RESEARCH ARTICLE

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON NUTRIENT CONTENT AND YIELD OF WHEAT UNDER RICE-WHEAT CROPPING SYSTEM

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Abstract : A field experiment was conducted during rabi 2013-14 and 2014-15 to assess the effect of combined application of fertilizer, manure and biofertilizer on yield and nutrient content in wheat. The results revealed that the treatments significantly affected grain and straw yields, as well as grain protein content. The highest values of previous traits were obtained from treatment T10 (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA). Also, this treatment gave the maximum grain yield, nutrient protein content compared with the other treatments. Thus the integrated plant nutrient supply system improved the crop yield and produce quality grain as well as improve soil fertility and environment pollution.

Keywords: IPNM, Manure, Biofertilizer, Grain quality, Nutrient management

INTRODUCTION

The rice–wheat cropping system is very critical for food security in South Asia, occupies approximately 13.5 Mha of land, extending across Indo-Gangetic Plains covering Pakistan (2.2 Mha), India (10.5 Mha), Bangladesh (0.8 Mha) and Nepal (0.5 Mha) and plays an important role in providing livelihood to millions of people. In India, it is the most important cropping system and stands first in coverage. Wheat is one of the most important cereal crops in the world and it has the widest distribution among cereal crops. The crop is primarily grown for its grain, which is consumed as human food.

Sustainable agricultural productivity might be achieved through a wise use of integrated nutrient management. It enhanced plant growth, water, and soil and land management The use of organic soil amendments has been associated with desirable soil properties including higher plant available water holding capacity and cation exchange capacity and lower bulk density, and can foster beneficial microorganisms. Organic fertilization was found to be favorable for enhancing growth and productivity of wheat. Application of Farm yard Manure helps to increase the DMP, yield and nutrient uptake by wheat. Also, the application of organic fertilizer increased grain protein content. The combination of mineral fertilizers, with organic fertilizer, helped in increasing the grain yield of wheat and implied a saving of 50% cost, compared to a system with only mineral fertilization Essam A. Abd El-Lattief (2014). The present work was carried out to study Effect of Integrated nutrient management on nutrient content and yield of wheat under rice-wheat cropping system.

MATERIAL AND METHOD

The field experiment was conducted during rabi 2013-14 and 2014-15 at Crop Research Farm Nawabganj of department of soil science, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The soil of the experimental site is sandy-loam with a pH value of 7.80, 0.40 EC (dSm-1), 0.39% organic matter content and the available N, P, K and S 165, 6, 191, 9.9 kg ha^{-1} respectively with a value of 0.54, 4.7 ppm available Zn and Fe respectively. The experiment was carried out in a randomized Block Design to test the 11 treatments with 3 replications. The treatments were T_1 =control (no fertilizer), T_2 = 100 % NPK (RDF), T_3 =100 % NPK + FYM, T_4 = 100 % NPK + BGA, T_5 = 100 % NPK + FYM + BGA, T_6 =100 % NPK + S_{40} , T_7 = 100 % NPK + Zn5, T_8 = 100 % NPK + S_{40} + Zn_5, T_9 = 100 % NPK + S_{40}+ Zn_5 + Fe_{10}, T_{10} =100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA, T_{11} =125 % NPK.

Wheat, seed of variety 'PBW-343' were sown @ 100 kg seed ha-1 behind plough in furrows 20 cm. apart followed by planking. Whole of phosphorus and potassium were applied basally before sowing in all treatments. Nitrogen fertilizer was applied in three equal doses; the first, during soil preparation, and the second and third at tillering and panicle emergence stages respectively. The other cultural practices were carried out as recommended for the crop. The plant samples were collected at harvest, oven dried at 70 °C, processed and analyzed for N, P K, S, Zn and Fe following standard procedures. The grain and straw yield of rice were recorded and nutrient content were analysed from each treatment.. N content of grain and straw were estimated by Jackson *(1967)*, P and K determined *by (Chapman and Pratt 1961)*, S by

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turbidimetric method (Chesnin and Yien 1951) , Zn and Fe by determined using AAS as described by Lindsay and Norvell (1978).

RESULT AND DISCUSSION

Grain and straw yield (q/ha)

Data on grain and straw yield are presented in table 1. The grain yield of wheat varied from 30.40 to 53.80 q ha^{-1} and 31.00 to 54.20 q ha^{-1}during first and second year, respectively. All the treatments were significantly superior to control during the both the years of study. The data clearly indicate that all the treatments are significantly superior to control. The highest grain yield 53.8. and 54.20 qha^{-1} respectively during both the years were recorded under the treatment T_{10} (NPK + S_{40}+ Zn_5 + Fe_{10}+ FYM + BGA). The treatment T_{11} (125 % NPK) received the second position 48.0 and 49.20 qha^{-1} after the T_{10} (NPK + S_{40}+ Zn_5 + Fe_{10}+ FYM + BGA) in terms of grain yield in first and second year respectively. The treatment T_1 (control) were recorded the lowest grain yield 30.40 and 31.00 qha^{-1} respectively during both the years.

The increased grain yield might be due to balance supply of macro and micro nutrient. Addition of FYM, besides its nutritional role might be instrumental in improving the physio chemical properties of soil specially the moisture retention aggregate formation, soil aeration and enhanced microbial activity. Since the soil under study here low in organic carbon. FYM and BGA might stand as safe guard to the situation. Addition of sulphur and micro nutrients like zinc and iron might have balancing effect besides there important role in metabolic function of plant.

The similar trends were observed in both grain and straw yield during both the years. The straw yield varied from 45.60-80.70 q ha^{-1} and 46.50-83.10 q ha^{-1} during first and second year, respectively. All the treatments were significantly superior to control. Addition of FYM and BGA to 100% NPK (RDF) did not cause any significant increase in yield however FYM+BGA, combination gave highly significant and positive results over 100%NPK (RDF). The Best treatment showed two times higher straw yield than control. Addition of S_{40}+Zn_5+Fe_{10} also resulted in a significant increase in straw yield over 100% NPK (RDF) during first year, however during second year it was not significant. The results were highly significant in case of 100% NPK (RDF) +S_{40}+Zn_5+Fe_{10}+FYM+BGA over 100% NPK (RDF) and magnitude of increase was of about 24.00%. The result of this study for corroborated with the findings of Rathor *et al.*(1995), Jana and Ghosh (1996).

Nutrient content in wheat grain

NPK content in grain

The data for nitrogen, phosphorus and potash content in grain of wheat is given in Table number 2.The N content of wheat grain varied from 1.92 to 2.12 % and 1.98 to 2.14 % during first and second year, respectively. The treatment combination T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10}+ FYM + BGA) gave the maximum nitrogen content in wheat grain. The nitrogen content increases with increase doses of nitrogen containing fertilizer and also by organic and Bio-fertilizers. All the treatments are the significantly superior in comparison to control during first and second year.

The phosphorus content of wheat grain varied from 0.29 to 0.32 % and 0.30to 0.35 % during first and second year, respectively. The trends of variation similar as case of N content in both the years of experimentation like other parameters the treatment T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10}+ FYM + BGA) gave maximum phosphorous content in wheat grain. The data of the table is clearly indicated that the FYM and the BGA containing treatment enhance the availability of the phosphorous.

The potassium content ranges from 0.19 to 0.30 % and 0.20 to 0.31 % during first and second year, respectively. Like Nitrogen and Phosphorous the treatment T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10}+ FYM + BGA) found best among all the treatments in terms of potassium content in wheat grain. All the treatments are significantly superior in comparison to control. The trends of variation in different treatments are more or less similar as nitrogen and phosphorous. The result of present study are conform with Yaduvanshi(2000), Bajpai *et al.* (2006), Reddy *et al.* (2010, Thakur *et al*. (2004).

S, Zn and Fe content in grain

The relevant data for both the years of experimentation are given in Table 3. The sulphur content ranges from 0.10 to 0.22 % and 0.11 to 0.23 % during first and second year, respectively. Like Nitrogen and Phosphorous the treatment T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10}+ FYM + BGA) found best among all the treatments in terms of Sulphur content in wheat grain .All the treatments are significantly superior in comparison to control. The trends of variation in different treatments are more or less similar as nitrogen and phosphorous.

The zinc content ranges from 14.00 to 25.00 ppm and 15.00 to 25.20 ppm during first and second year, respectively. The zinc content treatments gave more zinc content to wheat grain in comparison to non-zinc containing treatments. The sulphur and FYM also releases the status of available zinc in soil. About 10 ppm zinc content increased due to the addition of different treatments. About 1.00ppm content of zinc increased in wheat grain from first year to second year. All the treatments are significantly superior to T_1 control. The increased in zinc content in first year to second year is due to the residual status of zinc in soil.

The iron content of Wheat grain varied from 51.00-84.00 ppm and 50.20– 80.00 ppm in first and second year, respectively. The Fe containing treatment gave more Fe content in Wheat grain and straw. All the

treatments were significantly superior in compare to control. The Wheat grain in Fe content in grain was estimated highest under treatment T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA) during both years. Control treatments recorded significantly minimum Fe content followed by 125 % NPK application. The treatment combination T_{11} (125 % NPK) also gave the sufficient quantity of iron during first and second year of experimentation. This treatment gave marginal less value in comparison to T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA).

Nutrient content in wheat straw

N, P and K content in wheat straw

The relevant data for both the years of experimentation are given in Table 3. The nitrogen content ranges from 0.40to 0.52 % and 0.42 to 0.53 % during first and second year, respectively. The treatment combination T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA) gave the maximum nitrogen content in wheat straw. The nitrogen content increases with increase dose of nitrogen containing fertilizer and also by organic and Bio-fertilizers. All the treatments are the significantly superior in comparison to control during first and second year. The treatment combination T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA) gave the maximum nitrogen content in both the years closely followed by 125% NPK. About 0.10 % increase in nitrogen content due to the addition of manures, fertilizers and bio-fertilizers.

The phosphorus content ranges from 0.10 to 0.17 % and 011.to 0.17 % during first and second year, respectively. The treatment T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA) gave maximum phosphorous content in wheat straw. The data of the table is clearly indicated that the FYM and the BGA containing treatment enhance the availability of the phosphorous.

The Potassium content ranges from 1.72 to 2.18 % and 1.74 to 2.20 % during first and second year, respectively. Like Nitrogen and Phosphorous the treatment T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA) found best among all the treatments in terms of potassium content in wheat straw. All the treatments are significantly superior in comparison to control. The trends of variation in different treatments are more or less similar as nitrogen and phosphorous. The result conform with Mishra and Sharma(1999) and Thakur *et al*. (2004).

The data related to the sulphur, zinc and iron content in straw of wheat are presented in Table 4. The sulphur content ranges from 0.12 to 0.18 % and 0.13 to 0.19 % during first and second year, respectively. Like Nitrogen, Phosphorous and potassium the treatment T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA) found best among all the treatments in terms of Sulphur content in wheat straw .All the treatments are significantly superior in comparison to control. The trends of variation in different treatments are more or less similar as nitrogen, phosphorous and potash.

The zinc content ranges from 10.40 to 19.00ppm and 10.80 to 19.40ppm during first and second year, respectively. The zinc content treatments gave more zinc content to wheat straw in comparison to non-zinc containing treatments. The sulphur and FYM also releases the status of available zinc in soil. About 10.00ppm zinc content increased due to the addition of different treatments. All the treatments are significantly superior to T_1 control. The increased in zinc content in first year to second year is due to the residual status of zinc in soil.

The iron content of Wheat straw varied from 96.00-128.00 ppm and 94.00 – 125.00 ppm in first and second year, respectively. The treatments are significant in comparison to control treatment. The Fecontent in straw was estimated highest under treatment T_{10} (100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA) during both years. Control treatments recorded significantly minimum Fe content followed by 125 % NPK application. The trends of variation are more or less similar in case of both the year of experimentation. The iron content plays significant role to enhance the grain and strawyield and nutrient content (NPK) in both the year of experimentation. The isolated response of iron over sulphur and zinc (T_9 over T_8 was not significant). The similar result were found Singh and Nand Ram (2012), Titab Das *et al*. (2012) and Gurpreet Singh *et al.* (2011).

Table 1. Effect of integrated use of nutrients on grain and straw yield of Wheat

Treatment	**Grain yield (q/ha)**		**Straw yield (q/ha)**	
	2013-14	**2014-15**	**2013-14**	**2014-15**
T1 Control	30.40	31.00	45.60	46.50
T2 100 % NPK (RDF)	46.40	47.20	69.60	70.80
T3 100 % NPK + FYM	47.00	47.80	70.50	71.70
T4 100 % NPK + BGA	46.80	47.40	70.20	71.10
T5 100 % NPK + FYM + BGA	47.60	48.00	71.40	72.00
T6 100 % NPK + S_{40}	47.20	47.60	70.80	71.40
T7 100 % NPK + Zn_5	47.10	47.30	70.70	71.00
T8 100 % NPK + S_{40} + Zn_5	47.80	48.20	71.70	72.30
T9 100 % NPK + S_{40}+ Zn_5 + Fe_{10}	47.90	48.30	71.90	72.50
T10 100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA	53.80	54.20	80.70	81.30
T11 125 % NPK	48.00	49.20	73.20	73.80

S.E. (d)	0.915	1.102	1.552	1.802
C.D. (P=0.05)	1.909	2.299	3.237	3.759

Table 2. Effect of Integrated nutrient management on nutrient content in wheat grain at maturity.

Treatments	Nitrogen (%)		Phosphorous (%)		Potassium (%)		Sulphur (%)		Zinc (PPM)		Iron (PPM)	
	2013-14	2014-15	2013-14	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2014-15	2013-14	2014-15
T1 Control	**1.92**	**1.98**	**0.29**	**0.30**	**0.19**	**0.20**	**0.10**	**0.11**	**14.00**	**15.00**	**51.00**	**50.20**
T2 100 % NPK (RDF)	**1.94**	**2.00**	**0.31**	**0.31**	**0.22**	**0.24**	**0.14**	**0.16**	**16.00**	**17.00**	**56.00**	**54.00**
T3 100 % NPK + FYM	**2.04**	**2.05**	**0.33**	**0.34**	**0.24**	**0.26**	**0.15**	**0.17**	**17.00**	**18.00**	**59.00**	**57.00**
T4 100 % NPK + BGA	**2.02**	**2.04**	**0.30**	**0.33**	**0.23**	**0.25**	**0.15**	**0.16**	**16.00**	**17.00**	**61.00**	**59.00**
T5 100 % NPK + FYM + BGA	**2.06**	**2.08**	**0.34**	**0.34**	**0.25**	**0.26**	**0.16**	**0.18**	**18.00**	**19.00**	**64.00**	**63.00**
T6 100 % NPK + S_{40}	**2.02**	**2.04**	**0.31**	**0.31**	**0.26**	**0.27**	**0.17**	**0.18**	**19.00**	**19.00**	**67.00**	**66.00**
T7 100 % NPK + Zn_5	**2.04**	**2.06**	**0.31**	**0.31**	**0.27**	**0.27**	**0.17**	**0.17**	**20.00**	**21.00**	**69.00**	**68.00**
T8 100 % NPK + S_{40} + Zn_5	**2.08**	**2.10**	**0.31**	**0.31**	**0.28**	**0.28**	**0.18**	**0.18**	**21.00**	**22.00**	**74.00**	**72.00**
T9 100 % NPK + S_{40}+ Zn_5 + Fe_{10}	**2.09**	**2.12**	**0.31**	**0.31**	**0.28**	**0.29**	**0.19**	**0.19**	**22.00**	**22.00**	**80.00**	**78.00**
T10 100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA	**2.12**	**2.14**	**0.32**	**0.35**	**0.30**	**0.31**	**0.22**	**0.23**	**25.00**	**25.20**	**84.00**	**80.00**
T11 125 % NPK	**1.96**	**2.08**	**0.31**	**0.31**	**0.24**	**0.26**	**0.17**	**0.18**	**18.00**	**19.00**	**78.00**	**76.00**
S.E. (d)	**0.032**	**0.031**	**0.027**	**0.003**	**0.016**	**0.018**	**0.010**	**0.012**	**1.019**	**1.041**	**1.199**	**0.964**
C.D. (P=0.05)	**0.065**	**0.068**	**0.056**	**0.005**	**0.034**	**0.038**	**0.021**	**0.024**	**2.127**	**2.172**	**2.503**	**2.012**

Table 3. Effect of Integrated nutrient management on nutrient content in wheat straw at maturity.

Treatments	Nitrogen (%)		Phosphorous (%)		Potassium (%)		Sulphur (%)		Zinc (PPM)		Iron (PPM)	
	2013-14	2014-15	2013-14	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2014-15	2013-14	2014-15
T1 Control	**0.40**	**0.42**	**2014**	**2015**	**1.72**	**1.74**	**0.12**	**0.13**	**10.40**	**10.80**	**96.00**	**94.00**
T2 100 % NPK (RDF)	**0.43**	**0.44**	**0.10**	**0.11**	**1.90**	**1.92**	**0.13**	**0.14**	**12.80**	**13.00**	**99.00**	**98.00**
T3 100 % NPK + FYM	**0.45**	**0.46**	**0.12**	**0.12**	**1.92**	**1.94**	**0.13**	**0.14**	**13.00**	**14.40**	**103.00**	**101.00**
T4 100 % NPK + BGA	**0.44**	**0.45**	**0.13**	**0.12**	**1.91**	**1.93**	**0.12**	**0.13**	**13.20**	**13.80**	**105.00**	**103.00**
T5 100 % NPK + FYM + BGA	**0.46**	**0.47**	**0.12**	**0.11**	**1.98**	**2.00**	**0.14**	**0.15**	**13.80**	**14.00**	**116.00**	**108.00**
T6 100 % NPK + S_{40}	**0.45**	**0.47**	**0.14**	**0.14**	**1.94**	**1.96**	**0.16**	**0.17**	**14.00**	**14.40**	**112.00**	**110.00**
T7 100 % NPK + Zn_5	**0.47**	**0.48**	**0.13**	**0.13**	**1.96**	**1.98**	**0.16**	**0.17**	**16.00**	**17.00**	**113.00**	**111.00**
T8 100 % NPK + S_{40} + Zn_5	**0.48**	**0.49**	**0.14**	**0.14**	**1.98**	**2.04**	**0.17**	**0.17**	**17.00**	**18.00**	**118.00**	**113.00**
T9 100 % NPK + S_{40}+ Zn_5 + Fe_{10}	**0.49**	**0.50**	**0.15**	**0.14**	**2.10**	**2.12**	**0.16**	**0.16**	**17.20**	**18.00**	**123.00**	**120.00**
T10 100 % NPK + S_{40}+ Zn_5 + Fe_{10} + FYM + BGA	**0.52**	**0.53**	**0.16**	**0.15**	**2.18**	**2.20**	**0.18**	**0.19**	**19.00**	**19.40**	**128.00**	**125.00**
T11 125 % NPK	**0.57**	**0.48**	**0.17**	**0.17**	**1.98**	**2.00**	**0.14**	**0.15**	**13.40**	**14.60**	**114.00**	**110.00**
S.E. (d)	**0.016**	**0.015**	**0.13**	**0.12**	**0.075**	**0.038**	**0.010**	**0.008**	**0.593**	**0.471**	**6.458**	**5.132**
C.D. (P=0.05)	**0.034**	**0.032**	**0.010**	**0.012**	**0.157**	**0.078**	**0.021**	**0.017**	**1.237**	**0.983**	**13.476**	**10.708**

CONCLUSION

It was concluded that balancing of above NPK (RDF) with above components increased the wheat yield and nutrient content over RDF. The highest yield and nutrient content were recorded under the treatment T_{10} (100 % NPK + S40+ Zn5 + Fe10 + FYM + BGA). Therefore the IPNM practice might be suggested to farmers for high sustainable yield and quality under rice-wheat system.

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