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Studies on the response of dwarf wheats to irrigation and its Economics under Varied Nitrogen levels *

Y. G RAO[1] & R. B. L. BHARDUAJ[2]

A field experiment was conducted at Indian Agricultural Research Institute, New Delhi to study the response of dwarf wheats to irrigation under different levels of nitrogen and its economics in reelation to grain and straw yield during the *rabi* seasons 1976-77 and 1977-78. Since the effect of irrigation on grain yield was significant during both the years, regression equations representing quadratic response could be developed to fit the data for grain yield. A strong correlation was identified between the irrigation frequencies and grain yield. The maximum mean grain yield for two seasons (49 Q/ha.) was obtained when the crop received irrigations at 0.5 atm. tension at 25 cm soil. depth. Appreciable reduction in grain yield was noticed (45 Q/ha.) when the irrigations given at CRI and boot stages of crop but this was further reduced to 43 Q/ha when the irrigation was restricted to CRI stage alone.

The net profit was increased progressively as the number of irrigations increased, but the net return per rupee invested on irrigation followed the reverse trend.

Responsive cultivars optimum soil moisture and nitrogen are the three major pre-requisites for obtaining higher wheat yields. In dwarf wheats, crown root initiation (CRI), jointing. flowering and grain formation are the critical stages of growth (Gautham *et al.*, 1968; Anonymous. 1969; Mrsra *et al.*, 1970; Patil *et al.*, 1969) and moisture stress at these stages effect the grain yield advarsely Singh and Gandhi (1964) opined that the application of nitrogenous fertilizers was essential to enhance water use efficiency under irrigated conditions. The present investigation was undertaken to study the response of dwearf wheats to irrigation and its economics to grain yield

MATERIAL AND METHODS

The experiment was conducted at Indian Agricultural Research Institute, New Delhi during the *rabi* seasons 1976–77 and 1977-78. It was laid out in a split plot design with cultivars (HD 2177, HD 2160 and HD 4530) and irrigation frequencies (irrigation at CRI; irrigation at CRI and boot stages and irrigation at 0.5 atm. tension at 25 cm soil depth) as main plots while nitrogen rates (0, 40, 80 120 and 160 Kg/ha) assigned to sub plots. Full dose of phosphorus was given by placement at the time of sowing. Half of the total nitrogen was drilled at sowing and the rest half was applied just before giving CRI irrigation. The quantity of water to be applied was calculated by estimating the deficit from the field capacity in the main root zone by the formula outlined by Dastane (1967). Irrigation

* Extracts from Ph. D. thesis of the senior author.

Present address: 1. Asst. Agronomist, Cotton Research Station, Nandyal (AR)
2. Senior Scientist, Wheat directorate, I. A. R. I.; New Delhi 110012.

water was measured with the help of 76.2 mm parshall flume. The grain yield data for two seasons and pooled data obtained under different irrigation frequency treatments were statistically analysed and the input-output relation ship were developed by fitting response curves. The difference in grain yield due to variation in irrigation frequencies for the two seasons as well as for pooled data was splitted into linear, quadratic and cubic and tested by variance ratio ('F' test) to determine the nature of response curve.

The nature of quadratic response function can be expressed mathematically as $Y=a+bx-cx^2$ where

- Y=dependent variable and denotes grain yield (g/ha) corresponding to irrigation frequencies under investigation.
- X=Independent variable representing irrigation frequencies.
- a and b=constants.

Economics of irrigation with respect to grain yield was worked out on the basis of mean response over two seasons. Net profit under different irrigation frequency treatments and net return per rupee investment on irrigation were also estimated.

RESULTS AND DISCUSSION

Grain yield:

The individual and pooled yield responses of the irrigation frequencies are shown in functional from by the equations along with correlation coefficients between the levels of moisture regimes and corresponding grain yield and coefficient of determination have been presented in table 1.

Grain yield:

The regression of irrigation frequencies on grain yield was quadratic in nature both seasons as well as for the pooled data. This denotes that to a certain level of irrigation supply the grain yields were increased, after that there was reduction of the same.

The data showed a progressive declaine in grain yield with the increase in soil moisture stress The highest yield of grain for the average of seasons was obtained when the crop was adequately irrigated. A strong correlation between the moisture supply and grain yield in both years as well as over pooled data was identified. The coefficient of determination for the response function for the pooled data was of the order of 90 percent, whereas the corresponding values for the two years taken separately being 93 percent (1976-77) and 92 percent (1977-78), respectively.

Magnitude of varietal response to irrigation:

The magnitude of yield response of three genotypes included in the experiment over the lowest frequency (one irrigation at CRI) of irrigation as well as over immediately previous frequencies of irrigation have been summerised in Table 2.

The genotypes exhibited differential behaviour in responding to levels of irrigation with one irrigation at CRI alone, HD4530 was the highest yeilder and HD2177 the lowest, HD2160 was very close to HD4530. HD2160 maintained the highest yield level at two and adequate irrigation frequencies which was very closely followed by HD 4530. At all irrigation frequencies HD2177 was the lowest yielder of grain. The magnitude of response to two irrigations over one irrigation was the highest for HD2177 and the lowest for HD4530 while HD2160 closely followed by HD2177 responded with higher magnitude to adequate irrigation over two irrigations. It was also observed that HD2177 responded to irrigation very favourably and yielded grain appreciably over HD4530 and slightly over HD2160 at two irrigations level and equally under adequate irrigation conditions.

Economics of irrigation :

Economics on the average effects of all irrigation frequencies have been worked out and presented in Table 3. The cost for one irrigation and the price of grain per quintal were taken as Rs. 26/-and Rs 115/- respectively. The cost of other inputs like seeds,fertilizers,plant protection etc. have been assumed to be constant for different irrigation frequencies. The cost of all input variables and yield returns is based on the prevailing rates at the time of investigation.

As could be expected from the performance of all the three genotypes, responding significantly to adequate irrigation, the average not profit per hectare from two irrigations was higher (Rs. 4468/-) than one irrigation at CRI (Rs. 4296/-). By giving one irrigation at boot stage in addition to CRI irrigation the net profit increased by Rs. 172 and by further increasing the number of irrigations to 5 (adequate irrigation frequency) a still higher additional return of Rs. 332/- was obtained. It was further observed that the net return per rupee of investment on irrigation was drastically reduced with increased number of irrigations.

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REFERENCES

ANONYMOUS. (1969). Ann. Rep. Co-ord. Scheme for wheat research I. C. A. R. New Delhi, 1964-69.

DASTANE, N. G. (1967). A Practical manual for water use research Nav Bhaxat Prakasan.

GAUTAM, D. P., BHARDWAJ, R. B. L., SINGH, Y. and SINGH, R. P. (1968)Irrigation studies with tall and dwarf varieties of wheat. proc. Symo. water management Udipur. 110-17

MISRA, R D, SHARMA, K. C., WRIGHT, B C. and SINGH V. P. (1970). Critical stages of Irrigation and Irrigation requirment of wheat variety Lerma Rajo. Review of work done on water requirements of crops in India: 39

PATIL, V. S., KULKARNI G. N., ACHAR, H. P., BHADRAPUR, T. G., PANCHAL, Y. P., CHANNABASIAB, H. S. M. and DASTANE, N. G. (1969). Ann Rep. Siriguppa Res. Sta. Major River Valley Projects. I. C. A. R. Irrigation scheme with Univ. of Agril. Sci. Bangalore.

SINGH, MUKTAR and GANDHI, R. T., (1964). Review of Irrigation and Fertilizer srudies Proc. 5th. NESA irrigation Practices Seminar Delhi - 486.

TABLE 1. Average yield of grain due to different levels of irrigation.

Irrigations at	No. of irrigations	Year 1976-77	1977-78	19 Pooled
CRI	1	35 6	51.2	43.4
CRI and boot	2	36 2	53.6	45 0
0.5 atm. tension	3	38 4	59 8	49.1
*rI×Y		0 963)	0 9674	0.9511
Response equation:		Y=23.7+0.2849-0.00101×²	Y=42 1+0.3288×-0.00140×²	Y=32 9+0 3056×-0.00120×²
Coefficient of determination		0.93	0.92	0.90

* correlation coefficient between irrigation frequencies and corresponding grain yicls.

TABLE 2. Magnitude response of grain yield to irrigation.

Genotype	Grain yield (q/ha) with one irrigation	Yield (q/ha) and response over one irrigation with: Two irrigations	Adeqate irrigation	Response over immediately previous irrigation level: Two irrigations	Adequate irrigations.
HD2177	40 4 (0.0)	43.3 (2.9)	47 6 (7.2)	2 9	4.3
HD2160	44 4 (0.0)	56 0 (1.6)	50 6 (6 2)	1.6	4.6
HD4530	45.2 (0.0)	45 4 (0.2)	49.2 (4.0)	0.2	3 8

TABLE 3. Economics of irrigation for wheat (Mean of two seasons).

Irrigation at	No of Irrigations	Gross return (Rs/ha)	Cost of irrigation (Rs./ha)	other costs (Rs/ha)	Threshing costs (Rs./ha)	Total costs (Rs.ha)	Net return due to irrigation (Rs/ha)	Net return per rupee of investment (Rs/ha)
CRI	1	5653	28	1084	245	1357	4296	153
CRI and boot	2	5889	56	1084	281	1421	4468	80
0.5 atm tension	3	6409	140	1084	385	1609	4800	34