International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(4): 1366-1369

Received: 29-05-2017
Accepted: 30-06-2017

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Effect of integrated nutrient management on yield attributes and yield of wheat (*Triticum aestivum* L.)

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Abstract
A field experiment was conducted during *rabi* 2012-13 at the Regional Research Station, Anand Agricultural Univrity, Anand. The important soil properties were pH – 8.1, $EC_{2.5}$ – 0.15 dS m^{-1}, organic C – 0.32 %, available N – 250 kg ha^{-1}, available P_2O_5 – 30.0 kg ha^{-1}, available K_2O – 245 kg ha^{-1}, available S – 6.5 mg kg^{-1} and DTPA – Zn – 1.05 mg kg^{-1}. The wheat (var. GW 173) was grown and treatments were replicated three times in randomised block design. The treatments comprised viz.T_1: 100 % RDF ha^{-1}, T_2: 75 % RDF + 10 t FYM ha^{-1}, T_3: 75 % RDF + 3 t vermicompost ha^{-1}, T_4: 75 % RDF + 1.0 t castor cake ha^{-1}, T_5: 75 % RDF + 1.5 t vermicompost ha^{-1} + 0.5 t castor cake ha^{-1}, T_6: 50 % RDF + 6.0 t vermicompost ha^{-1}, T_7: 50 % RDF + 2.0 t castor cake ha^{-1} and T_8: 50 % RDF +3.0 t vermicompost ha^{-1} + 1.0 t castor cake ha^{-1}. The treatments were applied to wheat crop keeping recommended dose for wheat @ 120 kg N + 60 kg P_2O_5 ha^{-1}.

Keyword: inm, wheat, yield attributes, yield

Introduction
The stagnation in production of food grains for the past few years has become a matter of concern and is posing a serious threat to our national food security. Soil health degradation has emerged as a major factor responsible for the stagnation in agricultural production. The degradation of soil health in many intensively cultivated areas is manifested in terms of loss of soil organic matter, depletion of native soil fertility due to imbalance and unscientific use of fertilizer, which is now one of the major constraints in improving crop productivity.

In India, there is sufficient availability of organic manures like animal dung manure (791.6 mt), crop residues (603.5 mt), green manure (4.50 m ha^{-1}), rural compost (148.3 mt), city compost (12.2 mt) and bio-fertilizer (0.41mt) (Bhattacharya and Chakraborthy, 2005) and these may become a good substitute of inorganic fertilizers to maintain the soil physico-chemical and biological properties. The FYM and vermi-compost are helpful to recoup the soil health; use of vermi-compost is a means to combat the ill effects of chemical fertilizers to the soil health; and crop residues improve the efficiency of applied fertilizer. On the whole, incorporation of organic manures improves the nutrient content and uptake. Although organic manures contain plant nutrients in small quantities as compared to the fertilizer, the presence of growth promoting principles like enzyme and hormones besides plant nutrients make them essential for improvement of soil fertility and productivity (Srivastava, 1988).

The basic concept underlying the principles of integrated nutrient management (INM) is the maintenance and possibly improvement of soil fertility for sustaining crop productivity on long term basis. This may be achieved through combine use of all possible sources of nutrients and their scientific management for optimum growth, yield and quality of different crops and cropping systems. In practical term, a system of crop nutrition in which plant nutrient needs are met through a pre-planned integrated use of mineral fertilizers; organic manures (e.g. green manure, recyclable wastes, crop residues, FYM etc.) and bio fertilizers. The appropriate combination of different sources of nutrients varies according to the system, land use and ecological, social and economic condition at the local level.

Wheat is second important food grain crop being consumed next to rice and contributes to extent of 20 per cent of food grains. It is widely grown on a variety of soils ranging from sandy to heavy clay for higher production. Fertile and well drained loam to clay loam soils are most suitable (Hossian *et al.*, 2006) in major wheat growing countries in the world are USSR, USA, China, India, and Bangladesh. Gujarat ranks sixth in the cereal production, the area under wheat crop in Gujarat is about 12.07 lakh ha with total production of 28.97

lakhtonnes and productivity of 2.40 tonnes ha (Anon., 2009). With these background a field trial was conducted during *rabi* season 2012-13 at the Regional Research Station, Anand Agricultural Univrity, Anand.

Materials and methods

The field experiment was conducted during *Rabi* season of 2012 -13 on the farm of Regional Research station, Anand Agricultural University, Anand, Gujarat. The soil is representative of the region and is locally known as *"Goradu"* soil. The texture of the soil is loamy sand. The experiment comprised of eight treatments with three replications involving use of various levels of NPK fertilizers alone and in combination with organic sources viz., Farm Yard Manure (FYM), Vermicompost (VC) and Castor Cake (CC) in a Randomized Block Design. The treatments comprised viz.T_1: 100 % RDF (120 – 60 -0 kg NPK ha^{-1}), T_2: 75 % RDF + 10 t FYM ha^{-1}, T_3: 75 % RDF + 3 t vermicompost ha^{-1}, T_4: 75 % RDF + 1.0 t castor cake ha^{-1}, T_5: 75 % RDF + 1.5 t vermicompost ha^{-1} + 0.5 t castor cake ha^{-1}, T_6: 50 % RDF + 6.0 t vermicompost ha^{-1}, T_7: 50 % RDF + 2.0 t castor cake ha^{-1} and T_8: 50 % RDF +3.0 t vermicompost ha^{-1} + 1.0 t castor cake ha^{-1}. The net plot size was 3.60m x 6.00m during the experiment. The variety of wheat was GW-173 and seed rate @ 120 kg ha^{-1}. The wheat crop was sown by drilling method and spacing was 22.5 cm. and seven irrigation were given during crop growth period.

Observation recorded

During experimentation, observations like plant height, number of effective tillers, spikelets spike^{-1} and test weight (1000 seeds) were recorded along with yield of grain and straw of wheat.

Statistical analysis

Experimental data generated during the experiment were analyzed statistically for their test of significance as per Randomized Block Design (Steel and Torrie, 1982) [10] using the facilities available at the Department of Agricultural Statistics, B. A. College of Agriculture, AAU, Anand. The results are reported at 5 and 1% level of significance.

Results and Discussion

1. Effect of integrated nutrient management on yield attributes and yields of wheat.

1.1 Yield attributes

The data presented in Table 1 revealed that effect of INM on plant height, effective tillers and test weight of wheat was found significant. Among the different treatments, T_2 (75% RDF + 10 t FYM ha^{-1}) registered maximum value for plant height (78.00 cm), No. of effective tillers (82.77) and test weight (33.30 g 1000 seeds^{-1}) which was significantly more than RDF (T_1). The plant height under T_2 being on par with T_3, T_4, T_5, T_7 and T_8 differed significantly from rest of the treatments. However, the effective tillers under T_2 being on par with all the INM treatments differed significantly from T_1 and T_7 treatment. The test weight under T_2, T_5 and T_6 was on par but T_2 differed significantly from rest of the treatments. These data revealed that percentage improvement in plant height, effective tillers and test weight under T_2 over 13.27, 18.07 and 6.45 over T_1, respectively. However, the number of spikelet/spike was non-significantly improved by different INM treatments as this is an inherent character of the variety of a crop. The increase in plant height, number of effective tillers and test weight by INM treatments might be due to addition of nitrogen as well as other nutrients and growth promoting substances through organic manure (FYM 10t ha^{-1}).

Table 1: Effect of integrated nutrient management on yield attributes of wheat

Treatments	Plant height at harvest (cm)	Effective tillers	Number of spikelets per spike	Test weight (g)
T_1-100% RDF	68.86	70.10	13.93	31.28
T_2-75% RDF + 10 t FYM ha^{-1}	78.00	82.77	15.93	33.30
T_3-75% RDF + 3 t VC ha^{-1}	71.66	77.66	15.53	31.74
T_4-75% RDF + 1.0 t CC ha^{-1}	76.46	79.77	15.93	31.82
T_5-75% RDF +1.5 t VC ha^{-1} + 0.5 t CC ha^{-1}	73.60	78.10	15.73	32.46
T_6-50% RDF +6.0 t VC ha^{-1}	65.66	75.32	15.07	33.05
T_7-50% RDF +2.0 t CC ha^{-1}	72.46	69.77	15.27	32.34
T_8-50% RDF +3.0 t VC ha^{-1} ha^{-1}+1.0 t CC ha^{-1}	69.13	75.88	15.13	32.27
S. Em±	2.22	2.63	0.85	0.30
CD @ 0.05%	6.74	7.98	NS	0.89
CV %	5.35	5.99	9.56	1.62

The similar results were also reported by Verma *et al*. (2006) [12\] and they observed that the growth parameter (plant height) and crop dry matter were significantly affected with 100% NPK +FYM 10 t ha^{-1} treatment. The results are in accordance with those of Singh *et al*. (2008) [4]. They reported that growth attributes (plant height, number of tillers and gains per spike) were significantly higher with FYM @7.5 t ha^{-1} +50% RDF + bio fertilizers treatments. Shivakumar and Ahlawat (2004) revealed that yield attributes (number of ears, ear weight, 1000 seed weight) were significantly influenced with 5 t ha^{-1} crop residue + 5 t ha^{-1} FYM + 5 kg ha^{-1} Zn treatments. Similar results were also found by Totawat *et al*. (2001) [11] and Gawai and Pawar (2006) [2].

2. Effect of integrated nutrient management on grainand straw yieldof wheat

2.1 Grain and straw yield of wheat

The considerable increased in grain and straw yield of wheat due to integrated nutrient management (INM) treatments in comparison to only chemical fertilizers (Table 2 and Fig 1). The grain yield of wheat was significantly increased by supplementation of T_2: 75% RDF +10 t FYM ha^{-1} over T_1, T_5, T_6, T_7 and T_8, however it was on par with T_3 and T_4 treatments. Similarly, straw yield was also significantly more under T_2 than rest of the treatments except T_3, T_4 and T_5 treatments. The increase in grain and straw yields under T_2 was 24.74 and 42.29 per cent over T_1, respectively. Looking to the addition of major nutrients (N, P & K) through chemical fertilizers and organic manure under different treatment**,** it is interesting to note that T_5 (161.3 kg ha^{-1}), T_7 (150.8 kg ha^{-1}) and T_8 (147.8

kg ha^{-1}) received more nitrogen than T_2 (140.0 kg ha^{-1}) through both chemical fertilizer and organic manure but the T_2 produced the highest grain (4093 kg ha^{-1}) and straw (6103 kg ha^{-1}) yield probably due to higher amount of organic carbon as compared to other treatments which has helped in improving physico-chemical properties of soil**.**

The improvement in soil properties has reflected in better growth and development of crop as resulted by maximum values for yield attributes under T_2: 75% RDF +10 t FYM ha^{-1} (Table 1). The data indicated that addition of well decomposed organic manures help in steady and constant release of nutrients.

Table 2: Effect of integrated nutrient management on grain and straw yield of wheat

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1-100% RDF	3281	4289
T_2-75% RDF+10 t FYM ha^{-1}	4093	6103
T_3-75% RDF+3 t VC ha^{-1}	3595	5293
T_4-75% RDF+1.0 t CC ha^{-1}	3972	5864
T_5-75% RDF+1.5 t VC ha^{-1}+0.5 t CC ha^{-1}	3475	5509
T_6-50% RDF+6.0 t VC ha^{-1}	3287	5000
T_7-50% RDF+2.0 t CC ha^{-1}	3368	4850
T_8-50% RDF + 3.0 t VC ha^{-1} + 1.0 t CC ha^{-1}	3242	4657
S.Em±	197	323
CD @5%	597	978
CV %	9.63	10.75

Shivkumar and Ahlawat (2008) [8] observed that the 100% RDF + 5 t FYM ha^{-1} significantly gave higher wheat yield. Parihar *et al*. (2010) [5] postulated that the FYM improving soil physical, chemical and biological properties and had synergistic relationship with N, P, thereby helping in mineralization of applied N and P helped in increasing the growth and mean while grain yield. The similar results were also found by Shivaumar and Ahlawat (2008) [8], Behera *et al*. (2007) [1], Kundu *et al*. (2007) [3], Singh *et al*. (2008) [4], Mishra *et al*. (2008) [4], Ramesh *et al*. (2009) [6] and Sharma *et al*. (2013) [7].

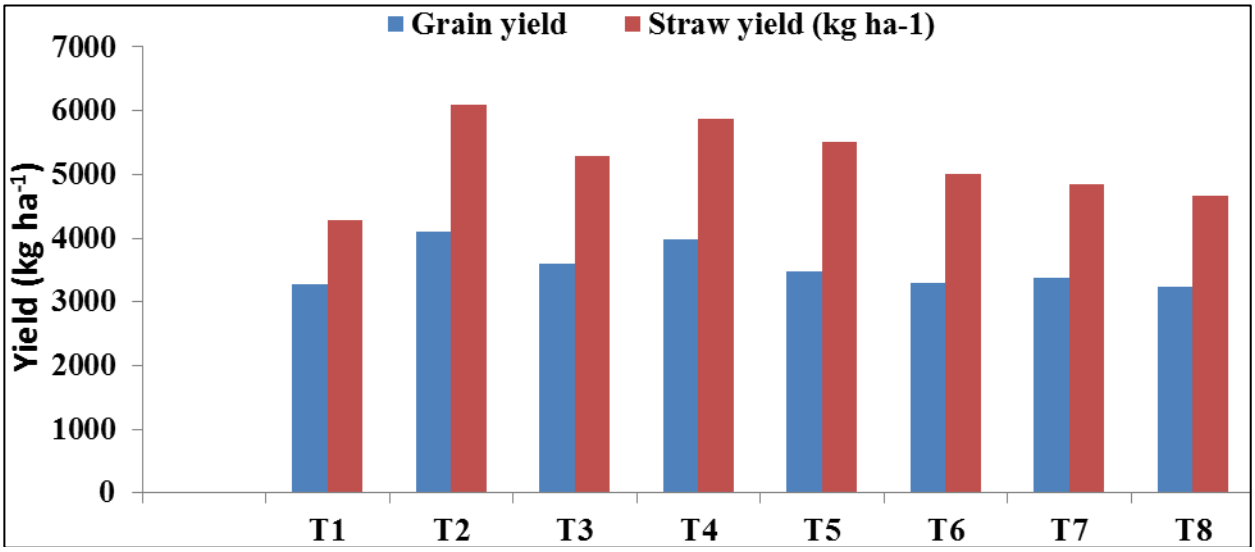

Fig 1: Effect of INM on grain and straw yield of wheat

Conclusion

From the above results, it can be concluded that supplementation of 75% RDF along with 10 t FYM ha^{-1} significantly improved the plant height and effective tillers which reflected in increasing grain and straw yield of wheat. Hence, integrated nutrient management practices helps in decreasing 25% dose of chemical fertilizer besides in increasing crop yields.

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