

Review of Manurial trials in Madras State on Potato

by

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Synopsis: In this paper, the results of manurial trials on Potato conducted at the Agricultural Research Station, Nanjanad since its inception in 1917 have been reviewed.

Manurial trials on potato have been done mostly in the Agricultural Research Station, Nanjanad which was established in 1917 in the Nilgiris District. The experiments carried out on potato can be broadly grouped into 1. Experiments carried out for formulation of Nanjanad farm mixture. 2. Changes and modifications tried in the mixture on the change of ingredients of N, P and K and its comparison to other types, and 3. Others.

Response to organic manures: Cattle manure at 5 tons and 10 tons along with sodium nitrate and lime were tried during 1923-'28 with different varieties in different seasons. The results indicated that maximum response up to 483% in case of 10 tons of cattle manure over control was obtained¹¹.

During the years 1923-'28, fish guano at 1,120 pounds with and without lime at 448 pounds, cattle manure at 5 tons and sodium nitrate at 112 pounds were tried on different varieties in different seasons. The results indicated maximum response to fish guano plus cattle manure ranging from 228% to 686% (13,500 pounds) increase over no manure and nearly double over the other treatments¹¹.

To find out the best level of fish guano to be used, the quantities of 5, 10 and 15 cwts were tried. The yield increased with the increased application of fish guano. ¹¹ The cattle manure and fish guano and their combinations were tried to find out their comparative effect on the yield of potato. The results are furnished below:

| S. No. | Treatments | Average yield of potato in pounds per acre for five years |
|--------|--|---|
| 1. | Cattle manure at 10 tons | 5,746 |
| 2. | Fish guano alone at 1,120 pounds | 4,812 |
| 3. | Cattle manure at 5 tons and fish guano at 1,120 pounds | 9,928 |

Cinchona spent bark as a manure: The experiment was conducted during 1955-'56. It was observed that the cinchona bark compost had no effect in improving the yield of potatoes but a depressing effect was noticed.

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A series of trial started to find out cheaper substitutes for fish guano resulted in the discovery of the now famous manure mixture popularly known as the Nanjanad mixture. This mixture with following ingredients gave good yields of potato.

| | | |
|-----------------------------|---------------|---|
| Groundnut cake | 500 pounds | } Approximate yield 16,000 pounds per acre |
| Ammonium sulphate | 200 " | |
| Concentrated superphosphate | 336 " | |
| Steamed bone meal | 350 " | |
| Potassium sulphate | 224 " | |
| | <hr/> 1,610 " | |

This mixture is applied at the rate of 80 pounds N, 200 pounds P_2O_5 and 100 pounds K_2O .

The later experiments were all carried out for further improvement of this Nanjanad mixture to have more efficient and economic combination.

Changes and modifications tried in the mixture on the change of ingredients of N, P and K and its comparison to the types: (a) Over a basal dose of 3 tons of cattle manure, a combination of fish guano at 1,680 pounds, super phosphate at 560 pounds and muriate of potash at 224 pounds analysing 130 pounds N, 210 pounds P_2O_5 and 110 pounds K_2O were tried with 112 pounds and 214 pounds of sodium nitrate.

There was no response to sodium nitrate indicating no additional need for nitrogen over the combination ¹¹.

(b) In another experiment during the same period, fish guano at 1,120 pounds with super phosphate at 560 pounds and muriate of potash at 224 pounds analysing 90 pounds N, 320 pounds P_2O_5 and 110 pounds K_2O was compared to one mixture with 200 pounds groundnut cake plus 200 pounds steamed bone meal plus 200 pounds super phosphate plus 240 pounds sodium nitrate plus 120 pounds potassium sulphate and another mixture containing 224 pounds each of super phosphate, potassium nitrate and ammonium sulphate both analysing less of N, P and K than the fish guano mixture.

There was no response to higher doses of phosphoric acid, the yield being non-significant in the three treatments ¹¹.

(c) Again in another experiment during the same period, a mixture containing 200 pounds of potassium sulphate, 1,120 pounds fish guano substitute and 550 pounds super phosphate analysing 90 pounds N, 210 pounds P_2O_5 and 94 pounds K_2O had given significantly higher yield than two other mixtures one containing 130 pounds N plus 270 pounds P_2O_5 with no potash and the second containing 64 pounds N plus 60 pounds P_2O_5 and 94 pounds K_2O ¹¹

Complex manurial trials for reducing manurial composition and dosage of farm mixture were tried during the year 1949-'50 by keeping the potash content constant at 100 pounds with nitrogen at 2 levels (40 and 80 pounds) and phosphoric acid at 4 levels (0, 40, 120 and 200 pounds) with and without lime at 2 tons per acre.

The results indicated that (1) The higher the dose of N, the greater the yield, (2) The yield increases with increased dose of P_2O_5 and (3) Farm mixture with 80 pounds N, 200 pounds P_2O_5 and 100 pounds K_2O seems to contain the minimum ingredients necessary for good yields of potato and no further reduction of either N or P seems possible without reducing the yield¹.

These results showed that the composition and dosage of farm mixture consistently proved to be the best for increased yield.

Farm mixture compared with Mixtures prepared by manure firms: The trials were conducted for 3 years comparing the manure mixtures of Parry and Co., and Shaw Wallace and Co. with and without application of Farm yard manure.

The results indicated that the farm mixture was superior to others².

Changes tried in the nitrogenous, phosphoric and potassic Content of Nanjanad mixture:

1. *Replacement of ammonium sulphate by groundnut cake:* This was tried during the year 1941-'42 with three forms of nitrogen mainly 80 pounds N as ammonium sulphate, 80 pounds N as groundnut cake and 40 pounds N as ammonium sulphate with 40 pounds N as groundnut cake.

The result indicated that 80 pounds N as groundnut cake is the best and that it can replace ammonium sulphate in the mixture. This also confirms an earlier experiment on the formulation of manure that ammonium sulphate can be replaced by groundnut cake and that combination of organic and inorganic forms of nitrogen are better than inorganic forms alone³.

2. *Replacement of ammonium sulphate and groundnut cake by Chilean nitrate:* This was tried for three seasons between 1954-'56 over a basal dose of 5 tons of cattle manure with and without lime at 80 pounds level of nitrogenous fertiliser.

The result indicated that farm mixture is superior to chilean nitrate mixture and that maximum yield was obtained by ammonium sulphate plus groundnut cake in the farm mixture⁴.

3. *Replacement of ammonium sulphate by ammonium sulphate nitrate:* This was tried in 1958-'59 by replacing ammonium sulphate content in the mixture by ammonium sulphate nitrate.

The result indicated no difference in the yield and as such ammonium sulphate nitrate can be used in the mixture⁵.

4. *Replacement of ammonium sulphate by calcium ammonium nitrate*: This was tried at Central Potato Research Station at Ootacamund during the year 1958-'59 on equal nitrogen basis.

The result indicated that calcium ammonium nitrate is as good as ammonium sulphate and as such it can be used in the mixture ⁶.

In a similar experiment conducted at the Agricultural Research Station, Nanjanad in 1962 it was found that Calcium ammonium nitrate can replace ammonium sulphate if used in the mixture ⁷ b. However, the mixture had to be freshly made and used immediately to avoid reversion of the water soluble P_2O_5 in the super phosphate.

5. *Replacement of ammonium sulphate by urea and chilean nitrate*: This was tried during the year 1952-'55 by changing the ammonium sulphate content of mixture by urea and chilean nitrate with and without lime and green leaf.

The result indicated that ammonium sulphate is superior to urea and chilean nitrate ².

6. *Replacement of fish guano substitute by Niciphos and ammonium sulphate*: Niciphos (which is a mixture of ammonium sulphate and ammonium phosphate) was compared to fish guano substitute and ammonium phosphate in the mixture over a basal dose of cattle manure during the years 1923-'29.

The result indicated that farm mixture was the best followed by niciphos ¹¹.

7. *Replacement of groundnut cake in the mixture by other cakes*: This was tried between 1930-'40 by replacing groundnut cake in the mixture by castor (white and black) cake, coconut cake, neem cake and *pungam* cake.

The result indicated that all the cakes are on par except neem cake which was significantly inferior ¹⁰.

Phosphatic manures:

1. *Different forms of phosphates compared in the mixture*: Different kinds of phosphates namely concentrated super phosphate, dicalcic phosphate, steamed bone meal and a mixture of super phosphate and steamed bone meal with and without lime were compared as replacements of phosphates in the farm mixture in single and double doses.

The results indicated that (i) steamed bone meal is definitely inferior to more soluble forms of phosphates and (ii) full doses of phosphates have proved better than the corresponding half doses. The farm mixture with mono and tricalcic phosphates is as good as smaller quantities of phosphates applied as concentrated super phosphate or dicalcic phosphate ⁹.

TABLE 1

| Crop | Place | No. expt. | Bulky | | N | P | K | Combination | Others | Conclusions |
|--------|---------------|-----------|--|---|---|---|--|---------------------|--|--|
| | | | Manures | Doses | | | | | | |
| Potato | Nanjana alone | 36 | FYM Castor cake, neem cake, groundnut cake, gingam cake, coconut cake | 10 tons To supply 80 lb. of nitrogen | Ammonium sulphate, groundnut cake, Chilean nitrate, calcium ammonium nitrate, sodium nitrate up to 100 lb. of N. | Fish guano, 1120 lb., superphosphate 200 lb., P_2O_5 , steamed bone meal 200 lb., P_2O_5 , Fused phosphate 200 lb., P_2O_5 , Dicalcium phosphate up to 240 lb., P_2O_5 , ammonium phosphate | Potassium sulphate and potassium chloride up to 100 lb. K_2O | Used in combination | Limo up to 5000 lb. micro-nutrients (1) copper sulphate and zinc 15 lb./ac. (2) Borax 5 to 20 lb. (3) Magnesium up to | 1. Organic forms of nitrogen are superior but combination of organic and inorganic nitrogen is economical. Ammonium sulphate can be replaced by CAN, and ammonium sulphate nitrate. Optimum level of nitrogen remained at 80 lb. of nitrogen. 2. Superphosphate and bone meal combination was found to be the best than any other combinations. 3. Potassium requirement of farm mixture is met best of potassium sulphate than any other sources. 4. Basal dressing of cattle manure is desirable for increasing yield. 5. Magnesium had no effect: Higher doses depressed the yield. Other micronutrients had no effect. 6. Basal application of the entire manure was better than the split application of manure. 7. Normal furrow application was superior. |

2. *Replacement of super phosphate by fused phosphate:* This was tried in the year 1951-'52 by using fused phosphate in the place of superphosphate on equal phosphoric acid basis.

There was no significant difference in both seasons of crop

3. *Optimum requirement of phosphoric acid in the mixture:* This was tried in the year 1951-'52 with varying doses of super phosphate at 30, 60, 120, 180, 200 and 240 pounds P_2O_5 along with the other ingredients of manure mixture over a basal dressing of 1,500 pounds of lime and 5,000 pounds of green leaf.

Best yield was obtained at the normal dose of 200 pounds super phosphate, thus indicating no scope for reducing the P_2O_5 content ?

4. *Reversion of phosphates:* In an experiment conducted in 1958-'60 on the availability of phosphates by the addition of organic matter and lime to release the locked up phosphate and to render available for long period, it was found that (1) dicalcium phosphate is superior to rock phosphate and bone meal, (2) super phosphate is superior to bone meal but on a par with dicalcium phosphate and rock phosphate, (3) rock phosphate and bone meal are on a par (4) application of lime is clearly beneficial and (5) there is no significant difference between green manure and no green manure on phosphate availability ⁶.

These results indicate that insoluble forms of phosphates applied alone are not useful and that steamed bone meal and super phosphate as used in the farm mixture will give the best results and can be replaced only by soluble or available forms of phosphates.

Potassic fertilisers:

1. *Replacement of potassium sulphate by muriate of potash:* This was tried during the period 1930-'40 with K_2O at 0, 1 and 2 cwt levels. The result indicated slightly favourable yields with potassium sulphate at 2 cwt level ¹⁰.

2. *Replacement of potash by cattle manure:* The NPK values contained in cattle manure were tested during 1930-'40 by substituting with artificials in combination of usual farm mixture. Treatments with no potash and increasing levels of potash were also included.

The results indicated the value of potash and the efficiency of cattle manure ¹⁰.

3. *Replacement of potassium sulphate by wood ash:* This was tried during the year 1942-'46 to find out the effect of wood ash in the place of potassium sulphate. The result indicated that wood ash in any quantity had no effect on the yield of potatoes and that potassium sulphate is significantly better than wood ash ¹.

Thus, the results indicate that the K_2O requirement of farm mixture is met best by potassium sulphate than other sources.

Other experiments:

1. *Foliar application of peptonised cake as alternate source of nitrogen:* This was tried during the year 1958-'60 by replacing the 80 pounds nitrogen in the mixture partly by 20 pounds N as peptonised cake. The result indicated that 20 pounds N peptonised cake along with 60 pounds N, and 200 pounds of P_2O_5 and 100 pounds of K_2O had given better yield than farm mixture containing 80 pounds N, 200 pounds P_2O_5 and 100 pounds K_2O ⁵ & ⁶.

2. *Foliar spray with nutrients:* This was tried in the year 1955-'56, to find out the effect of foliar spray of nutrients (12 pounds water soluble plant concentrates similar to the Monsanto product Folium) at 10 weekly sprays to supply 40 pounds each of N, P and K over soil dressing of 1/5, 2/5 and 3/5 of normal dose of mixture.

The result indicated that foliar spray was not helpful for potato ⁷.

3. *Response to lime:* Prior experiments conducted in the years 1925-'28, 1946-'47, 1947-'49 and 1951-'52 had indicated that there was no increase in yield by the application of lime.

But recent experiments conducted during 1957-'60, indicated response to lime ⁸ & ⁹.

4. *Response to calcium carbonate slurry:* This was tried during the year 1951-'52 along with farm mixture and 2,000 pounds green leaf by comparing with slaked lime. There was no response either due to lime or calcium carbonate slurry ⁷.

5. *Response to borax:* This was tried during the year 1947-'48 by the application of borax at 5, 10, 20 and 30 pounds per acre along with farm mixture. There was no response and at higher doses, the yield was depressed ⁷.

6. *Response to Magnesium:* This was tried in the year 1957-'59 to find out the effect of magnesium application. Magnesium sulphate at 30, 60 and 90 pounds per acre along with farm mixture was compared to 10 pounds spray in two instalments at 6th and 8th week.

The result indicated that while there was increase in yield by spray applications in 1957-'58, there was no response in 1958-'59 ⁹.

7. *Response to other micronutrients:* This was tried in the year 1954-'56 with copper sulphate, zinc sulphate and urea sprayed at 15 pounds per acre singly and in combination.

The result indicated that while there was increase in yield due to urea spray to an extent of 350 pounds there was no response with copper, zinc and sulphur ⁹.

8. *Time of application:* Application of farm mixture in splits doses was tried in 1954-'56. The result indicated that single dose application was better than split applications ⁹.

9. *Placement of fertilisers*: This was tried in 1946-'48 by applying the super phosphate of mixture at 3" deep below the seeds and comparing with normal furrow application.

Normal application in the furrows was found definitely better than deep placement⁷. In an earlier experiment conducted during the period between 1930-'40, the application of cattle manure in furrows was found better than broadcasting⁹.

Summary of the results of the experiments are presented in table I

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