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Nutrient content and their uptake by wheat crop (*Triticum aestivum* L.) as influenced by nutrient management and growth regulators

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Abstract
A field experiment was carried out at Instructional Farm of Agronomy, Rajasthan College of Agriculture, Udaipur during *rabi* 2016-17. The objectives were to assess the effect of nutrient management and plant growth regulators on nutrient content and their uptake by wheat. The result revealed that significantly highest nitrogen, phosphorus and potassium content and their uptake by grain and straw recorded with the application of 150% RDF + 15 t ha^{-1} FYM and growth regulators chlormequat chloride 0.2% + tebuconazole 0.1% over the control while, nitrogen content and their uptake by straw did not significantly affect by growth regulators.

Keywords: wheat, nutrient management, PGRs, nutrient content and uptake

Introduction
Wheat is the second most important cereal in India after rice contributing substantially to the national food security by providing more than 50 per cent of the calories to the people who mainly depend on it. In chronological perspective, India has made spectacular advancement in productivity and sustainability of wheat over the years. Production of wheat can be increased by various improved agronomic practices such as nutrient management, application of growth regulators etc. The combined use of NPK fertilizers plays an important role in wheat production. Application of NPK in balanced share at proper time has great impact on wheat yield. Plant species, even varieties within species vary in their behaviour to obtain and utilize NPK for grain production. Further, growth retardant are chemical compounds that regulate stem elongation through inhibiting biosynthesis of gibberellins or release ethylene. Anti-gibberellic plant growth regulators (CCC, trinexapac-ethyl) used for shortening cereal stems inhibits gibberellin biosynthesis at different stages of the metabolic pathway.

Materials and Methods
A field experiment was conducted during *rabi* season 2016-17 at Instructional Farm of Agronomy, Rajasthan College of Agriculture, Udaipur (Rajasthan) situated at 24º35' N latitude, 73º42' E longitude. The soil of the experimental site were clay loam in texture and slightly alkaline in reaction. They were medium in available nitrogen, phosphorus and high in available potassium. The experimental field was prepared by ploughing once with tractor drawn disc plough followed by cross cultivation and planking to obtain thoroughly pulverized seed bed for wheat. Wheat variety HI-1544 was used as a test crop. The experiment consisted of 16 treatment combination comprising four nutrient management (control, RDF, 150% RDF and 150% RDF + 15 t FYM ha^{-1}) with four levels of growth regulators (control, chlormequat chloride 0.2%, tebuconazole 0.1% and chlormequat chloride 0.2% + tebuconazole 0.1%). The experiment was laid out in factorial randomized block design and replicated thrice. As per treatments, fertilizer application was made through urea, DAP and MOP. Full dose of phosphorus (80 kg P_2O_5 ha^{-1}), potash (60 kg $P_2O_5$$ha^{-1}$) and $^1/_3$ dose (40 kg N ha^{-1}) was supplied at sowing while, remaining $^2/_3$ N (80 kg N ha^{-1}) was top dressed in two equal splits at the time of first and second irrigation. After recording dry matter production at harvest, samples were grinded for estimation of N, P and K content in grain and straw by employing the following methods.

Methods for determination of nutrient content

Nutrients	Method of analysis	References
Nitrogen	Nesseler's reagents colorimetric method	Lindner (1944)
Phosphorus	Ammonium vanadomolybdo phosphoric	Richards (1968)
	acid yellow colour method	
Potassium	Flame photometre method	Jackson (1973)

The uptake of N, P and K at harvest was calculated by using the following formula:

$$\text{Uptake of NPK (kg ha}^{-1}) = \frac{\text{Per cent NPK content in Grain / straw} \times \text{Yield (kg ha}^{-1}\text{) grain / straw}}{100}$$

Table 1: Effect of nutrient management and growth regulators on N, P and K content in grain and straw of wheat

Treatments	N content (%)		P content (%)		K content (%)	
	Grain	Straw	Grain	Straw	Grain	Straw
Nutrient management						
Control	1.226	0.259	0.264	0.105	0.409	1.782
RDF	1.600	0.343	0.286	0.107	0.417	1.808
150% RDF	1.966	0.378	0.300	0.110	0.432	1.846
150% RDF+15 t FYM ha^{-1}	2.056	0.390	0.317	0.117	0.440	1.883
S.Em.±	0.010	0.005	0.002	0.001	0.003	0.006
CD (P=0.05)	0.029	0.013	0.006	0.003	0.009	0.018
Growth Regulators						
Control (water spray)	1.534	0.348	0.284	0.108	0.419	1.817
Chlormequat chloride	1.738	0.338	0.289	0.109	0.422	1.826
Tebuconazole	1.783	0.342	0.293	0.109	0.427	1.827
Chlormequat chloride + tebuconazole	1.793	0.342	0.300	0.113	0.432	1.849
S.Em.±	0.010	0.005	0.002	0.001	0.003	0.006
CD (P=0.05)	0.029	NS	0.006	0.003	0.009	0.018

Result and Discussion

Effect of nutrient management

Nitrogen, Phosphorus and Potassium Content in Grain and Straw

Application of RDF, 150% RDF and 150% RDF + 15 t FYM ha^{-1} significantly affect the nitrogen, phosphorus and potassium content in grain and straw over control. Further, application 150% RDF + 15 t FYM significantly increased nitrogen, phosphorus and potassium content in grain and straw over control by 67.6, 50.5, 20.0, 11.4, 7.5 and 5.6 per cent, respectively (Table.1).

Nitrogen, Phosphorus and Potassium Uptake by Grain, Straw and Total

Data indicate (Table. 2) that application of RDF, 150% RDF and 150% RDF + 15 t FYM ha^{-1} significantly affect the nitrogen, phosphorus and potassium uptake by grain**,** straw and total over control. Further, application 150% RDF + 15 t FYM ha^{-1} significantly increased nitrogen phosphorus and potassium uptake by grain**,** straw and total over control by 138.0, 143.0, 139.0, 71.7, 82.1, 74.9, 55.0, 71.5 and 68.7 per cent, respectively. The increase in uptake of nutrients in the organic manure and inorganic fertilizer treated plots may be due to extra amount of nutrients supplied by these organics and inorganic fertilizer. Organics providing conductive physical environment facilitating better root growth and absorption of nutrients from the native as well as applied sources which ultimately favoured the highest nutrient uptake. Balanced supply of plant nutrients particularly N, P and K it might be due to active root system in optimum nutrition, which efficiently helps in better absorption of nutrients from the soil producing higher biomass and nutrient concentration resulting in higher nutrient uptake. The results are in close conformity with the finding of Kumar and Dhar (2010) [2], Singh and Kushwaha (2013) [7], Paswan *et al.* (2014) [5] and Kumar *et al.* (2015) [3].

Effect of growth regulators

Nitrogen, Phosphorus and Potassium content in Grain and Straw

It is obvious from data (Table. 1) that the application of chlormequat chloride 0.2%, tebuconazole 0.1% and chlormequat chloride 0.2% + tebuconazole 0.1% significantly affect the nitrogen, phosphorus and potassium content in grain and straw over control. Further, critical examination of data showed that chlormequat chloride 0.2% + tebuconazole 0.1% also significantly increased nitrogen, phosphorus and potassium content in grain and straw over control by 16.8, 5.6, 4.6, 3.1 and 1.7 per cent respectively. While, N content in straw did not significantly effect by growth regulators.

Table 2: Effect of nutrient management and growth regulators on N, P and K uptake by grain and straw of wheat

Treatments	N uptake (kg ha^{-1})			P uptake (kg ha^{-1})			K uptake (kg ha^{-1})		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
Nutrient management									
Control	42.21	9.91	52.12	9.02	3.98	13.00	13.89	68.09	81.98
RDF	73.33	20.82	94.14	13.07	6.51	19.58	19.13	110.12	129.25
150% RDF	94.16	23.70	117.86	14.26	6.90	21.16	20.52	115.64	136.16
150% RDF+15 t FYM ha^{-1}	100.48	24.18	124.66	15.49	7.25	22.74	21.53	116.84	138.37
S.Em.±	1.87	0.80	1.90	0.33	0.21	0.33	0.50	3.55	3.40
CD (P=0.05)	5.41	2.32	5.50	0.95	0.63	0.97	1.45	10.26	9.83
Growth Regulators									
Control (water spray)	58.97	17.80	76.77	10.63	5.44	16.06	15.89	91.84	107.73
Chlormequat chloride	80.63	20.04	100.67	13.29	6.32	19.61	19.25	105.42	124.67
Tebuconazole	82.77	20.54	103.30	13.51	6.42	19.93	19.29	106.83	126.12
Chlormequat chloride+ tebuconazole	87.81	20.22	108.03	14.41	6.47	20.88	20.64	106.60	127.24
S.Em.±	1.87	0.80	1.90	0.33	0.21	0.33	0.50	3.55	3.40
CD (P=0.05)	5.41	NS	5.50	0.95	0.63	0.97	1.45	10.26	9.83

Nitrogen,

Phosphorus and Potassium Uptake in Grain, Straw and Total

An insight data (Table. 2) that the application of chlormequat chloride 0.2%, tebuconazole 0.1% and chlormequat chloride 0.2% + tebuconazole 0.1% significantly affect the nitrogen, phosphorus and potassium uptake in grain, straw and total over control. Further, analysis of experimental of data revealed that chlormequat chloride 0.2% + tebuconazole 0.1% also significantly increased in nitrogen, phosphorus and potassium uptake by grain, straw and total over control by 48.9, 40.7, 35.5, 18.9, 30.0, 29.8, 16.0 and 18.1 per cent, respectively. While, N uptake in straw did not significantly effect by growth regulators. Thus plant growth regulator is organic substances which in low concentration promotes, inhibits or modify growth and development, whereas growth inhibitor is an organic compound that retards growth generally. The increasing in level of growth regulators are also increase in nutrient content and uptake.

Conclusion

To nhance nutrient content in grain and straw of wheat (*Triticum aestivum* L.) as well as their uptake should be treated with combination of 150% RDF + 15 t FYM ha^{-1} chlormequat chloride 0.2% + tebuconazole 0.1%.

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