

MANURING FOR LAND IMPROVEMENT AND CROP PRODUCTION.

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ABSTRACT.

The paper deals with the results of manuring experiments on wheat and paddy conducted in Madhya Pradesh for some years past. The main points brought out are that in the case of wheat, for immediate increase in production, application of fertilizers is necessary, but from the point of view of land improvement, the superiority of organic manures is unquestionable. Deleterious effect of sodium nitrate on soil fertility has also been brought out. A long range policy calls for judicious use of both organic and inorganic manures. Among the fertilizers Niciphos has been found to be superior to ammonium sulphate.

2. As regards paddy, superiority of organic manures both from a short range and long term policy has been brought out. It is only to supplement its supplies that recourse to fertilizers has to be taken to get immediate results.

In this country where soils have reached almost the low levels of productivity, it is in fitness of things to examine how manuring can help immediately in stepping up production of food and fibre and yet maintain or increase the productivity of soil.

2. In Madhya Pradesh, the major important food crops are paddy, jowar and wheat, while cotton is the main fibre crop. In this paper, only wheat and paddy are dealt with. The conditions under which the two crops are grown vary widely, paddy being a monsoon crop and facilities for irrigating it in certain parts being available, adequate soil moisture is comparatively more assured. In the case of wheat it is grown during dry season and for which no irrigation is possible in this State except to a very limited extent. Because of the more complex nature of the problem, a large number of experiments were carried out on this crop at different stations in the wheat tract and it would be appropriate to deal with them first. Various manures, both organic and inorganic, were tried as also different methods of application of some of them. The details of these experiments are furnished in the statements enclosed, along with the results of several treatments. The results have not been statistically examined, but indicate the order of magnitude of yield responses to be obtained. The economics of manuring depends on the relative prices of manures and fertilizers and that of the produce. As they vary from time to time, the profits can be worked out from the extra yields obtained on the basis of relative rates.

3. Taking first the immediate effect on crop outturn, superiority of fertilizers over organic manures, is clearly evident, from the results of experiments Nos. 1 to 7 carried out at Powarkhera (Hoshangabad), Adhartal (Jabalpur) and Chhindwara. The increase in yield as a result of application of ammonium phosphate was up to 50 per cent as against up to 9 per cent with organic manurial treatment. At Chhindwara, where the soil is lighter and less retentive of moisture than that at the other two stations, the effect is less perceptible although greater than obtained by application of organic manure.

4. Although over most of the area, the crop is grown dry, there is microscopic acreage which is irrigated with well water. Under such conditions, too, the fertilizer, ammonium phosphate, applied singly, has given a response up to 33 per cent (Experiment No. 12) as against a maximum of 7 per cent with organic

manures (Experiment No. 11). Possibly the dose applied is not optimum. Hence the response to fertilizer is not so high as under dry conditions.

5. As regards the combination of the two kinds of manures, organic and inorganic, results of experiment No. 2 at Powarkhera for the dry crop and of most of the experiments on irrigated crop, show that addition of fertilizer to organic manures has enhanced the yield greater than the application of the latter singly. This combination has not, however, given as good a response as obtained by fertilizers applied singly.

6. Thus for an *immediate* increase in production the efficacy of fertilizers appears to be beyond doubt.

7. The next important aspect is the lasting effect of the two kinds of manures on soil. For this, experiments Nos. 13, 14 and 15 carried out at Powarkhera provided sufficient data. The residual effect of the several manures was studied over a period of two, eighteen and seven years respectively. In experiment No. 13, the plots previously manured with ammonium sulphate, were as bad as no manure plots whereas those given farm-yard manure showed an increase in yield up to 22 per cent, for a period of two years. The experiment No. 14 furnishes a very conclusive data obtained over a very long period, viz., 18 years. The harmful effect of sodium nitrate and the beneficial result of farm-yard manure are clearly brought out. The latter finding is also confirmed by the results of experiment No. 15. Thus from the point of view of land improvement, the superiority of organic manures is unquestionable. Equally true is the deleterious effect of fertilizers on the soil fertility.

8. Now as regards the third aspect, viz., protection against accentuation of damage through manuring by drought or rust, the period during which the experiments were carried out covered both these contingencies. The findings referred to earlier therefore hold good for this aspect too. Observation during the rust epidemic season showed that the plots manured with ammonium phosphate showed lesser damage than other treatments. Even during the dry season, the desiccating effect of this and the other fertilizer was not seen. Even in the case of farm-yard manure, plots treated with small dressings of 10 to 12 cart-loads were unaffected. In case of groundnut cake, however, germination was patchy particularly in a dry season, in the plots treated with it just at about sowing time. This effect was got over by applying the manure 5 to 6 weeks earlier.

9. Among the fertilizers, Niciphos has been found to be superior to ammonium sulphate. With an effective dose of 15 lbs. N per acre, the increase in yield due to these fertilizers has been 46 and 21 per cent respectively at Powarkhera. At Adhartal, the two fertilizers did not exhibit such a contrast with heavier application, viz., at 20 lbs. N but the difference was quite apparent in the smaller dose of 10 lbs. N per acre. At Chhindwara, too, the variation in the response to the two fertilizers was not appreciable, although it was higher with 15 lbs. N treatments. Even under irrigation, Niciphos has given greater response than the other fertilizer. Sodium nitrate has gone into disrepute. The effect of superphosphate was not perceptible since the need of the crop is more for nitrogen.

10. With regard to bulky manures, farm-yard manure and properly made compost are the best. Green manuring has not attained success worth the name. Besides, there are great limitations to adopting its use. In the wheat tract there is hardly a long break during the monsoon, to plough in the green crop. Further, its growth remains stunted on account of over saturation of soil moisture. Thirdly, there is the possibility of rains ceasing abruptly towards the month of September, in which case, the manure remains undecomposed. As regards oil cake, groundnut cake has given good results with earlier applications. But it is also exposed to the same danger of abrupt stoppage of monsoon in September. The risk, however, is relatively less since comparatively less moisture is required to bring about its fermentation. When supplies of farm-yard manure or compost manure are limited

recourse has to be taken to cake manure. Although obviously inferior to the cattle manure or compost, in its residual effect on soil fertility, the results do show that the plots treated with cake continued to give higher yield than no manure or fertilizer treated plots. Another good source is cattle urine. If conserved properly, it is more efficacious than cattle manure. With regard to the time and the doses the results are too clear to need any comment.

11. It will thus be apparent that these experiments have dispelled the popular prejudice against the manuring of wheat crop and furnish conclusive evidence with regard to the utility of several manures. They further indicate that although immediate and substantial increase in crop outturn could be obtained by resorting to the use of fertilizers, the value of organic manures in gradually building up soil fertility cannot and should not be ignored. A long range policy calls for judicious use of both organic and inorganic manures. Taking a period of 4 to 5 years, application of manures and fertilizers is positively a paying proposition and one that cannot be avoided any further except at dwindling prospects of wheat cultivation in the State.

12. Turning to the crop of paddy, only a few experiments conducted very recently will be enough to show the response of various manures. The details of layout, etc., have been furnished in the following tables. The experiment conducted at Kheri (Jabalpur) Station was confined to three different oil-cakes whereas at Labhandi (Raipur) besides oil-cakes, town compost, farm-yard manure, ammonium sulphate were tried and their residual response also studied. The effect of incorporation of Karanj leaf in various quantities too was observed.

13. The results although very much less exhaustive than those of experiments on wheat, are clearly indicative. The direct and residual response has been greatest with 40 lbs. N_2 applied in the form of town compost, farm-yard manure coming next in order. With regard to ammonium sulphate, the immediate increase in yield has been of the same order as with town compost, or farm-yard manure. But its residual effect has been negative. With regard to groundnut cake, both the direct and residual response has been of the same order. Groundnut cake appears to leave residual effect.

14. The second experiment on incorporation of karanj leaf has furnished equally interesting results although requiring to be confirmed. A dose of 3 tons produced the greatest response. The value of this finding is very great in that it shows a valuable source of manure to supplement compost or cowdung.

15. The experiment on oil-cakes at Kheri station has yielded conclusive results. All the three cakes have given almost the same response; 40 lbs. N_2 appears to be the optimum. As regards the economics, prices of til and linseed cake are higher than that of groundnut cake which is available at control rates. Under the existing circumstances, therefore, manuring with groundnut cake alone seems to be profitable.

16. Thus in the case of paddy under conditions of adequate soil moisture, superiority of organic manures both from a short range and long term policy is clearly brought out. It is only to supplement its supplies, that recourse to fertilizers has to be taken to get immediate results in the case of paddy.

Experiment number.	Name of experimental station.	Duration of experiment.	Crop strains used.	Treatment per acre.	Grain yield percentage (Wheat).	Increased outturn of grain in lbs. obtained as result of manurial treatment.
1	Powarkhera (Hoshangabad)	Five years, i.e. 1941-1945.	AO 13 & A 115.	(1) No manure—Control (2) 10 lbs. N ₂ as A.S. (Ammonium Sulphate) (3) 10 lbs. N ₂ as N.Ph.II (Niciphos II) (4) 15 lbs. N ₂ as A.S. (5) 15 lbs. N ₂ as N.Ph.II	100.0 117.3 123 121.5 146.9	.. 61 123 85 176
2	Powarkhera (Hoshangabad)	Five years, i.e. 1941-1945.	A 115	(1) No manure—Control (2) 15 lbs. N ₂ as F.Y.M. (Farm-Yard Manure) (3) 15 lbs. N ₂ as compost (4) 7½ lbs. N ₂ as F.Y.M. 7½ lbs. N ₂ as A.S. (5) 7½ lbs. N ₂ as compost 7½ lbs. N ₂ as A.S.	100.0 104.4 42 112.2 108.9	.. 20 42 56 41
3	Adhartal (Jabalpur)	Four years, i.e. 1946-1949.	NP 52	(1) No manure—Control (2) 10 lbs. N ₂ as Amm. Phos. drilled with seed (3) 20 lbs. N ₂ as Amm. Phos. drilled with seed (4) 40 lbs. N ₂ as A.S. Phos. drilled with seed (5) 20 lbs. N ₂ as A.S. Phos. drilled with seed (6) 10 lbs. N ₂ as Amm. Phos. broadcast (7) 20 lbs. N ₂ as Amm. Phos. broadcast (8) 10 lbs. N ₂ as A.S. broadcast (9) 20 lbs. N ₂ as A.S. broadcast	100.0 140.1 150.8 128.2 143.6 124.7 123.7 112.2 115.9	.. 155 196 109 168 95 91 47 61
4	Adhartal (Jabalpur).	One year 1948-49. Due to heavy rains in November and subsequent dry weather the crop yields were above normal during this season.	AO 90	(1) No manure—Control (2) 20 lbs. N ₂ as town compost before monsoon (3) 40 lbs. N ₂ as town compost before monsoon (4) 20 lbs. N ₂ as F.Y.M. before monsoon (5) 40 lbs. N ₂ as F.Y.M. before monsoon (6) 10 lbs. N ₂ as groundnut cake at sowing (7) 20 lbs. N ₂ as groundnut cake at sowing (8) 10 lbs. N ₂ as A.S. at sowing (9) 20 lbs. N ₂ as A.S. at sowing	100.0 108.7 102.0 106.7 111.7 128.3 139.4 135.0 170.6	.. 43 10 33 58 139 194 172 346

Experiment number.	Name of experimental station.	Duration of experiment.	Crop strains used.	Treatment per acre.	Grain yield percentage (Wheat).	Increased outturn of lbs. obtained as result of manurial treatment.
5	Chhindwara ..	Four years, i.e. 1932-1935.	AO 49	(1) No manure—Control .. (2) Synthetic manure at 4 tons .. (3) F.Y.M. at 4 tons ..	100.0 105.1 104.4	.. 25 23
6	Chhindwara ..	Five years, i.e. 1936-1940.	AO 49	(1) No manure—Control .. (2) 20 lbs. N ₂ as F.Y.M. .. (3) 20 lbs. N ₂ as synthetic manure .. (4) 20 lbs. N ₂ as A.S. with seed .. (5) 20 lbs. N ₂ as N.Ph.II with seed ..	100.0 97.8 104.2 113.1 116.9	.. -16 32 100 128
7	Chhindwara ..	Two years, i.e. 1941-1942.	..	(1) No manure—Control .. (2) 10 lbs. N ₂ as A.S. drilled with seed .. (3) 15 lbs. N ₂ as A.S. drilled with seed .. (4) 10 lbs. N ₂ as Ph.II drilled with seed .. (5) 15 lbs. N ₂ as N.Ph.II drilled with seed ..	100.0 111.1 123.7 111.1 130.9	.. 43 83 43 123
8	Powarkhera ..	Three years, i.e. 1940-1942.	AO 13, AO 90, A 115/ NP 52, NP 101 & E.B. 28 (ir- rigated)	(1) 5 tons F.Y.M. as basal dressing .. (2) 5 tons F.Y.M. plus 10 lbs. N ₂ as A.S. (3) 5 tons F.Y.M. plus 10 lbs. N ₂ as N.Ph.II	100.0 112.1 121.9	.. 128 233
9	Powarkhera ..	Four years, i.e. 1942-1945.	AO 13, A 115 & NP 101 (ir- rigated)	(1) 3 tons of F.Y.M. as basal dressing (Control) (2) 3 tons of F.Y.M. plus 10 lbs. N ₂ as A.S. (3) 3 tons of F.Y.M. plus 10 lbs. N ₂ as N.Ph. (4) 3 tons of F.Y.M. plus 20 lbs. N ₂ as A.S. (5) 3 tons of F.Y.M. plus 20 lbs. N ₂ as N.Ph.	100.0 116.3 125.1 116.1 132.2	.. 104 162 103 207

Experiment number.	Name of experimental station.	Duration of experiment.	Crop strains used.	Treatment per acre.	Grain yield percentage (Wheat).	Increased outturn of grain in lbs. obtained as a result of manurial treatment.
10	Chhindwara ..	Four years, i.e. 1932-1935.	AO 49 (Irrigated).	<p>(1) 4,000 lbs. of F.Y.M.—Control</p> <p>(2) 8,000 lbs. of F.Y.M.</p> <p>(3) 4,000 lbs. of F.Y.M. plus 100 lbs. A.S.</p> <p>(4) 4,000 lbs. of F.Y.M. plus 110 lbs. N.Ph.II</p> <p>(5) 4,000 lbs. of F.Y.M. plus 120 lbs. A.S. plus 120 lbs. Super Phos. single</p> <p>(6) 4,000 lbs. of F.Y.M. plus 120 lbs. super phosphate single.</p>	100.0 102.1 120.6 121.6 121.8	19 181 190 192 —20
11	Chhindwara ..	Five years, i.e. 1936-1940.	A 112 (Irrigated).	<p>(1) No manure—Control</p> <p>(2) 20 lbs. N₂ as F.Y.M.</p> <p>(3) 10 lbs. N₂ as F.Y.M.—10 lbs. N₂ as A.S. top dressed</p> <p>(4) 10 lbs. N₂ as F.Y.M.—10 lbs. N₂ as N.Ph. top dressed</p> <p>(5) 20 lbs. N₂ as Karanj cake drilled with seed</p> <p>(6) 20 lbs. N₂ as A.S. top dressed</p> <p>(7) 20 lbs. N₂ as N.Ph.II top dressed</p>	100.0 107.1 121.8 120.0 122.3 125.9 123.5	48 148 136 162 176 160
12	Tharsa (Nagpur).	Nine years, i.e. 1941-1949.	AO 49 (Irrigated).	<p>(1) No manure—Control</p> <p>(2) 25 lbs. N₂ as F.Y.M.</p> <p>(3) 10 lbs. N₂ as castor cake with seed plus 15 lbs. N₂ as castor cake top dressed.</p> <p>(4) 10 lbs. N₂ as A.S. with seed plus 15 lbs. N₂ as A.S. top dressed.</p> <p>(5) 10 lbs. N₂ as N.Ph.II with seed plus 15 lbs. N₂ as N.Ph.II as top dressed.</p> <p>(6) 10 lbs. N₂ as F.Y.M. plus 7½ lbs. N₂ as A.S. with seed and 7½ lbs. N₂ as A.S. top dressed.</p> <p>(7) 10 lbs. N₂ as F.Y.M.—7½ lbs. N₂ as N.Ph.II with seed plus 7½ lbs. N₂ as P.Ph. top dressed.</p> <p>(8) 10 lbs. N₂ as F.Y.M.—7½ lbs. N₂ as castor cake with seed and 7½ lbs. N₂ as castor cake top dressed.</p>	100.0 104.2 114.9 105.6 133.0 115.3 126.3 106.5	21 71 27 157 73 126 32

Experiment number.	Name of experimental station.	Duration of experiment.	Crop strains used.	Treatment per acre.	Result of grain yield in per cent of control (Wheat).		Increased outturn of grain in lbs. obtained as a result of manurial treatment.	
					Direct.	Residual.	Direct.	Residual.
13	Powarkhera (Hoshangabad)	Manures applied during the year 1947-48 only and residual effect studied during two years, i.e. 1949 and 1950.	A 115	(1) No manure—Control	100-0	100-0	..	..
				(2) 10 cart-loads town compost	108-4	103-5	43	15
				(3) 20 cart-loads town compost	109-6	111-8	49	48
				(4) 10 cart-loads of F.Y.M.	103-1	110-3	16	42
				(5) 20 cart-loads of F.Y.M.	107-5	122-1	36	90
				(6) 4 mds. groundnut cake	72-0	111-0	-143	42
				(7) 120 lbs. A.S.	130-1	100-0	159	0-5
14	Powarkhera (Hoshangabad)	Manures applied during the period 1920 to 1931 and residual effect studied during the period of 18 years, i.e. 1932 to 1949.	A 115	(1) No manure—Control	100-0	100-0	..	..
				(2) 100 mds. F.Y.M. every year applied before monsoon.	125-3	142-3	154	128
				(3) 100 mds. urine earth every year applied as presowing cultivation.	121-6	119-8	131	60
				(4) 6 mds. castor cake applied every year at presowing cultivation.	125-4	109-1	153	30
				(5) 6 mds. treated castor cake applied every year with seed.	120-1	106-9	122	21
15	Powarkhera (Hoshangabad)	Manures applied during the period 1921-31 and residual effect studied for 7 years, i.e. 1932 to 1938.	..	(6) 1½ mds. sodium nitrate applied every year.	109-5	94-6	58	-16
				(1) No manure—Control	100-0	100-0	..	..
				(2) 100 mds. F.Y.M. every year	133-9	166-4	199	253
				(3) 300 mds. F.Y.M. every three years.	133-9	148-4	199	186
				(4) 100 mds. F.Y.M.—20 mds. lime every year.	124-3	133-1	143	126
(5) 300 mds. F.Y.M.—40 mds. lime every three years.	126-6	140-9	156	100				

Experiment number.	Name of experimental station.	Duration of experiment.	Crop strains used.	Treatment per acre.	Result of grain yield in per cent of control (Paddy).		Increased outturn of grain in lbs. obtained as a result of manurial treatment.	
					Direct.	Residual.	Direct.	Residual.
1	Labhandi (Raipur).	1948-49 The manurial treatment was given last year, i.e. 1948-49 and the residual effect studied this year.	..	(1) No manure	100.0	100.0	..	..
				(2) Town compost at 20 lbs. N ₂ per acre.	109.2	114.3	65	59
				(3) Town compost at 40 lbs. N ₂	151.8	157.0	367	235
				(4) 20 lbs. N ₂ as cattle dung	121.5	130.6	152	126
				(5) 40 lbs. N ₂ as cattle dung	151.6	161.1	366	252
				(6) 10 lbs. N ₂ as groundnut cake.	115.3	133.3	108	125
				(7) 20 lbs. N ₂ as groundnut cake.	135.6	137.6	252	155
				(8) 10 lbs. N ₂ as Ammonium Sulphate.	120.2	102.7	143	11
				(9) 20 lbs. N ₂ as Ammonium Sulphate.	150.4	89.9	357	-42
2	Labhandi (Raipur)	1949-50	..	(1) No manure	100.0	..	..	..
				(2) One ton leaves of Karanj tree.	114.0	..	160	..
				(3) Two tons leaves of Karanj tree.	147.0	..	520	..
				(4) Three tons leaves of Karanj tree.	165.0	..	720	..
3	Kheri (Jabalpur).	Four years—1942 to 1945-46.	..	(1) No manure	100.0	..	..	..
				(2) 20 lbs. N ₂ as Groundnut cake.	138.4	..	260	..
				(3) 40 lbs. N ₂ as Groundnut cake.	270.4	..	511	..
				(4) 60 lbs. N ₂ as Groundnut cake.	325.1	..	661	..
				(5) No manure	180.6	..	237	..
				(6) 20 lbs. N ₂ as linseed cake	262.5	..	477	..
				(7) 40 lbs. N ₂ as linseed cake	326.1	..	664	..
				(8) 60 lbs. N ₂ as linseed cake	..	..	..	..
				(9) No manure	181.0	..	251	..
				(10) 20 lbs. N ₂ as til oil-cake	266.0	..	490	..
				(11) 40 lbs. N ₂ as til oil-cake	310.8	..	620	..
				(12) 60 lbs. N ₂ as til oil-cake	..	..	..	..