

The First evident on effect of Organic and Inorganic Fertilizers on Growth and Yield of Wheat (*Triticum estivum* L.) in agency area of Vishakhapatnam District

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ABSTRACT: Organic manures are traditionally used for plant nutrients. Major difficulty of organic manures is transportation and application. This study evaluated how organic manures and mineral fertilizers affect wheat grain and straw yields. Soil fertility maintenance requires a balanced application of inorganic and organic nutrient sources. Sustainable agricultural productivity might be achieved through a wise use of integrated nutrient management. Integrated use of chemical and organic fertilizer on yield and yield components of wheat is very crucial for assurance of food security. The experiment was conducted during 2018-20 to evaluate the effect of organic fertilizers and inorganic fertilizers (NPK Fertilizer) on plant height, number of tillers per plant, number of spikes per m², number of spikes m² and number of grains per m², panicle weight, test weight, grain weight, straw yield and BC Ratio in wheat. The fertilizer treatments were T₁: control T₂: RDF (120:40:40 kg NPK ha⁻¹); T₃: 100% NPK through RDF + Bio fertilizer; T₄: 75% RDF+ 25% NPK through organic sources (FYM); T₅: FYM 5 t/ha + sheep manure 3 t/ha; T₆: Incorporation of *Kharif* rice bran + 75% NPK through RDF; T₇: Neem cake @ 120 kg ha⁻¹ + Poultry manure 2 t ha⁻¹. The maximum number of tillers (71), highest number of spikes per m² (75.10), the maximum spike length (8.73 cm), the highest spikelet's per spike, maximum weight of spike (5.46g), highest 1000 grain weight (56g) and highest grain yields were recorded in the T₄: 75% RDF + 25% NPK through organic sources (FYM) (4.33 t/ha). The lowest yields were provided in the unfertilized control (2.36 t/ha). Combination of bio fertilizer is the best way to achieve high grain yield as well as BC Ratio. The impact of organic manures and inorganic fertilizers on productivity of Wheat was investigated in sandy clay loam soils. The wheat plant height, number of tillers, spike length, straw yield, grain yield and 1000 grain weight all were statistically different from that of control. The findings of the trial suggested that crop productivity may be improved significantly by the combined application of organic manures and inorganic fertilizers.

Keywords: Organic manures, *Triticum estivum*, mineral fertilizers, NPK, crop productivity.

INTRODUCTION

Wheat is a dominant cereal crop of north –western zone of India and it is second most common crop of the country. It is also one of the major staple crops in many countries in terms of production and consumption. Balanced application of inorganic and organic fertilizers is the key role to maintenance soil fertility. The only way for sustainability is integrated nutrient management. Integrated approach of inorganic fertilizers and organic fertilizers on yield and yield components of wheat. Wheat is very crucial for assurance of food security.

The main aim of integrated nutrient management approach is to enhance soil productivity through a

balanced use of fertilizers combined with organic and biological sources of plant nutrients. In the world Wheat is the most important cereal crop and stands next to rice in India. Increase agricultural productivity occurred largely due to the development of high-yielding cultivars and increased fertilizer use. There is a need to increase the productivity (quality and quantity) of wheat because of increasing population as well as food crisis. To overcome the demand, yield can be improved by application of organic fertilizers and inorganic fertilizers in a balanced manner. Integrated nutrient management minimize the indiscriminate use of chemical fertilizers to the crop. Moreover integrated nutrient management promotes the use of balanced and

judicious use of chemical fertilizers in conjunction with manures like compost, farmyard manure, vermicomposting, green manures and use of fertilizers fortified with micro-nutrients, use of bio-fertilizers that can supplement a part of NPK fertilizers. Organic manures like FYM, poultry manure, sheep manure etc. Improves the physical soil properties like bulk density, particle density and porosity of the soil and also increase the nutrient status of soil as well as microbial population. Organic manures are plant and animal wastes that are used as plant nutrients. After decomposition of organic waste material it releases nutrients to the soil. Manures are the organic materials derived from animal, human and plant residues which contain plant nutrients in complex organic forms. Moreover, organic materials improve the soil physical-chemical properties. The main objective of using organic manures is improving soil health. Different countries are utilizing the organic manures except poor countries. These practices pose serious threat to the environment and loss of useful pool of plant nutrients. The total concentration of nitrogen and other macro nutrients in the upper soil layer can be influenced by the application of organic manures and mineral fertilizers (Hlisnikovsky and Kunzova 2014a). Organic manures also positively influence the organic carbon content of the soil (Sradnick *et al.*, 2014) and affect the amount of the microbial biomass in the soil horizon (Geisseler and Scow 2014). Organic manures have direct and indirect effects. The direct effect consist of slow release of nutrients into the environment due to the mineralization process (Hlisnikovsky and Kunzova 2014b), while indirect effect consist of favorable influence on soil structure (Biau *et al.*, 2012). The combined application of organic manures and mineral fertilizers plays an important role in optimizing soil nutrient pool, increasing crop yield or increasing the efficiency of water use (Zhang *et al.*, 2016).

MATERIALS AND METHODS

The field experiment was conducted at the research farm of RARS, Chintapalle, Andhra Pradesh in a silty clay loam soil. The experiment plot was geographically situated at 17.8713° N longitude, 82.3533° E latitude in the Regional Agricultural Research station, High altitude Tribal zone, Chintapalle. The experimental soil texture was sandy loam. organic carbon 0.73%, available nitrogen 435.5 kg ha⁻¹, available phosphorus 16.58 kg ha⁻¹ and available potassium 250.9 kg ha⁻¹ and acidic reaction (pH 5.9). The treatments consisted of T₁: control T₂: RDF (120:40:40 kg NPK ha⁻¹); T₃: 100% NPK through RDF+ Bio fertilizer; T₄: 75% RDN+ 25% NPK through organic sources; T₅: FYM 5 t/ha + sheep manure 3 t/ha; T₆: Incorporation of *Kharif* rice bran + 75% NPK through RDF; T₇: Neem cake @ 120 kg ha⁻¹ + Poultry manure 2 t ha⁻¹. The field experiment was laid in RBD with seven treatments. To eliminate border effect, only the central 6m × 6m area of each 8m × 8m experimental plot is used for the determination of yield and soil sample collection. Winter wheat was sown in October with a seed depth of 3-4 cm and the distance between rows 12.5 cm. the seed rate was 60 kg ha⁻¹. Need based pesticides was used to control pest. The experiment was conducted under randomized block design replicated thrice. The treatment were imposed at the time of sowing. The physical and chemical properties were determined at the time of sowing and post-harvest stage.

Soil pH was determined by soil: water solution (1:2.5 ratio) Statistical analysis and benefit cost ratio were computed following standard procedures. Soil bulk density was determined by using core sampler method. Soil porosity was calculated using bulk density and particle density in the following formula and the results expressed as percentage. Maximum water holding capacity was determined by Keen Rackowski cup method by Sankaram (1966).

Table 1: Effect of integrated nutrient management on growth parameters of Wheat (pooled data).

Treatments	Plant height (cm)	No. of tillers per plant	No of spikes per m ²	Spike length (cm)	Spikelet per spike	No. of grains per spike	Spike weight (g)	Test weight (g)
T ₁ : control	103	48	58.33	6.96	11.76	51.6	3.93	36.6
T ₂ : RDF (120:40:40 kg NPK ha ⁻¹)	125	65	65.40	8.56	13.20	61.5	4.57	45.9
T ₃ : 100% NPK through RDF + Bio fertilizer	124	61	61.23	8.30	13.36	58.1	5.12	46.8
T ₄ : 75% RDF + 25% NPK through organic sources (FYM)	130	71	75.10	8.73	14.20	63.4	5.46	56.0
T ₅ : FYM 5 t/ha + sheep manure 3 t/ha	124	50	59.03	8.40	13.73	50.8	4.81	38.5
T ₆ : Incorporation of <i>Kharif</i> rice bran + 75% NPK through RDF	123	54	48.60	7.20	13.03	53.7	4.40	47.0
T ₇ : Neem cake @ 120 kg ha ⁻¹ + Poultry manure 2 t ha ⁻¹	104	63	45.73	8.53	11.97	55.9	4.45	39.4
CD (5%)	5.08	7.8	8.95	0.82	1.15	8.78	0.76	6.01
SEm(±)	1.8	2.6	2.81	0.26	0.35	2.6	0.20	2.41

Table 2: Effect of integrated nutrient management on yield parameters of Wheat (pooled data).

Treatments	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	B:C Ratio
T ₁ : control	2.36	2.50	1.72
T ₂ : RDF (120:40:40 kg NPK ha ⁻¹)	3.46	3.63	1.82
T ₃ : 100% NPK through RDF + Bio fertilizer	3.83	3.16	1.99
T ₄ : 75% RDF + 25% NPK through organic sources (FYM)	4.33	4.10	2.03
T ₅ : FYM 5 t/ha + sheep manure 3 t/ha	3.90	3.36	1.51
T ₆ : Incorporation of <i>Kharif</i> rice bran + 75% NPK through RDF	3.26	3.40	1.55
T ₇ : Neem cake @ 120 kg ha ⁻¹ + Poultry manure 2 t ha ⁻¹	3.13	2.70	1.72
CD (5%)	0.79	0.61	—
SEm(+)	0.20	0.23	—

Table 3: Effect of integrated nutrient management on soil properties.

Treatments	N	P	K	OC (%)
	(kg ha ⁻¹)			
T ₁ : control	251	25.7	140.6	0.44
T ₂ : RDF (120:40:40 kg NPK ha ⁻¹)	325	31.2	242.6	0.52
T ₃ : 100% NPK through RDF + Bio fertilizer	341	36.2	228.0	0.42
T ₄ : 75% RDF + 25% NPK through organic sources (FYM)	366	43.2	231.0	0.58
T ₅ : FYM 5 t/ha + sheep manure 3 t/ha	255	29.3	198.0	0.52
T ₆ : Incorporation of <i>Kharif</i> rice bran + 75% NPK through RDF	293	28.9	215.6	0.46
T ₇ : Neem cake @ 120 kg ha ⁻¹ + Poultry manure 2 t ha ⁻¹	271	26.0	241.0	0.47
CD (5%)	69.0	8.9	44.2	NS
SEm(+)	21.2	2.2	16.5	0.047

RESULTS AND DISCUSSION

The aim of our work was to determine how the application of manures and manure combination with mineral fertilizers in soil of the test areas affects yield and straw of winter wheat. The combined application of organic and inorganic fertilizer showed highest plant height (130 cm), highest number of tillers per m² (71) was showed in treatment T₄: 75% RDF + 25% NPK through organic sources (FYM). Dixit and Gupta (2000); Selvakumari *et al.* (2000); Khoshgoftarmansh and Kalbasi (2002) had also concluded that crop growth may be improved by the use of organic materials and Inorganic fertilizers

The highest number of spike per plant (75.10), spike length (8.73 cm) spike lets per spike (14.20), number of grains per spike (63.4) was showed in treatment T₄: 75% RDF + 25% NPK through organic sources (FYM). The maximum spike weight (5.46 g) and the highest 1000 grain weight (56.0 g) was also recorded in T₄: 75% RDF + 25% NPK through organic sources (FYM) compared to all other treatments. However the lowest was recorded in control.

The highest grain yield was recorded in 75% RDF + 25% NPK through organic sources (FYM) (4.33 t ha⁻¹) on other hand, the lowest grain yields were showed in the control (2.36 t ha⁻¹). Combined application of inorganic fertilizers and FYM has showed highest grain yield compared to all other treatments. The highest BC Ratio was recorded in 75% RDF + 25% NPK through organic sources (FYM). The similar effect of the application of manure on the yield of grain was

determined by Zhang *et al.* (2016) and also stated that the lower yield could be caused by the permanent loss of mineralized nitrogen by leaching and processes connected with evaporation which reduce the effect of the nitrogen use. Ayoub *et al.* (1994) reported the increase in yield and yield parameters of wheat with the nitrogen application. Gelato *et al.* (1995) reported that grain yield and biomass yield and yield and most grain yield components increased by increasing N rate. Additionally results showed that the use of chemical fertilizers combination with organic materials (compost) and further enhancement the grain yield. Similar results were obtained by Parmer and Sharma 2002; Sarwar *et al.*, 2007; Sarwar *et al.*, 2008. Besides the positive effect of organic fertilizers on soil structure that lead to better root development that results in more nutrient uptake. Compost not only slowly release nutrients but also prevent the loss of chemical fertilizers through denitrification and volatilization. The simultaneous use of fertilizers and manures increasing the uptake of nutrients by plants is also stated by Beri *et al.*, (1995).

Nutrient status of the soil was significantly increased from initial (before sowing) to harvest in all the treatments. However the highest nitrogen (366 Kg ha⁻¹), Phosphorus (43.2Kg ha⁻¹) content, was recorded in treatment T₄: 75% RDF + 25% NPK through organic sources (FYM). The highest potassium was recorded with RDF ((120:40:40 kg NPK ha⁻¹) which was on par with 75% RDF + 25% NPK through organic sources (FYM). There is no significant difference between treatments for organic carbon content. However the

highest organic carbon content was recorded in 75% RDF + 25% NPK through organic sources (FYM). Addition of various levels of organic manure and compost to wheat compensated for chemical fertilizer, which might give a substitution under field conditions. Previous studies have shown that organic materials (compost, manures) enhances nutrient use efficiency by slow releasing of nutrients and reducing their losses (Rekhi *et al.*, 2000; Chang and Janzen 1996; Paul and Clark 1996; Muneswar *et al.*, 2001; Nevens and Reheul 2003). The addition of organic fertilizers increases phosphorus mobilization and soil microbial activities; it might also contribute in improving nutrition as well as crop root system. The combined use of organic manures and mineral fertilizers leads to an increase of the nitrogen concentration, better use of phosphorus and potassium as a consequences of the improved soil properties, better absorption of water and nutrients from the soil and applied fertilizers (Brar *et al.*, 2015).

CONCLUSION

Combination of bio fertilizer is the best way to achieve high grain yield as well as BC Ratio. The impact of organic manures and inorganic fertilizers on productivity of Wheat was investigated in sandy clay loam soils. The wheat plant height, number of tillers, spike length, straw yield, grain yield and 1000 grain weight all were statistically different from that of control. The findings of the trial suggested that crop productivity may be improved significantly by the combined application of organic manures and inorganic fertilizers.

Conflict of Interest. None.

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