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Review Article

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON WHEAT – A REVIEW

JAGA P. K., UPADHYAY V.B

Department of Soil Science and Agricultural Chemistry, J.N. Agricultural University,[JNKVV] College of Agriculture Ganjbasoda, Vidisha MP-464221 India Email : praveen_jaga@yahoo.co.in

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ABSTRACT

At global level, India ranks as second largest wheat producing nation and contributing approximately 11.9% to the world wheat production from about 12% of global area (USDA, 2010). The area under wheat throughout the world as well as in India has become nearly constant around 217.9 million ha and 26.9 million ha respectively. Wheat contributes about 30% of total grain production in India (Economic Survey, 2007).Long time studies being carried out at several locations in India indicated that application of all the needy nutrients through chemical fertilizers have deterious effect on soil health leading to unsustainable yields. During 2008-09, India produced a record wheat production of 80.58 million tones. One of the major constraints in boosting up the wheat production is the deterious effect on soil health. Therefore; there is a need to improve nutrient supply system in terms of integrated nutrient management involving the use of chemical fertilizers in conjunction with organic manures coupled with input through biological processes. Balanced fertilizer is the application of essential plant nutrients in light proportion and in optimum quantity for a specific soil crop condition. Continuous imbalanced use of fertilizer led to the deterioration in the soil fertility and decrease in soil productivity. Higher yield at balanced nutrition safe guard soil fertility. Integrated plant nutrient supply system could help in meeting the goals of balanced fertilization. The research findings on various aspects of the integrated nutrient management on wheat are reviewed.

Keywords: *Azotobacter,* Kukreja and Narura, Biswas and Khosla, *Azospirillum.*

INTRODUCTION

INFLUENCE OF FYM ON WHEAT

Organic matter like FYM has supplied available nutrients to the plants provided favourable soil environment and increase water holding capacity of soil for longer time. Application of Farm yard Manure helps to increase the DMP, yield and nutrient uptake by wheat (Singh and Tomer, 1991).The soil incorporation of mustard/taramira + FYM and FYM at 10 t ha^{-1}significantly increased grain yield of wheat across the years (Regar *et al*.,2005). FYM application (10tha^{-1}) resulted in a 2004 and 21.5 % increase in grain and straw yield over control respectively. Prakash *et al.* (2002) also reported that soil density undergoes greater reduction with the use of FYM than chemical fertilizers. Application of FYM @ 10 and 20 tonnes / ha increased the grain yield and the total N P and K uptake in wheat crop (Singh and Agrawal, 2005) .Response of FYM measured as kg grain $tonne^{-1}$ was highest in wheat (Mahapatra *et al.,* 2007). Trial conducted at farmer's field in Sehore and Bhopal districts for three years further confirmed that integrated nutrient management id the best option as far as productivity and profitability of the soybean-wheat system is concerned (Singh *et al.,*2008). The Long- term experiments (LTEs) being carried out under AICRP on Farming system (AICRP-CS from 1993-2002) indicated that FYM can substitute a part fertilizer N needs of monsoon crop without any adverse effect on the total productivity of cereal based cropping system. It was further noticed that fertilizer needs of the winter wheat could be reduced to the extent of 25% by substituting 25% needs of proceeding monsoon crop through FYM at some location.(Muneshwar Singh *et al., 2009*). Application of organic amendments improves soil physical fertility (Biswas and Khosla, 1971) and using them in conjunction with organic fertilizers augments the beneficial effects. Soil organic matter imparts desirable physical environments to soils by favourably affected soil structure expressed through soil porosity, aggregation, bulk density and soil water storage (Benbi *et al., 1998;* Benbi and Nieder, 2003). Singh, *et al., (*2007) have shown that use of inorganic fertilizers in combination with FYM / green manure (GM) /crop residue (CR) plays an important role in improving the damaged soil structure by reducing bulk density and increasing infiltration rate and the mean weight diameter of the aggregates. Organic carbon content registered an increase varying from 28.6 to 35.7 % over control due to continuous application of FYM, rice straw, or green karanj leaf over the year. Addition of organic nutrient source might have created environment conducive for formation of humic acid, stimulated the activity of soil microorganism resulted in an increase in the organic carbon content of the soil (Bajpai *et al., 2006*).

INFLUENCE OF BIO-FERTILIZERS ON WHEAT

Azotobacter supplied additional nitrogen in an eco-friendly manner and plays a vital role in wheat. Hence, *Azotobacterization* has synergistic effect on yield. Generally with the application of Azotobacter, the yield of agriculture crops is increased by 10-12% (Jaga and Singh 2011, Kukreja and Narura, 1995). Seed inoculation with *Azotobacter* markedly increased the grain and straw yield of wheat from 39.4 q ha^{-1} to 41.8 q ha^{-1} and 54.3 q ha^{-1} to 57.2 q ha^{-1} respectively (Singh and Singh.2002). The biofertilizer application significantly improved grain yield and straw yield of wheat over un-inoculated plots and enhanced the concentration of micro nutrients like Fe,Zn,Cu and Mn (Malik *et al.,* 2009). The significant increase in N content of grain due to inoculation with *Azotobacter* (1.92 and 2.0%) with mixed strain as compared to uninoculated control (1.82 and 1.90%) (Katiyar *et al.,*2011, Panday *et al* ,2003 and Panday and Singh ,2007). The lysine content in wheat decreased and increased starch content due to *Azotobacter* strain has also been reported (Singh and Pathak, 2007). The beneficial effects of *Azotobacter* inoculation could be attributed to their multiple actions for synthesise growth promoting substances, antifungal and antibiotics which might have been utilized by the plants in synthesis of protein, carbohydrates starch and other assimilates, thereby improving growth of plants. Inoculation of *Azospirillum* plus PSB significantly recorded 23.2 and 11.9, 21.6 and 9.9, 32.3 and 15.7 % higher grain and straw yield and net returns over control and *Azospirillum* respectively in wheat crop (Kaushik *et al.,* 2012). In a 3 year field study on sandy loam alluvial soil of Modipuram, however PSM inoculation of wheat seed did increase crop response to P and soil available P content over non-inoculated treatments, but the magnitude of increase in these parameters was generally too small to attain statistical significance (Dwivedi *et al.,*2004) There was significant increase in nitrogen content due to inoculation with Azotobacter (1.92 and 2.00%) with mixed strain as compared to uninoculated control (1.82 and 1.90%) (Katiyar *et al.,*2011) and *(* Panday *et al.,*2003).

INFLUENCE OF CHEMICAL FERTILIZER ON WHEAT

The chemical fertilizers, no doubt, are the important source, which can meet the nutrients requirement but their imbalanced and continuous use lead to environmental pollution and deterioration of soil physic-chemical properties. Biomass and grain yield of wheat increased (44.67 q ha^{-1} to121.16 q ha^{-1}) with the full doses of NPK fertilizers. The nutrients removal particularly NPK by wheat crop was 227 kg ha^{-1} (Kharub and Sharma, 2002). Application of nitrogen significantly increased the grain yield of wheat. Difference among 40, 80 and 120 kg N ha^{-1} were significantly while between 120 and 160 kg N ha^{-1} was not significantly during both the year (Kumpawat and Rathod, 2002). Application of 100 % NPK significantly improved the grain yield of wheat by 21.5% over application of 75% NPK (Bandyopadhyay *et al., 2009*). Application of different levels of potassium and zinc significantly increased all the yield attributes and yield of wheat (Khare and Dixit,2011). Higher seed yield (36.42 q ha^{-1}) of wheat was recorded when 120 kg N ha^{-1} was applied to preceding rice crop and 120 kg N ha^{-1} was applied to succeeding wheat crop. Application of N @120 kg N ha^{-1} helps to increased uptake of N by wheat significantly (Kumar et al.,2011).Application of 100% N ,100% NP and 100% NPK produced 2681,4431 and 4950 kg ha^{-1} grain of wheat.(Chauhan, *et al,2011*). Application of 180 kg ha^{-1} significantly increased the grain and straw yield of wheat by 32.5 and 33.7 % compared with the 60 kg N ha^{-1} 100% NPK in wheat showed beneficial effect on plant height and dry matter accumulation at harvest in wheat (Kumar *et al,* 2005, Katyal *et al,* 2002). The sulphur content in wheat increased with the increase in the level of applied S but the increase was non-significant (Amandeep *et al.,* 2009). Maximum grain yield of wheat was recorded with 150% RDF (2.1 t ha^{-1}) followed by 100% RDF (4.98 t ha^{-1}).The grain and straw yields of wheat increased significantly with K application over control. (Khare and Dixit,2011 and Singh and Singh,2000).Plant height of wheat increased significantly from 78-81 to 84-85 cm when the rate of P application was increased from 0 to 80 kg P_2O_5 ha^{-1} as DAP in all the 3 years of study and incorporation of crop residues increased cost of cultivation by 9.1% over control. (Sharma *et al,* 2010).) Uptake of N in wheat was highest when N was scheduled as 1/3 basal+ 2/3 at is node under zero and in 1/3 basal + 1/3 at tillering + 1/3 at floral initiation under rotary tillage and the lowest was at full N application either at tillering as basal (Kharub and Chander,2010). Sharma (1997) reported that balanced fertilization significantly reduced the soil bulk density.

COMBINED EFFECT OF FYM, BIOFERTILIZER AND CHEMICAL FERTILIZERS ON WHEAT

Integrated nutrient supply which involves the conjunctive use of fertilizers and organic sources assumes great importance in recent years due to consistently increasing trend in the cost of fertilizers. Eight years of study on INM in rice-wheat at Jabalpur (Vertisols) revealed that conjunctive use of 5 t FYM and 6 t green manure with 90 kg N ha-1 not only sustained the productivity but also saved nearly 90-100 kg ha^{-1} yr^{-1} fertilizer N. (Singh *et al*., 2001). The yield of wheat was significantly higher (46.37q ha^{-1}) growth after maize and 41.16 q ha-1 growth after pearl millet respectively from the plot that had received a combination of FYM + fertilizers during *Kharif*. Inclusion of FYM in the fertilizer scheduled reduced the nutrients cost to about 18% (Hegde, 1998). The application of FYM @5 and 10 t ha-1 significantly increased the uptake of N in wheat crop over control (Singh and Singh, 2002). Sometimes, there is a buildup of insoluble phosphorus due to the application of phosphatic fertilizers over a long period. In this these situation, seed and soil inoculation of phosphate solubilizing microorganisms may benefits the crops by increasing the availability of P from insoluble sources (Gaur, 1990). Integrated use of 75% NPK and FYM @ 5 t ha-1 or poultry manure @ 1.5 mg ha^{-1} or phosphocompost @5 mg ha^{-1} to rainy season crops and 75% NPK to wheat significantly improved the yield of wheat over application of 100% NPK in both the season (Bandyopadhyay *et al.,* 2009). At maturity, wheat grain had highest Zn concentration under 100% NPK + Zn treatments (Peeyush and Mishra *et al.,* 2009). The highest OC content (9.4 g kg-1) was recorded in the treatment of 100% NPK + FYM 15 t ha^{-1} after the wheat crop (Chauhan *et al.,* 2011). Application of 150:75:75 of NPK + FYM 5 t ha-1 + 24 kg Zn SO_4 ha-1 resulted significantly higher plant height tiller m^{-1} effective tiller m^{-1} ,length of ears, grain per year and test weight as compared to rest of the treatments. Application of FYM @ 10 t ha^{-1} and poultry manure @ 2.5 t ha^{-1} along with 50% NPK resulted in 13.5 and 22.9% high yield respectively over 50% NPK alone (Behera *et al.*2007). Yadav *et al*., 2009 reported that Continuous rice-wheat cropping system had variable efforts on soil fertility depending on soil types, nutrient application and productivity levels. The improvement in mean grain yield of wheat (4.0 t ha^{-1}) and straw (6.3 t ha^{-1}) was recorded due to use of organic manure (FYM + Sesbania) to proceeding rice as compared to control (Singh *et al*., 2001). Application of wormi-compost at 3 t ha^{-1} + RDF significantly recorded maximum plant height ,at harvest ,DM and LAI at 30,60 and 90 DAS total and effective tillers per plant ,grain /ear ,1000 grain weight, grain and straw yield, net monetary return and B:C ratio in wheat crop. Combined application of 100% NPK + FYM 15 t ha^{-1} increased significantly in grain and straw yield of wheat and biofertilizer ,which sustained better growth produced better yield attributes and ultimately higher grain yield of wheat. Application of FYM (12 t ha^{-1}) with 75% NPK improves the fertility status and also recorded higher grain and straw yield of wheat than 100% NPK (Singh, M.V., 2008 Ram *et al.,* 2006). Application of 100% NPK + FYM (10 t ha^{-1}) recorded significant increase in biological parameters viz. soil microbial biomass carbon (SMBC),soil microbial biomass nitrogen (SMBN) and dehydrogenase activities (DHA) to the extent of 8.8, 9.8 and 9.0% compared to 150% NPK through chemical fertilizers without organics (Katkar *et al.,*2011).Application of NPK and FYM amended soil have higher microbial biomass in wheat (Majundar *et al.,*2008*).*Application of 100 % NPK + 50% N through FYM showed beneficial effect on plant height and dry matter accumulation at harvest in wheat. (Kumar, P. *et al.* 2005). Application of 100% NPK + 10 t ha^{-1} FYM significant improved the availability of micronutrients (Zn, Fe, Mn and Cu).

Thus, these results suggest that integrated use of chemical fertilizers, organic manures including green manure and recycling of crop residues, assume greater significance of improving efficiency of chemical fertilizers in soil.

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