https://doi.org/10.29321/MAJ.10.A03796

Soil Moisture and Yields of K.2 and K.5 *Karunganni* Cotton Crops at Coimbatore

by

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Synopsis : In this paper, the influence of soil moisture at different depths of 3", 6" and 12" on the growth and yield of two cotton strains raised under dryland conditions are discussed. Data collected for thirteen years from 1951–'52 to 1963–'64 have been critically examined and it is concluded that at the time of sympodial formation the lack of soil moisture adversely affects the yield.

Introduction : "The proper amount of soil moisture during the different stages of plant development is the most potent single factor making for a high crop yield" is the general conclusion drawn by Sawhney and Sikka (1960) in their monograph on "Physiology - Cotton in India". The importance of the role played by soil moisture should really be highly significant in the case of K.2 and K.5 strains of *Karunganni*, which have been evolved specially for the dryland areas of the Southern and Central districts of the Madras State. Under the All India Co-ordinated Crop Weather Scheme, these two strains of cotton are cultivated at the Central Farm, Coimbatore from 1948–'49 onwards. The data collected for thirteen years from 1951–'52 to 1963–'64 have been critically examined in this paper to assess the influence of soil moisture at different depths of 3", 6" and 12" on the growth and yield of K.2 and K.5 strains of cotton.

Materials and Methods : The soil moisture data at the depths of 3", 6" and 12", collected week-wise both in the open observatory and in the fields of K.2 and K.5 cotton crops for thirteen years from 1951–'52 to 1963–'64, were compiled along with the year-wise crop yields of these two strains of *Karunganni* cotton.

The details of the methods adopted are briefly given hereunder :—

(i) In the first instance, an analysis of variance was conducted with the yield data of these two *Karunganni* strains to assess the variations in yield due to strains and also due to years. The analysis of variance revealed no significant differences at P=0.01 level due to years. The yields of both K.2 and K.5 cotton crops were phenominally high in the year 1951–'52, fairly high in the years 1953–'54, 1959–'60, 1960–'61 and 1962–63, moderate in the years 1954–'55, 1955–'56 and 1957–'58 and low in the years 1952–'53, 1956–'57, 1958–'59, 1961–'62 and 1963–'64. The concerned data are presented in Table I.

(ii) Barring the phenominally high yield year of 1951–'52, and the moderate years 1954–'55, 1955–'56 and 1957–58 the remaining nine years were classified as high and low - yield years, each including respectively four and five

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Received on 2—7—1965.

TABLE I.

Analysis of variance of yields of K.2 and K.5 Karunganni strains.

Source	D. F.	S. S.	M. S.	'F'
Between strains ...	1	1,417·40	1,417·40	3·89
Between years ...	12	38,255·29	3,187·94	8·74*
Error ...	12	4,376·05	364·67	
Total ...	25	44,048·74		

* Significant at P = 0·01 level.

Comparison of years

	1	2	3	4	5	6	7	8	9	10	11	12	13	SED	C. D.
	1951-'52	1952-'53	1953-'54	1954-'55	1955-'56	1956-'57	1957-'58	1958-'59	1959-'60	1960-'61	1961-'62	1962-'63	1963-'64		
Yield means in ounces	192·57	72·29	142·46	95·15	98·69	63·05	94·70	83·38	127·50	139·78	79·72	133·80	44·26	19·10	41·62

Conclusion : 1, 3, 10, 12, 9, 5, 4, 7, 8, 11, 2, 6, 13

years. The moisture data for these nine years were converted into their angular sine values, both for the data collected in the open observatory and also in the cropped fields. An analysis of variance was worked out with the converted data to establish the variation of soil moisture due to conditions (open and cropped field), depths, yields and their interactions. For this analysis, the data from the third week after sowing to the date of last picking were considered. The analysed data have been given in Tables II to IV.

Results and Discussions: (i) The yield data, analysed and presented in Table I, reveal that the variation due to strains is not significant, while the variation due to years is highly significant at 1 per cent level. This inference throws light on the significant role played by the meteorological environmental conditions in the growth and performance of cotton crops. These meteorological environmental conditions will naturally vary from year to year and hence the variation in yield due to years is highly significant.

(ii) The data on means of soil moisture of all the three depths both in the open observatory and in the cropped fields, averaged over nine years, their Standard Error of Difference and Critical Difference, given in Table II, lead to the following tentative inferences :—

(a) In the period from third to tenth weeks after sowing, the soil moisture is lowered due to cropping only in the sixth week, perhaps due to the hoeing and weeding operations, generally given to the crops in this week. When fresh soil is exposed to the atmospheric air due to these operations, naturally the depletion of soil moisture should be more in the cropped field.

(b) From the eleventh week onwards till the date of the last picking the soil moisture in the cropped field is significantly lower than that in the open observatory. This inference indicates that from the eleventh week after sowing, which is roughly the sympodial formation stage, the crop depletes the soil moisture for its various and vigorous physiological developments.

(iii) From the means of soil moisture data, averaged over depths and conditions in respect of four high yield, and five low yield years for the period from third week after sowing and their corresponding Standard Error of Difference and Critical Difference, incorporated in Table III, the following tentative inferences are drawn.

(a) From third week to eighth week after sowing, there is no significant difference in the utilisation of soil moisture by crops, giving high and low yields.

(b) Signficant differences are observed in the following groups of weeks in the years of high and low yields: ninth and tenth, fourteenth and fifteenth, eighteenth and twenty-first to twenty-third. The ninth and tenth weeks constitute the critical period just before the commencement of sympodial branches. The fourteenth and fifteenth weeks represent the peak flowering period. In the eighteenth week the boll development will be highest. Twenty-first

TABLE II.

Comparison of conditions (Open and cropped fields).

S. No.	No. of week after sowing	Nature of significance	Mean		SED	C. D.	Conclusion	Remarks
			Open	Field				
1.	3	...	...	...	...	..	...	* = Significant at 5% level.
2.	4	...	...	...	...	...	...	
3.	5	...	...	...	...	...	...	
4.	6	†	21·6	19·8	0·5	1·0	Open, field	† = Significant at 1% level.
5.	7	...	...	...	...	...	...	
6.	8	...	...	...	...	...	...	
7.	9	..	...	...	...	...	...	
8.	10	...	...	...	...	...	...	
9.	11	*	21·4	20·0	0·6	1·2	Open, field	
10.	12	†	20·7	18·9	0·6	1·2	,,	
11.	13	†	20·3	18·5	0 6	1·2	,,	
12.	14	†	20·3	18·3	0·7	1·4	,,	
13.	15	†	20·4	18·1	0·7	1·4	,,	
14.	16	†	19·6	17·0	0·5	1·0	,,	
15.	17	†	18·1	15·8	0·7	1·4	,,	
16.	18	†	18·5	15·2	0·5	1·0	,,	
17.	19	†	18·1	15·3	0·3	0·6	,,	
18.	20	†	19·4	16·0	1·2	2·4	,,	
19.	21	†	17·8	15·2	0·8	1·6	,,	
20.	22	†	17·8	15·2	0·8	1·6	,,	
21.	23	†	17·3	14·4	0·7	1·4	,,	

TABLE III.

Comparison of low and high yields.

S. No.	No. of week after sowing	Nature of significance	Mean		SED	C. D.	Conclusion	Remarks
			Low	High				
1.	3rd to 8th	N. S.	...	...	...	...	...	N. S. = Not significant
2.	9th	†	19·1	22·2	0·6	1·2	High Low	* = Significant at 5% level.
3.	10	*	20·0	21·6	0·7	1·4	,,	
4.	11th to 13th	N. S.	...	...	...	...	...	† = Significant at 1% level.
5.	14	*	18·5	20·4	0·7	1·4	High low	
6.	15	*	18·4	20·3	0 7	1·4	,,	
7.	16th and 17th	N. S.	...	...	...	...	...	
8.	18th	†	16·1	17·8	0·5	1·0	High Low	
9.	19th and 20th	N. S.	...	...	...	...	...	
10.	21	†	15·6	17·7	0·8	1·6	High Low	
11.	22	†	15·5	17·8	0 7	1·4	,,	
12.	23	†	14·8	17·2	0·7	1·4	,,	

TABLE IV.

Comparison of depths

S. No.	No. of weeks after sowing	Nature of significance	Mean			SED	C. D.	Conclusion	Remarks
			3"	6"	12"				
1.	3	*	21·9	22·1	24·7	0·8	1·6	12, $\overline{6, 3}$	* = Significant at 1% level.
2.	4	,,	19·9	20·7	24·8	1·0	2·0	12, $\overline{6, 3}$	
3.	5	,,	18·6	20·5	24·7	0·8	1·6	12, 6, 3	
4.	6	,,	17·6	20·4	24·1	0·6	1·2	12, 6, 3	
5.	7	,,	19·0	20·8	24·4	1·0	2·0	12, 6, 3	
6.	8	,,	18·2	20·1	24·5	0·5	1·0	12, $\overline{6, 3}$	
7.	9	,,	17·4	20·3	23·8	0·5	1·0	,,	
8.	10	,,	17·7	20·1	24·3	0·8	1·6	,,	
9.	11	,,	17·4	20·4	24·1	0·8	1·6	,,	
10.	12	,,	15·9	19·6	24·0	0·7	1·4	,,	
11.	13	,,	15·5	18·9	23·8	0·8	1·6	,,	
12.	14	,,	15·3	19·2	23·5	0·9	1·8	,,	
13.	15	,,	15·2	18·9	23·6	0·9	1·8	,,	
14.	16	,,	13·6	18·6	22·8	0·9	1·8	,,	
15.	17	,,	12·5	16·6	21·7	0·9	1·8	,,	
16.	18	,,	12·0	16·5	22·1	0·7	1·4	,,	
17.	19	,,	11·5	16·6	21·8	0·5	1·0	,,	
18.	20	,,	13·2	16·8	23·2	1·5	3·0	,,	
19.	21	,,	12·1	15·9	21·6	0·7	1·4	,,	
20.	22	,,	12·2	15·8	21·4	0·9	1·8	,,	
21.	23	,,	11·5	15·0	21·0	0·9	1·8	,,	

to twenty-third weeks will be the period of maximum bursting of bolls. So, these four critical periods of crop growth have their own physiological importance. Hence, it is understandable that more the availability of soil moisture in these critical periods, greater will be the yield obtained from cotton crops. This inference is in consonance with the findings of Doss, Ashley and Bennett (1964); Marani and Horwitz (1963) and Fuchs (1964).

(iv) The data on the means of soil moisture at the depths of 3", 6" and 12" averaged over two conditions and nine years and their Standard Error Difference and Critical Difference contained in Table IV lead to the following main inferences:

(a) Variation of soil moisture in cropped field due to depths is highly significant.

(b) In third, fourth and seventh weeks after sowing the soil moisture status is practically alike at 3" and 6" depths, perhaps due to first inter-cultivation given to the crop. In other weeks, soil moisture increases significantly with depth. This should be so since the soil is of red sandy loamy nature, capable of easy percolation and retention of rain water at deeper levels.

(v) The interactions due to conditions and yields, conditions and depths and yields and depths were also worked out. The main inference drawn from these interactions is that the yield of the crop depends on soil moisture status in the field in the eighteenth and twenty-third weeks, representing respectively the periods of boll development and boll bursting. This inference supports the findings of Doss *et al* (1964) and also Morris (1964).

Summary: (i) There is no variation in the yields of K.2 and K.5 cotton crops due to strains. But due to years, a significant variation at one per cent level has been observed, indicating thereby, that the yield depends on meteorological environmental factors, which are bound to vary from year to year.

(ii) There is no difference in the soil moisture status in the open observatory and in cotton fields in the first ten weeks after sowing. Thereafter till the last picking is taken, the soil moisture in the cropped field is always lower than that in the open observatory.

(iii) The comparison of soil moisture status in cotton fields in years of high and low yields has shown that the variation in soil moisture status in these two groups is rathar wide in the most critical periods of ninth and tenth weeks, fourteenth and fifteenth weeks, eighteenth week and twenty-first to twenty-third weeks. The importance of these four critical periods in the life phase of cotton crop has been explained in the text of the paper.

(iv) In red sandy loamy soil, the soil moisture increases with depths due to easy percolation and retention of rain water at deeper levels.

(v) From the interactions worked out, the importance of soil moisture, particularly at boll development and boll bursting stages has been clearly brought out.

(vi) The yields of K.2 and K.5 *Karunganni* strains of cotton, raised under rain-fed conditions, depend mainly on the soil moisture status in the field. If rains fail during the most critical period of nine and ten weeks after sowing, i. e., at the time of sympodial formation, it is advisable to give one irrigation to rain-fed cotton crop to step up its yield.

Acknowledgement: The authors are thankful to all those, connected with the collection of the basic data, made use of in this study.

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