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The Effect of Environment on Yield and Quality of Cotton

by

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Introduction: The yield of a crop and quality of the agricultural produce for which it is valued are highly complex characters which are governed by a large number of genetic factors. The expression of these characters is also influenced to a great extent by the environment and the appearance and behaviour of a genotype may therefore be taken to represent an interaction between heredity and environment. Chandrasekharan and Parthasarathy (1948) stated that earliness in crops like *Cholam* and rice is a Mendelian character but it is also governed by an environmental factor like light. Garner and Allard (1920) pointed out that the length of the day and night has pronounced effect on the onset of flowering. Thus, even genetically pure strains of crop plants are known to show developmental or fluctuating variations under the influence of different set of environmental conditions. These fluctuating variations are important to the plant breeders engaged in crop improvement work as they affect the proper evalution of the desired genotype. Therefore, a detailed knowledge regarding the influence of environmental factors on economically important characters of crop plants is very essential.

In cotton, there are overwhelming evidences to show that, even well established pure strains, when grown in different places would show variations in their economic attributes. The prevalence of different market values for the same variety of cotton produced in different regions is an indirect recognition of this fact. Balasubramanian and Iyengar (1953) pointed out that in Madras Cambodia cotton grown in certain villages of Avanashi taluk, Karunganni cotton raised in portions of Tirunelveli district and westerns cotton produced in and around Guntakal area, are reputed for staple, quality, grade and ginning outturn. Experiments conducted elsewhere also by many cotton breeders have amply demonstrated the influence of environment on the expression of the economic attributes in cotton and established the peculiar features of the concerned regions. Bederker (1954) studying the peculiarities of the cotton growing regions of the Hyderabad State, has stressed

that such information regarding the peculiarities of the region for which cotton improvement work is in progress is very useful

The study reported in this paper relates to the variations observed in the economic attributes of Karunganni cotton varieties *(G. arboreum)* grown in the Southern and Northern Zones of the Tinnies tract in Madras State which constitutes distinct ecological Zones.

Review of Previous Work: Nayak (1941) studied the economic characters of Jaywant cotton in seven localities in Southern and Northern Kumpta tract over three seasons and concluded that the yield, fibre length and ginning percent were higher in the former tract. This was attributed to the wide variation in rainfall and soil condition between the places of growth. Iyengar (1941) recorded the variation in fibre properties observed during five seasons in Cambodia strains as grown at Coimbatore and Srivilliputhur in the Winter and Summer seasons. He found that the cotton fibres were definitely longer, finer, and more mature in the Summer crop at Srivilliputhur than at Coimbatore. He also recorded that the number of fibres on the seed, lint weight and ginning percent were considerably lower at Srivilliputhur. Khadilkar (1941) has stated that spinning value of Jarila, Banilla, and N. R. 6 were higher at Jalgaon and Dhulia than at Bhadgaon. Patel (1949) found that there was a general tendency for cotton to give higher ginning percent at Viramgaon than at Jagudan. Balasubramaniam and Iyengar (1953) studying the performance of American cotton grown under irrigated and rainfed conditions in seven localities in the Madras State concluded that halo-length, seed and lint weight as also ginning percent were highly influenced due to differences in place and season. Boomination *et al* (1953) reviewing the place effect on the yield and quality on row inter specific American cotton strains grown in the four sub-zones of the Cambodia tract under irrigated Winter and Summer crops found that the fibre length was the lowest while the fibre weight and maturity were the highest at Coimbatore than at Srivilliputhur and Tiruchengode where the tendency for higher length was noticed. Bederkar (1954) studying the behaviour of the newly evolved improved gaorani varieties grown in the three sub-zones of Gaorani and Oomars tracts in Hyderabad concluded that (1) the environment in North-Eastern and Central Zones of Gaorani tract was very favourable for production of high quality cotton (2) while in the South-Western Zones the environmental conditions exerted an unfavourable effect on the quality of cotton

produced, at the same time favouring higher production of both seed cotton and lint due to better yields and higher ginning percent. Gulati and Ahmad (1935) had shown that change in soil conditions resulting from different localities of growth was capable of greatly altering the state of fibre maturity of Banilla cotton. According to Balls (1915) hair weight is affected by environment and conditions of growth. Ramachandran *et al* (1954) reported that the environmental differences at Palur were responsible for registering significantly lower halo-length, higher seed and lint index as also ginning percent in comparison with those at Srivilliputhur.

Material and Methods: The data considered in this paper deal with the results of co-ordinated varietal trials and district trials (Scattered Blocks) conducted with new improved varieties viz; 6186–9, 6188–8, 6312–4. 6874 and the standard strains K. 2 and K. 5 in the Southern and Northern Zones of Tinnies tract in Madras State to find out the range of adaptability of the new varieties. The co-ordinated varietal trials were conducted at the two breeding centres Kovilpatti and Coimbatore representing the Southern and Northern Zones of Tinnies tract for six seasons since 1949–50 and the district trials scattered in these two zones for three seasons since 1952–53. The lay out adopted at the two breeding centres consisted of similar pattern of randomised and replicated blocks. The district trials were of the Scattered Block pattern where each village of trial constituted a randomised block. Sowing materials of each variety for these trials where supplied afresh every year from a common source. The cultural treatments corresponded to the local practices.

Observations on yield of *kapas*, ginning percent and halo-length were recorded for these trials in all the years of trial. Besides, fibre properties like fibre length, fibre weight and fibre maturity were determined in the case of co-ordinated varietal trials.

The characters on which the environmental influence is reported in this paper relates to all the above characters recorded from the co-ordinated varietal trials and district trials separately.

The data on the mean values for the above attributes were studied statistically by using Fisher's 't' test and the level of significance indicated at 5 per cent probability ($p = 0{\cdot}05$) to study the environmental effect on the performance of the above mentioned varieties.

Experimental Results: The mean data on yield of *kapas*, ginning percent, halo-length, fibre weight and fibre maturity per cent for the six arboreum varieties studied over six consecutive seasons in the co-ordinated varietal trials and for three seasons in the district trials are presented in Tables I and II respectively.

Data on mean monthly rainfall, maximum temperature, minimum temperature and humidity per cent (average of 6 years during 1950—'55) at Kovilpatti and Coimbatore are presented in table III and graphically represented in Figure 1.

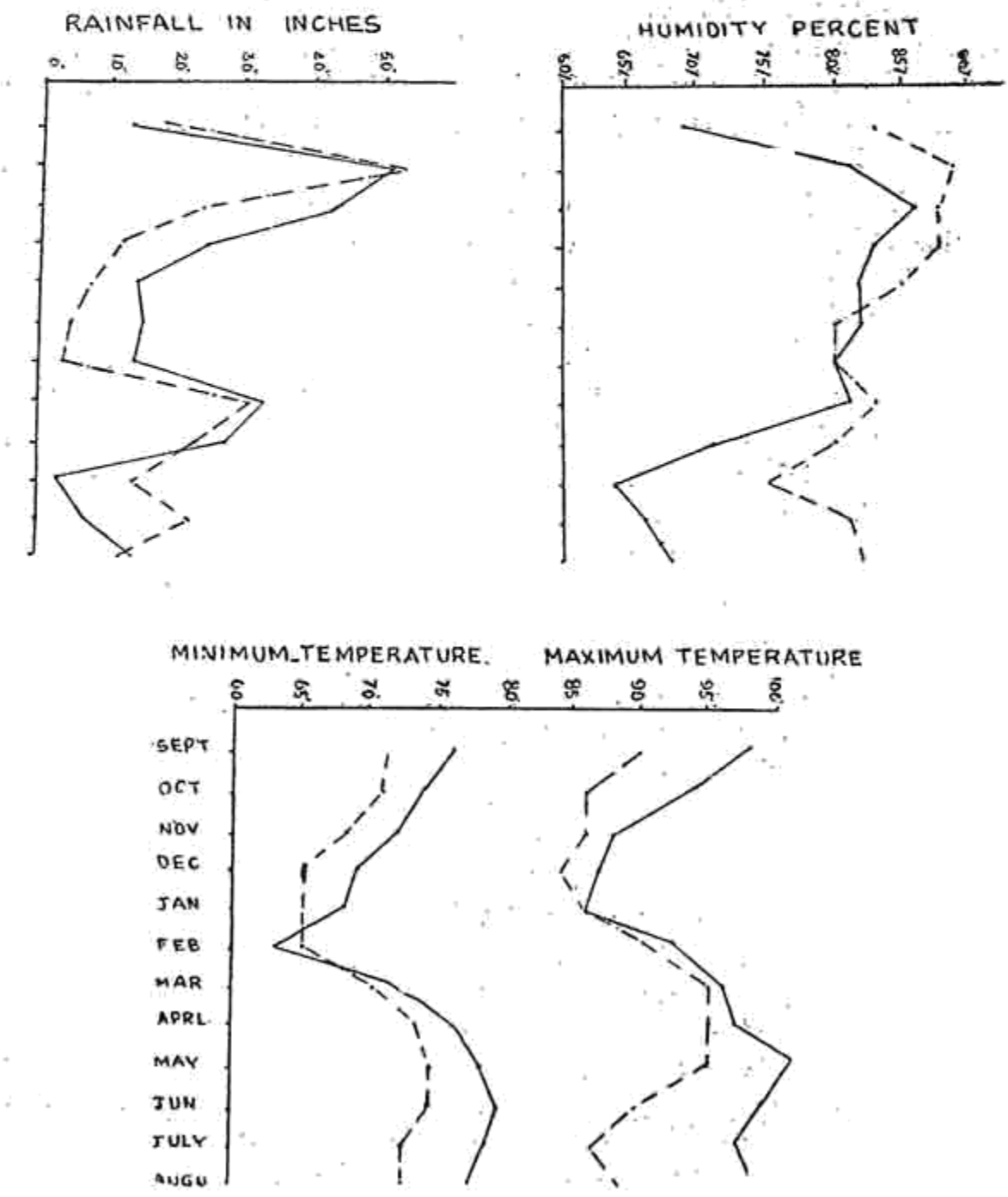

TABLE I

Mean performance over six seasons (1949 - '50 to 1954 - '55) in the co-ordinated varietal trials at Kovilpatti and Coimbatore

S. No.	Varieties	Yield of kapas in lb. / acre		Ginning percent		Halo-length in (mms)		Fibre length in (inch)		Fibre weight / cm ($\times 10^{-6}$ gms)		Fibre maturity %	
		Kovil-patti	Coim-batore	Kovil-patti	Coim-batore	Kovil-patti	Coim-batore	Kovil-patti	Coim-batore	Kovil-patti	Coim-batore	Kovil-patti	Coim-batore
1.	6186 - 9	492	314	32·4	33·5	25·3	24·4	0·98	0·94	1·86	2·06	72	78
2.	6188 - 8	452	316	32·1	33·6	25·7	24·4	0·98	0·94	1·83	1·99	75	79
3.	6312 - 4	453	297	31·8	33·5	25·6	24·8	0·97	0·95	1·65	1·84	73	79
4.	6874	475	300	32·1	33·4	25·0	23·9	0·96	0·94	1·91	1·97	75	81
5.	K. 2	426	257	31·9	32·0	23·0	22·3	0·90	0·87	1·93	2·13	72	83
6.	K. 5	403	278	31·0	31·1	23·1	22·6	0 90	0·87	2·09	2·20	79	79
	Mean	450	294	31·9	32·9	24·6	23·7	0·95	0·92	1·88	2·03	74	80
	Significent by 'z' test	Yes		Yes		Yes		Yes		Yes		Yes	
	S. E.	11·3		0·31		0·09		0·003		0·02		0·96	
	C. D.	36		0·7		0·2		0·1		0·06		3	

TABLE II

Mean performance over three seasons (1952 - '53 to 1954 - '55) in the district trials

S. No.	Cultures	Yield of kapas in lb. / acre		Ginning percent		Halo-length in (mms)	
		South Zone	North Zone	South Zone	North Zone	South Zone	North Zone
1.	6186 – 9	409	350	31·8	32·9	24·8	24·2
2.	6188 – 8	378	349	32·3	32·3	25·1	24·1
3.	6312 – 4	246	315	31·4	32·1	25·0	24·4
4.	6874	364	376	32·3	32·9	24·0	23·9
5.	K. 2	340	288	30·6	32·4	22·8	22·5
6.	K. 5	477	333	30·8	31·7	23·3	22·7
	Mean	369	335	31·5	32·5	24·2	23·6
	Significance by 'z' test	No		Yes		Yes	
	S. E.	29·3		0·13		0·03	
	C. D.	..		0·3		0·1	

TABLE III

Mean monthly rainfall, maximum temperature, minimum temperature and humidity over six years (1950—55) at the Agricultural Research Station, Kovilpatti and Agricultural College and Research Institute, Coimbatore

S. No.	Details	January	February	March	April	May	June	July	August	September	October	November	December	Total	Range
1.	Maximum rainfall Kovilpatti	1·37	1·48	1·40	3·30	2·65	0·19	0·64	1·37	1·26	4·82	4·33	2·48	25·3	..
	,, ,, Coimbatore	0·65	0·41	0·25	3·11	2·25	1·31	2·13	1·15	1·79	5·19	2·38	1·18	21·8	..
2.	Maximum temperature Kovilpatti	86·2	91·8	95·9	97·1	100·6	98·5	97·0	97·9	98·0	93·6	87·8	87·0	..	86·2 to 100·6
	,, ,, Coimbatore	86·0	90·4	94·8	94·7	94·9	89·0	86·4	88·0	89·6	86·2	86·0	84·0	..	84·0 to 94·9
3.	Minimum temperature Kovilpatti	63·3	63·3	72·3	75·6	78·4	79·0	77·5	77·2	76·0	74·0	71·8	69·2	..	63·3 to 79·0
	,, ,, Coimbatore	64·7	65·1	69·8	72·7	74·0	73·6	71·9	72·2	70·9	70·5	67·9	64·5	..	64·5 to 74·0
4.	Relative humidity Kovilpatti	82·2	81·8	70·6	80·5	70·9	63·6	65·9	67·5	69·0	81·0	86.3	83·2	..	63·6 to 85·5
	,, ,, Coimbatore	84·9	79·7	79·7	83·2	79·9	75·3	80·8	81·7	82·6	88·9	88·0	88·4	..	75·0 to 88·9

It would be seen from the data presented in table I that at Kovilpatti the mean yield of *kapas* by 56 lb. halo-length by 0·9 mm and fibre length by 3·03 inch are significantly higher than those at Coimbatore where the mean values for ginning by 1 per cent, fibre weight by 0·15×106 gms per cm and fibre maturity 6 per cent are significantly higher. The individual performance of the varieties is also found to be on the similar trend as the mean performance

As regards the performance in the district trials (Vide Table II) the differences between the two Zones are not significant for yield. However, the mean yield at the South Zone is numerically higher by 34 lb. than at the North Zone. In the matter of ginning per cent and halo-length, the two Zones differ significantly, the South Zone recording higher mean halo-length of 0·6 mm than the North where the ginning by 1 per cent is higher confirming the findings indicated in the co-ordinated varietal trials at Kovilpatti and Coimbatore which represent the South and North Zones respectively.

From the data presented in Table III, it can be seen that at Kovilpatti the annual rainfall, monthly mean maximum and minimum temperatures are higher than those at Coimbatore in a general nature. As regards humidity per cent, it is higher at Coimbatore than at Kovilpatti. It is to be noted here, the ranges of temperature as well as humidity per cent are wider at Kovilpatti and narrower at Coimbatore.

Discussion : The experimental results presented in the foregoing indicated that the economic attributes of rainfed Karunganni cotton varieties grown in the South and North Zones of Tinnies tract are influenced in a marked degree by environmental factors. The main findings that would emante from this study are (i) that at the South Zone, the environmental effects is to increase the yield of seed cotton per acre, fibre length, and halo-length while reducing the weight and maturity of the fibres, all these contributing for the high production of seed cotton per acre with better quality lint and (ii) that at the North Zone, to increase ginning percent, fibre weight and maturity of lint leading to slightly coarser type of cotton. The coarseness of fibre appears to be due to higher maturity as according to Koshal, Gulati and Ahmad (1940) mature fibres are generally coarse.

The higher level of seed cotton per acre and increasing fibre length at the South Zone may be due to higher fertility level of the

soil here with good drainage as also due to good amount of well distributed rainfall during the growing period of the crop. Young blood (1929) who undertook the study of the correlation between lint length and soil types came to the conclusion that longer lint was generally produced on more fertile soils. Ramiah and Panse (1941) observed that longer fibre are produced on fertile *Adhan* land. Bederkar (1954) observed that higher yields and better quality of cotton recorded at Nanded and Bhir were due to the higher fertility of soil.

As regards the ginning per cent which is lower in the South and higher in the North, it is attributable for the lower and higher fibre weights recorded in these two Zones respectively. Bederkar (1954) observed that the tendency towards increase in ginning percent at Mahdol as compared to that at Nanded is due to higher fibre weight. Patel and Patel (1951) has stated that the ginning per cent in the Virangam locality appears to be in higher fibre weight. The lower ginning per cent at the South may also be due to lesser number of fibres on the seed associated with higher temperature. Iyengar (1941) has stated that environment influences the production of fibre on the seed, the reduction in number being associated with higher temperature.

In the case of fibre weight and fibre maturity per cent, they are lower at Koilpatti than those at Coimbatore. Gulati and Ahamd (1935) contributed data show that where the fibre maturity was very low the fibre weight was also low. The fibre maturity at Kovilpatti is only comparatively lower than at Coimbatore but it is fairly well above the required minimum for the rainfed cottons. As such, therefore, it does not lower the quality of lint. Besides, at Kovilpatti congenial conditions of solar activity and adequate soil moisture coupled with the onset of " Uppam breeze " during the boll development period are found to promote fineness (low fibre weight) of lint attaining a maturity per cent of 75 which is well above the minimum required for these cottons.

As between the trials at the breeding stations and the districts, the mean values for ginning outturn and halo-length (Vide Table I and II) are almost equal in the respective Zones. It can therefore, be safely concluded that these two breeding stations at Kovilpatti and Coimbatore represent typically the South and North Zones respectively and the performance of the newly evolved

improved varieties when grown in these Zones, can easily be predicted from the results obtained in the breeding stations.

Summary : A detailed knowledge regarding the influence of environmental factors on economically important characters of crop plants is very essential to the plant breeders as they affect the proper evalution of the desired genotype. Such information gathered and studied with particular reference to the Karunganni cotton varieties (G. *arboreum*) grown under rainfed conditions in the Southern and Northern Zones of Tinnies tract helped to establish the peculiar features of the two Zones. The main findings are as follows :

(i) There is perceptible variation in the economic attributes of the rainfed Karunganni cotton varieties grown in these two Zones on account of the influence of the environmental factors.

(ii) The environmental influence is to increase the yield of *kapas* per acre, halo - length, fibre length but to reduce the fibre weight and fibre maturity per cent at the South, while to increase the ginning percent, fibre weight and fibre maturity at the North.

(iii) The environmental factors responable for these differences are found to be due to higher fertility of the soil, higher rainfall, higher temperature and low humudity per cent at Kovilpatti as against the medium type of soil, low temperature, low rain fall and higher humidity per cent at Coimbatore representing Southern and Northern Zones respectively.

(iv) The two breeding stations at Kovilpatti and Coimbatore typically represent the South and North Zones of the Tinnies tract respectively and performance of newly evolved improved cotton varieties when grown in these Zones, can easily be predicted from the results obtained in the breeding stations.

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