Int.J.Curr.Microbiol.App.Sci (2018) *7*(10): 1892-1902

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 10 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.710.218

Effect of Integrated Nutrient Management on Growth, Yield and Economics of Wheat (*Triticum aestivum* L.) in Inceptisol

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Keywords

INM, Wheat, FYM, PMC, Vermicompost

Article Info

Accepted:
15 September 2018
Available Online:
10 October 2018

A B S T R A C T

The present investigation was undertaken at Post Graduate Research Farm, College of Agriculture, Kolhapur during *rabi* 2016 with the objective to study the effect of integrated nutrient management on growth, yield and economics of wheat in Inceptisol. The experiment was laid out in a randomized block design with three replications and ten treatments. Studies revealed that the growth characters, yield attributes, grain and stover yields were influenced significantly due to conjunctive use of different organic manures with inorganic fertilizers. Amongst different treatments, the highest plant height (91.13 cm), total number of tillers meter^{-1} (412), length of panicle (8.40 cm), number of grains panicle^{-1} (36), thousand grain weight (41.83 g), grain weight panicle^{-1} (1.92 g), grain (43.43 q ha^{-1}) and stover (62.33 q ha^{-1}) yields, gross monetary returns (82.22 thousand₹ . ha^{-1}) and B: C ratio (2.98) were recorded in treatment T_4 i.e. with application of 75% inorganic RDN + 25% RDN through PMC + RD of P_2O_5 and K_2O, which was at par with treatment T_2. The results of the present investigation indicate that it is possible to replace 25% inorganic nitrogen through organic manures *viz*: PMC, VC and FYM with maintaining yield and organic carbon status of soil.

Introduction

Wheat (*Triticum aestivum* L.) is the World's most important widely cultivated food crop. World production of wheat was estimated to be 734.1 million tonnes during 2015-16. Wheat is the staple food crop which occupies important place next to rice in India.

In India, during the past three decades, intensive agriculture involving exhaustive high-yielding varieties of wheat has led to heavy withdrawal of nutrients from the soil. Since then, there was a continuous increase in fertilizer consumption too. Furthermore, imbalanced use of chemical fertilizers by farmers has deteriorated soil health which ultimately laid path for declining productivity.

Integrated nutrient supply is the systematic approach to nutrient management as the combined application of organic and inorganic sources improves the soil fertility and crop productivity (Shree *et al.*, 2014). Remarkable increase in nutrient uptake and yield by integrated nutrient supply has also been reported by Mohanty *et al.*, (2013). In view of this, the present investigation was undertaken

to study the effect of integrated nutrient management on growth, yield and economics of wheat in Inseptisol.

Materials and Methods

The field experiment was carried out during rabi, 2016 in the randomized block design with ten treatments replicated thrice. The sowing of seeds of wheat cv. PhuleSamadhan (NIAW-1994) was done by line sowing by hand at 2-3 cm depth of soil and with line to line spacing of 22.5 cm to maintain uniform plant population. Treatments superimposed were T_1-Absolute control, T_2-RDN + RD of P_2O_5 and K_2O, T_3-75% inorganic RDN + 25% RDN through FYM +RD of P_2O_5 and K_2O, T_4-75% inorganic RDN + 25% RDN through PMC + RD of P_2O_5 and K_2O, T_5-75% inorganic RDN + 25% RDN through Vermicompost + RD of P_2O_5 and K_2O, T_6-50% inorganic RDN + 50% RDN through FYM + RD of P_2O_5 and K_2O, T_7-50% inorganic RDN + 50% RDN through PMC + RD of P_2O_5 and K_2O, T_8-50% inorganic RDN + 50% RDN through Vermicompost + RD of P_2O_5 and K_2O, T_9-100 % RDN through organics (33% FYM + 33% PMC + 33% V.C) + RD of P_2O_5 and K_2O, T_{10}-Green manuring*in situ* of sunnhemp (2:1; wheat: sunnhemp) + RD of P_2O_5 and K_2O. FYM, PMC, Vermicompost were applied as per the treatments 15 days before sowing. Out of total recommended dose of fertilizer (120: 60: 40; N: P_2O_5: K_2O kg ha^{-1}) a basal dose of 60: 60: 40; N: P_2O_5: K_2O kg ha^{-1} was applied through urea, single super phosphate and muriate of potash and different organic manures as per the treatment details, except absolute control. The remaining half dose of nitrogen i.e., 60 kg ha^{-1} was applied at 25 days after sowing through urea except absolute control. At maturity, the observations on ancillary characters were recorded on randomly selected plants in each plot. The wheat crop was harvested when grains were fully matured and straw turned yellow. The total grain and straw yield were recorded. The plant and soil samples collected at harvest were analysed for different parameters by adopting standard procedures.

Results and Discussion

Effect of integrated nutrient management on growth and yield attributes

Data illustrated in Table 1 and graphically depicted in Figure 1, 2 and 3 reveal that the growth and yield of wheat were increased significantly with conjunctive use of different organic manures with inorganic fertilizers over control. The significantly highest number of tillers $meter^{-1}$ (412) was recorded with the treatment T_4 however it was at par with T_5 (407).

The significantly highest number of grains $panicle^{-1}$ was recorded with treatment T_4 (36), however it was at par with T_5 (34). The treatment T_4 recorded significantly more plant height (91.13 cm), however it was at par with T_5 (89.93), T_3 (88.40), T_2 (87.73) and T_7 (84.06). The treatment T_4 recorded significantly highest panicle length (8.40 cm), however it was at par with T_5 (8.20 cm), T_3 (8.06 cm), T_2 (8 cm), T_7 (7.40 cm), T_8 (7.20 cm) and T_6 (7 cm). These results are in confirmative with those reported by Nehra *et al.*, (2001), Bahadur *et al.*, (2013) and Singh *et al.*, (2018).

The significantly highest thousand grain weight was recorded with treatment T_4 (41.83 g), however it was at par with T_5 (41.40 g), T_3 (40.76 g), T_2 (40.30 g), T_7 (39.70 g) and T_8 (39.13 g). The significantly highest grain weight $panicle^{-1}$ was recorded with treatment T_4 (1.92 g), however it was at par with T_5 (1.85 g), T_3 (1.79 g) and T_2 (1.70 g). These results are confirmative with those reported by Bahadur *et al.*, (2013) and Singh *et al.*, (2018).

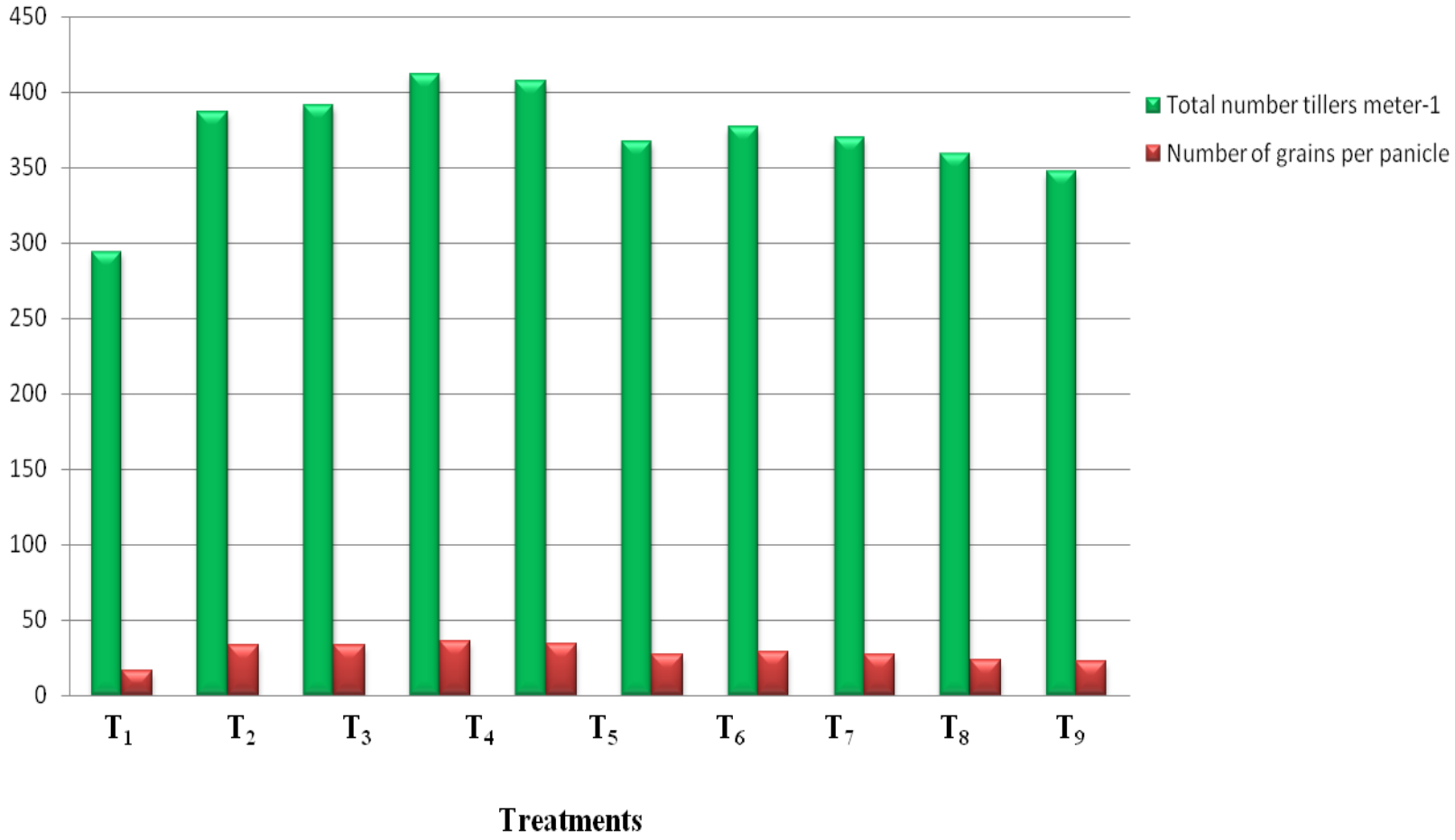

Fig 1. Effect of integrated nutrient management on total number of tillers meter $^{-1}$ and number of grains panicle^{-1} of wheat

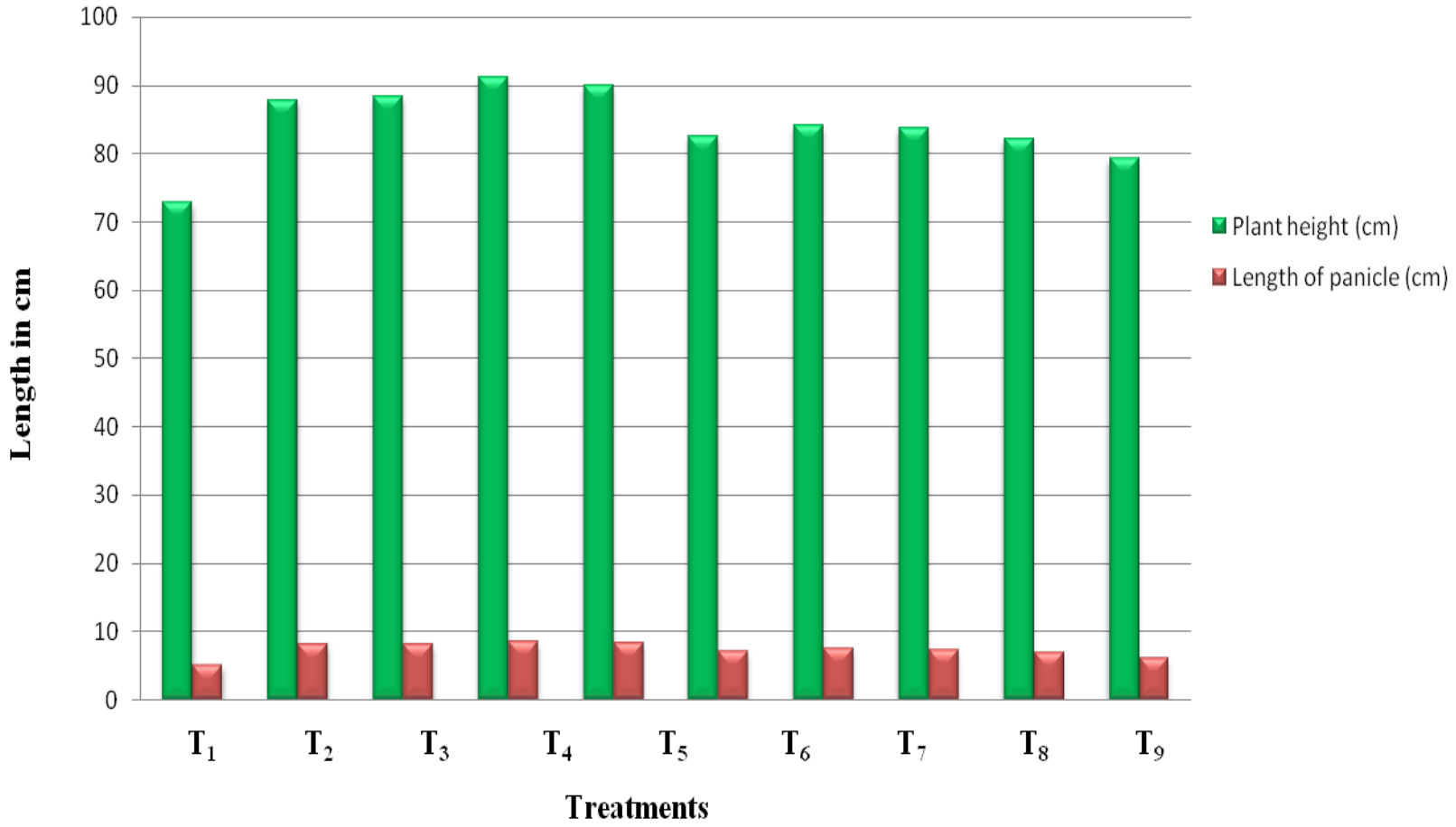

Fig 2. Effect of integrated nutrient management on plant height and length of panicle of wheat

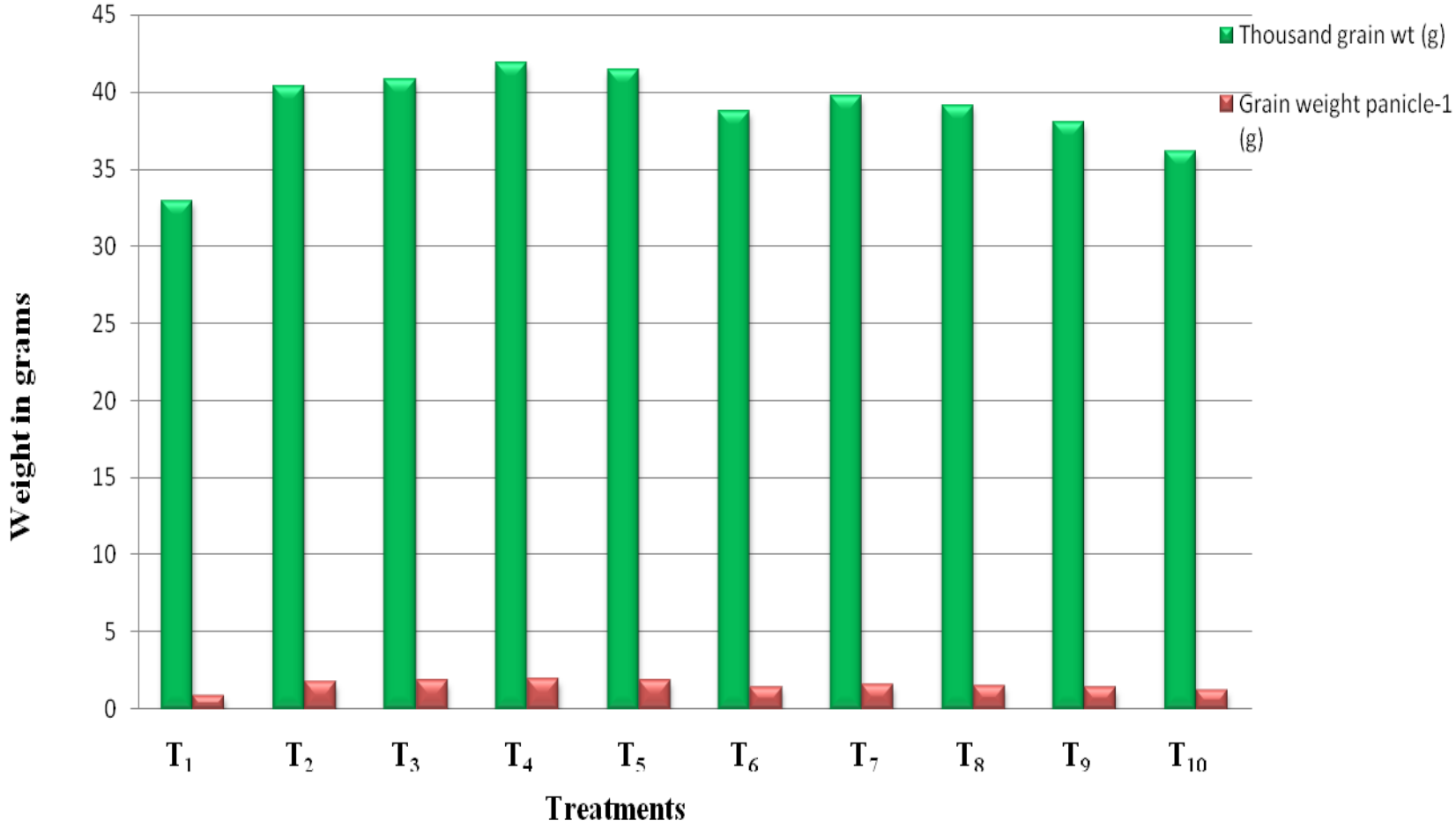

Fig 3. Effect of integrated nutrient management on thousand grain weight and grain weight panicle^{-1} of wheat

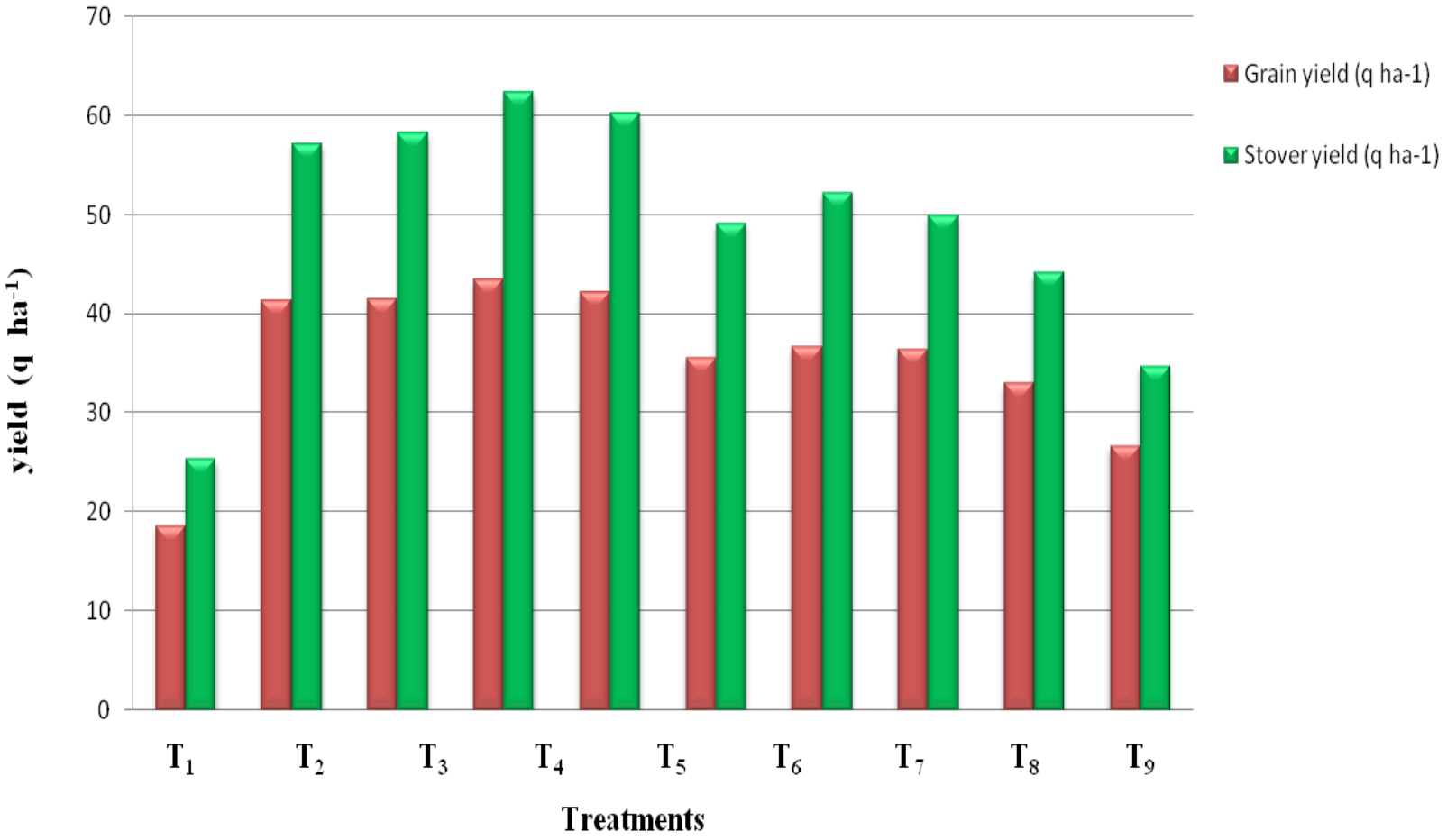

Fig. 4 Effect of integrated nutrient management on grain and stover yields of wheat

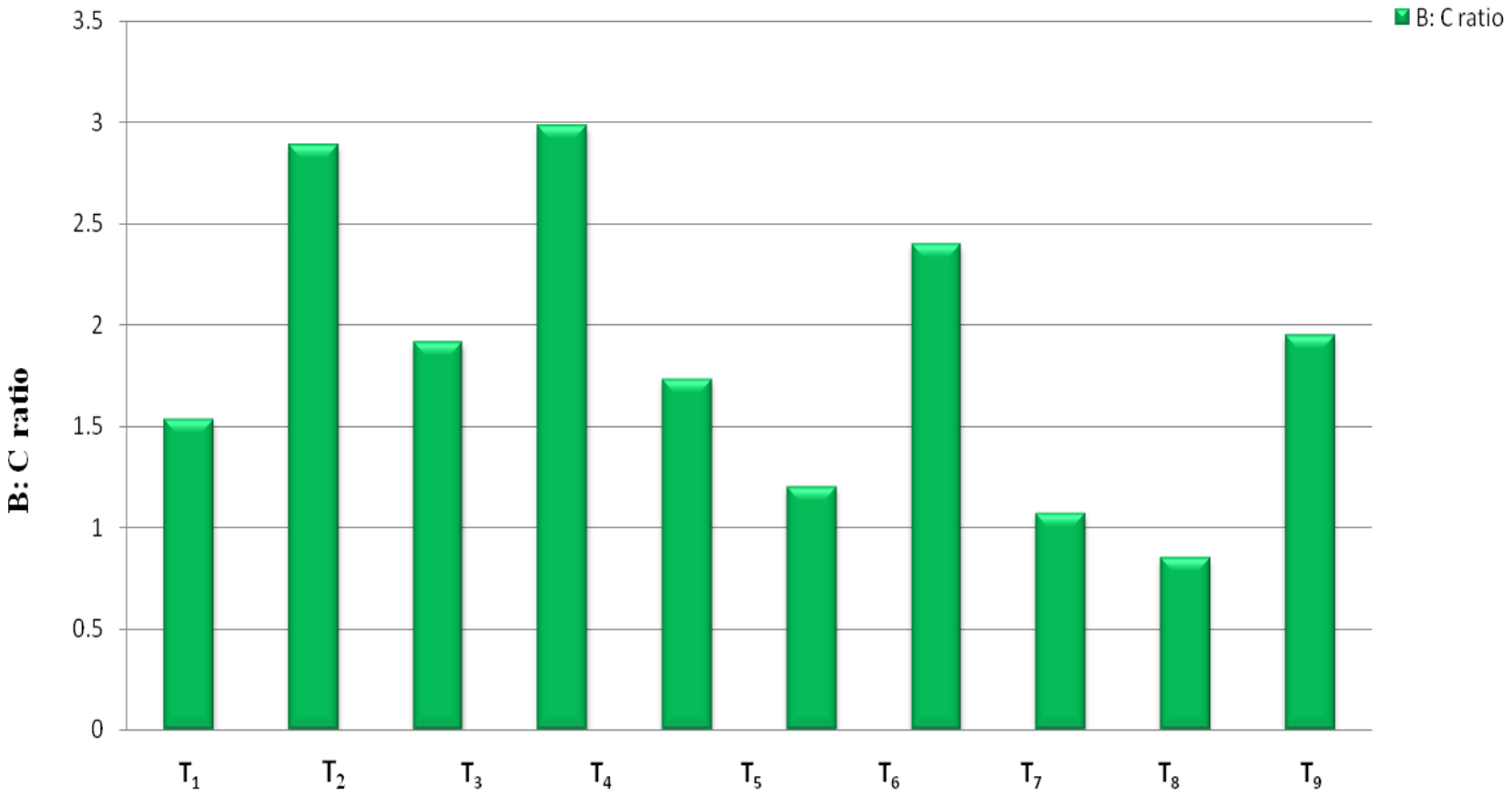

Fig 5. Effect of integrated nutrient management on B: C ratio of wheat

Table.1 Growth and yield attributing characters and yield of wheat as influenced by integrated nutrient management (INM)

Treatment	Total number of tillers meter^{-1}	Number of grains panicle^{-1}	Plant height (cm)	Length of panicle (cm)	Thousand grain wt (g)	Grain weight panicle^{-1} (g)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})
T_1 (Absolute Control)	294	16	72.80	5.06	32.93	0.86	18.56	25.32
T_2 RDN + RD of P_2O_5&K_2O	387	33	87.73	8.00	40.30	1.70	41.27	57.18
T_3 75% RDN + 25% RDN through FYM + RD of P_2O_5& K_2O	391	33	88.40	8.06	40.76	1.79	41.53	58.32
T_4 75% RDN + 25% RDN through PMC + RD of P_2O_5& K_2O	412	36	91.13	8.40	41.83	1.92	43.43	62.33
$T_5$75% RDN + 25% RDN through VC + RD of P_2O_5& K_2O	407	34	89.93	8.20	41.40	1.85	42.15	60.29
T_6 50% RDN + 50% RDN through FYM + RD of P_2O_5& K_2O	367	27	82.53	7.00	38.76	1.42	35.57	49.16
T_7 50% RDN + 50% RDN through PMC + RD of P_2O_5& K_2O	377	29	84.06	7.40	39.70	1.55	36.71	52.28
$T_8$50% RDN + 50% RDN through VC + RD of P_2O_5& K_2O	370	27	83.73	7.20	39.13	1.49	36.46	49.96
$T_9$100% RDN through (33% FYM + 33% PMC + 33% VC) + RD of P_2O_5& K_2O	359	23	82.00	6.86	37.97	1.34	33.00	44.10
T_{10} Green manuring *in situ* (2:1;wheat:sunnhemp) RD of P_2O_5& K_2O	347	22	79.26	6.00	36.09	1.21	26.62	34.77
S.E ±	4.51	0.94	2.39	0.49	0.96	0.09	1.51	1.95
C.D. (P=0.O5)	13.40	2.80	7.12	1.46	2.86	0.27	4.48	5.80

Table.2 Gross monetary returns, cost of cultivation, net monetary returns and B: C ratio of wheat crop as influenced by integrated nutrient management (INM)

Treatment	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Gross monetary returns (thousand ₹ . ha^{-1})	Cost of cultivation (thousand ₹ . ha^{-1})	Net monetary returns (thousand ₹ . ha^{-1})	B:C ratio
T_1 (Absolute Control)	18.56	25.32	35.02	22.83	34.15	1.53
T_2 RDN + RD of P_2O_5& K_2O	41.27	57.18	75.94	26.21	49.73	2.89
T_3 75% RDN + 25% RDN through FYM + RD of P_2O_5& K_2O	41.53	58.32	78.33	40.84	37.48	1.91
T_4 75% RDN + 25% RDN through PMC + RD of P_2O_5& K_2O	43.43	62.33	82.22	27.51	54.71	2.98
$T_5$75% RDN + 25% RDN through VC + RD of P_2O_5& K_2O	42.15	60.29	79.79	44.90	34.88	1.77
T_6 50% RDN + 50% RDN through FYM + RD of P_2O_5& K_2O	35.57	49.16	67.17	55.48	11.69	1.20
T_7 50% RDN + 50% RDN through PMC + RD of P_2O_5& K_2O	36.71	52.28	69.48	28.81	40.65	2.40
$T_8$50% RDN + 50% RDN through VC + RD of P_2O_5& K_2O	36.46	49.96	68.80	63.57	05.23	1.07
$T_9$100% RDN through (33% FYM + 33% PMC + 33% VC) + RD of P_2O_5& K_2O	33.00	44.10	62.15	72.35	0.21	0.85
T_{10} Green manuring *in situ* (2:1;wheat:sunnhemp) RD of P_2O_5& K_2O	26.62	34.77	50.07	25.59	21.81	1.95
S.E ±	1.51	1.95	2.74	-	6.67	0.08
C.D. (P=0.05)	4.48	5.80	8.16	-	19.84	0.26

Effect of integrated nutrient management on grain and stover yield

The significantly highest grain (43.43 q ha^{-1}) and Stover (62.33 q ha^{-1}) yields of wheat were recorded in treatment T_4 and it was at par with T_5, T_3 and T_2 as shown in Table 1 and graphically depicted in Figure 4. The results are confirmative with Bahadur *et al.*, (2012).

The significantly highest grain and stover yields of wheat were recorded in the treatments receiving 25% GRDN through organic manures *viz*., FYM, PMC and VC which might be due to proper supply of N at different growth stages of wheat and other beneficial and favourable effect of organic manures on soil properties. Further substituting 50% inorganic N with organic N through different organic manures significantly reduced the grain and stover yield of wheat however, the yields were significantly higher than 100% RDN through organic manures (T_9) and green manuring of sunnhemp *in situ* (T_{10}).

The green manuring of sunnhemp in wheat increased the grain and stover yield of wheat

significantly over absolute control (T_1) indicating the favourable effect of green manuring on soil and crop. These results are confirmative with those reported by Singh *et al.,* (2018), Prasad *et al.,* (2010) and Sharma *et al.,* (2016), who also reported increase in grain and stover yields of wheat with integrated use of inorganic fertilizers and organic manures.

Gross monetary returns, net monetary returns and B: C ratio as influenced by integrated nutrient management

Gross monetary, cost of cultivation, net monetary returns and B: C ratio as influenced by different treatments are presented in Table 2 and graphically depicted in Figure 5.

The significantly highest gross monetary returns were obtained in treatment T_4 (82.22 thousand ₹ . ha^{-1}) but it was at par with T_5, T_3 and T_2. The cost of wheat cultivation was significantly highest in treatment T_9 (72.35 thousand ₹ . ha^{-1}). The highest cost of cultivation in T_9 treatment was due to application of 100% RD of nitrogen was supplied through organic manures where the cost of vermicompost and Farm Yard Manures were very high ₹ .8000 t^{-1} and ₹ .2500 t^{-1}, respectively. The significantly highest B: C ratio (2.98) was recorded in T_4 (75% RDN + 25% RD of nitrogen through PMC + RD of P_2O_5 and K_2O). These results are confirmative with Ram *et al.,* (2014) and Singh *et al.,* (2016).

There was significant increase in plant height, number of tillers $meter^{-1}$, length of panicle, thousand grains weight, grain weight $panicle^{-1}$, number of grains $panicle^{-1}$, grain and stover yield over the control due to integrated application of organic manures with inorganic fertilizers. The highest B: C ratio was recorded with treatment T_4 (75% RDN + 25% RD of nitrogen through PMC + RD of P_2O_5 and K_2O) however it was at par with treatment T_2 (RDN + RD of P_2O_5 and K_2O). The substitution of 25% RDN through press mud cake significantly increased all the growth parameters, grain and stover yield of wheat. The results of the present investigation indicate that it is possible to replace 25% inorganic nitrogen through organic manures *viz.,* PMC, VC and FYM with maintaining yield and organic carbon status of soil.

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How to cite this article:

Reddy Tummala, K., R.B. Pawar and Patil, D.S. 2018. Effect of Integrated Nutrient Management on Growth, Yield and Economics of Wheat (*Triticum aestivum* L.) in Inceptisol. *Int.J.Curr.Microbiol.App.Sci.* 7(10): 1892-1902. doi: https://doi.org/10.20546/ijcmas.2018.710.218