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Performance of macaroni (*Triticum durum*) and bread wheat (*Triticum aestivum*) varieties with organic and inorganic source of nutrients under limited irrigated conditions of Vertisols*

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Wheat [*Triticum aestivum* L. emend. Fiori & Paol.] is the most predominant winter season crop grown on deep Vertisols of central India. Its productivity is mainly depend on the availability of irrigation water and balanced application of fertilizers. Nutrient responsive high yielding varieties that are tolerant to drought or limited irrigated conditions, should be encouraged to grow in this region. In the Malwa Plateau of Madhya Pradesh, macaroni or durum wheat *(Triticum durum* Desf) was found to be performed better than bread or *aestivum* wheat especially under limited (2–4) irrigation conditions (Behera and Thakur 1999). Judicious application of nutrients especially organic manures not only improves the productivity (Sushila and Giri 2000) but also make wheat cultivation sustainable (Tiwari *et al.* 2002). The present experiment was conducted to evaluate the performance of macaroni and bread wheat varieties with organic and inorganic source of nutrients under limited irrigated conditions in the Vertisols of central India.

A field experiment was conducted during winter season (*rabi*) of 2003–04 at the research farm of the Institute, Bhopal, on deep Vertisols. The soil was clayey in texture and classified as Typic Haplustert with *p*H 7.9 and EC 0.52 dS/m. The available soil N, P and K were 132, 12.4 and 560 kg/ha, respectively. Four sources of nutrients, viz poultry manure, vermicompost, cattledung manure and chemical fertilizers were applied in the main plots and 20 wheat varieties (13 bread wheat and 7 macaroni wheat) to sub plots. The experiment was laid out in split-plot design with 3 replications. The nutrient composition of organic manures used in the experiment were analyzed and presented in Table 1. Poultry manure (5 tonnes/ha), vermicompost (7.5 tonnes/ha) and cattledung manure (10 tonnes/ha) were applied 10 days before sowing. A fertilizer dose of 80, 40 and 20 kg N, P_2O_5 and K_2O/ha were applied in chemical treatment. Entire dose of phosphorus and potassium and half dose of nitrogen were applied at sowing and the remaining nitrogen at 30 days after sowing. One pre-sowing and 2 post-sowing irrigations during crown root initiation (25 days after sowing) and tillering stages (65 days after sowing) each at 7.5 cm depth were given through sprinklers. The varieties were hand sown at 22.5 cm inter row spacing. The rainfall received during the cropping season (November–March) was 56.6 mm.

Total number of tillers/m length was recorded at 70 days after sowing. Yield attributes and yield were recorded at harvest. Protein content of grain was estimated by multiplying the nitrogen content with 6.25. Water use efficiency (WUE) was calculated by dividing the grain yield with the consumptive use of water that was estimated as per Mishra and Ahmed (1987).

Among the source of nutrients, chemical fertilizers recorded higher number of tillers (120), spikes/m length (93 cm), straw yield (5 610 kg/ha) and WUE (19.84 kg/ha-mm) which were on par with that of poultry manure applied treatment (Table 2). The grain yield was significantly highest in chemical fertilizers (4 466 kg/ha) followed by poultry manure application (4 030 kg/ha). However, tiller conversion percent, grains/spike, 1 000-seed weight, harvest index and protein content were not changed significantly due to different source of nutrients. Organic nitrogen applied as manure is available slowly over long duration compared to chemical fertilizers. This often limits plant growth owing to mismatch between crop nutrient demand and supply potential from organic sources, especially during initial phase of conversion from conventional to organic management systems (Pang and Letey 2000).

On an average, bread wheat recorded higher number of

Table 1 Nutrient composition of organic manures

Nutrient	Poultry manure	Vermicompost	Cattledung manure
Total N (%)	2.23	1.61	1.09
P (%)	1.60	1.05	0.87
K (%)	1.68	0.85	1.03
S (%)	0.72	0.46	0.62
Zn (mg/kg)	24	42	16

*Short note

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Table 2 Effect of nutrients and varieties on yield attributes, yield, protein and water use efficiency*

Treatment	Total tillers/m length	Spikes/ m length	Tiller conversion (%)	Grains/ spike	1 000-seed weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index	Protein (%)	WUE (kg/ha -mm)
Source of nutrient										
Poultry manure	118	90	78	31.3	54.9	4 030	5 258	0.43	11.59	17.91
Vermicompost	116	87	75	28.2	53.7	3 635	4 815	0.43	11.58	16.15
Cattle dung manure	110	82	74	30.0	53.3	3 686	4 957	0.42	11.42	16.38
Chemical fertilizers	120	93	75	29.7	53.5	4 466	5 610	0.44	11.61	19.84
CD ($P = 0.05$)	8.1	6.2	NS	NS	NS	257	392	NS	NS	2.42
Bread wheat										
'HI 1500'	95	87	91	35.0	45.3	3 404	5 395	0.38	12.20	15.12
'HI 1418'	119	92	77	27.2	44.4	3 586	5 057	0.41	10.86	15.93
'HI 1479'	117	95	81	25.5	48.4	4 266	5 266	0.44	11.33	18.96
'HI 1454'	135	89	66	27.0	48.6	3 535	5 330	0.39	11.59	15.71
'HI 1077'	133	90	68	32.5	48.8	4 452	5 258	0.45	11.02	19.78
'DL 788-2'	112	87	77	25.2	51.8	3 444	6 066	0.36	11.25	15.30
'HW 2004'	136	77	56	33.2	49.6	2 788	5 716	0.32	12.26	12.39
'Lok 1'	132	92	70	26.5	57.4	3 204	4 661	0.40	11.14	14.24
'GW 322'	122	111	90	40.7	47.6	5 357	6 419	0.45	9.66	23.80
'GW 273'	114	105	92	29.5	51.7	4 723	5 231	0.47	10.84	20.99
'GW 173'	146	96	66	26.0	46.9	4 106	5 715	0.41	11.16	18.24
'WH 147'	122	82	67	24.2	46.7	3 088	4 089	0.43	11.88	13.72
'Sujata'	115	84	73	30.5	47.6	3 490	5 047	0.40	11.07	15.51
Mean	123	91	74	29.4	48.8	3 801	5 329	0.40	11.25	16.89
Macaroni wheat										
'HI 8498'	115	87	75	30.0	61.9	4 257	5 186	0.45	12.03	18.92
'HI 8627'	102	83	81	38.0	56.3	4 150	5 004	0.45	12.16	18.44
'HI 8634'	101	96	95	28.0	57.4	4 877	4 988	0.49	11.99	21.67
'HI 8638'	118	92	77	29.0	55.5	4 350	4 715	0.47	11.91	19.33
'HD 4672'	107	91	85	33.2	54.7	4 706	4 337	0.52	11.86	20.91
'HI 8381'	122	78	83	30.0	59.7	3 648	5 416	0.40	11.84	16.21
'Raj 1555'	98	80	81	29.5	56.7	3 666	4 422	0.45	12.21	16.29
Mean	109	86	79	31.1	57.4	4 235	4 866	0.46	12.00	18.82
CD ($P = 0.05$)	12.4	9.7	6.4	3.7	1.6	574	810	0.07	0.97	1.92

*Nutrient variety interaction was not significant for any of the characters; WUE, water use efficiency

tillers (123), spikes/m length (91) and straw yield (5 329 kg/ha), whereas macaroni wheat recorded higher tiller conversion (79%), grains/spike (31.1), 1000-seed weight (57.4 g), grain yield (4 235 kg/ha), harvest index (0.46), protein content (12%) and WUE (18.82 kg/ha-mm). Behera *et al.* (2002) also reported that macaroni cultivars gave higher grain yield than bread wheat under limited irrigated conditions.

Among the bread wheat varieties 'GW 173' recorded the highest number of tillers (146) and 'HI 1500' recorded the lowest number of tillers (95). Whereas, in macaroni wheat, total tillers varies from 98 ('Raj 1555') to 122 ('HI 8381'). Number of spikes/m length varies from 82 ('WH 147') to 111 ('GW 322') among the bread wheat and from 78 ('HI 8381') to 96 ('HI 8634') among the macaroni wheat varieties. Tiller conversion per cent ranges from 56 ('HI 2004') to 92 ('GW 273') in bread wheat and from 75 ('HI 8498') to 95 ('HI 8634') in macaroni wheat.

'GW 322' recorded the highest number of grains/spike (40.7) and 'WH 147', the lowest (24.2) among the bread wheat. In macaroni wheat 'HI 8627' recorded higher number of grains/spike (38) and 'HI 8638' recorded the lowest (29). 1000-seed weight varies from 44.4 ('HI 1418') to 57.4 g ('Lok 1') in bread wheat and from 54.7 ('HD 4672') to 61.9 g ('HI 8498') in macaroni wheat.

In bread wheat, 'GW 322' recorded significantly highest grain yield (5 357 kg/ha) and 'HW 2004' recorded the lowest grain yield (2 788 kg/ha). 'GW 273', 'HI 1077', 'HI 1479' and 'GW 173' varieties recorded more than 4 000 kg/ha of grain yield. In macaroni wheat, 'HI 8634' recorded the highest grain yield (4 877 kg/ha) and 'HI 8381' recorded the lowest grain yield (3 648 kg/ha). Straw yield varies from 4 661 ('Lok 1') to 6 419 kg/ha ('GW 322') in bread wheat and from 4 422 ('Raj 1555') to 5 416 kg/ha ('HI 8381') in macaroni wheat.

Harvest index was lowest (0.32) in 'HW 2004' and highest (0.47) in 'GW 273' in bread wheat and from 0.40 ('HI 8381') to 0.52 ('HD 4672') in macaroni wheat. Protein content varies

from 9.66 ('GW 322') to 12.26% ('HW 2004') in bread wheat and from 11.84 ('HI 8381') to 12.21% ('Raj 1555') in macaroni wheat. The maximum water use efficiency was recorded in 'GW 322' (23.80 kg/ha-mm) and the lowest (12.39 kg/ha-mm) in 'HW 2004' among the bread wheat. In macaroni wheat, water use efficiency varies from 16.21 ('HI 8381') to 21.67 kg/ha-mm ('HI 8634').

SUMMARY

Among the source of nutrients, chemical fertilizers (80-40-20 kg N, P_2O_5 and K_2O/ha) resulted in higher yield attributes, grain yield and water use efficiency of wheat and application of poultry manure @ 5 tonnes/ha is better than vermicompost @ 7.5 tonnes/ha and cattledung manure @ 10 tonnes/ha. On an average, macaroni wheat *(Triticum durum* Desf.) performed better than bread wheat in terms of grain yield, protein content and water use efficiency. Among the varieties, 'GW 322' of bread wheat recorded the highest grain yield (5357 kg/ha) and water use efficiency (23.80 kg/ha-mm) but had the lowest protein content (9.66 %). In macaroni wheat, 'HI 8634' recorded the highest grain yield (4877 kg/ha) and water use efficiency (21.67 kg/ha-mm) with 11.99 % protein content. Apart from these varieties, 'GW 273', 'HI 1077', 'HI 1479' and 'GW 173' in bread wheat and 'HD 4672', 'HD 8638', 'HI 8498' and 'HI 8627' in macaroni wheat recorded grain yields more than 4 000 kg/ha under limited irrigated conditions of vertisols.

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REFERENCES

Behera U K and Thakur R S. 1999. Production technology to improve yield and quality of durum wheat under irrigated conditions in the Malwa Plateau of Madhya Pradesh. *Indian Farming* **49**(8) : 6–8.

Behera U K, Ruwali K N, Verma P K and Pandey H N. 2002. Productivity and water use efficiency of macaroni and bread wheats under varying irrigation levels and schedules in the vertisols of Central India. *Indian Journal of Agronomy* **47**(4) : 518–25.

Mishra R D and Ahmad M. 1987. *Manual of Irrigation Agronomy*, pp 412 Oxford & IBH Publishing Co. Pvt Ltd, New Delhi.

Pang X P and Letey J. 2000. Organic farming: Challenge of timing nitrogen availability to crop nitrogen requirements. *Soil Science Society of America Journal* **64** : 247–53.

Sushila R and Giri G. 2000. Influence of farmyard manure, nitrogen and biofertilizers on growth, yield attributes and yield of wheat under limited water supply. *Indian Journal of Agronomy* **45**(3) : 590–5.

Tiwari L, Dwivedi A K and Dikshit P R. 2002. Long-term influence of organic and inorganic fertilization on soil fertility and productivity of soybean-wheat system in a vertisol. *Journal of Indian Society of Soil Science* **50** (4): 472–5.