

Yield and economics of late sown wheat as influenced by balanced fertilization, organic manures and bioregulator

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ABSTRACT : An experiment was conducted at udaipur during *Rabi* 1994 -95 and 1995-96 to study the effect of balanced fertilization, organic manures and bioregulator on productivity of late sown wheat. The crop fertilized with 120 kg N+40 kg P₂O₅+ 30 kg K₂O+60 kg S+8 kg Zn ha⁻¹ (NPKSZn) produced significantly higher effective tillers/m, ear length, test weight, filled spikelet/ear, grain/ear, grain weight/ear, ear weight thereby significantly increased grain, straw and net returns by 82.1, 23.8 and 17.6, 82.6, 17.7 and 14.1 and 111.9, 25.7 and 18.7 per cent over no fertilization, NP and NPK, respectively but remained at par with NPKS and NPKZn. Application of FYM and biogas slurry proved equally effective however, both significantly increased yield of grain by 26.5, 26.1 per cent, straw by 25.8, 24.9 per cent thus resulted higher net returns by 28.3 and 27.3 per cent, respectively over no manure application. Foliar application of brassinosteroid @0.25 ppm significantly improved yield attributes which resulted significantly higher grain and straw yield to the tune of 7.1 and 7.6 per cent, respectively over water spray.

Key Words : Balanced fertilization, Farm yard manure (FYM), Biogas slurry (BGS), Yield attributes and yield, Late sown wheat

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Wheat is considered to be backbone of nation's food security system. Since green revolution in mid sixties, our country has witnessed significant increases in its productivity, thereby production which has transferred nation's status from scarcity to self sufficiency. Despite these significant achievements, there is a need of further enhancement in wheat production to feed ever huge population and strengthening food security. It has been estimated that India will need at least 109 mt of wheat by 2020 as against present production of 80.78 mt from an area 28.50 m ha (Mishra, 2006). Since very little scope lefts for horizontal growth, the alternative seems to achieve vertical growth through increasing productivity. Major reasons for recently observed decline in growth rate of food grain production and factor productivity are the large scale nutrient through crop harvest on one hand and low level of nutrient replenishment to the soils on the other hand (Tiwari and Gill, 2007). Despite the application of recommended quantities of major nutrients, the increase in yield is not encouraging. This indicates that in addition to major nutrients, there is a urgent need to supply secondary and micro nutrients. The factor productivity of N as well as P has gone

down with the passage of time due to deficiency of other nutrients such as K, Zn, S, Fe and so on. Balanced nutrition of plant is one of the most important factor determining ultimate wheat productivity and maintenance of soil health.

The use of organic manures improve soil physical, chemical and biological properties, fertilizer use efficiency, mitigate short supply of micro nutrients, stimulates the proliferation of diverse group of soil microorganisms and improve ecological balance of rhizosphere. Among bioregulator, brassinosteroid is known to play vital role in simulating cell division, elongation and also help to overcome environmental stress thereby improving stress tolerance. Keeping in view the above facts, the present study was, therefore, undertaken to assess the effect of balanced fertilization, organic manures and bioregulator on yield and economics of late sown wheat under zone IV A of Rajasthan.

RESEARCH PROCEDURE

The field experiment was conducted at the Instructional Farm, Department of Agronomy, Rajasthan College of

Agriculture, Udaipur, during two consecutive *Rabi* seasons of 1994-95 and 1995-96. The soil was clay loam in texture, alkaline in reaction (pH 8.2-8.3), medium in available nitrogen (240-245 kg/ha), phosphorus (23-24 kg/ha) and potassium (270-278 kg/ha). The soil is having sulphur 8.1-8.2 ppm and DTPA extractable Zn 0.84-0.89 ppm. The experiment consisted of 36 treatments comprising combinations of six balanced fertilization system (no fertilizer, 120 kg N+ 40 kg P₂O₅ ha⁻¹ (NP), NP+30 kg K₂O ha⁻¹ (NPK), NPK+60 kg S ha⁻¹ (NPKS), NPK+8 kg Zn ha⁻¹ (NPKZn) and (NPKSZn), three organic manures (no manures, farm yard manure (FYM @ 10t ha⁻¹) and biogas slurry (BGS @ 3.33 t ha⁻¹) and two bioregulator (water and brassinosteroid @ 0.25 ppm). These were evaluated in split plot design keeping balanced fertilization in main plot whereas, organic manures and bioregulator placed as sub plot treatments replicated thrice. The sources of N, P, K, S and Zn were urea, DAP, MOP, elemental sulphur and zinc sulphate, respectively. The whole quantity of elemental sulphur and organic manures were manually incorporated into the soil three weeks before sowing. The total quantity of phosphorus, potassium, zinc and half dose of nitrogen were drilled in furrows at the time of sowing. The remaining half dose of N was applied just before first irrigation (CRI stage). The brassinosteroid was foliar sprayed at 30, 45 (maximum tillering) and 60 (ear emergence) DAS using

a spray volume of 600 l/ha. The wheat variety LOK-1 was sown on 8th and 9th December during respective years, by opening furrows 18 cm apart using seed rate 125 kg/ha. The crop was irrigated at CRI, late tillering, late jointing, flowering, milking and dough stages.

RESEARCH ANALYSIS AND REASONING

The crop under balanced fertilization significantly enhanced all the yield attributing characters, grain, straw and biological yields, net returns and B:C ratio over no fertilization (Table 1 and 2). The addition of K alongwith NP fertilization failed to record significant gains in yield attributing characters and yield (grain, straw and biological) of wheat over NP fertilization. The crop under the influence of conjoint application of NPKSZn recorded maximum effective tillers/m, ear length, test weight, grain/ear, ear weight, filled spikelets/ear and grain weight/ear which were significantly higher by 11.9, 7, 6.9, 9.4, 9.0, 10.10 and 10.0 per cent, respectively over NPK but was found at par with NPKS. Further when compared to NPK, the addition of Zn alongwith NPK increased effective tillers, ear length, test weight and grain/ear but variation was not significant. The positive impact of balanced fertilization with NPKSZn and NPKS on yield attributes could be ascribed to

Table 1: Effect of balanced fertilization, organic manures and bio-regulators on yield attributes of late sown wheat (pooled)

Treatments	Effective tillers/m	Ear length (cm)	Test weight (g)	Filled spikelet/ear	Un filled spikelet/year	Grains / ear	Ear weight (g)	Grain weight / ear (g)	Straw weight/ear (g)	Grain: straw ratio of ear
Balanced fertilization										
No fertilization	68.91	7.43	36.17	10.90	3.08	29.51	1.50	1.17	0.33	3.57
NP	84.48	9.34	41.30	13.87	2.61	33.77	2.08	1.66	0.42	3.98
NPK	89.82	9.50	41.98	14.11	2.45	36.78	2.12	1.70	0.42	4.07
NPKS	99.33	10.11	44.59	15.37	2.28	39.58	2.24	1.82	0.42	4.28
NPKZn	97.10	10.06	43.69	15.13	2.31	38.35	2.24	1.81	0.43	4.25
NPKSZn	100.48	10.23	44.89	15.54	2.17	40.23	2.31	1.87	0.44	4.32
S.E. ±	2.61	0.23	0.67	0.26	0.04	0.76	0.031	0.032	0.007	0.07
C.D. (P= 0.05)	8.24	0.72	2.12	0.82	0.13	2.38	0.098	0.100	0.022	0.22
Organic manure										
No manure	80.10	8.71	41.59	12.91	2.52	33.52	1.97	1.58	0.39	4.03
FYM	95.80	9.85	42.37	14.84	2.46	37.93	2.14	1.72	0.42	4.11
BGS	94.16	9.77	42.31	14.71	2.47	37.65	2.13	1.71	0.42	4.09
S.E. ±	1.55	0.09	0.35	0.12	0.03	0.33	0.016	0.017	0.004	0.04
C.D. (P= 0.05)	4.30	0.25	NS	0.33	NS	0.93	0.044	0.047	0.011	NS
Bioregulators										
Water	85.64	9.16	41.68	13.66	2.51	35.65	2.03	1.63	0.40	4.02
Brassinosteroid	94.40	9.72	42.50	14.65	2.47	37.08	2.13	1.71	0.41	4.13
S.E. ±	1.27	0.07	0.29	0.10	0.02	0.27	0.013	0.014	0.003	0.03
C.D. (P= 0.05)	3.51	0.21	0.80	0.27	NS	0.76	0.036	0.038	0.009	0.09

NS=Non-significant

overall improvement in crop growth in terms of DMA/unit area by virtue of its impact on morphological and photosynthetic components of growth along with enhancement in accumulation and translocation of nutrients. Thus adequate supply of photosynthates due to higher photosynthetic efficiency at ear emergence might have enhanced number of flowers and their fertilization resulting in higher number of filled spikelets and grains/ear. Further greater assimilating surface at reproductive development and improvement in nutritional condition of grain under NPKSZn fertilization seems to have provided congenial environments for ear and grain growth. These results are in accordance with the finding of Dewal and Pareek (2004) and Sharma (2008).

Data (Table 2) revealed that the application of S+Zn in combination with primary nutrients NPK produced highest grain, straw and biological yields which were significantly higher by 17.3, 14.1 and 15.4 per cent, respectively over NPK which was found at par with NPKS and NPKZn except NPKZn in case of grain yield. The application of NPKS was found next in order which increased aforesaid parameters by 12.1, 10.4 and 11.1 per cent, respectively over NPK. The harvest index was significantly influenced by the application of balanced fertilization. As the yield is the resultant outcome of the effect of various growth and yield parameters its expression was

observed with their integrated influence. Improvement in yield of wheat due to balanced fertilization was also reported by Singh and Rai (2002) and Sharma (2008). The conjoint application of NPKSZn realized significantly higher net returns Rs 23647/ha and B:C ratio 2.11:1 closely followed by NPKS application (net returns Rs 22746/ha and B:LC ratio 2.14:1) over NPK fertilization. The higher net returns and B:C ratio was due to higher yield.

Effect of organic manures :

The application of farm yard manure and biogas slurry significantly remained at par however, both significantly enhanced yield attributing characters and yield of wheat compared to no organic manure. The magnitude of increases in effective tillers/m, ear length, filled spikelets/ear, grain/ear, ear weight and grain weight/ear were to the tune of 19.6, 13.1, 14.9, 13.2, 8.6 and 8.9 per cent due to FYM and 17.6, 12.2, 18.0, 12.3, 8.1 and 8.2 per cent due to BGS, respectively. This improvement led plant to produce higher grain, straw and biological yield. Which were significantly by 26.5, 25.8 and 26.0 per cent due to FYM and 20.5, 24.9 and 25.3 per cent due to BGS application, respectively over no manure. The harvest index was not improved significantly by the application of organic manure. These findings are in accordance with the

Table 2 : Effect of balanced fertilization, organic manures and bio-regulator on yield (q/ha), harvest Index (%) and economics of late sown wheat (pooled)

Treatments	Yield (kg/ha)			Harvest index (%)	Net returns (Rs./ha)	B : C
	Grain	Straw	Biological			
Balanced fertilization						
No fertilization	28.14	40.91	69.05	40.83	11158	1.42
NP	41.37	63.45	104.82	39.54	18806	1.96
NPK	43.66	65.44	109.10	40.13	19922	2.01
NPKS	48.94	72.22	121.17	40.34	22746	2.14
NPKZn	46.96	71.58	118.55	39.51	21635	2.05
NPKSZn	51.23	74.69	125.92	40.61	23647	2.11
S.E.±	1.22	1.54	2.24	0.76	762	0.07
C.D. (P= 0.05)	3.85	4.84	7.06	NS	2400	0.22
Organic manure						
No manure	36.93	55.37	92.30	40.20	16581	1.91
FYM	46.70	69.63	116.32	40.10	21269	1.97
BGS	46.55	69.13	115.67	40.20	21107	1.96
S.E.±	0.71	0.88	1.10	0.54	466	0.04
C.D. (P= 0.05)	1.97	2.44	3.05	NS	1291	NS
Bioregulators						
Water	41.90	62.34	104.23	40.24	19172	2.02
Brassinosteroid	44.87	67.10	112.00	40.10	20133	1.88
S.E.±	0.58	0.72	0.90	0.44	380	0.032
C.D. (P= 0.05)	1.60	1.99	2.49	NS	NS	0.090

NS=Non-significant

finding of Mehra *et al.* (2001), Kumar and Ahlawat (2004) and Singh *et al.* (2007). The beneficial effect of organic manures on yield and yield attributes can also be assigned to the fact that after proper decomposition and mineralization these manures supplied all the available plant nutrients directly to the wheat plants and also had solubilising effect on fixed form of nutrients in soil. The better efficiency of both the manures on yield may be clear to containing higher number of nitrogen fixing, phosphate solubilizing and other beneficial micro-organisms, antibiotics, vitamins, hormones, enzymes etc. which have better effect on the growth, yield attributes and yield of wheat plant (Yawalkar *et al.*, 2008).

Effect of bioregulator :

Foliar spray of brassinosteroid significantly improved yield attributes characters *viz.*, effective tillers/m, ear length, test weight, filled spikelets /ear, grain/ear, ear weight, grain weight and grain : straw ratio of ear over water spray. The magnitude of increases were of the order of 10.2, 6.1, 2.0, 7.2, 4.0, 4.9, 4.9, and 2.7 per cent, respectively. These improvements

ultimately manifested in production of significantly higher grain, straw and biological yield by 7.1, 7.8 and 7.4 per cent over that of water spray. Significant increases in grain yield with brassinosteroid application could be ascribed to the fact that crop yield is not an abstract entity but it is in outcome of positive interaction between vegetative and reproductive growth of crop. The positive influence might be on account of increased photosynthetic efficiency and greater developed assimilating apparatus thereby increased division and elongation of cells which affect the elongation, swelling and splitting of nodes. The results are in collaboration with the findings of Mandava (1988).

Conclusion :

On the basis of the results emanated from the present investigation it is concluded that under late sown irrigated conditions, organic fertilization with either farm yard manure or biogas slurry and balanced application of NPKSZN (120 kg N+40 kg P₂O₅+ 30 kg K₂O+60 kg S+8 kg Zn ha⁻¹) maximized wheat productivity and returns.

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