal requirements of each crop in its different growth phases. The effect of these thermal requirements on the grain yield of the crop was also statistically assessed for each crop. Table VI contains the data collected and computed in this connection.

Discussion : The data presented in Table I indicate that of the four periods considered, only the duration of the maturity period has negative significant influence on the grain yields of *swarnavari* and *navarai* crops of paddy, more conspicuously in the latter. In the case of *samba* crop which is a long duration crop, even the duration of the maturity period has no significant influence on the grain yield. It is to be tentatively inferred that the longer the duration of the maturity period in the case of *swarnavari* and *navarai* crops, the lower will be the grain yield of these crops per acre.

In regard to the study of the influence of the weekly pattern of rainfall from planting to harvest on the grain yield of each of these three crops of paddy, the inferences drawn from tables II and III are presented hereunder crop wise.

(a) *Swarnavari crop :* (i) More than the distribution, the total rainfall in the fourth week after planting has a greater negative influence on the grain yield of the crop. Perhaps the crop requires dry weather in this week to step up its growth phase. (ii) Only the total rainfall in the fifth week after planting has highly significant and positive influence on the grain yield of the crop. This indicates that the crop requires alternate spells of dry and wet weather to enable it to have a rank growth and record high yield.

(b) *Samba crop :* (i) Sixth week and tenth week after planting appear to be important periods when this crop wants only dry weather for its luxuriant growth. In the sixth week more than the total rainfall, its distribution has a greater depressing effect on the grain yield of the crop. In the case of tenth week, only the total rainfall has a negative and significant influence on the performance of the crop. It is to be noted that both these critical weeks practically come in the growth period of the crop. This inference connotes that the crop does require alternate spells of wet and dry weather, especially in its growth period, particularly only dry weather in the sixth and tenth weeks after planting. (ii) In the fourteenth week after planting the crop responds favourably, though not very significantly, to the total rainfall only but not to its distribution. This is the period when the grain development will be nearing its completion stage.

(c) *Navarai crop:* (i) More than the total rainfall, its distribution in the seventh week after planting has a greater positive influence on the grain yield of the crop. The influence of total rainfall is also positive and significant, but only at the level of P = 0.1. (ii) Ninth week seems to be another critical period when the crop cannot tolerate cloudy weather with rains 5 cents and above per day. But this inference is supported only at the level of P = 0·1. This crop also appears to require alternate spells of wet and dry weather for its normal growth. This ninth week represents the first phase of flowering in the crop. So at the initial stage of flowering the crop requires only dry and bright weather.

In regard to the similarity in the behaviour of fluctuations in the grain yields of these three crops of paddy, the details furnished in Table IV will give an idea to the effect that each crop behaves as an independent unit. Out of 17 years' data all the three crops behaved alike by giving either good (above mean plus $\frac{1}{2}$ S. D), poor (below Mean — $\frac{1}{2}$ S. D), or range yield (Mean + $\frac{1}{2}$ S. D. only in five years). In the remaining twelve years they have behaved differently. If these twelve years' performances of the three crops are considered in pairs, it is tentatively inferred that *swarnavari* and *samba* crops behave alike in 7 out of 12 years, *swarnavari* and *navarai* in one out of 12 years and *samba* and *navarai* in 3 out of 12 years. Hence it is evident that in 12 out of 17 years, both the *swarnavari* and *samba* crops have fared alike by giving either good, poor or range yields, whereas in the other two combinations of *swarnavari* and *navarai* as well as *samba* and *navarai*, the years of similarity in yields are only 6 and 8 respectively. So it may be tentatively concluded that if the season for the *swarnavari* crop is good, it is likely to be equally good only for the *samba* crop, but not to the *navarai* crop.

As regards the cyclic nature in the fluctuations of grain yields, the data presented in Table V indicate that only *samba* and *navarai* crops have a natural tendency to fluctuate in yields in periods of 6 and 5 years respectively, as indicated by the lowest values of coefficient of variation. This inference supports partially the inference drawn from Table IV to the effect that each crop behaves as a separate unit. When data are collected for some more years it may be possible to narrow down the cyclic period in *samba* and *navarai* crops and also to establish a cyclic period in the case of *swarnavari* crop as well.

The data given in Table VI show that each crop has its own specific pattern of thermal requirement in its different stages of growth and also in its entire life period. So far as the effect of these various thermal requirements on the grain yield is concerned, the thermal requirement of *swarnavari*

crop only in its growth period seems to have highly significant and positive influence on its grain yield. In the case of other two crops no such relationship seems to exist. But this is only a tentative inference as the data available for this study cover only 5 years in the case of *swarnavari* and *samba* crops and 6 years in *navarai* crop. With data covering longer periods it may be possible to get a more precise inference in regard to the influence of thermal requirements of these crops in its different growth phases on their grain yields.

Summary and Conclusion: The longer the duration of the maturity period, the lower will be the grain yield in *navarai* crop. To some extent this inference holds good in *swarnavari* crop as well. In the case of the long duration *samba* crop no such depressing effect of the duration of the maturity period on its grain yield is noted. The critical periods, when the crop requires a particular type of weather, either dry or cloudy with rains, appear to be different for these three crops of paddy. These critical periods are given hereunder cropwise:

Swarnavari : 4th and 5th weeks after planting.
Samba : 6th, 10th and 14th weeks after planting.
Navarai : 7th and 9th weeks after planting.

This inference leads to the conclusion that each crop requires its own type of climate for its normal growth and performance. *Swarnavari* and *samba* crops behave practically alike while *navarai* crop has no such correlation with anyone of the preceding two crops. But in regard to the cyclic nature of fluctuation in the yields of these three crops of paddy, *samba* and *navarai* have cycles of 6 and 5 years respectively. With 17 years' data it has been found to be not possible to establish statistically a similar cycle in the case of *swarnavari* crop. Each crop has its own particular pattern of thermal requirements in its different growth phases. Only in the case of *swarnavari* crop, its thermal requirements in its growth period significantly and positively influence the grain yield of the crop. With reference to other two crops no such effect seems to exist.

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TABLE I.

Duration of different periods in days and their effect on grain yield.

S. No.	Details of periods	Swarnavari			Samba			Navarai		
		A	B	C	A	B	C	A	B	C
1.	Nursery ...	+ 0·29	0·25	No	+ 0·29	0·24	No	+ 0·33	0·24	No
2.	Growth ...	— 0·35	0·24	No	— 0·18	0·25	No	+ 0·39	0·24	No
3.	Maturity ...	— 0·41	0·24	Yes at P = 0·1	— 0·38	0·23	No	— 0·53	0·22	Yes at P = 0·05
4.	Life period ...	— 0·27	0·25	No	— 0·28	0·24	No	+ 0·24	0·25	No

N. B.: Flowering period is taken as 9 days for all the three crops.

TABLE II.

Weekly Rainfall and Yield of Paddy.

S. No.	Details of the weeks considered (planting to harvest)	Swarnavari			Samba			Navarai		
		A	B	C	A	B	C	A	B	C
1.	First ...	+ 0·34	0·24	No	+ 0·12	0·25	No	+ 0·32	0·24	No
2.	Second ...	— 0·01	0·26	No	+ 0·35	0·23	No	+ 0·16	0·25	No
3.	Third ...	— 0·12	0·26	No	+ 0·31	0·24	No	+ 0·35	0·24	No
4.	Fourth ...	— 0·48	0·23	Yes at P = 0·05	— 0·09	0·25	No	+ 0·12	0·26	No
5.	Fifth ...	+ 0·67	0·19	Yes at P = 0·001	— 0·12	0·25	No	— 0·08	0·26	No
6.	Sixth ...	— 0·23	0·25	No	— 0·41	0·23	Yes at P = 0·1	— 0·27	0·25	No
7.	Seventh ...	— 0·01	0·26	No	— 0·12	0·25	No	+ 0·47	0·23	Yes at P = 0·1
8.	Eighth ...	+ 0·05	0·26	No	+ 0·38	0·23	No	+ 0·14	0·26	No
9.	Ninth ...	— 0·28	0·25	No	— 0·11	0·23	No	— 0·37	0·24	No
10.	Tenth ...	+ 0·40	0·24	No	— 0·52	0·21	Yes at P = 0·01	+ 0·24	0·25	No
11.	Eleventh ...	— 0·13	0·26	No	— 0·07	0·25	No	— 0·12	0·26	No
12.	Twelfth ...	...	...	...	— 0·13	0·25	No	— 0·04	0·26	No
13.	Thirteenth ...	...	...	...	— 0·05	0·25	No	— 0·24	0·25	No
14.	Fourteenth ...	...	...	...	+ 0·43	0·23	Yes at P = 0·1	...	...	...
15.	Fifteenth ...	...	...	...	+ 0·03	0·25	No	...	...	...

A—Correlation coefficient (r); B—Standard Error (S. E.); C—Nature of significance.

TABLE III.

Weekly Number of Rainy days (0·05" and above) and Yield of Paddy.

S. No.	Details of the weeks considered (planting to harvest)	Swarnavari			Samba			Navarai			Remarks
		A	B	C	A	B	C	A	B	C	
1.	First ...	+0·20	0·25	No	+0·18	0·25	No	−0·04	0·26	No	A—Correlation
2.	Second ...	−0·16	0·25	No	+0·08	0·25	No	*	0·26	No	coefficient
3.	Third ...	+0·14	0·26	No	−0·01	0·25	No	+0·26	0·25	No	(r)
4.	Fourth ...	−0·41	0·24	Yes at P = 0·1	−0·04	0·25	No	+0·24	0·25	No	B—Standard Error (S. E.)
5.	Fifth ...	+0·26	0·25	No	+0·10	0·25	No	−0·38	0·24	No	
6.	Sixth ...	−0·07	0·26	No	−0·47	0·22	Yes nearly at P = 0·05	−0·35	0·24	No	C—Nature of significance
7.	Seventh ...	+0·22	0·25	No	−0·26	0·24	No	+0·50	0·22	Yes at P=0·05	
8.	Eighth ...	+0·31	0·25	No	+0·30	0·24	No	+0·01	0·26	No	* Correct figures is r = +0·0010
9.	Nineth ...	+0·07	0·26	No	+0·26	0·24	No	−0·41	0·24	Yes at P = 0·01	
10.	Tenth ...	+0·07	0·26	No	−0·38	0·23	No	+0·21	0·25	No	** Correct figures is r = +0·0036
11.	Eleventh ...	−0·13	0·26	No	**	0·25	No	−0·17	0·25	No	
12.	Twelfth ...	...	...	...	−0·11	0·25	No	−0·36	0·24	No	
13.	Thirteenth ...	...	...	...	+0·13	0·25	No	−0·08	0·26	No	
14.	Fourteenth ...	...	...	...	−0·12	0·25	No	...	...	...	
15.	Fifteenth ...	...	...	...	−0·13	0·25	No	...	...	...	

TABLE IV.

Yield of Paddy.

S. No.	Year	Swarnavari	Samba	Navarai	Remarks
					I. *Swarnavari crop:*
1.	1943—44	C	C	A	Mean = 2793 lb
2.	44—45	B	B	B	S. D. = 485
3.	45—46	B	B	B	A = > Mean + 1/2 S. D. = > 3036 lb
4.	46—47	C	C	B	B = < Mean − 1/2 S. D. = < 2550 lb
5.	47—48	C	B	B	C = Between 2550 and 3036 lb
					II. *Samba crop:*
6.	48—49	A	A	A	Mean = 1729 lb
7.	49—50	A	C	A	S. D. = 585
8.	50—51	A	C	B	A = > Mean + 1/2 S. D. = > 2022 lb
9.	51—52	C	C	B	B = < Mean − 1/2 S. D. = < 1436 lb
10.	52—53	A	A	B	C = Between 1436 and 2022 lb
					III. *Navarai crop:*
11.	53—54	B	B	C	Mean = 2062 lb
12.	54—55	A	A	C	S. D. = 364
13.	55—56	C	B	B	A = > Mean + 1/2 S. D. = > 2244 lb
14.	56—57	B	C	C	B = < Mean − 1/2 S. D. = < 1880 lb
15.	57—58	C	C	C	C = Between 1880 and 2244 lb
16.	58—59	A	A	A	
17.	59—60	C	C	A	

TABLE V

Cyclic Nature of Variations in the Grain Yields of Paddy.

No.	Centre shift average for periods of	Swarnavari			Samba			Navarai		
		S. D.	C. V.%	S. E.	S. D.	C. V.%	S. E.	S. D.	C. V.%	S. E.
1.	One year	485	17·4	118	585	33·8	138	364	17·7	88
2.	Two years	391	14·0	98	369	21·3	90	291	14·3	73
3.	Three years	331	11·8	86	339	19·3	85	218	10·8	56
4.	Four years	282	10·0	75	284	16·2	73	160	8·0	43
5.	Five years	230	8·1	64	245	13·9	66	112	5·6	31
6.	Six years	180	6·2	52	125	6·9	35	292	14·6	84
7.	Seven years	145	5·0	44	135	7·5	39	96	4·8	29
8.	Eight years	109	3·8	34	109	6·0	33	78	3·9	25

TABLE VI

Thermal requirements and their influence on yield.

Name of Crop	S. No.	Details of period	Total °F	Duration in days	Daily mean	Correlation co-efficient	Standard error	Nature of significance
Swarnavari	1.	Nursery period	3434	34	101	— 0·47	0·51	No
	2.	Growth period	4329	43	101	+ 0·95	0·18	Yes at P=0·01
	3.	Flowering period	845	9	94	+ 0·25	0·56	No
	4.	Maturity period	2874	31	93	+ 0·12	0·56	No
	5.	Life period	11482	117	98	+ 0·36	0·54	No
Samba	1.	Nursary period	3174	35	91	+ 0·04	0·57	No
	2.	Growth period	6298	69	91	+ 0·61	0·46	No
	3.	Flowering period	773	9	86	+ 0·24	0·56	No
	4.	Maturity period	2494	30	83	— 0·69	0·42	No
	5.	Life period	12739	143	89 r =	— ** — 0·0041	0·58	No
Navarai	1.	Nursery period	2945	34	87	+ 0·25	0·30	No
	2.	Growth period	5477	58	94	— 0·22	0·36	No
	3.	Flowering period	841	9	93	— 0·23	0·35	No
	4.	Maturity period	2791	29	96	— 0·22	0·35	No
	5.	Life period	12054	130	91	+ 0·10	0·50	No

AWARD OF Ph. D. DEGREE.

Sri K. Mahadevan Pillai, B. Sc. (Ag.), M. Sc., formerly Assistant Lecturer in Botany, Agricultural College and Research Institute, Coimbatore has been awarded Ph. D. degree in Agronomy with special references to Plant Physiology and Plant Nutrition by the University of Gottingen (Germany).

Our hearty congratulations to him.