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National Academy of Agricultural Science (NAAS) Rating : 3. 03

"Effect of Integrated Nutrient Management on Growth and Yield of Wheat (*Triticum aestivum*)"

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ABSTRACT: A field experiment was conducted during Rabi *season of 2009-10 at Experimental Farm (A-3), at AICRP on Integrated Farming System, MarathwadaKrishiVidyapeeth, Parbhani with the objective to evaluate effect of integrated nutrient management on growth and yield attributes of wheat and to find out suitable integrated nutrient management practice for wheat, to workout economics of different treatments. The experiment was laid out in the Randomized Block Design (RBD) with 9 treatments replicated thrice from the result it can be concluded that growth factors* viz.*plant height (cm), number of functional leaves and dry matter accumulation (g), and yield attributing character* viz.*effective tillers plant^{-1}, length of spike (cm) number of grain spike^{-1}, number of spikelets spike^{-1}, test weight of wheat was recorded in highest in treatment T_5- RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg boron ha^{-1}. The highest grain yield (26.87 q ha^{-1}), straw yield (41.47 q ha^{-1}) and biological yield (68.14 q ha^{-1}) was recorded in treatment T_5- RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg boron ha^{-1}, whereas the lowest grain, straw and biological yield recorded in treatment T_7 -75% RDF + PSB seed treatment.*

***Key words:** Fym, Nutrient, Wheat, Yield,, etc.*

INTRODUCTION

Wheat is world's leading cereal crop. Maximum area under wheat is in china followed by India. In production, china stands first & India second. In India, the area under wheat was 9.7 mha in 1950-51 which was increased to 26.85 mha in 2008-09. India produces 776.3 lakhtonnes with productivity 2703 kg ha^{-1} which is much lesser than most of the wheat growing countries of the world. Whereas Maharashtra produces 15.53 lakhtonnes with productivity 1575 kg ha^{-1}. (Anonymous, 2009). The low productivity of wheat in Maharashtra is due to comparatively shorter favorable growing period i.e. high temperature with low humidity and short cool spell during its vegetative growth phase accompanied with fluctuation in temperature, most of the area is under rainfedwheat, non availability of seed of high yielding varieties, late sowing of wheat, insufficient irrigation, use of insufficient fertilizers and inadequate plant population.

The practice of using large amount of high analysis macronutrient fertilizers, together with less use of organic manure and little recycling of crop residue, lead to micronutrients hunger of many crops including wheat, whereas the need of micronutrients has been essentially and entirely met through its native resource of the soil.High dose of nitrogen and the maximum benefit from nitrogen use can be achieved by applying required quantity at right time. Application of nitrogen not synchronizing with the demand of the plant may result in various losses. (Verma, 1989). In India, intensively cultivated area and, a high annual productivity of wheat result in removal of nutrients in substantial amounts that often exceed replenishment through fertilizers and manures ultimately leading has deterioration of soil health. Yield decline and decreasing factor productivity have been reported in wheat and farmers have started to use higher doses of N (up to 180 kg/ha) to maintain higher yield levels.Now a days, in advance agricultural, fertilizer use is not economical because only 50 per cent of applied fertilizer-N is utilized by the plants and most of the remainder is being lost either through

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denitrification or leaching. An increase demand for nitrogen in modern agriculture could therefore be solved by the exploitation of biologically fixed nitrogen.

Integrated nutrient supply and management system aimed at sustainable crop production by orchestrating the combined use of inorganic fertilizers. Balanced and efficient fertilizer application is essential to compensate the increased yield and hence greater removal of soil nutrients. The recent concept of integrated use of various sources (organic, inorganic and biofertilizer) of nutrient in crop production has started gaining ground. The basic concept under line the principal of integrated nutrient supply system is the improved of soil fertility for sustainable crop production on long term basis. It may be achieved through integrated use of all the possible sources of plant nutrient and their scientific management in different crops and cropping system. It is evident that biofertilizer like *Azotobacter* and *Azospirillum* alone or in combination have great prospects for increasing the productivity of wheat (Bhattersperger *et al.*, 1978). However, very little information is available regarding the effect of *Azotobacter* and *Azospirillum* combination with farm yard manure and inorganic nitrogen fertilizers under the field conditions. Productivity of *Aestivum* wheat is higher than *durum* wheat. *Aestivum* wheat is grown under irrigated condition and *durum* is grown under rainfed conditions in India. The fertilization to the wheat crop both organic and inorganic and integrated nutrient management play an important role for improving the yield and quality of wheat crop (Nehra*et al.*, 2001).With the recent globalization, there is more scope for export of wheat and hence it is necessary to increase the productivity of *Aestivum* wheat. Voluminous data is available for fertilizer/manures or irrigation effects on bread wheat, however, limited information is available on the effect of integrated nutrient supply system.

METHOD AND MATERIALS

The field experiment was conducted in A-3, experimental plot at AICRP on Integrated farming system, MarathwadaKrishiVidyapeeth, Parbhani during *Rabi* season 2009-2010. The topography of plot was fairly leveled. Before sowing, the soil analysis revealed that the soil of the experimental plot was clayey in texture. The soil reaction was slightly alkaline. It was medium in total nitrogen, low in available phosphorus and high in available potassium. Depth of soil layer was 140 cm.

The data on weather parameters collected during experimental period showed that precipitation received during experimental period was 19.9 mm distributed over two rainy days. The maximum and minimum temperature levels during the experimental period were (28.1 to 37.2^{0}C) and (8.5 to 17.3^{0}C) respectively. The experimental field was laid out in Randomized Block Design with three replications. Each replication consisted of nine treatments. Plot Size Gross : 5.4 m x 3.6 m Net : 3.6 m x 2.7 m.The treatment details are as T_1 - RDF (100 : 50 : 50 NPK kg ha^{-1}), T_2 - 75 % RDF + 5 t FYM ha^{-1}, T_3 -75% RDF + 5 t FYM ha^{-1} + 2% urea spraying, T_4 -75% RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ + 2 % urea spraying, T_5 - RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg boron ha^{-1}, T_6 -75% RDF + *Azotobacter*seed treatment, T_7 -75% RDF + PSB seed treatment, T_8 -75% RDF + *Azotobacter*seed treatment + PSB seed treatment, T_9-75% RDF + *Azotobacter*seed treatment + PSB seed treatment + 2 % Urea spraying. Sowing was done by drilling method at 22.5 cm row to row distance with weighed quantity of seed for each. Irrigation was applied to different plots by the surface irrigation methodplot at five critical growth stages viz. CRI, tillering, jointing, flowering and grain development. In order to record observations on various growth characters at different growth stages. Five plants were selected at random from each net plot and they were labeled with wire rings and bamboo pegs. All successive biometric observations were recorded periodically on selected plants. These selected plants were harvested separately for assessing the individual plant yield attributes at harvest. The data were analyzed as per the standard procedure given by Panse and Sukhatme (1967). Split plot design. The total variance (S^2) and d.f. (n-1) were partitioned into different possible sources. Wherever the results were found significant, the appropriate standard error (SE $\pm$) and critical difference (C.D.) at 5 per cent level of significance were calculated for treatment comparisons.

RESULT AND DISCUSSION

Effect on growth attributes

The mean plant height wasinfluenced by different treatment. At 30 DAS treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) recorded significantly higher (8.24 cm) plant height over all treatments except treatment T_4 (8.18 cm).At 60 DAS treatment T_5 recorded significantly higher (52.24 cm) plant height over treatments $T_6$and T_7 were at par with each other. At 90 DAS and at harvest same trend was observed for height. The mean number of functional leaves was found to be highest 44.60 at 90 DAS. At the 30 DAS, treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) recorded maximum (6.7) number of functional leaves, followed by T_7 treatment. At 60 DAS, treatment T_5 (13.68) recorded maximum number of leaves and which is at par with T_4 (13.28). At 90 DAS, treatment T_5 (44.60) significantly superior over all other treatments.

The dry matter $plant^{-1}$ was at 30 DAS treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) (0.67 g) found superior over treatments T_4 (75% RDF + 5 t FYM + 10 kg $ZnSO_4$ + 2 % urea spray) (0.64 g) and T_3 (75% RDF + 5 t FYM ha^{-1} + 2 % urea spraying) (0.62 g).At the 60 DAS, treatment T_5 recorded maximum dry matter accumulation (3.9 g) which is at par with treatment T_4. While treatment T_3 (3.8 g) and T_2 (3.8 g) found at par with each other. Similar trend was observed at 90 DAS and at harvest.

This might be due to higher availability of nutrient to the plant through various means i.e. cultural, biological, chemical practices. As the nutrients are available to sufficient quantity their utilization by plants results in vigorous growth and it ultimately increases the plant height, dry matter accumulation and no. of leaves.

Effect on Yield attributing characters

The Number of effective tillers $plant^{-1}$in an integrated nutrient management treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) recorded maximum number of effective tillers $plant^{-1}$ (1.9) and found significantly superior over treatments T_4 (1.8) and T_3 (1.8) while treatment T_3 and T_2 (1.8) were at par with each other. The mean length of spike was found to be 8.13 cm. Treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) recorded maximum length of spike (9.0 cm) and found to be significantly superior over all treatments except T_4 treatment. The other treatments were at par with each other. The mean number of spikelets per spike was 16.28.In case of fertilizer dose treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) maximum number of spikelets per spike (17.79) and

Table 1
Growth and yield attributes of Wheat as influenced by different treatment.

Treatment	*Plant height (cm)*	*No.of leaves*	*Dry matter accumulation (g)*	*Effective tillers plant^{-1}*	*Length of spike (cm)*	*No. of spikelets spike^{-1}*	*No. of grains spike^{-1}*	*Test weight (g)*
T_1-RDF (100 : 50 : 50 NPK kg ha^{-1})	92.76	34.77	7.6	1.68	7.5	15.51	46.39	35.88
T_2-75 % RDF + 5 t FYM ha^{-1}	94.64	42.16	8.3	1.8	8.3	17.36	49.05	37.00
T_3-75% RDF + 5 t FYM ha^{-1} + 2% urea spraying	96.41	42.80	8.8	1.8	8.3	17.45	49.44	37.80
T_4-75% RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ + 2 % urea spraying	97.64	43.83	8.8	1.8	8.5	17.56	50.19	37.97
T_5-RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ + 5 kg boron	98.25	44.60	8.9	1.9	9.0	17.79	50.80	38.12
T_6-75% RDF + Azotobacterseed treatment	92.50	33.30	8.9	1.6	7.3	15.11	46.00	35.72
T_7-75% RDF + PSB seed treatment	85.03	32.56	8.9	1.7	7.7	14.66	44.00	34.18
T_8-75% RDF + Azotobacterseed treatment + PSB seed treatment	95.45	37.03	7.9	1.7	8.0	15.53	46.67	36.00
T_9-75% RDF + Azotobacterseed treatment + PSB seed treatment + 2 % Urea spraying	93.46	39.53	8.4	1.8	8.0	15.56	47.16	36.68
S.E.$\pm$	0.86	0.13	0.12	0.31	0.18	0.20	0.30	0.69
C.D. at 5 %	2.60	0.41	0.37	0.93	0.54	0.61	1.80	2.00

Table 2
Grain, straw and biological yield (q ha^{-1}) and harvest index as influenced by different treatments

Treatment	*Grain yield (q ha^{-1})*	*Straw yield (q ha^{-1})*	*Biological yield (q ha^{-1})*	*Harvest Index*
T_1-RDF (100 : 50 : 50 NPK kg ha^{-1})	21.70	32.04	53.73	39.67
T_2-75 % RDF + 5 t FYM ha^{-1}	25.39	37.49	62.88	40.49
T_3-75% RDF + 5 t FYM ha^{-1} + 2% urea spraying	26.68	40.38	67.06	39.93
T_4-75% RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ + 2 % urea spraying	26.64	40.27	66.91	39.46
T_5-RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ + 5 kg boron	26.87	41.27	68.34	40.80
T_6-75% RDF + Azotobacterseed treatment	18.78	30.07	48.85	38.52
T_7-75% RDF + PSB seed treatment	17.02	29.98	48.80	36.12
T_8-75% RDF + Azotobacter seed treatment + PSB seed treatment	22.04	32.12	54.17	39.52
T_9-75% RDF + Azotobacterseed treatment + PSB seed treatment + 2 % Urea spraying	22.40	34.72	57.14	39.77
S.E.$\pm$	0.86	2.9	3.0	2.02
C.D. at 5 %	2.5	8.6	9.0	6.04

was found to be significantly superior over all the treatments except T_2 and T_4.

Mean number of grains per spike was higher in Treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) recorded maximum number of grains $spike^{-1}$ (50.80) and was found to be significantly superior over all treatment except T_4 (50.19), T_3 (49.44) and T_2 (49.05). Integration of nutrient proved to be superior in respect of test weight the treatment T_5 (38.12) recorded highest test weight and significantly superior over the treatment T_1, T_6 and T_7. The other treatment were at par with each other. It was revealed from the data that effect of fertilizer doses was found to be non-significant on thousand grains weight. As the grain yield $plant^{-1}$ was concerned theTreatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) recorded maximum (1.8 g) grain yield $plant^{-1}$ and found to be significantly superior over treatment T_4 (1.8 g). Treatment T_4 and T_3 (1.8 g) were at par with each other.

This might be due to higher nutrient availability at the initial stage of the crop. It's higher uptake by the plants result in the higher growth attributes like no.ofleaves ,dry matter etc.which result in the higher photosynthetic rate and ultimately result in higheryield attributing characters**.**

Effect on Yield

The grain yield, straw yield, biological yield were influenced by different integrated nutrient management. Treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) recorded higher grain yield (26.87 q ha^{-1}), straw yield (41.47 q ha^{-1}) and biological yield (68.14 q ha^{-1}) followed by 75 per cent RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ + 2 % urea spraying (26.64 q ha^{-1}, 40.27 q ha^{-1}, 67.07 q ha^{-1}), respectively the treatment T_7 (75 % RDF + PSB seed) treatment recorded lowest grain yield (17.02 q ha^{-1}). Straw yield (29.98 q ha^{-1}) and biological yield (46.99 q ha^{-1}). As observed in the treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ + 5 kg Boron) the higher grain and straw yield in this treatment is might be the combined effect of availability of various nutrients to the plant at proper growth stage through the various means i.e. chemical (macro and micro nutrients) and organic source (FYM) i.e. treatment T_5 shows higher yield due to the balanced use of fertilizer dose and essential micro nutrients. Maximum harvest index was recorded in treatment T_5 (RDF + 5 t FYM ha^{-1} + 10 kg $ZnSO_4$ ha^{-1} + 5 kg Boron ha^{-1}) 40.80 per cent and minimum harvest index was observed in treatment T_7 (36.12 per cent).

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