Indian Journal of Agronomy **46** (1) : 118–121 (March 2001)

Response of macaroni wheat *(Triticum durum)* to nitrogen, phosphorus and sodic water on loamy-sand soils of south-west Haryana

ANIL KUMAR, BIKRAM SINGH AND JAGDEV SINGH

Regional Research Station, Chaudhary Charan Singh Haryana Agricultural University, Bawal 123 501

Received : May 2000

ABSTRACT

A field experiment was conducted on loamy-sand soil at Bawal, Haryana, during 1997–98 and 1998–99 to evaluate the performance of macaroni wheat (*Triticum durum* Desf.) under different levels of nitrogen, phosphorus and sodic water. Nitrogen @ 160 kg/ha and P @ 60 kg/ha produced significantly taller plants and ears/m row length over their lower doses. However, the response of dry-matter accumulation/m row length was significant up to 120 kg N and 40 kg P/ha. The heading and maturity were significantly delayed by 5 days with 160 kg N over 80 kg N and by 4 days with 60 kg P over 20 kg P doses. The yield attributes, viz grains/ear, 1,000-seed weight and ears/m, were significantly more at 120 and 160 kg N/ha and 40 and 60 kg P/ha than lower dose of 80 kg N and 20 kg P. All the growth and yield attributes were significantly reduced by 12.0 residual sodium carbonate (RSC) sodic water than 2.5 RSC water. The maturity of the crop was significantly advanced by about 3 days with sodic water of 12.0 RSC.

Key words : Macaroni or durum wheat, Nitrogen, Phosphorus, Sodic water

In Haryana Macaroni or durum wheat is the new introduction with the preliminary studies of realization of higher grain yield potention than bread wheat *(Triticum aestivum)*. Due to higher grain yield potential the response to nitrogen and phosphorus may differ in *T. durum* compared with *T. aestivum* group.

In Haryana, of the 55% poor-quality groundwater, 44 and 30% are saline and sodic respectively. In southern Haryana it accounts for 60–73% of the total groundwater which is the only source for supplemental irrigation. Wheat responds to nitrogen up to 180 N/ha under sodic conditions (Kumar *et al.*, 1995). Keeping above points in view, the present study on response of macaroni wheat to nitrogen, phosphorus and sodic water was undertaken.

MATERIALS AND METHODS

A field experiment was conducted at Regional Research Station, Bawal, during 1997–98 and 1998–99. The soil of the experimental field was alkaline in reaction, heaving pH 8.3 and loamy sand in texture with organic carbon (0.17%), available N (130 kg/ha), available P (9.0 kg/ha) and available K (383 kg/ha). The experiment was laid out in split-plot design with 3 replications. The treatments consisted of 3 levels of each nitrogen (80, 120 and 160 kg/ha) and phosphorus (20, 40 and 60 kg/ha), and 2 environments of water, i.e. good water of < 2.5 RSC and sodic water of 12.0 RSC. Durum wheat var. 'WH 896' was evaluated under various levels of nitrogen, phosphorus and irrigation water conditions. It was sown in lines 20 cm apart with the seed rate 125 kg/ha on 1 November 1997 and 6 November 1998.

Nitrogen was applied in 3 equal parts, at basal, tillering and flowering stages as per treatment through urea and P through single superphosphate. A total number of 5 irrigations at critical stages excluding pre-sowing were applied with both good and sodic water. The crude protein was estimated by microkjeldahl's method (N × 5.7) as reported by Nanval *et. al.* (1998).

RESULTS AND DISCUSSION

Growth parameters

The various growth parameters, viz. plant height, number of ears and dry-matter accumulation/m row length, were

Table 1. Effect of nitrogen, phosphorus and sodic water on various parameters of growth and phenology

Treatment	Plant height (cm)		Ears/ m		Dry-matter accumulation (g/m row length)		Days to 50% heading		Days to maturity	
	1997–98	1998–99	1997–98	1998–99	1997–98	1998–99	1997–98	1998–99	1997–98	1998–99
Nitrogen (kg/ha)										
80	86.0	88.5	92.8	95.9	170.0	173.0	103.1	104.6	149.1	151.4
120	90.0	92.0	104.9	106.8	183.0	184.0	107.4	108.9	153.2	155.0
160	93.5	95.2	111.5	114.3	186.0	188.4	108.5	109.6	155.1	156.8
CD (P=0.05)	3.4	3.0	4.6	3.9	11.0	9.0	2.0	3.1	2.4	1.9
Phosphorus (kg/ha)										
20	86.9	88.4	98.2	99.4	174.0	175.0	104.7	105.3	151.0	152.0
40	90.2	92.4	103.1	106.2	181.0	184.0	106.9	107.7	153.4	155.5
60	92.4	94.9	107.9	111.4	184.0	186.0	107.2	109.0	154.0	156.8
CD (P=0.05)	2.0	2.4	2.5	3.1	6.0	7.0	1.3	1.4	1.1	1.6
Sodic water quality (meq/litre)										
12.0 RSC	88.1	90.2	101.0	102.4	174.5	176.4	104.5	106.2	150.2	153.0
2.5 RSC	92.1	94.2	105.4	108.4	184.7	186.8	107.0	108.4	153.2	155.7
CD (P = 0.05)	2.1	2.2	2.3	2.9	4.0	4.8	1.1	1.2	1.0	0.9

Table 2. Effect of nitrogen, phosphorus and sodic water on yield attributes and yield of durum wheat

Treatment	Grains/ ear		Test weight (g)		Protein content (%)		Grain yield (q/ha)		Straw yield (q/ha)	
	1997–98	1998–99	1997–98	1998–99	1997–98	1998–99	1997–98	1998–99	1997–98	1998–99
Nitrogen (kg/ha)										
80	39.9	41.1	44.3	45.8	10.41	10.60	42.04	44.89	74.31	77.21
120	44.2	45.3	45.2	46.5	10.99	12.53	52.11	54.32	82.42	85.48
160	47.1	48.1	45.4	47.0	13.74	13.82	59.06	59.41	85.09	91.20
CD (P=0.05)	1.8	1.6	0.6	0.7	0.45	0.51	3.11	2.47	3.21	4.02
Phosphorus (kg/ha)										
20	40.0	41.2	44.3	45.6	12.00	12.02	44.80	49.22	76.00	80.17
40	44.4	44.5	45.2	46.7	12.15	12.42	49.40	53.90	80.52	85.40
60	45.4	47.4	45.6	46.9	12.29	12.51	52.01	55.45	83.30	88.32
CD (P=0.05)	1.1	1.2	0.7	0.6	0.30	0.28	1.92	1.53	2.62	2.84
Sodic water quality (meq/litre)										
12.0 RSC	42.4	42.5	44.0	45.2	12.00	12.22	47.22	50.50	78.44	83.40
2.5 RSC	45.0	46.3	46.0	47.6	12.14	12.73	50.28	53.92	82.16	85.50
CD (P=0.05)	1.0	1.2	0.5	0.6	ns	0.29	1.89	1.25	2.41	2.00

significantly influenced by N, P and sodic water. Application of N @ 160 kg/ha and P @ 60 kg/ha produced significantly taller plants and ears/m row length over lower doses of N and P. However, dry-matter accumulation increased significantly up to 120 kg N and 40 kg P/ha. All the above growth parameters were significantly affected by 12.0 RSC sodic water, as it increased the pH and ESP of soil. With increase in pH, more time is required to complete the hydrolysis of urea, availability of P also decreases up to pH 9.0 and Zn and Ca availability also decreasess as reported by Dhankhar (1999). Heading and maturity of the crop were significantly delayed by 5 days and 4 days, respectively, with the application of 160 kg N over 80 kg N only and 60 kg P over 20 kg P. However, significant differences were not observed between 120 kg N and 160 kg N, and between 40 kg P and 60 kg P. The maturity of crop was significantly advanced by 3–4 days with the application of 12.0 RSC water than 2.5 RSC water. Nitrogen is an important constituent of chlorophyll, nucleotides and enzymes, which play a significant role in metabolic processes and various metabolic activities. Therefore, better nitrogen resulted in taller plants, more number of tillers and high dry-matter production. Sometimes because of excessive uptake of nitrogen, the leaf-area increases beyond optimum as a result the net assimilation of photosynthesis is less. Similar results were reported by Kataria *et*

al. (1998). Forster (1973) reported that cereals provided with higher nitrogen, the carbohydrates are prefrentially diverted to the ears. This effect is dependent on the level of nitrogen maintaining in the leaves which maintains leaves in green state for longer period of time, extending the duration of dry-matter assimilation and grain-filling. Higher nitrogen supply also stimulates the synthesis of cytokinins and its supply to the leaves and ears, therefore, delayed the maturation process phosphorus delayed maturity due to better enchorage and longer duration of root activities.

Yield attributes and yield

Application of 60 kg N and 60 kg P resulted in significantly more number of grains/ear than lower doses of N and P. There was significant increase in test weight up to 120 kg N and 40 kg P/ha. These parameters were significantly decreased by 12.0 RSC water. Nitrogen @ 160 kg/ha significantly increased grain and straw yields over lower doses. Grain yield is a function of tillers, grains/ear and weight of an individual grain. Since all the yield-attributing parameters were superior at 160 kg N and higher grain yield was recorded over 80 and 120 kg N/ha. Protein content was also significantly increased by 160 kg N/ha.

'WH 896' responded significantly up to 160 kg N and 60 kg P under loamy-sand soil of Haryana and all the growth and yield attributes were significantly decreased by sodic water of 12.0 RSC.

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