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Effect of N and P levels and biofertilizers on the growth and yield of wheat under late sown irrigated conditions

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ABSTRACT

A field experiment was conducted during the *rabi* season of 2002-2003 at the wheat research unit of Dr.P.D.K.V. Akola to study the effect of N and P levels and biofertilizers on the growth and yield of wheat under late sown irrigated conditions. Four NP fertilizer levels (0:0, 40:20, 60:30 and 80;40 kg NP/ha corresponding to control, 50%, 75%, and 100% RDF) in main plots and four biofertilizer treatments (control,Azotobacter, Phosphate Solubilizing bacteria(PSB) and coinoculation of Azotobacter+ PSB) in subplot were replicated four times in split plot design. The growth and yield attributes showed an increase with increase in the NP fertilizer levels.100% RDF recorded significantly highest grain yield (32.40 q/ha) and staw yield (39.78 q/ha). Azotobacter and PSB inoculation, being at par caused significant improvement in the growth and yield attributes over control. Co-inoculation of both the biofertilizers further increased the growth and yield attributes over individual inoculation. Combined inoculation yielded maximum grain yield (26.06 q/ha) and staw yield (33.69 q/ha). Interaction effect showed that application of 60:30 kg N:P/ha (75%RDF) coupled with combined inoculation registered significantly higher grain yield (30.96 q/ha) of wheat with higher net profit, B:C ratio than those with 80;40 kg N:P/ha (100%RDF) (30q/ha) without biofertilizer inoculation. Thus 25% saving in nitrogen and phosphorus application could be possible with combined inoculation of Azotobacter+ PSB.

Key words : Wheat, Nitrogen, Phosphorus, Biofertilizer, Late sown, Irrigated conditions.

INTRODUCTION

Wheat is the major foodgrain crop of India. To meet the growing demand of people for food the only suitable strategy now available in the country for large scale application is to increase production per unit area per unit time. Wheat is a fertilizer responsive and comparatively less risky crop. On the basis of field experimental results fertilizer recommendations have been made for different agro-ecological zones of the country. In Vidarbha region of Maharashtra state, a fertilizer dose of 80:40:40 NPK kg/ha has been recommended for irrigated wheat under late sown conditions.Sowing may be delayed because of previous *kharif* crop, non-availability of labour, seed material, irrigation etc.

Commercial fertilizer input is very expensive and there is finance constraint. It is in these contexts that the concept of integrated plant nutrient supply system(IPNS) is gaining ground. The concept calls for judicious and integrated use of chemical source of nutrients along with nutrients through green manures, crop residues, rural and urban wastes and biofertilizers.

Crop receiving Azotobacter inoculation with moderate level of fertilizer N gave similar yield as the crop receiving higher dose of mineral fertilizer but uninoculated (Nair andTauro, 1979). Phosphorus is an important macro plant nutrient ranked next only to N. Only about 20-25% of P applied to the soil is available for crop in the year of application and remaining part is converted into unavailable forms. Inoculation of seed or seedling with PSB can solubilze 30-50 kg P2O5/ha equivalent to p applied as s.s.p by solubilizing soil phosphorus and also applied phosphorus (Singh, 2002). Biofertilizers based on renewable energy source are a cost effective supplement to chemical fertilizers and can help to economise on the high investment needed for fertilizer use as far as N and P are concored.

MATERIALS AND METHODS

A field experiment was conducted at the Wheat research unit, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola, on plot no. 8 during *rabi* season of 2002-2003. The soil of the experimental field characterized clay loam in texture with PH 7.67 and was low in organic carbon (0.32%) and available nitrogen (171.3kg/ha),medium in available phosphorus (37.4kg/ha) and high in available potassium (352kg/ha). Treatments consisting of four combinations of N and P levels through urea and s.s.p. (0:0, 40:20, 60:30 and 80:40 kg NP/ha corresponding to control, 50%, 75%,and 100%RDF) in main plots and four biofertilizers treatments (control,Azotobacter, Phosphate Solubilizing bacteria (PSB) and coinoculation of Azotobacter+ PSB) in subplot were replicated four times in split plot design. The uniform dose of 40kg K20/ha was given through muriate of potash.

Treatment wise ½ dose of N and full dose of P and K were drilled in rows at the time of sowing. Remaining ½ dose of N was given at 30 days after sowing through urea. The crop variety was AKW-1071 (purna).The crop

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was sown on 5 th December, 2002 and harvested by 21 st March 2003. Rainfall received amounted to 2.2 mm with 8 irrigations scheduled during the crop growth period.

The seed was inoculated with Azotobacter (*A. chroococcum*) and PSB (*Pseudomonus striata*) separately and with combined culture of Azotobacter and PSB.

RESULTS AND DISCUSSION

Effect of fertilizer:

In the present investigation full recommended dose of NP fertilizer (80:40 kgNP/ha) was compared with ¾ th (60:30 kgNP) and ½ of the recommended dose (40:20 kgNP/ha). Every increasing level of fertilizer produced more height (74.32) and dry matter (10.4) per plant than its preceding lower levels. Plant height was significantly increased upto half recommended dose only. Significant improvement in growth due to N and P was reported by Sarkar *et al*. (1999), Shah *et al.* (2000) and Singh and Agarwal (2001).

Icreased dry matter weight provided sound base for yield attributing characters. Because of progressively more dry matter accumulation with each additional level, partitioning of dry matter into reproductive parts was producing more number spikes (99.68), number of grains/ spike(43.4) and grain weight/ spike(1.86)with each succeeding level of fertilizer (Table 1). Each of these parameters contributed and cumulatively enhanced the grain yield with each succeeding level of fertilizer. The findings are in consonance with the results reported by Vyas and Choudhary (2000), Pandey *et al*.(2000), Singh and Agarwal (2001).

The test weight (43.30 g) increased with increase in fertilizer level (Table 1) than lower fertilizer level.The findings are in conformity with those reported by Sarkar *et al*. (1999) and Tripathi and Chauhan (2001).

The grain and straw yields and harvest index (Table 2) of wheat significantly increased with increasing fertilizer level and maximum grain yield (32.40 q/ha) and straw yield (39.78 q/ha) was obtained at 80:40 NP kg /ha recommended dose of fertilizer. Numerous research workers reported significant responses in respect of grain and straw yields to varying fertilizer levels (Pandey *et al.*, 2000; Khan *et al.*, 2000; Singh and Agrawal, 2001).

Effect of Biofertilizers:

Increase in growth and yield of wheat due to biofertilizers was probably because of enhanced N and P availability to the crop. Apart from its ability to fix atmospheric nitrogen, Azotobacter is also known to synthesize biologically active growth substances such as Indole Acetic acid, gibberellins, B-vitamins and antifungal substances. Whereas PSB are known to have the ability to solubilize inorganic P from insoluble sources and make available fixed forms of soil P. (Palaniappan and Annadurai, 1999).These properties of the two biofertilizers seemed to have enhanced the availability of both the nutrients (NP) and benefits the crop.

The seed inoculation with Azotobacter and PSB combinely (B3) recorded significantly more number of tillers, dry matter, number of spikes per meter row length over control, individual inoculation. The co-inoculation recorded significantly higher grain weight and number of grains per spike over Azotobacter (B1)and no inoculation but it was at par with PSB inoculation (B2). The co-inoculation (Table 1 and 2) recorded significantly increased 1000 grain weight (42.88g), grain yield (26.06q/ha), straw yield (33.69q/ha) as compared to either of the single inoculation. The single inoculation significantly increased in test weight, grain and straw yield over no inoculation but both were at par with each other. The increased in

Table 1 : The effect of N and P levels and biofertilizers on growth and yield of wheat under late sown irrigated conditions

Treatments	Plant height (cm)	No. of tillers / m row length	Dry matter / plant(g)	No.Spikes / m row length	Spikelets / spike	Grains/ spike	Grain wt/spike (g)	Test wt. (g)
Fo (No:Po)	64.70	65.62	7.18	60.56	14.00	34.49	1.40	41.35
F1 (N40:P20)	71.69	77.87	8.32	70.75	15.50	41.71	1.69	42.00
F2 (N60:P30)	73.25	92.31	8.79	81.43	15.60	43.16	1.78	42.70
F3 (N80:P40)	74.32	109.31	10.40	99.68	16.00	43.40	1.86	43.30
S.E.±	1.33	2.67	0.25	2.63	0.26	1.17	0.04	0.17
C.D. (P=0.05)	4.26	8.54	0.80	8.41	0.85	3.73	0.13	0.54
No inoculation(Bo)	70.90	66.43	8.49	61.93	14.77	39.85	1.61	41.68
Azotobacter(B1)	71.01	87.12	8.67	77.43	15.17	40.60	1.68	42.34
PSB(B2)	71.00	89.43	8.68	79.56	15.24	40.89	1.70	42.43
Azotobacter + PSB (B3)	71.06	102.12	8.83	93.50	15.92	41.43	1.74	42.88
S.E.±	0.28	4.08	0.04	3.80	0.27	0.24	0.02	0.05
C.D. (P=0.05)	NS	11.69	0.12	10.91	0.79	0.68	0.05	0.14
Interaction	NS	NS	NS	NS	NS	NS	NS	Sig.

Table 2 : The effect of N and P levels and biofertilizers on growth and yield of wheat under late sown irrigated conditions

Treatments	Biological yield q/ha	Grain yield q/ha	Straw yield q/ha	Harvest index %
Fo (No:Po)	29.31	11.32	17.99	38.58
F1 (N40:P20)	49.85	21.52	28.33	43.15
F2 (N60:P30)	62.47	27.63	34.84	44.20
F3 (N80:P40)	72.18	32.40	39.78	44.90
S.E.±	2.50	1.25	1.25	0.28
C.D. (P=0.05)	8.00	4.00	4.00	0.88
No inoculation (Bo)	48.31	20.81	27.50	42.34
Azotobacter (B1)	52.39	22.94	29.45	43.05
PSB(B2)	53.34	23.06	30.28	42.48
Azotobacter+PSB (B3)	59.75	26.06	33.69	42.96
S.E.±	0.55	0.13	0.46	0.30
C.D. (P=0.05)	1.57	0.38	1.31	NS
Interaction	NS	Sig.	NS	NS

NS-Non significant

grain yield over no inoculation due to Azotobacter and PSB was 2.13(10.24%)and 2.25q/ha(10.81%), respectively (Table 2). The combined inoculation(B3) was significantly superior to the individual inoculation. It recorded an grain yield 3.00(13.01%),3.12(13.60) and 5.25 (25.33%) over B2, B1 and B0.

Increase in grain yield due to Azotobacter inoculation was reported by Sushila and Giri (2000). Increase in grain yield due to PSB inoculation was also reported by Mukherjiee and Rai (2000). In a comparison of two biofertilizers, PSB was more beneficial than Azotobacter in terms of growth, yield attributes and grain yield (Table 1 and 2). The combined use of azotobacter and PSB was much more effective as compared to use of individual biofertilizer. Beneficial effect on yield due to dual inoculation was also reported by Mohiuddin *et al.*(2000). All yield attributing characters were found to be increased, which resulted into higher grain, straw and biological yield of wheat due to combined seed inoculation.

Interaction effect :

A significant increase in 1000 grain weight and grain yield (Table 3 and 4) was observed due to single and co-inoculation at each fertilizer level compared to no inoculation.Both inoculations individually were at par and co-inoculation (B3) proved superior to them at each fertilizer level. The treatment combination of F3B3 recorded significantly higher 1000 grain weight (43.82g) and grain yield (35.47q.) of all treatment combination and F2B3 recorded significantly higher test weight (43.30g) and grain yield (30.96q.) than F3B0 having test weight (42.72g) and grain yield (30.00q.).

Most prominent findings emerged was regarding superiority of 3/4th recommended dose with combined inoculation of biofertilizers over full recommended dose of fertilizer without biofertilizers in respect of test weight and grain yield. There was a fertilizer economy to the extent of 25%(20kg N and 10kg P_2O_5/ ha) when seed inoculation with two biofertilizers was done.

Table 3 : Effect of Biofertilizer on1000 grain weight of wheat under various fertilizer levels

Treatments	No inoculation (Bo)	Azotobacter (B1)	PSB (B2)	Azotobacter + PSB (B3)	Mean
Fo (No:Po)	40.90	41.27	41.37	41.85	41.35
F1 (N40:P20)	41.00	42.17	42.27	42.55	42.00
F2 (N60:P30)	42.12	42.65	42.72	43.30	42.70
F3 (N80:P40)	42.72	43.27	43.37	43.82	43.30
Mean	41.68	42.34	42.43	42.88	-
S.E.±					0.09
C.D. (P=0.05)					0.26

Table 4 : Effect of Biofertilizers on grain yield under various fertilizer levels

Treatments	No inoculation (Bo)	Azotobacter (B1)	PSB(B2)	Azotobacter + PSB (B3)	Mean
Fo (No:Po)	9.42	11.30	11.25	13.30	11.32
F1 (N40:P20)	18.60	21.46	21.50	24.51	21.52
F2 (N60:P30)	25.22	27.02	27.31	30.96	27.63
F3 (N80:P40)	30.00	31.97	32.19	35.47	32.40
Mean	20.81	22.94	23.06	26.06	-
S.E. ±					0.26
C.D. (P=0.05)					0.75

The beneficial effect due to Azotobacter inoculation with nitrogen and PSB inoculation with P_2O_5 was found by Yadav *et al.* (2000) and Mukherjee and Rai (2000), respectively.

The treatment combination of F3B3 (100%RDF+ combined inoculation) recorded significantly highest net profit (Rs. 15623.59/ha)of all treatment combination. Persual of the data also revealed that 75% recommended dose with co-inoculation(F2B3) recorded significantly higher net profit (Rs.12782.76/ha) than 100% recommended dose with no inoculation *i.e.* F3Bo (Rs.12047.54/ha).

The maximum B:C ratio (1.93) was obtained with a treatment combination of F3B3 followed by F3B2 (1.84). But the 75% RDF with co-inoculation (F2B3) recorded higher B:C ratio (1.83) than 100%RDF (F3Bo) without inoculation *i.e.*(1.79).

The seed inoculation of two Biofertilizer in combination with 3/4th R.D.F.(60:30 KG NP/ha)brought 25 % economy in Nitrogen and Phosphatic fertilizers for late sown wheat crop with higher grain yield, net profit and B:C ratio.

REFERENCES

Khan J.A., Tiwari, O.P., Shrivastava, G.K. and Singh, A.P. (2000). Effect of irrigation schedules, levels and split application of nitrogen on yield attributes and yield of late sown wheat (*Triticum aestvum* L.). *Ann.Agric. Res.*, **21**(4): 561-563.

Mohuiddin, M.D., Das, A.K. and Ghosh, D.C. (2000). Growth and productivity of wheat as influenced by integrated use of chemical fertilizer, Biofertilizer and growth regulator. *Indian J. Pl. Physiology*, **5** (4) : 334-338.

Mukherjee, P.K. and Rai, R.K. (2000). Effect of Vesicular Arbuscular mycorrhizae and phosphate solubilizing bacteria on growth, yield and phosphorus uptake by wheat (*Triticum aestivum*) chickpea (*Cicer arientinum*). *Indian J. Agron.*, **45** (3) : 602-607.

Nair, S.K. and Tauro, P. (1979). Effect of inoculation with *pseudomonas azotogensis* on the yield and straw weight of wheat. *Plant and Soil*, **52** (3) : 453-455.

Palanniapan, S.P. and Annadurai, K. (1999). *Organic farming. Theory and Practice*, scientific publishers (India), Jodhpur : 69-70.

Pandey, I.B., Thakur, S.S., Singh, S.J. and Mishra, S.S. (2000). Effect of fertilizer and weed management on nutrient economy and yield of wheat (*Triticum aestivum*). *Indian J. Agron.*, **45** (3) : 596-601.

Sarkar, S.K., Pradan, A.C. and Ghosh, D.C. (1999). Effect of fertility level and seeding rate on growth and productivity of late sown wheat in Terai region of West Bengal. *Aric. Sci. Digest*, **19** (2) : 77-80.

Shah, R.R., Rai, R.K. and Mukherjiee, P.K. (2000). Effect of green manure dhaincha (*sesbania aculeata*) and phosphorus on growth, yield and phosphorus uptake by wheat (*Triticum aestivum*). *Indian J. Agron.*, **45** (4) : 707-710.

Singh, R.and Agrawal, S.K. (2001). Growth and yield of wheat (*Triticum aestivum)* as influenced by levels of farm yard manure and Nitrogen. *Indian J. Agron.*, **46** (3) : 462-467.

Singh, S.K. (2002). Effect of phosphobacteria, nitrogen and phosphorus on the tuber yield of potato (*Solanum tuberosum)* under East khasi hill conditions of Meghalaya. *Indian J. Agron.*, **47** (2) : 273-277.

Sushila, R. and Giri, G. (2000). Influence of farm yard manure, nitrogen and biofertilizers on growth, yield attributes and yield of wheat (*Triticum aestivum*) under limited water supply. *Indian J. Agron.*, **45** (3) : 590-595.

Tripati, S.C. and Chauhan, D.S. (2001). Effect of tillage and fertilizer on productivity of wheat (*Triticum aestivum*) under dry seeded and transplanted rice conditions. *Indian J. Agron.*, **46** (1) : 107-111.

Vyas, A.K. and Choudhary, N.R. (2000). Response of wheat to zinc fertilization under varying levels of nitrogen and phosphorus. *Annl. Aric. Res.*, **21** (2) : 294-295.

Yadav, K.S., Singh, D.P. and Sunita Suneja, Narula, N. and Lakshminarayana, K. (2000). Effect of *Azatobactor chroococcum* on yield and nitrogen economy in wheat under field condition. *Environ. & Ecol.*, **18** (1) : 109-113.

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