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Effect of Nitrogen and Phosphorus singly and in combination with varying row spacings on the yield of *Jowar* Crop.*

by

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Synopsis: The investigation on manuring of *jowar* with nitrogen and phosphorus, both singly and in combination with varying spacings in rows, conducted during 1959–'60 at Rafi Ahamad Kidwai Agricultura Instituto Farm, Sehore, M. P., reveals that application of 20 lbs. N and 15 lbs. P_2O_5 per acre with 12" spacing gives the maximum yield of grain and fodder. It is found to be the most economical dose also.

Jowar is one of the most widely grown food-grain crops of India India is the biggest producer of *jowar* in the world. Its suitability to low rainfall tracts and ability to withstand considerable drought make it an ideal crop for cultivation over vast areas. The plant may remain dormant but uninjured during long periods of drought and because of this character it is often called a "crop–camel".

Though India is the biggest *jowar* producing country of the world, yet the yield per acre is very low. Amongst various factors that help to increase the yield per acre, supply of nutrients like nitrogen and phosphorus which are deficient in most of the Indian soils, is the major factor.

The Royal Commission of the Agriculture (1928) reported, "Indian soils are poor in their nitrogen, organic matter and phosphorus content". The Indian soils have greatest hunger for nitrogen the soil content of which is much lower than the requirements of crops. The other important nutrient is phosphorus. The efficiency of nitrogen applied to the soil increases in the presence of phosphorus. Spacing is intimately connected with root development as well as plant growth. Generally most appropriate spacing is one which enables the plants to take the best advantage of various growth factors. Too close or too wide spacings are not desirable.

Keeping in view the results of experiment conducted by Netram (1958–'59), in which nitrogen application increased the crop yield, it was found desirable to add some more factors and undertake the investigation on manuring of *jowar* with nitrogen and phosphorus, both singly and in combination with varying spacings in rows in 1959–'60 at Rafi Ahamad Kidwai Agricultural Institute Farm, Sehore, M. P.

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Stewart (1947) summarising the manurial work done on crops in India stated that 20 lbs. N gave an average response of 7.9 lbs. *jowar* grain per pound of N applied and seemed to be the optimum dose. Singh Sardar (1952) stated that application of 40 lbs. N as F. Y. M. increased the yield significantly in sorghum. Annual report of Institute of Plant Industry, Indore (Anon. 1954) recorded that ammonium sulphate at 20 lbs. N per acre gave higher yields than control. Mirchandani (1954) reported that 20 lbs. N per acre gave a response of 9·9 lbs. of grain per lb. of N Basu (1955) stated that in Bombay State, 10 lbs. N in the form of groundnut cake per acre gave an economical return in normal years. Pande *et al.* (1954) reviewing the research work done on *jowar* in Bombay State concluded that there was a linear response to nitrogen. M. P. Technical Report, Labhandi (Anon. 1956a) reveals that manuring with 15 lbs. and 30 lbs. N per acre gave 30 and 40% increase in grain and yield of *jowar* respectively over control on cultivators' fields at Akola. Technical report of Agronomy Section, M. P. (Anon. 1956b) showed that plots which received 20 lbs. N as ammonium sulphate gave the highest yield in sorghum and was followed by one which received 40 lbs. in the form of F. Y. M. Singh Sardar and Sahastrabudhe (1957) found that application of 20 lbs. N as ammonium sulphate increased the yield of grain and *karbi* at Indore.

Reddy and Sreeramitai in Andhra Pradesh (1956) found significant increase in grain of *jowar* crop when P_2O_5 was applied @ 56 lbs. per acre. Singh and Sahastrabudhe *(loc. cit.)* found that application of P_2O_5 @ 20 lbs. per acre increased the yield of *jowar* fodder but grain produce remained unaffected.

Ray and Chaudhari have reported that nitrogen is better utilized by sorghum when applied with requisite quantity of P_2O_5. Rao and Govindarajan (1956) obtained more recovery of N at increasing levels of P_2O_5.

Panse *et al.* (1947) summarising the experimental work done on millets stated that the combined application of 45 lbs. N and 20 lbs. P_2O_5 gave average response of 5.9 lbs. of grain per lb. of N and 8·4 lbs. of P_2O_5 applied. Painter and Leamer (1953) in sorghum found that 60 lbs. N when used in combination with 40 lbs. P_2O_5 over N alone gave 6.5 bushels more yield per acre. Pandey and Chavan (1954) found that a combination of 40 lbs. N and 20 lbs. P_2O_5 per acre gave the best results at Kaporgoan.

Pandey and Chavan *(loc. cit.)* indicated that in experiments conducted at Dharwar, Surat and Jalgaon, 24" spacing was found optimum. Chavan *et al.* (1958) reported 18" spacing best in *rabi jowar*.

Methods and Material: The present investigation was carried out to study the effect of N and P singly and in combination with varying row spacings on the yield of *jowar* crop during 1959–'60 at Rafi Ahamad Kidwai Agricultural Instituto Farm, Sehore, M. P. The farm has the typical black cotton soils of Malwa tract. Following were the factors,

Nitrogen:	1.	No nitrogen	N_0
	2.	10 lbs. N./acre	N_1
	3.	20 lbs. N/acre	N_2
Phosphorus:	1.	No phosphorus	P_0
	2.	15 lbs. P_2O_5	P_1
Row spacings:	1.	12" spacing	S_1
	2.	18" spacing	S_2
	3.	24" spacing	S_3

The experiment was laid out in split plot design with four replications. In order to study the effect of N more critically, its treatments were taken in the sub-plots and the other two factors viz. P and spacing were taken in the main plots before sowing. P_2O_5 was supplied through superphosphate which was drilled with seed at the time of sowing. *Pilya*, a popular local variety of *jowar*, was sown at a seedrate of 6 srs. per acre. Weeding and thinning were done when the crop was about a month old. The uniform distance of 9" was maintained between the plants in rows. When the crop matured, the cobs from the net plots were removed and weighed after drying. On complete drying the weight of *karbi* was also recorded. The data were statistically analysed.

Results and Discussion: *Yield of Grain:* As per analysis of variance, the main effects of spacing and phosphorus are insignificant, but the main effect of nitrogen is highly significant. The interaction SP is also siginificant and no other interaction is significant. The results are summarised in the following tables:

TABLE NO. 1 (A)

Yield of grain per acre (in mds.) under different treatments.

	S_1P_0	S_1P_1	S_2P_0	S_2P_1	S_3P_0	S_3P_1	Mean.
No	8·75	11·56	10·87	10·95	10·98	9·37	10·42
N1	11·46	13·15	12·24	±2·17	12·26	12·12	12·23
N2	13·50	15·35	14·87	14·56	13·84	13·18	14·22
	11·24	13·35	12·66	12·56	12·36	11·56	

TABLE No. 1 (B).

	No	N1	N2	Mean.
S_1	10·15	12·31	14·42	12·29
S_2	10·91	12·21	14·71	12·61
S_3	10·18	12·19	13·51	11·96
	10·41	12·23	14·22	...

C. D. for different comparisons :

1.	Main treatments	:	1·19
2.	Sub-treatments	:	0·57
3.	For levels of N for a fixed main treatment	:	1·37

The above table shows that the application of N has increased the yield of grain per acre. The higher dose of N i. e. 20 lbs. N/acre has given the significant response as compared to lower dose and no nitrogen application. The lower dose i. e. 10 lbs. N/acre has also given significant increase in yield over no nitrogen. The overall increase in yield of grain over control by the application of 10 and 20 lbs. N is 1·82 and 3·81 mds. respectively. The increase in yield by higher dose over the lower one is 1·99 mds. per acre. It shows that there is an upward trend in the reponse with increasing levels of nitrogen. The application of N has increased the yield of grain per acre because of low N content of our soils as reported by Viswanathan (1914), Stewart (1947), Ray Chaudhri (1952) and others. The application of N affected the growth of plants along with the increase in size, weight of cobs and test weight which are directly related to yield. The above results are in agreement with the findings of Stewart (1947), Mirchandani (1954) and Sardar Singh and Sabastrabudhe (1957). Similar results have been reported at Indore (Anon. 1954).

Spacing and phosphorus have no effect on the yield character but the interaction SP is significant. When the main effects are not significant, much importance should not be given to their significant interaction.

Phosphorus application had no effect on the yield of grain. The same was reported by Singh and Sahastrabudhe (1957).

In the present investigation, though wider spacing of 24" gave better response on the size of cobs and test weight, still it has failed to give the same response over other spacings on the final yield. On the other hand the yield has slightly gone down with 24" spacing. The reason for this may be that in narrow spacing of 12", the number of plants was more which could easily make up the shortage and increased the yield finally though

not significantly. These results are in confirmity with the observations made by Jamkhindikar (1949) who reported that at Nandyal spacing of 10·5' to 24" made little difference in the yield of sorghum.

Yield of dry fodder : As per analysis of variance, the main effects of P and N are significant for this character. The effect of spacing and other interactions are not significant. The results are summarised in the following table:

TABLE No. 2 (A).

Yield of Karbi per acre (in mds.) under different treatments.

	S_1P_0	S_1P_1	S_2P_0	S_2P_1	S_3P_0	S_3P_1	Mean
No	18·90	26·22	19·42	21·18	17·94	19·84	20·58
N1	20·68	25·42	20·42	23·54	21·42	19·24	21·79
N2	24·06	28·04	23·24	26·68	23·30	26·74	25·34
	21·21	26·56	21·02	23·80	20·88	21·94	

	N_0	N_1	N_2	Mean
P_0	18·75	20·84	23·52	21·04
P_1	22·40	22·74	21·16	24·14
	20·58	21·79	25·34	

C. D. for comparing any two means of main treatments : 2·98
C. D. for comparing any two means of sub-treatments : 2·60

From the above tables it is evident that N has increased the yield of *karbi* significantly. The highest dose of N (20 lbs./acre) is statistically superior to N_1 and N_0, where as N_1 and N_0 are statistically insignificant. 20 lbs. N has given an overall increase of 4·76 mds. and 3·55 mds. of *karbi* per acre over control and 10 lbs. of N respectively, whereas the application of 10 lbs. N has resulted in the increase of 1·21 mds. of *karbi* only per acre over control. Increase in the yield of *karbi* has also been reported by Singh and Sahastrabudhe (1957) by N application. It may be due to the beneficial effect of N on the height of plants, number of leaves and girth of stem which finally increased the yield of *karbi*.

Application of P also has given the significant increase on the yield of *karbi*. 15 lbs. P_2O_5 per acre application increased the yield of *karbi* over control. This result is in agreement with the findings of Singh and Sahastrabudhe (1957) who reported that application of superphosphate increased the yield of *jowar* fodder. This may be due to the production of more dry matter in plants.

In the present investigation, wider spacing of 24" though increased the girth of plants, it could not maintain its superiority in giving higher yield of *karbi* per acre. The probable reason may be that narrow spacing had more number of plants per unit area as compared with under spacing and finally increased the yields though it could not give sufficient response over other spacings.

Economics of Manuring: The ultimate aim of the farmer for manuring any crop is to get more net profit per acre. Therefore from practical point of view, the best treatment is that which gives the most economical return. A particular dose might increase the yield to a high level but still it may not be economical. The net profit per acre from different treatments under Sehore conditions was as follows:

TABLE 3.

Expenditure and income per acre under different treatments.

Treatments	Yield / acre in mds.		Total income from grain @ Rs. 12·00/ md & *Karbi* @ Re. 1·0 per md.	Cost of cultivation	Cost of fertilizer	Net income
	Grain	*Karbi*				
$S_3P_1N_0$	9·37	19·84	132·00	91·00	9·37	31·91
$S_1P_0N_0$	8·75	18·90	137·00	91·00	...	46·00
$S_2P_1N_0$	10·95	21·18	152·58	91·00	9·37	52·21
$S_3P_1N_1$	12·12	19·24	164·68	91·00	17·87	55·81
$S_1P_0N_1$	11·46	20·68	158·20	91·00	8·50	58·70
$S_3P_0N_0$	10·98	17.94	149·70	91·00	...	58·70
$S_2P_0N_0$	10·87	19·42	149·86	91·00	...	58·68
$S_2P_1N_1$	12·17	23·54	160·58	91·00	17·87	60·71
$S_1P_1N_0$	11·56	26·22	164·94	91·00	9·37	64·57
$S_3P_1N_2$	13·18	26·74	184·90	91·00	26·37	67·53
$S_2P_0N_1$	12·24	20·42	167·30	91·00	8·50	67·80
$S_3P_0N_1$	12·26	21·42	168·54	91·00	8·50	69·04
$S_1P_1N_1$	13·15	25·42	183·22	91·00	17·87	74·35
$S_1P_0N_2$	13·50	24·06	186·08	91·00	17·00	78·06
$S_3P_0N_2$	13·84	23·30	189·41	91·00	17·00	81·41
$S_2P_0N_2$	14·87	23·24	201·68	91·00	17·00	93·68
$S_2P_1N_2$	14·56	26·68	201·40	91·00	26·37	84·03
$S_1P_1N_2$	15·35	28·04	212·24	91·00	26·37	94·47

The above table reveals that a combination of 20 lbs. N and 15 lbs. P_2O_5 per acre with 12" spacing ($S_1P_1N_2$) proved to be the most profitable treatment.

Conclusion: The main effects of spacing and phosphorus on the yield of grain are insignificant but the N application has increased the yield significantly. The higher dose of N (20 lbs./acre) has given significant increase even over the lower dose (10 lbs./acre). Moreover there is an upward trend in the response with increasing levels of N. The interaction SP is significant.

The N & P application has increased the yield of dry fodder significantly but spacing has no effect on it. No interaction is significant.

On the basis of expenditure and income statement, it may be concluded that application of 20 lbs. N and 15 lbs. P_2O_5 per acre with 12" spacing gave the maximum yield of grain and dry fodder. It was found to be the most economical dose also.

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