

Review Article

Results of Manurial Trials in Madras State on Cotton *

by

A. MARIAKULANDAI¹ and Y. B. MORACHAN²

Synopsis: This review gives a succinct summary of the results of the various manurial trials done in the Madras State on Cotton for the past fifty years. The experiments carried under rainfed and irrigated conditions are dealt separately.

Manurial experiments on cotton have been done in Madras State mainly in the Agricultural Research Stations at Koilpatti (black soil) and Coimbatore (mixed black and red soils). Experiments were conducted in recent years at the Agricultural Research Station, Bhavanisagar also. The experiments are reviewed separately for rainfed conditions (cotton-dry) and for those grown under garden land conditions (cotton-irrigated).

I. COTTON (DRY):

A. NITROGENOUS MANURES: *Ammonium Sulphate*: This was tried in the red soils of Coimbatore in the years 1929-'31 with 2 cwt. of ammonium sulphate and 1 cwt. of super phosphate per acre. There was no response as the no manure plot gave equally a good yield of 470 pounds of *kapas* (8).

In a similar experiment, in the same place, in the same year in black soil, over a basal dressing of 9 cart loads of farm yard manure, there was significant response of 10 per cent additional yield over the no manure plot yield of 430 pounds of *kapas* (8).

In an earlier experiment at Kovilpatti in the years 1921-'24, response to 100 pounds of ammonium sulphate was tried. Though there was an extra yield of 11.5 per cent it was not significant to the no manure plot yield of 460 pounds of *kapas* (8).

***Ammonium sulphate compared to chilean nitrate*:** This was compared at Koilpatti in the years 1954-'56 on equal nitrogen basis. There was no significant difference (2).

***Ammonium sulphate compared to groundnut cake*:** This was compared at Koilpatti in the years 1929-'31 on equal nitrogen basis of 44 pounds over a basal dressing of 112 pounds of super phosphate. Though the response was significant (39%) over no manure plot, there was no difference due to the form of nitrogen

1. Professor of Agronomy and Associate Dean, Agricultural College and Research Institute, Coimbatore. 2. Lecturer in Agriculture (now prosecuting higher studies in U. S. A.).

* Received on 18-4-1964.

applied, the yield being 410 pounds *kapas* in no manure plot and 560 pounds and 570 pounds in the treated plot of ammonium sulphate and groundnut cake respectively (8, 6). Again in the years 1943—'48, under the co-ordinated scheme conducted at Koilpatti, there was no differential response between ammonium sulphate and groundnut cake (1).

In an earlier experiment conducted between 1930—'40 at Koilpatti, the application of (1) ammonium sulphate alone at 112 pounds or (2) 56 pounds of ammonium sulphate plus 250 pounds of groundnut cake and (3) 500 pounds of groundnut cake alone, had given an increased yield of 17 per cent over no manure. But there was no difference between the forms and combinations of manures tried (7).

Levels of ammonium sulphate: This was compared at Cotton Breeding Station, Coimbatore in the years 1939—'41 with 1, 2, 3 and 4 cwt. of ammonium sulphate. No conclusive and dependable results were obtained (1).

In a similar experiment conducted at the Central farm, Coimbatore and the Agricultural Research Station, Palur, in the years 1942—'47, with different doses of ammonium sulphate, with and without P_2O_5 , there was no significant difference between the treatments (1).

Split doses of ammonium Sulphate: This was tried at Koilpatti in the years 1930—'40 with 2 cwt. of ammonium sulphate in 1, 2 and 3 doses. All of them increased the yield by 20–25 per cent over no manure plot yield of 560 pounds of *kapas*, but the difference among them was insignificant (6, 7).

In a similar experiment, over a basal dressing of 6 cart loads of farm manure and 1 cwt. of super phosphate, there was no significant difference (7).

Calcium cyanamide: This was tried at Coimbatore singly and in combination with super phosphate. There was no response (1).

Saltpetre: This was tried at Koilpatti in the years 1905—'06 singly and in combination with super phosphate by application of 300 pounds. There was significant yield increase with 53 per cent and 75 per cent over the no manure plot yield of 350 pounds of *kapas* (8).

Response to Nitrogen under Free-Fertiliser Demonstration scheme of Indian Council of Agricultural Research 1954—'55: The response to nitrogenous manure (expressed as increase over control in pounds of cotton *kapas* per pound of Nitrogen) was 3 to 6 pounds in case of inorganic N in experiments conducted in Madras State as compared to 0.6—1.2 pounds outside the State. The manures tried were ammonium sulphate and urea (6).

From these experiments, it was also clear that dry cotton responds to nitrogenous fertilisers and that 20 pounds N may be optimum. There was no differential response in the different forms and split doses.

B. PHOSPHATIC MANURES: *Super phosphate*: This was tried at Koilpatti in the years 1905-'08 and super phosphate at 300 pounds was applied. There was increase of 37 per cent over no manure plot yield of 350 pounds of *kapas* (8).

Super phosphate along with ammonium sulphate: This was tried in red soils of Coimbatore in the years 1929-'31 with 2 cwt. ammonium sulphate and 2 cwt. of super phosphate. There was no increased response as compared to the no manure yield of 470 pounds of *kapas* (8).

Fish guano: This was tried at Koilpatti in the year 1922-'23 by applying 700 pounds of fish guano per acre. There was no response as compared to the yield of 350 pounds of *kapas* under no manure plot (8).

Basic slag: This was tried at Koilpatti in the years 1905-'08 along with saltpetre at 300 pounds. There was an increase of 72 per cent additional yield over no manure plot yield of 350 pounds of *kapas*, while saltpetre alone had given only 53 per cent additional yield (8).

The response to phosphates was erratic. But with combination of nitrogen, the response to phosphorus was seen in the latter experiments.

C. POTASSIC MANURES: *Potassium sulphate*: This was tried at Koilpatti in the year 1922-'23 by applying 112 pounds of potassium sulphate per acre. There was 5.9 per cent increase in yield over no manure plot yield of 350 pounds of *kapas* (8).

Potassium chloride: In a similar experiment conducted in the same year at Koilpatti, Potassium chloride (112 pound/acre) increased the yield by 17.1 per cent over the no manure yield of 350 pounds of *kapas* (8).

Response to potash was found wherever the soil was found deficient in the same.

D. COMBINATION OF MANURES: *Ammonium sulphate plus super phosphate*: At Central farm, Coimbatore in the years 1929-'31, ammonium sulphate at 212 pounds and super phosphate at 112 pounds were applied. There was no significant difference (8).

But in a similar experiment over a basal dose of 9 cart loads of farm yard manure significant increase in yield was obtained (8).

Fertiliser mixture: At Koilpatti in the years 1930-'40 Parry and Company's cotton fertiliser mixture, analysing N (6%), P (10%) and K (9.5%) at 1, 2 and 4 cwt per acre, increased the yield by 15 per cent, 50 per cent and 71 per cent respectively over the control plot of no manure with 330 pounds of *kapas* (7).

From the above experiments, it is clear that a combination of N plus P plus K manures gave good response in cotton.

Neem cake alone and in combination of super phosphate: This was tried at Koilpatti in the years 1905—'08 with 1,000 pounds neem cake plus 300 pounds super phosphate as compared to super phosphate at 300 pounds and neem cake at 1,000 pounds alone. The combination of manures had given an additional yield of 105 per cent over the no manure yield of 350 pounds of *kapas* while neem cake alone had given 37 per cent additional yield (8).

In the old permanent manurial experiment at Coimbatore during the years 1930—'40, the plots treated with cattle manure, direct and residual and artificials N plus P plus K and N plus P have given 155 per cent, 12 per cent, 35 per cent and 68 per cent respectively over the control (no manure) yield 426 pounds of *kapas* per acre. These increases may be due to the continuous manuring of each crop ever since the inception of the experiment in 1909 (7, 6).

E. BULKY ORGANIC MANURES: *Neem cake:* This was tried at Koilpatti in the years 1905—'08 with 1,000 pounds of neem cake. Significant increase of 100 per cent additional yield over no manure was obtained, the yield being 710 pounds of *kapas* as compared to 350 pounds of *kapas* in the no manure plot (8).

Farm yard manure: This was tried at Coimbatore with nine cartloads of farm yard manure. An increased yield of 18 per cent of *kapas* was obtained (1).

In a similar experiment conducted at Koilpatti, the increased yield of 46 per cent was obtained (1).

Molasses: This was tried at Koilpatti in the years 1939—'40. The application of 5 tons of molasses per acre had given an increase of 46 per cent over no manure plot in one year (7, 6).

Compost: Prickly pear compost at 10 cart loads applied at Koilpatti in the years 1929—'31 had not shown any increased yield over no manure, the yield being 400 pounds of *kapas* in both cases (7, 6).

Sheep penning: This was done at Koilpatti with 1,000 sheep per acre. An increase in yield of 60 per cent was obtained over no manure plot (8).

Sheep penning at different times: Different times of sheep penning before the sowing of cotton was compared with farm yard manure at Koilpatti in the year 1919—'20. The sheep penning immediately before sowing in September had given 18.5 per cent (620 pounds) increased yield while in August it had given 3.5 per cent (540 pounds) only. Sheep penning in July had given 520 pounds which was taken as control. The yield from cattle manure plot applied in September was 630 pounds which was 20.2 per cent more than the control.

From these, it is clear that, bulky organic manures such as farm yard manure is found essential for increasing the yield of crop. Without a basal dressing of cattle manure, cotton was not benefitted directly or residually by artificial fertilisers.

Results of Manurial Trials in Madras State on Cotton 151

Residual effects of nitrogenous manures: This was tried at Koilpatti between the years 1930-'40 to test the effects of ammonium sulphate at 2 cwt or groundnut cake at 500 pounds per acre applied to the previous cereal crop of *cumbu* or *cholan* over a basal dressing of 4 cart loads of cattle manure, 2 cart loads of cotton compost and 1 cwt of super phosphate. Increased yield of 15-30 per cent over control (700 pounds of *kapas*) was obtained. In case of second year, 9-10 per cent increase over control (700 pounds of *kapas*) was obtained, when grown after cotton and *cumbu* or cotton and *cholan* (7, 6).

II COTTON (Irrigated):

A. NITROGENOUS MANURES: *Ammonium sulphate compared with cattle manure alone and in combination:* Ammonium sulphate at 30 pounds N was compared at Koilpatti in the years 1928-'31 alone and in combination with potassium sulphate at 25 pounds K_2O and super phosphate at 40 pounds P_2O_5 per acre. N plus P gave the highest significant yield and was better than N plus P plus K (8).

In a similar experiment conducted at Coimbatore between the years 1930-'40, N at 60 pounds alone as ammonium sulphate and in combination with K_2O at 40 pounds and P_2O_5 at 80 pounds was tried. N plus P gave 40 per cent additional yield followed by N plus P plus K which gave 34 per cent (7).

Ammonium sulphate response in rice-fallows cotton: In the experiments conducted at Coimbatore and Aduthurai in the years 1954-'56, 30 pounds N in the form of ammonium sulphate in equal doses gave the best response. No deleterious effect was seen in the following paddy crop (2).

From the experiments conducted, it is clear that irrigated cotton responds well to N and P in combination.

B. PHOSPHATIC MANURES: *Super phosphate:* This was tried at Cotton breeding Station, Coimbatore in the years 1928-'31. Super phosphate alone and in combination with ammonium sulphate did not result in any additional yield (1).

In a similar experiment, conducted in the irrigated soils of Koilpatti in 1930-'31, with 112 pounds of super phosphate and 224 pounds of ammonium sulphate, no significant response over the no manure plot yield of 1040 pounds of *kapas* was seen (8).

C. POTASSIC MANURES: *Potassium sulphate:* This was tried in Cotton Breeding Station, Coimbatore in the years 1928-'31. Potassium sulphate alone and in combination with ammonium sulphate did not result in any additional yield (8).

There seems to be no response for P and K when applied separately.

D. BULKY ORGANIC MANURE: *Farm Yard Manure:* The application of 9 cart loads of farmyard manure at Cotton Breeding Station, Coimbatore increased the yield by 18 per cent (1).

At Central farm, Coimbatore, farmyard manure at 15 cart loads increased the yield by 22 per cent over no manure (1, 6).

Green Manure: In an experiment at Coimbatore the application of green manures, daincha and sunhemp grown *in situ*, increased the yield of *kapas* by 16 per cent over no manure plot (1).

In a similar experiment, at Central farm, Coimbatore, in 1929-'30, sunhemp grown *in situ* and applied gave 1520 pounds which was 19 per cent higher than the no manure yield of 1280 pounds of *kapas* (8, 6).

E. COMBINATION OF MANURES: To find out the manurial requirements, an experiment was conducted at Bhavanisagar, in the years 1957-'61, with N at 0, 30 and 60 pounds in the form of ammonium sulphate, P_2O_5 at 0, 30 and 60 pounds in the form of super phosphate, K_2O at 0, 30 and 60 pounds in the form of potassium sulphate and farm yard manure at 0 and 5,000 pounds per acre.

The result indicated that there was corresponding increase in yield due to the increase in level of N, P and K. Phosphate in combination with nitrogen, recorded the maximum yield of *kapas* per acre with an increase of 157.4 per cent over no manure plot (3).

In an earlier experiment, conducted at Coimbatore in the years 1928-'31 N alone in the form of ammonium sulphate at 30 pounds, N at 30 pounds plus P_2O_5 at 40 pounds in the form of super phosphate, N plus K (N at 30 pounds and K at 25 pounds) and N plus P plus K (30 plus 45 plus 25 pounds) were compared. Though there was no significance in the first year, significant response was seen in the second and third years.

In the second year, N at 30 pounds plus P_2O_5 at 40 pounds had given the maximum additional yield of 71 per cent over no manure yield of 500 pounds of *kapas*, followed by N plus P plus K and N treatments.

In the third year, the maximum response was obtained by N plus K and N plus P treatments (8).

In the experiments conducted in the years 1939-'40 in the new permanent manurial plots with cattle manure and artificials, N plus K plus P only in the no basal manure series, gave increases of 31 per cent and 10 per cent respectively over the yield of 1,200 pounds of *kapas* in the no manure plot. A basal application of 2,000 pounds of cattle manure per acre increased the yields of all the treatments, the cattle manure plot yielded more than 100 per cent while the other treatments gave 30 per cent more than the control plot with yield of 950 pounds of *kapas*. The response due to basal dressing is also appreciable, being about 15 per cent (7).

The response was 2 to 3.5 pounds of *kapas* per pound of N in the inorganic form and 9 to 39 pounds when organic form of N was supplied (6).

From these, it can be concluded that the combination of N plus P plus K is essential for irrigated cotton crop for maximum yield.

E. OTHER ASPECTS: *Farm-yard manure verses irrigation:* This was compared at Coimbatore in the years 1929—'30. Farm yard manure at 12 cart loads, was compared to no manure along with irrigation at every 10 days and 20 days. Farm yard manure with irrigation once in 10 days had given 30 per cent additional yield over no manure plots while once in 20 days gave only 9 per cent additional yield (8).

Method of application: In an experiment conducted under co-ordinated scheme in the years 1943—'48, there was no difference in the application of ammonium sulphate by drilling or broadcasting. But in the case of groundnut cake drilling was found to be better (7).

At Cotton Breeding Station, Coimbatore in the years 1930—'32, top dressing of 1.5 cwt of ammonium sulphate was found to have no beneficial effect (1).

Residual response: This was tried at Coimbatore in the years 1929—'33 to find out the residual response of 2 cwt of ammonium sulphate plus 1 cwt of super phosphate plus 9 cart loads of farm yard manure, by applying to cotton. There was no residual response (1).

Time of application of manure: This was tried at Bhavanisagar in the years 1957—'61 with ammonium sulphate and urea applied (a) at sowing (b) at thinning (c) at flowering (d) half at sowing plus half at flowering (e) $\frac{1}{3}$ at sowing plus $\frac{2}{3}$ at thinning and $\frac{1}{3}$ at flowering (f) half at flowering plus half at one month after flowering over a basal dressing of 20 pounds phosphate and 5,000 pounds compost.

The result indicated that the maximum yields were obtained when N was applied in 2 doses during sowing and flowering (3). Summary and Results of the experiments are furnished in table I.

Conclusions: From the results of these experiments, though one uniform recommendation is not possible, the following conclusions can be drawn.

1. Cotton responds to nitrogenous fertilisers and the optimum dose may be 20 lb. N in case of dry cotton with over 30" rainfall and 30 lb. N for irrigated cotton.

2. Oil cakes are as good as artificials as suppliers of Nitrogen.

3. The optimum supply of Nitrogen can be given in two doses, namely one prior to sowing and the other at flowering time.

4. The response of cotton to phosphorous and potash had been low and uneconomical, but the combination of N plus P plus K had given good response.

TABLE I

Crop	Place	N		Bulky		N per acre	P ₂ O ₅ per acre	K ₂ O per acre	Combina- tion	Important conclusions
		to acre	to acre	Manures	Dose					
Cotton Dry	Coimbatore and Koilpatti	34	Farm yard	9 to 15	Ammonium	20 to	Super	Potassium	N+P+K	Responds to Nitrogen. Optimum 20 lb. N for dry. Optimum 30 lb. N for irrigated. Split doses better for irrigated. Response to P & K is unecono- mical but N+P +K gave good result. Bulky organic manure essential for increasing yield. Green manures can be used for irrigated cotton.
			Manure	cartloads	Sulphate	30	48 lb.	sulphate	N+P+K	
	Compost	5 to 10	Na NO ₃	30	of P ₂ O ₅	50 lb.	50	50 lb.	50 lb.	
		tons.	Calcium	per	K ₂ O	K ₂ O				
			5 tons	Cyanamide	acre	Fish				
Molasses	5 tons			guano						
Cotton (irri- gated)	Coimbatore	20	Sheep penning	100			Basic			
			Oil cakes	500 lb.			slag			
Cotton (irri- gated)	Koilpatti and Bhavanisagar	20	Farm yard	10 cart- loads	Ammonium	30	Super	K ₂ SO ₄	30 to 60	Green manures can be used for irrigated cotton.
					manure	loads	to	30 to	50 to 60 lb.	
	Green manure		60	60 lb.	K ₂ O	30 to 60				
Cotton (irri- gated)	Coimbatore	20	Green manure	Daincha and sunhemp	lb.N	per	P ₂ O ₅	per acre	P ₂ O ₅	
					per	acre	per	acre	30 to 60	K ₂ O per acre

5. Bulky organic manures such as farm yard manure is found essential for increasing the yield of cotton.

6. Without a basal dressing of cattle manure, cotton was not benefitted directly or residually by artificials.

7. Green manure can be profitably utilised in the case of irrigated cotton.

8. The optimum dose of manurial ingredients vary from place to place and hence separate recommendations, have to be made based on the response obtained in each locality or based on quick soil tests.

BIBLIOGRAPHY

- | | |
|---|--|
| 1. Anonymous | 1954 Memoirs of Department of Agriculture. |
| 2. ——— | 1956 Annual Administrative report. Madras Agricultural Department (1956). |
| 3. ——— | 1961 Annual Administrative report Bhavanisagar Experiments. (1956—'57). |
| 4. ——— | 1957 The Report of results of Fertiliser Demonstration in India (1957—'61) (unpublished). |
| 5. ——— | 1950 Annual Report of the Agricultural Stations (1906—'50) Government Press, Madras. |
| 6. Mariakulandai, A. | 1957 Manuring Crops. <i>Madras agric J.</i> 44: 271—313 |
| 7. Paddy Specialist & Govt. Agri. Chemist | 1944 Review of Manurial experiment on the agricultural crops of the Madras Presidency for decennial period 1930—'40. <i>Madras agric. J.</i> 32: 39, 83. |
| 8. Vaidyanathan, M. | 1933 Analysis of Manurial experiments in India. Imperial Council of Agricultural Research, Government of India Press, Simla. |