

# ARE FERTILISER APPLICATIONS TO JOWAR, MAIZE AND BAJRA ECONOMICAL ?

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## Abstract

*The paper reports an economic analysis of response data from 774 simple fertiliser trials on jowar, 580 on maize and 477 on bajra conducted on cultivators' fields under the All India Coordinated Agronomic Experiments Scheme during 1967-71. It was found that at any level of fertiliser application, the hybrids gave distinctly higher responses than the composite or local varieties. The average responses to fertilisers were the highest with  $N_{120}P_{60}K_{60}$  followed by  $N_{120}P_{60}$ . The differences between the average responses obtained with  $N_{120}$  and  $N_{60}P_{30}$  were not marked and in some cases the response with  $N_{60}P_{30}$  was higher than that with  $N_{120}$ . The patterns of distribution of profits obtained by individual farmers by application of different fertiliser doses have been presented. These indicated that it was possible to improve the returns to farmers by cultivation of these crops under irrigated as well as un-irrigated conditions by balanced use of fertilisers and by growing hybrids in preference to composite or local varieties.*

Based on experiments conducted on cultivators' fields, Kanwar *et al* (1, 2) reported the economics of fertiliser application to high yielding varieties (HYV) and tall varieties (TV) of wheat and rice and concluded that (i) fertiliser application was more profitable in case of HYV than the TV at a given level, (ii) to maximise net returns, balanced use of fertilisers containing NP or NPK is essential in preference to N alone as the latter can even result in losses under conditions of deficiency of the other major nutrients, and (iii) in situations where fertilisers are in short supply, it is more profitable to use lower dose of nitrogen balanced with phosphate than using higher dose of nitrogen such as  $N_{120}$ .

In the present paper an attempt has been made to study the pattern of profits which the farmers

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were likely to get from the application of fertilisers to jowar, maize and bajra on the basis of simple fertiliser trials conducted on cultivators' fields under the All-India Coordinated Agronomic Experiments Scheme during 1967 to 1971.

## MATERIAL AND METHODS

Data of 774 trials conducted on jowar in four districts of Bhavnagar (Gujarat), Parbhani and Poona (Maharashtra) and Jhansi (U.P.), of 580 trials conducted on maize in four districts of Monghyr (Bihar), Ludhiana (Punjab), Kanpur (U.P.) and Mandi (H.P.) and of 477 trials conducted on bajra in four districts of Aligarh (U.P.), Mehsana (Gujarat), Coimbatore (Tamil Nadu) and Delhi, were available for study. The trials were conducted on hybrids and local varieties of jowar and bajra and hybrids as well as composite varieties of maize which were grown under irrigated as well as unirrigated conditions. The districts covered along with the number of trials and varieties used are given in Table I.

TABLE 1—Names of districts and number of trials conducted on jowar, maize and bajra

State	District	Soil class	Season	Variety	No. of trials
<b>Jowar</b>					
Gujarat	Bhavnager	Medium black	Kharif (I)	CSH-1	61
	"	"	"	E-56	55
Maharashtra	Parbhani	Medium black	Kharif (UI)	CSH-1	114
	"	"	"	PJNK	109
	"	"	Rabi (I)	CSH-1	104
	"	"	"	M-35-1	110
	Poona	"	"	CSH-1	64
	"	"	"	M-35-1	81
U.P.	Jhansi	Mixed red & black	Kharif (UI)	CSH-1	38
	"	"	"	Local	38
<b>Maize</b>					
Bihar	Monghyr	Alluvial	Kharif (I)	Ganga Safed-2	67
	"	"	"	Jaunpur Safed	66
	"	"	Kharif (UI)	Ganga Safed-2	88
H.P.	Mandi	Sub-montane	Kharif (UI)	Ganga-5	20
	"	"	"	Ganga-3	30
	"	"	"	Him-123	41
Punjab	Ludhiana	Alluvial	Kharif (I)	Vijay-1	108
U.P.	Kanpur	Alluvial	Kharif (UI)	Ganga-5	74
<b>Bajra</b>					
Delhi	Delhi	Alluvial	Kharif (I)	HB-1	38
Gujarat	Mehsana	"	Kharif (UI)	J-104	82
	"	"	"	N-207	111
Tamil Nadu	Coimbatore	Mixed red & black	Rabi (I)	HB-3	105
	"	"	"	X-3	103
U.P.	Aligarh	Alluvial	Kharif (I)	HB-1	38

(I) Stands for irrigated. (UI) Stands for unirrigated.

In each of the above mentioned districts, 64 villages were selected at random every year and in each of the selected villages, two fields were selected randomly for two trials, one with hybrid and other with composite variety. Each selected field was divided into 10 equal plots. In one of these plots, no fertiliser was applied and was taken as 'control' and each of the remaining nine plots were treated with fertiliser doses made up of different combinations of levels of nitrogen, phosphorus and potassium. The 10 treatments were as fol-

lows, where suffixes indicate the doses of nutrients in kg/ha:

- |                     |  |
|---------------------|--|
| 1. Control          | 6. N <sub>60</sub> P <sub>30</sub>                   |
| 2. N <sub>60</sub>  | 7. N <sub>60</sub> P <sub>60</sub>                   |
| 3. N <sub>120</sub> | 8. N <sub>120</sub> P <sub>30</sub>                  |
| 4. P <sub>30</sub>  | 9. N <sub>120</sub> P <sub>60</sub>                  |
| 5. P <sub>60</sub>  | 10. N <sub>120</sub> P <sub>60</sub> K <sub>60</sub> |

The various agricultural practices adopted in carrying out the experiments were uniform in

all the 10 plots. The results of statistical analysis of yield data indicated that the fertiliser treatments  $N_{60}$ ,  $N_{120}$ ,  $N_{60}P_{30}$ ,  $N_{120}P_{60}$  and  $N_{120}P_{60}K_{60}$  per hectare were significantly better than the control and gave marked increases in yield. The present study is, therefore, confined to the analysis of these five fertiliser treatments only.

### RESULTS AND DISCUSSION

The average responses to fertilisers of jowar, maize and bajra for different soil classes are given in Table 2. The results show that the average responses were the highest with  $N_{120}P_{60}K_{60}$  followed by  $N_{120}P_{60}$ . The differences between the average responses obtained with  $N_{120}$  and  $N_{60}P_{30}$  were not marked and in some cases the response with  $N_{60}P_{30}$  was higher than that with  $N_{120}$ . Further, it was found that at any level of fertiliser application, the hybrids gave distinctly higher responses than the local and composite varieties.

In order to study the pattern of distribution of profits obtained by the individual farmers by application of fertiliser doses, namely  $N_{60}$ ,  $N_{120}$ ,  $N_{60}P_{30}$ ,  $N_{120}P_{60}$  and  $N_{120}P_{60}K_{60}$ , the net returns in rupees were obtained by deducting the cost of fertiliser applied from the value of additional produce in the form of grain. It may be mentioned that no other costs except that of fertilisers have been considered for calculating the net profit due to fertiliser from each field as it is assumed that other costs are a part of package of practices for all the treatments including the control as well. For calculations the price per kg. of N,  $P_2O_5$  and  $K_2O$  was taken as Rs. 2.00, Rs. 2.13 and Re. 0.79 respectively, and the grain of jowar, maize and bajra was evaluated at the rate of Rs. 55 per quintal. In the years to come the price of these crops may undergo some change. In order that the results of this investigation may be of use under the changed circumstances, the results corresponding to prices of Rs. 50 and Rs. 60 per quintal have also been presented.

#### JOWAR

*Irrigated Jowar:* On the basis of the results obtained from individual fields, the percentage of fields giving net profits of different order by investment in application of  $N_{60}$ ,  $N_{120}$ ,  $N_{60}P_{30}$ ,  $N_{120}P_{60}$ ,  $N_{120}P_{60}K_{60}$  to jowar crop are presented in Table 3. It may be seen that with hybrid jowar grown under irrigated conditions in *kharif* season, about three-

fourths of the cultivators could not get enough response to the application of  $N_{60}$  or  $N_{120}$ , even to meet the cost of the fertiliser. However, when phosphorus was added the situation was improved somewhat but still 49 per cent were losing in case of treatment  $N_{60}P_{30}$  and 67 per cent with  $N_{120}P_{60}$ . With  $N_{120}P_{60}K_{60}$  the percentage of losers was about 50. As against these, with local varieties grown under similar conditions, 88 per cent of the farmers sustained losses by using  $N_{120}$  and the percentage was reduced to 71 with  $N_{120}P_{60}K_{60}$ . It shows that high doses of fertilisers were wasteful in case of local varieties of jowar and the only hope was hybrids though there also majority of the farmers were suffering losses on the application of fertilisers. About 25 per cent of the cultivators growing hybrid jowar got profits exceeding Rs. 100 per hectare by application of  $N_{60}P_{30}$  or  $N_{120}P_{60}$  or  $N_{120}P_{60}K_{60}$ , while the corresponding figures with application of nitrogen alone were of the order of 8 to 10 per cent.

In the *rabi* irrigated jowar about 70 per cent of the fields of hybrids raised with  $N_{60}$  or  $N_{120}$  came under 'losing class'. Addition of P or PK to N did not appreciably reduce the percentage cases of losers. It shows that there is great risk involved in fertilising *rabi* jowar. The results pertaining to losers in case of local varieties also showed more or less similar trend.

*Unirrigated Jowar:* Examining the results of *kharif* crop grown under unirrigated conditions, it is seen that the percentage of losers is more in medium black soils than in mixed red and black soils. While in about 80 per cent of the fields in medium black soils grown with hybrid jowar with  $N_{120}$  losses were sustained, the addition of  $P_{60}$  or  $P_{60}K_{60}$  reduced the percentage of losers to about 60. On the other hand, with a lower dose of  $N_{60}$  the percentage of cases showing losses was 64 and it was reduced to 48 per cent with the addition of  $P_{30}$  to  $N_{60}$ . The results pertaining to local varieties are still more discouraging as they indicate that 80 to 95 per cent of the cultivators did not get enough response even to meet the cost of fertiliser with any of the five treatments under study. The percentage of losers in mixed red and black soil region were 50 to 58 in case of hybrids and 45 to 82 in case of the composites.

Since a large proportion of fields which had received the fertilisers more particularly N alone,

**TABLE 2—Average response (kg/ha) of jowar, maize and bajra to fertiliser treatments in different soil classes**

Soil class/ District	Variety	No. of trials	Ar. yield (kg./ha) without fertiliser	Response to treatment				
				N <sub>60</sub>	N <sub>60</sub> P <sub>30</sub>	N <sub>120</sub>	N <sub>120</sub> P <sub>60</sub>	N <sub>120</sub> P <sub>60</sub> K <sub>60</sub>
<b>Kharif Jowar (Irrigated) (kg/ha)</b>								
Medium black (Bhavnagar)	Hybrid	61	1,665	50	329	221	551	743
	Local	55	837	134	245	186	457	511
<b>Kharif Jowar (Unirrigated)</b>								
Medium black (Parbhani)	Hybrid	114	816	177	425	305	682	818
	Local	109	522	102	218	148	354	414
Mixed red & black (Jhansi)	Hybrid	38	879	225	323	395	640	733
	Local	38	670	217	273	354	531	612
Average over soil classes	Hybrid	152	847	171	374	350	661	775
	Local	147	596	159	245	251	442	513
<b>Rabi Jowar (Irrigated)</b>								
Medium black (Parbhani) (Poona)	Hybrid	168	957	189	311	269	546	680
	Local	191	989	155	286	219	411	603
<b>Kharif Maize (Irrigated)</b>								
Alluvial (Monghyr) (Ludhiana)	Hybrid	175	1,928	532	728	859	1,304	1,487
	Composite	66	1,203	409	520	678	905	1,153
<b>Kharif Maize (Unirrigated)</b>								
Alluvial (Kanpur) (Monghyr)	Hybrid	162	1,984	916	1,144	1,479	2,143	2,398
	Composite	86	2,084	811	1,112	1,228	1,845	2,168
Sub-montane (Mandi)	Hybrid	50	1,563	295	455	470	747	1,016
	Composite	41	2,011	409	758	547	1,296	1,553
Average over soil classes	Hybrid	212	1,773	606	799	974	1,445	1,707
	Composite	127	2,047	610	935	888	1,571	1,861
<b>Kharif Bajra (Irrigated)</b>								
Alluvial (Delhi, Aligarh)	Hybrid	76	1,351	424	570	770	1,108	1,264
<b>Kharif Bajra (Unirrigated)</b>								
Alluvial (Mehsana)	Hybrid	82	1,862	249	429	381	593	795
	Local	111	1,319	238	360	311	564	664
<b>Rabi Bajra (Irrigated)</b>								
Mixed red & black (Coimbatore)	Hybrid	105	1,611	327	564	563	1,027	1,115
	Local	103	1,039	271	457	440	808	888

TABLE 3—Distribution of fields (in percentage) according to net profit per hectare due to investment on different fertilisers applied to jowar crop in different soil classes

Soil class/District	Variety	No. of fields	Net profit Rs/ha	N <sub>60</sub>	N <sub>120</sub>	N <sub>60</sub> P <sub>30</sub>	N <sub>120</sub> P <sub>60</sub>	N <sub>120</sub> P <sub>60</sub> K <sub>60</sub>
<b>Kharif (Irrigated)</b>								
Medium black (Bhavnagar)	Hybrid	61	Less than 0	74	74	49	67	54
			1-100	21	15	25	10	16
			101-200	3	3	11	11	5
			201-300	2	3	10	2	7
			More than 300	—	5	5	10	18
	Local	55	Less than 0	78	88	76	76	71
			1-100	18	7	10	12	5
			101-200	—	5	7	5	12
			201-300	2	—	7	4	10
			More than 300	2	—	—	3	2
<b>Rabi (Irrigated)</b>								
Medium black (Parbhani & Poona)	Hybrid	168	Less than 0	70	76	66	70	65
			1-100	14	10	15	13	7
			101-200	8	6	10	5	12
			201-300	2	5	4	2	5
			More than 300	6	3	5	10	11
	Local	191	Less than 0	72	82	65	80	68
			1-100	17	10	21	8	8
			101-200	2	2	8	6	6
			201-300	5	2	1	2	5
			More than 300	4	4	5	4	13
Medium black (Parbhani)	Hybrid	114	Less than 0	64	81	48	61	64
			1-100	28	11	21	11	6
			101-200	5	4	11	8	8
			201-300	2	2	8	6	9
			More than 300	1	2	12	14	13
	Composite	109	Less than 0	81	96	85	92	90
			1-100	19	1	7	1	—
			101-200	—	2	4	2	5
			201-300	—	1	1	1	2
			More than 300	—	—	3	4	3
<b>Kharif (Unirrigated)</b>								
Mixed red & black (Jhansi)	Hybrid	38	Less than 0	53	58	55	55	50
			1-100	37	18	32	19	26
			101-200	10	16	8	21	16
			201-300	—	8	5	5	5
			More than 300	—	—	—	—	3
	Local	38	Less than 0	45	68	68	82	76
			1-100	55	26	29	18	19
			101-200	—	6	3	—	5
			201-300	—	—	—	—	—
			More than 300	—	—	—	—	—
Over all the soils	Hybrid	152	Less than 0	61	75	50	60	60
			1-100	30	13	24	13	11
			101-200	7	7	10	11	10
			201-300	1	3	7	6	8
			More than 300	1	2	9	10	11
	Local	147	Less than 0	71	89	81	89	87
			1-100	29	7	13	6	5
			101-200	—	3	3	1	5
			201-300	—	1	1	1	1
			More than 300	—	—	2	3	2

were classified as losers, further statistical analysis was undertaken to study the extent of loss and it was found that while in the *kharif* crop the loss did not exceed Rs. 200/ha in most of the cases, over 50 per cent of the losers in *rabi* season sustained losses exceeding Rs. 200 per hectare. In view of these results, it is not surprising that the use of fertilisers in case of jowar is not picking up and there is still no breakthrough in production of this crop. The position is very unsatisfactory with unirrigated *kharif* crop as well as *rabi* irrigated crop.

It was further revealed that by increasing the price of grain from Rs. 55/q to Rs. 60/q, only about 5 per cent of the farmers could convert loss into profit. This was so in the case of both hybrids and local varieties under irrigated and unirrigated conditions both during *kharif* and *rabi* seasons. Also by decreasing the price of grain from Rs. 55/q to Rs. 50/q, the percentage of farmers sustaining losses increased by about 5.

#### MAIZE

*Irrigated Maize:* In Table 4 are given the percentages of fields showing net profits on fertiliser application in case of maize crop, both under irrigated and unirrigated conditions. The results of irrigated trials with hybrids conducted in alluvial soil region indicated that in 20 per cent of the fields where either  $N_{60}$  or  $N_{120}$  was applied, the responses obtained were not enough to even meet the cost of fertiliser. However, when  $P_{60}$  was added to  $N_{120}$ , the situation improved and the percentage of losers dropped to 11. Addition of  $K_{60}$  to  $N_{120} P_{60}$  further reduced the percentage of losers to 10. It was also found that over 70 per cent of the fields fertilised with  $N_{120} P_{60}$  or  $N_{120} P_{60} K_{60}$  yielded profits exceeding Rs. 200 per hectare, whereas this order of profit was attained by 45 to 55 per cent of the fields fertilised with nitrogen alone. With composites grown under similar conditions one-fourth of the cultivators sustained losses with the application of any one of the five fertiliser treatments under study. But profits exceeding Rs. 200 per hectare were attained in over 65 per cent cases with balanced and adequate application of fertilisers, namely  $N_{120} P_{60}$  or  $N_{120} P_{60} K_{60}$  as compared with 48 to 54 per cent cases of application of nitrogen alone.

*Unirrigated Maize:* Under unirrigated culture of the crop, the losers in alluvial soil region were

small (4 to 6 per cent with hybrids and 5 to 10 per cent with composites) as compared to sub-montane region where as high as 52 per cent of the experiments with hybrids and 37 per cent with composites recorded losses. Over 85 per cent of the cultivators in alluvial soil region who fertilised their plots of hybrids or composites maize with  $N_{120} P_{60}$  or  $N_{120} P_{60} K_{60}$  secured profits exceeding Rs. 300 per hectare, but with the application of nitrogen alone, only about 60 to 73 per cent growing hybrids and 40 to 55 per cent growing composites, could attain profits of this order. Against this, in sub-montane soil region, 56 per cent of the cultivators who applied  $N_{120} P_{60}$  or  $N_{120} P_{60} K_{60}$  to composites could secure profits exceeding Rs. 300 per hectare but with hybrids 18 per cent of those who applied  $N_{120} P_{60}$  and 38 per cent of those who applied  $N_{120} P_{60} K_{60}$  could get returns of this order. With the application of nitrogen alone profits exceeding Rs. 300 per hectare were obtained in 2 to 4 per cent cases of hybrids and 12 to 14 per cent cases of composites only.

The study further revealed that by increasing the grain price of hybrids from Rs. 55/q to Rs. 60/q during *kharif* season under irrigated as well as unirrigated conditions not more than 5 per cent of the farmers could convert their loss into profit. Similar trend was observed with composite with all the five treatments except in case of application of  $N_{120}$  to irrigated maize with which about 9 per cent more farmers could be included in the profit class. However, when price was reduced from Rs. 55/q to Rs. 50/q, another about 5 per cent of the farmers suffered loss in all the cases.

#### BAJRA

*Irrigated Bajra:* The distribution of profits obtained by investment on application of fertilisers is given in Table 5. In *kharif* irrigated crop about 75 per cent of the cultivators growing hybrids obtained profits and 25 per cent suffered losses by application of any of the five fertiliser treatments. While in a little over one-third of the fields of hybrids fertiliser with  $N_{120} P_{60}$  or  $N_{120} P_{60} K_{60}$  the profits obtained exceeded Rs. 300 per hectare, this order of profits could be secured by application of  $N_{120}$  in only one-fourth of the cases.

In the *rabi* irrigated crop, it was found that by application of nitrogen alone, about 50 per

TABLE 4—Distribution of fields (in percentage) according to net profit per hectare due to investment on different fertilisers applied to maize crop in different soil classes

Soil class/District	Variety	No. of fields	Net return Rs./ha	N <sub>60</sub>	N <sub>120</sub>	N <sub>60</sub> P <sub>30</sub>	N <sub>120</sub> P <sub>60</sub>	N <sub>120</sub> P <sub>60</sub> K <sub>60</sub>
<b>Irrigated</b>								
Alluvial (Ludhiana)	Hybrid	175	Less than 0	20	21	15	11	10
			1-100	22	15	16	8	6
			101-200	13	10	17	10	6
			201-300	14	12	14	11	12
			More than 300	31	42	38	60	66
(Monghyr)	Composite	66	Less than 0	23	32	24	26	22
			1-100	20	6	12	5	5
			101-200	9	8	12	5	5
			201-300	15	5	9	6	—
			More than 300	33	49	43	58	68
<b>Unirrigated</b>								
Alluvial (Kanpur & Monghyr)	Hybrid	162	Less than 0	6	6	4	5	5
			1-100	14	4	9	2	2
			101-200	16	7	10	3	3
			201-300	13	10	13	4	3
			More than 300	51	73	64	86	87
(Monghyr)	Composite	86	Less than 0	6	10	7	6	5
			1-100	17	10	4	6	2
			101-200	19	11	15	2	1
			201-300	18	14	12	2	4
			More than 300	40	55	62	84	88
Sub-montane (Mandi)	Hybrid	50	Less than 0	40	52	26	22	22
			1-100	30	14	20	26	12
			101-200	20	26	26	22	12
			201-300	8	4	22	12	16
			More than 300	2	4	6	18	38
	Composite	41	Less than 0	29	37	27	29	27
			1-100	34	24	15	15	15
			101-200	13	15	7	—	—
			201-300	10	12	20	—	2
			More than 300	14	12	31	56	56
(Kanpur, Monghyr & Mandi)	Hybrid	212	Less than 0	13	16	9	9	8
			1-100	18	7	11	8	4
			101-200	16	12	14	7	5
			201-300	12	9	16	6	6
			More than 300	41	56	50	70	77
	Composite	127	Less than 0	13	19	13	14	12
			1-100	23	15	7	8	6
			101-200	17	12	13	2	1
			201-300	15	13	14	2	3
			More than 300	32	41	53	74	78

cent of the fields of hybrids and 40 to 50 per cent of the fields of local varieties obtained profits and the rest suffered losses. By adding P<sub>60</sub> or P<sub>60</sub>K<sub>60</sub> to N<sub>120</sub>, the losers were reduced to 22 per cent in case of hybrids and 29 to 36 in case of composites. Over one-third of the fields of

hybrids, which were fertilised with N<sub>120</sub>P<sub>60</sub> or N<sub>120</sub>P<sub>60</sub>K<sub>60</sub> the profits obtained exceeded Rs. 300 per hectare whereas in only 15 per cent cases of application of nitrogen alone profits of this order could be secured. Against this with local varieties hardly 6 to 7 per cent of fields

TABLE 5—Distribution of fields (in percentage) according to net return per hectare due to investment in different fertilisers crop in different soil classes

Soil class/District	Variety	No. of trials	Net return Rs./ha	N <sub>60</sub>	N <sub>120</sub>	N <sub>60</sub> P <sub>30</sub>	N <sub>120</sub> P <sub>60</sub>	N <sub>120</sub> P <sub>60</sub> K <sub>60</sub>
<b>Kharif (Irrigated)</b>								
Alluvial (Delhi & Aligarh)	Hybrid	76	Less than 0	27	28	26	30	24
			1-100	36	27	34	14	13
			101-200	18	8	12	12	13
			201-300	8	11	9	7	11
			More than 300	11	26	19	37	39
<b>Kharif (Unirrigated)</b>								
Alluvial (Mehsana)	Hybrid	82	Less than 0	48	64	45	58	47
			1-100	31	14	22	14	15
			101-200	7	6	12	6	6
			201-300	9	9	13	6	11
			More than 300	5	7	8	13	21
	Local	111	Less than 0	59	59	44	58	57
			1-100	17	15	22	12	15
			101-200	14	11	13	9	9
			201-300	8	9	8	9	1
			More than 300	2	6	13	12	18
<b>Rabi (Irrigated)</b>								
Mixed red & black (Coimbatore)	Hybrid	105	Less than 0	50	50	21	22	22
			1-100	24	17	32	15	15
			101-200	8	9	18	17	19
			201-300	7	9	16	11	11
			More than 300	11	15	13	35	33
	Local	103	Less than 0	51	59	32	29	36
			1-100	29	20	28	25	23
			101-200	13	14	23	25	17
			201-300	6	3	13	14	18
			More than 300	1	4	4	7	6

fertilised with balanced doses of N<sub>120</sub>P<sub>60</sub> or N<sub>120</sub>P<sub>60</sub>K<sub>60</sub>, profits exceeding Rs. 300/ha could be secured, while the corresponding figures for nitrogen alone were of the order of 1 to 4.

*Unirrigated Bajra:* It may be seen that in case of *kharif* crop raised under unirrigated conditions in Mehsana district application of any of the five fertiliser treatments resulted in losses in 45 to 64 per cent fields of hybrids and 44 to 59 per cent fields of local varieties. It is, however, observed that percentage of cases showing profits of more than Rs. 100 per hectare was 50 to 100 per cent higher, with N<sub>120</sub>P<sub>60</sub>K<sub>60</sub> than with nitrogen alone. The differences were not so marked in case of local varieties though in these cases also balanced fertilisation was superior to N alone. Further, profits exceeding Rs. 300 per hectare were secured in about one-fifth of the fields fertilised with N<sub>120</sub>P<sub>60</sub>K<sub>60</sub>, while

with application of nitrogen alone this order of profit was secured in 2 to 7 per cent of the fields.

Since a large proportion of unirrigated fields in alluvial region during *kharif* season as well as of the fields in mixed red and black soil region during the *rabi* season had sustained losses, a detailed statistical analysis was undertaken to work out the exact amount of losses in these cases. It was found that in *rabi* season the loss sustained with any of the five treatments generally did not exceed Rs. 200 per hectare. However, during *kharif* season in alluvial region, the loss sustained exceeded Rs. 200 per hectare in about 30 per cent of the cases of losers who had fertilised their hybrids with N<sub>120</sub>P<sub>60</sub> or N<sub>120</sub>P<sub>60</sub>K<sub>60</sub> and in almost 50 per cent of the losers who had grown local varieties with same fertiliser treatments. Against these, the losses in case



of application of nitrogen alone to the *kharif* unirrigated crop in alluvial region generally did not exceed Rs. 200 per hectare.

Further, it was found that when grain was evaluated at Rs. 60/q instead of Rs. 55/q, the percentage of losers reduced by about 5 in case of all the five treatments for *kharif* irrigated crop of hybrids in alluvial region, by about 10 in case of application of  $N_{120}$  or  $N_{120}P_{60}$  to *kharif* unirrigated crop of hybrids in alluvial region and by 10 to 20 in case of application of  $N_{60}$  or  $N_{120}$  to *rabi* irrigated crop of hybrids and local varieties in mixed red and black soil. On the other hand, when grain was evaluated at a lower price of Rs. 50/q, the increase in percentage of losers as compared to Rs. 55/q was of the order of 5 to 8 except in case of application of  $N_{120}P_{60}$  to *rabi* irrigated crop of local varieties in mixed red and black soil where the corresponding figure was 14.

#### SUMMARY AND CONCLUSIONS

Data of 774 simple fertiliser trials on jowar, 580 on maize and 477 on bajra conducted on cultivators' fields under the All-India Coordinated Agronomic Experiments Scheme during 1967 to 1971 were utilised for the study. The price of jowar, maize and bajra was taken as Rs. 55/q, being the current procurement price and the fertiliser prices were taken as Rs. 2.00, Rs. 2.13 and Re. 0.79 per kg. of N,  $P_2O_5$  and  $K_2O$  respectively. The profit corresponding to any fertiliser treatment was obtained by deducting the cost of the fertiliser applied from the value of the additional produce in the form of grain. No other factors of cost have been taken into account. The following conclusions emerged from the study.

##### Jowar

1. Three out of every four cultivators who applied nitrogen alone ( $N_{60}$  or  $N_{120}$ ) to hybrids grown during *kharif* or *rabi* seasons could not get adequate response to even meet the cost of the fertiliser. The percentage of farmers who sustained loss with application of only nitrogen was even greater in case of local varieties.

2. The addition of phosphorus to N reduced the percentage of farmers sustaining losses. The effect was more pronounced in *kharif* season than in *rabi* season.

3. High doses of fertilisers were wasteful in case of local varieties of *jowar*.

4. In *kharif* season, the loss sustained on account of application of fertiliser did not exceed Rs. 200/ha in most of the cases but over 50 per cent of the losers in *rabi* season sustained losses exceeding Rs. 200/ha.

5. It seems that more stable, better fertiliser responsive and better yielding varieties of hybrids, particularly under rainfed conditions, are needed. The soil, water and crop management also need improvement as despite the good potentiality of hybrids still many farmers are sustaining losses.

##### Maize

1. Application of nitrogen alone to irrigated maize resulted in profits in 80 per cent cases and loss in about 20 per cent of the cases. But when balanced dose of  $N_{120}P_{60}K_{60}$  was applied the percentage of losers was reduced to 10.

2. More than 70 per cent of irrigated fields of hybrids treated with  $N_{120}P_{60}$  or  $N_{120} + 60 K_6$  gave profits exceeding Rs. 200/ha as against 45 to 55 per cent of the fields treated with N alone.

3. The proportion of fields giving high order of profit was more in case of hybrids as compared to composites.

4. On alluvial soils, application of  $N_{120}P_{60}$  or  $N_{120}P_{60}K_{60}$  to unirrigated crop of hybrids or composites gave profits exceeding Rs. 300/ha in more than 85 per cent of the cases, but with application of nitrogen alone only 50 to 73 per cent of fields growing hybrids and 40 to 55 per cent of fields growing composites could attain profits of this order. Against these, the corresponding figures for sub-montane soil region (Mandi, H.P.) were of lower order, showing thereby that better soil and water management practices for this region are needed.

##### Bajra

1. About 75 per cent of the farmers in *kharif* season and 40-50 per cent in *rabi* season under irrigated conditions obtained profits from the use of fertiliser on bajra. It shows that for increasing the production from bajra and stabilising yields, it is essential to use fertilisers for bajra crop, but remunerative results can be obtained in *kharif*.

2. About 25 per cent of the farmers in *kharif* season and 50 to 60 per cent in *rabi* season sustained losses even under irrigated conditions. The percentage of farmers failing to earn profits after application of fertiliser was even higher in case of unirrigated crop. The main cause of such losses seems to be incidence of diseases and lack of soil and water management.

3. Under irrigated conditions during *kharif* and *rabi* seasons, the treatments  $N_{120}P_{60}$  or  $N_{120}P_{60}K_6$  gave profits exceeding Rs. 300/ha in about one-third of the cases, whereas under unirrigated conditions only 20 per cent of the farmers could secure profits of this order. It indicates that for unirrigated conditions of Mehsana district (Gujarat) where the experiment was conducted it may be rather uneconomical dose.

4. With application of N alone to hybrids, profits exceeding Rs. 300/ha were obtained in about 25 per cent of the fields of *kharif* irrigated crop, about 15 per cent of the fields of *rabi* irrigated crop and only about 7 per cent of the fields of *kharif* unirrigated crop. But generally, the performance of hybrids was much better than the local varieties, indicating the possibility of advantageous exploitation of hybrid vigour.

5. The percentage of farmers getting profits was always higher when balanced fertilisers such as  $N_{120}P_{60}$  or  $N_{120}P_{60}K_6$  were applied as compared to N alone.

#### GENERAL CONCLUSION

The experiments on cultivators' fields with jowar, bajra and maize confirm that it is possible to improve the returns to farmers by cultivation of these crops under irrigated as well as unirrigated conditions by balanced use of fertilisers, growing hybrids in preference to composite or local varieties and better soil, water and crop management. Even under unirrigated conditions, these crops give good returns but there are quite a high percentage of cases where the farmers are unable to obtain remunerative returns. It is particularly evident in *rabi* jowar in Parbhani black soil region of Maharashtra. It seems that better hybrids and more scientific fertiliser use and better pest management are necessary.

Price changes also improve the position of net returns, but it is impracticable without disturbing the relationship between different commodities.

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#### REFERENCES

1. Kanwar, J. S., Das, M. N., Sardana, M. G. and Bapat, S. R.: *Fertiliser News*, 17 (11), 19-30 (Nov. 1972).
2. Kanwar, J. S., Das, M. N., Sardana, M. G. and Bapat, S. R.: *Fertiliser News*, 18 (1), 71-88 (Jan. 1973).

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