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Effect of different spacings on the growth and yield of wheat under dibbling method of sowing[1]

by

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Synopsis : The results of an investigation undertaken during 1959—'60 and 1960—'61 with a view to determine the optimum combination of spacing between rows and between plants under dibbling method of sowing wheat are presented in this paper.

Among the factors contributing an increase in production of a field crop, improved cultural operations including sowing are the most important. Among the methods of sowing of wheat, dibbling method, i. e., sowing of seeds with hand tools by making holes well spaced suiting to different soil conditions, moisture status and fertility level is a recently advocated method.

Literature on dibbling method of sowing is very meagre and little attention has been paid to this aspect of investigation in India and elsewhere. Singh (1957) who conducted the experiments in Uttar Pradesh revealed that this method helped in quickly and in substantial quantity multiplying the improved seed of wheat and barely, hence the best use can be made of the small amount of improved seed available. He further reported 9 p. c. increased yield due to dibbling over the conventional method of sowing. Other workers have also reported that spacing given to a plant influences plant growth and yield. Pendleton and Dungan (1953) pointed out that plant height, tillering capacity and kernel size increased with an increase in spacing. Raheja (1948), Verma (1958), Kanada (1957) and Frey and Wiggans (1957) have also reported similarly. On the other hand, Dutta (1945) reported that closer planting was advantageous from economic point of view. Many workers have stressed the fact that spacing has positive correlation with the grain yield per ear (Singh, 1952, Pendleton and Dungan, 1953 and Verma, 1958). According to them the positive correlation exists only upto a certain spacing beyond which it is not found. Hudson (1941) found that maximum yield was obtained from the medium density of plants and least for low and high densities.

In order to find out the best combination of spacings between rows and plants in dibbling method of wheat sowing, trials were conducted at Bihar Agricultural College Farm, Sabour (Bhagalpur) for two consecutive seasons (1959 to 1961). The results obtained are reported in this paper.

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Materials and Methods: In these investigations four row spacings (R_1–6", R_2–9", R_3–12" and R_4–15") and six plant spacing (P_1–2", P_2–4", P_3–6", P_4–8", P_5–10" and P_6–12") were tried. The twenty four treatment combinations were randomised and laid out in a split plot design with five replications. The net size of each plot was 1/580 th acre. The experiment was conducted for the two years in the same field without any alteration. The variety N. P. 799 was tested.

With the help of a fine rope, lines were marked at different row and plant spacings. At each cross, a hole was made with a long and narrow *khurpi* maintaining the depth of about 2½ inches. In each hole a mixture of fertilizers containing N, P and K at the rate of 60 lb., 40 lb. and 40 lb. per acre respectively was applied and then mixed thoroughly with the soil in the hole. Then in each hole, 4 seeds were dropped, covered with fine soil and pressed properly.

For maintaining only two plants in each hole, the extra wheat plants were removed from the field after 15 days of sowing. Two irrigations were applied in each year after 25 and 55 days of sowing. After every irrigation, i. e., twice the plots were hoed with handhoe to produce a natural mulch and to remove weeds.

Results: *Plants Height:* During both the years of trial, observations on plant height were started from 30th day after sowing and subsequent observations were taken at regular intervals of 15 days. The last and final observation was recorded on 120th day after sowing. The mean values of final reading of different treatments have been shown in table I.

TABLE I.

Mean height of plants in cms.

R/P	R_1		R_2		R_3		R_4		Mean	
	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61
P_1	124·0	126·6	126·8	129·0	127·7	126·1	125·5	127·2	126·0	127·2
P_2	129·7	130·2	130·6	135·2	131·9	130·2	128·4	132·7	130·1	132·1
P_3	130·7	131·5	130·3	134·4	133·2	131·1	130·4	132·2	131·1	132·3
P_4	131·4	134·4	131·0	135·5	131·4	130·4	131·5	135·9	131·3	134·1
P_5	132·4	131·5	131·0	136·2	130·5	129·2	129·8	137·1	130·9	133·5
P_6	132·6	133·3	130·7	138·2	129·0	130·2	122·1	136·7	128·6	134·6
Mean	130·1	131·1	130·1	134·8	130·6	129·5	128·0	133·6		

	1959–'60	1960–'61
S. E. Means:	(R) = ± 0·41 ; (P) = ± 0·69	(R) = ± 0·96 ; (P) = ± 0·49
	(RXP) = ± 1·37	(RXP) = ± 0·99
C. D. at 1%	(R) = 1·26 ; (P) = 1·92	(R) = — 1·83 ; (P) = 4·15
	(RXP) = 3·88	

The analysis of variance shows that significant treatment differences were obtained during both the seasons.

The average values of two years' data were then analysed. The resuults of the combined analysis of two years' data have been furnished in table II.

TABLE II.

Mean height of plants in cms. (average of two years)

R/P	R_1	R_2	R_3	R_4	Mean
P_1	125·26	127·88	126·90	126·38	126 61
P_2	130·21	133·08	131·06	130·55	131·23
P_3	131·08	132·34	132·15	131·32	131·72
P_4	132·17	133·40	130·90	133·73	132·73
P_5	131·97	133·61	129·85	133·48	132·23
P_6	132·94	134·44	129·57	129·43	131·72
Mean	130·72	132·54	130·07	130·82	

S. E. Mean : (R) = ± 1·58 ; (P) = ± 0·92 ; (RXP) = ± 1·16

C. D. at 5% (P) = 3·34

Mean value for P at 5% $\overline{P_4 \quad P_5 \quad P_3 \quad P_6 \quad P_2}$ P_1

The analysis of variance shows that inter-row spacing did not differ significantly. Plant to plant spacing of 2 inches proved significantly inferior to all the other spacings. The interactions were not significant.

Number of tillers per clump : The number of tillers per clump in the different treatments was counted periodically at an interval of 15 days starting from 30th day after sowing to ascertain whether the varying levels of row and plant spacing and their combinations had any influence on the formation and development of tillers and their mortality. The treatments varied considerably in the potentiality for tiller production. The potentiality of tiller production increased appreciably with every increase in the spacing either between rows or between plants. Maximum number of tiller production was observed in the treatment combinations of 12 and 15 inches inter-row spacing with 12 inches plant spacing. Mortality of tillers was maximum in the treatment combinations of wider spacings.

Mean number of effective tillers were recorded on 120th day of sowing which are presented in table III.

TABLE III.

Mean number of tillers per clump.

R/P	R_1		R_2		R_3		R_4		Mean	
	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61
P_1	3·6	3·0	5·2	4·0	5·2	3·8	4·6	4·0	4·6	3·7
P_2	5·6	4·8	7·8	8·4	7·0	7·0	7·2	9·4	6·9	7·4
P_3	6·2	4·0	10·2	9·4	12·2	12·0	12·4	9·6	10·2	8·8
P_4	6·6	5·8	10·8	9·8	13·6	11·0	13·8	14·4	11·2	10·3
P_5	7·4	6·0	13·2	14·0	16·0	15·0	15·8	16·0	13·2	12·9
P_6	4·0	9·0	14·4	14·0	17·2	16·0	16·4	18·2	14·2	14·3
Mean	6·4	5·4	10·3	9·7	12·0	10·8	11·7	12·0	10·1	9·6

1959–'60

S. E. Means: (R) = ± 0·16
(P) = ± 0·21
(RXP) = ± 0·42

C. D. at 5% (R) = 0·50
(P) = 0·60
(RXP) = 1·18

1960–'61

S. E. Means: (R) = ± 0·10
(P) = ± 0·10
(RXP) = ± 0·20

C. D. at 5% (R) = — 0·45
(P) = 0·28
(RXP) = 0·56

The results have shown that during both the seasons, mean number of tillers per clump increased steadily with every increase in the spacings between plants and rows. The interactions were also significant during both the years. The close spacings between plants combined with close inter-row spacings gave the lowest number of tillers per clump. Tiller production per clump was highest in the treatment with 12 inches plant to plant spacing combined with 12 and 15 inches inter-row spacings during 1959–'60 and 1960–'61 respectively.

The results of combined analysis of the data of two seasons have been shown in table IV.

TABLE IV.

Mean number of tiller per clump for both the years.

R/P	R_1	R_2	R_3	R_4	Mean
P_1	3·3	4·6	4·5	4·3	4·17
P_2	5·2	8·1	7·0	8·3	7·14
P_3	5·1	9·8	12·1	11·0	9·49
P_4	6·2	10·3	12·3	14·1	10·72
P_5	6·7	13·6	15·8	16·2	13·07
P_6	9·0	14·2	16·6	17·3	14·27
Mean	5·9	10·1	11·4	11·9	

Significant at 1% level

S. E. Mean: (R) = ± 0·49
(P) = ± 0·50
(RXP) = ± 0·7071

C. D. at 5% (R) = 1·56
(P) = 1·29

Mean values R — R_4 R_3 R_2 R_1

P — P_6 P_5 P_4 P_3 P_2 P_1

From table IV; it is seen that both the main effects as also the interactions were highly significant. Plant to plant spacings of 10 and 12 inches did not differ significantly, but they yielded significantly greater number of tillers per clump than any other closer spacings. Similarly, there was no significant difference between inter-row spacings of 15 and 12 inches, but the former recorded significantly larger number of tillers per clump than any other inter-row spacings. Highest tiller production per clump was obtained in the treatment with widest plant to plant spacing of 12 inches.

Yields: (i) *Yield of grain :* The mean data of grain yield in maunds per acre have been presented in table V which will show that during both the seasons acre yields decreased steadily with every widening of the spacing either between plant or between rows.

TABLE V.

Mean weight of grain in maund per acre.

R/P	R_1		R_2		R_3		R_4		Mean	
	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61	1959-'60	1960-'61
P_1	27·53	26·12	27·18	26·62	25·06	237·2	28·24	25·91	27·00	25·59
P_2	25·42	26·64	27·50	28·24	21·88	22·45	24·00	22·24	24·70	24·89
P_3	22·59	26·65	23·65	26·47	20·12	23·08	22·24	19·20	22·15	23·85
P_4	27·88	24·50	21·18	23·29	19·06	20·82	18·35	20·12	21·61	22·18
P_5	22·24	24·43	24·00	22·66	17·65	20·33	17·30	17·08	20·29	21·12
P_6	21·74	23·08	22·59	21·39	16·95	19·06	17·30	17·51	19·64	20·26
Mean	24·56	25·23	24·35	24·78	20·12	21·56	21·23	18·67		

1959–'60

S. E. Means (R) = ± 1·013
(P) = ± 1·02
C. D. at 5% (R) = 2·19
(P) = 2·05

1960–'61

S. E. Means (R) = ± 0·78
(P) = ± 0·76
(RXP) = ± 1·51
C. D. at 5% (R) = 1·70
(P) = 1·51
(RXP) = 3·01

During 1959–'60, inter-plant spacing of 2 inches proved significantly better than all the other wider spacings; while in 1960–'61 the spacings of 2 and 4 inches did not differ significantly but the former recorded significantly better yields than any other wider spacing. During both the seasons inter-row spacings of 6 and 9 inches gave significantly higher yield than spacings of 12 and 15 inches.

TABLE VI.

Mean weight of grains in maunds per acre (Average of two years)

R/P	R_1	R_2	R_3	R_4	Mean
P_1	26·82	26·90	24·39	27·04	26·29
P_2	26·03	27·88	22·16	23·12	24·79
P_3	24·62	25·60	21·60	20·72	23·13
P_4	26·19	22·23	19·94	19·23	21·89
P_5	22·34	23·23	18·94	17·19	20·45
P_6	22·41	21·99	18·00	17·40	19·95
Mean	24·73	24·65	20·84	20·78	

S. E. Means (R) = ± 0·60; (P) = ± 0·60; (RXP) = ± 0·90
C. D. at 1% (R) = 2·37; (P) = 2·37;
C. D. at 5% (RXP) = 2.49

			R_1	R_2	R_3	R_4		
Mean values :	At 1%	(R)	24.73	24·65	20·84	20·78		
			P_1	P_2	P_3	P_4	P_5	P_6
		(P)	26·29	24·79	23·13	21·83	20·45	19·95

In the combined analysis of the data of two years (Table VI), inter-row spacings of 6 and 9 inches were significantly better than the other two wider spacings of 12 and 15 inches recording about 4 maunds extra yield per acre. Plant to plant spacing of 2 inches gave significantly higher yield than any other spacings; the acre yields recorded by interplant spacing of 2, 4, 6, 8, 10 and 12 inches being 26·3, 24·8, 23·1, 21·9, 20·4 and 19·9 maunds respectively. Maximum yield of 27·9 maunds per acre was recorded by the combination of inter-row and inter-plant spacings of 9 and 4 inches respectively followed by 15 and 2 (27·0 maunds), 9 and 2 (26·9 maunds) and 6 and 2 inches (26·8 maunds per acre).

(ii) *Yield of straw :* From the data obtained plant to plant spacing of 2 inches recorded the highest straw yield, 58·94 and 59·65 maunds per acre in 1959–'60 and 1960–'61 followed by next wider spacing of 4 inches. Among the different inter row spacings, 9 inches in 1959–'60 and 6 inches in 1960–'61 gave the maximum straw yield of 50·00 and 55·18 maunds respectively.

From the combined analysis of the two years data, it has been found out that there was a marked effect of row and plant spacings. Inter-row spacing of 6 and 9 inches proved significantly better than any other spacings. These two spacings recorded 6 to 7 maunds higher yield. Plant to plant spacing of 2 and 4 inches did not differ significantly but both gave

significantly higher straw yield than all the other spacings, recording 54·04 and 52·85 maunds per acre as against 47·10, 48·33, 45·33 and 43·03 maunds under spacings of 6, 8, 10 and 12 inches respectively.

The interactions were not significant suggesting that the best spacing combinations would be inter-row spacing of 6 or 9 inches combined with inter-plant spacings of either 2 or 4 inches.

Summary and Conclusion : The investigation was undertaken during 1959–'60 and 1960–'61 with a view to determine the optimum combination of spacings between rows and between plants under dibbling method of sowing wheat. The treatment consisted of all combinations of four levels of inter-row spacing viz. 6, 9, 12 and 15 inches and six levels of inter-plant spacing viz., 2, 4, 6, 8, 10 and 12 inches.

Significant differences accrued due to inter-row and inter-plant spacings, in plant height, number of tillers per clump and yield of grain and straw in both the years.

(i) *Plant height :* Significant differences were found in height of plant due to different spacings in both the years but in the combined analysis for both the years only inter-plant spacing of 2 inches proved significantly inferior to all the other spacings. The inter-row spacings and interactions were not significant.

(ii) *Number of tillers per clump :* In both the seasons and also in combined analysis, wider spacings stimulated greater tiller production. Highest tiller production of clump was obtained in the treatment with widest plant to plant spacing of 12 inches and row to row spacing of 15 inches.

Yield of grain and straw : Significantly higher yields of grain and straw were found in close spacing of inter-row and inter-plant. Highest grain yields were obtained in closer inter-row spacings of 6 and 9 inches and inter-plant spacing of 2 inches. As regards the interaction is concerned, the inter-row and inter-plant spacings of 9 and 4 inches proved best. In the case of straw yield, the inter-row spacings of 6 and 9 inches and inter-plant spacings of 2 and 4 inches were significantly superior to all other spacings.

Thus it can be concluded that high yield of wheat grain and straw can be obtained by using inter-row spacing of 6 inches or 9 inches and inter-plant spacing of 2 or 4 inches. However, for making final recommendation more investigations are under progress.

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