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Gurjeet Singh
M.sc. Scholar, Rama University, Kanpur, Uttar Pradesh, India

Ravikesh Kumar Pal
Assistant Professor, Department of Agronomy, Rama University Kanpur, Uttar Pradesh, India

Naveen Kumar Maurya
Assistant Professor, Department of Agronomy, Rama University, Kanpur, Uttar Pradesh, India

Devashish Mishra
M.sc Scholar, Chaudhary Charan Singh University, Meerut, Uttar Pradesh, India

Raj Yadav
M.sc. Scholar, Rama University, Kanpur, Uttar Pradesh, India

Corresponding Author:
Gurjeet Singh
M.sc. Scholar, Rama University, Kanpur, Uttar Pradesh, India

Effect of integrated nutrient management on growth, yield and economics of timely sown wheat (*Triticum aestivum* L.)

Gurjeet Singh, Ravikesh Kumar Pal, Naveen Kumar Maurya, Devashish Mishra and Raj Yadav

Abstract
A field experiment was conducted during rabi season of 2022-23 at Rama University, Kanpur to study the effect of integrated nutrient management on growth, yield and economics of timely sown wheat (*T. aestivum* L.) CV. K 1006. There was total 9 treatments with three replication consist in a randomized block design. Under the investigation, significantly highest plant height, number of tiller (m^{-2}), number of grains per ear, grain yield and straw yield (kg ha^{-1}), biological yield (q/ha) were found superior under the treatment T_1 (RDF 100%), at par with treatments RDF = 50% + FYM 25% + VC 25% (T8), RDF = 60% + FYM 20% + VC 20% (T7) overall other treatments.

Keywords: INM, growth, yield, economics wheat

Introduction
Triticum aestivum L. a member of the Poaceae family, is one of the most important cereal crops in the world and is regarded as a crucial component of the food security systems of many nations worldwide. Wheat is a *Rabi* season crop and will be sown from November to December. It is the cereal that is grown the most around the world and contributes about 19% of our total daily caloric intake. It ensures both food security and extensive adaptation to varied agro-climatic settings. It is an excellent dietary grain for boosting health since it contains large amounts of minerals and vitamins, 78% carbohydrates, 11–12% protein, and 2% fat, Wheat is typically milled into flour which is then used to make a wide range of foods including bread, crumpets, muffins, noodles, pasta, biscuits, cakes, pastries, cereal bars, sweet and savoury snack foods. Almost every country in the world has some form of wheat-based bread, soup, or mixed dish in its culture.

Since it is unlikely that the land area planted to wheat will increase, the majority of this output requirement will have to be met by raising productivity. The two key elements that can aid in accomplishing the goal are effective input management and varietal improvement. At the time of grain filling, the ideal average temperature is between 25 and 30 °C. The temperature during ripening and development is extremely important for yield. Grain weight tends to decrease at temperatures over 25 °C Wheat contains more protein in the form of gluten than other cereals crop.

India is lucky to have both a climate that is perfect for growing crops and fertile territory. Wheat production is currently at the second-highest rate in the world as a result. There are still a lot of factors at play in this country that contribute to the low average wheat output. One of these environmental problems is improper planting, which significantly reduces the production of wheat crops. Another significant issue is that, because of the crop's exceptionally brief growing season and short maturity, improved cultivars are perfect for late sowing conditions. In late-sown conditions, cultivars differ in yield and nutrient uptake as well. As a result of focused and ongoing development, several high yielding wheat genotypes have been developed. The more recent high producing varieties do well even when cultivated late because of their relative thermo sensitivity. The low temperatures in December and January make short duration high yielding wheat the most competitive and profitable crop. The present analysis was conducted with this idea in mind to determine the water need of wheat crop. Thus, scientists brought the concept of Integrated nutrient management to provide adequate amount of nutrients to the crop individually or in combination with inorganic sources but the aim is to conserve the soil and environment to maximum extent.

Method and Materials

The field experiment was carried out during the winter season of 2022-23 at Rama University, Kanpur. Geographically experimental site is situated at 25° 56' to 28° 58' N latitude and 79° 31' to 80° 34' E longitude with an altitude of 125.9 m above the mean sea level in Indo-gangetic regions of eastern Uttar Pradesh. The experimental site was fairly uniform in topography and well drained, the total rainfall was recorded 5.4 mm besides the crop was irrigated four times, coinciding with the critical stages of the plant growth. The average weekly maximum and minimum temperatures during the crop growing period ranged from 5.3 to 36.1 °C. The relative humidity ranged between 30.2 to 97 per cent, The mean sunshine hours ranged from 3.6 to 9.9 hours with an average of 7.15 hours. The soil was silt loam in texture with 7.7 pH. The experiment consisted of 12 treatments *viz.* T_1 i.e. RDF 100%, T_2 i.e. VC 100%, T_3 i.e. FYM 100%, T_4 i.e. RDF = 90% + FYM 10%, T_5 i.e. RDF = 80% + FYM 10% + VC 10%, T_6 i.e. RDF = 70% + FYM 15% + VC 15%, T_7 i.e. RDF = 60% + FYM 20% + VC 20%, T_8 i.e. RDF = 50% + FYM 25% + VC 25%, T_9 i.e. Control (No fertilizer). Half of nitrogen and full dose of phosphorus and potash were applied at the time of sowing as per the treatment combination. The remaining nitrogen as per treatment was top dressed after first irrigation. N, P, and K were applied through urea. DAP and muriate of potash respectively. The crop received four irrigations (at CRI, flowering, milking and dough stages). Organic carbon, pH, available N, P, K of soil and N, P, K content in plant were estimated by standard methods. Dhaka, B. R. and Pathan, A. R. K. (2013) [6]. Response of wheat to integrated nutrient management in typic ustipsamment. Annals of Plant and Soil Research. 15 (1):50-53.

Results and Discussion

Growth Parameters: The data on plant height, number of tiller (m^{-2}) under different treatments have been showed in the table 1. The plant height, number of tiller (m^{-2}) at all growth stages was significantly influenced by different treatments. Application of RDF 100% (T1) produced highest plant height, number of tiller (m^{-2}), and it were at par with to application of RDF = 50% + FYM 25% + VC 25% (T8), RDF = 60% + FYM 20% + VC 20% (T7). The greater availability of nutrients in soil due to increasing application might have enhanced multiplication and elongation of cells leading to increased number of tillers and leaf area index. Significantly improvement in chlorophyll content in leaves might have resulted in better interception and utilization of solar energy leading to higher photosynthetic rate and finally more accumulation of dry matter by the crop. These results are in line with the Sharma and Jain, 2014 under wheat-based cropping system and Bhagwati *et al*., 1992 [4] also reported to responses of nitrogen on wheat.

Yield parameters: The data on number of grains per ear, grain yield and straw yield (kg ha^{-1}), biological yield (q/ha) under different treatments have been showed in the table 2. The number of grains per ear, grain yield and straw yield (kg ha^{-1}), biological yield (q/ha) at all yield stages was significantly influenced by different treatments. Application of RDF 100% (T1) produced maximum number of grains per ear, grain yield and straw yield (kg ha^{-1}), biological yield (q/ha) and it were at par with to application of RDF = 50% + FYM 25% + VC 25% (T8), RDF = 60% + FYM 20% + VC 20% (T7). This might be due to adequate quantities and balanced proportions of plant nutrients supplied to the crop as per need during the growth period resulting in favourable increase in yield attributing characters which ultimately led towards an increase in economic yield. Similar results were reported by Devi *et al*. (2011) [5]. These results are in agreement to the findings of Kumar and Singh (2010) [6] and Rather and Sharma (2009) [7].

Table 1: Effect of different treatment combinations on plant height –

Treatments	Plant height(cm)			
	30 DAS	60 DAS	90 DAS	Harvesting
T1 - RDF 100% (UREA, D.A.P, M.O.P)	25.02	53.84	94.82	92.75
T2 - VC 100%	22.35	42.18	78.36	78.36
T3 - FYM 100%	22.59	43.10	79.50	78.95
T4 - RDF = 90% + FYM 10%	22.69	44.29	80.91	80.78
T5 - RDF = 80% + FYM 10% + VC =10%	22.78	44.38	83.43	81.54
T6 - RDF = 70% + FYM 15% + VC 15%	23.57	48.47	89.46	85.63
T7 - RDF = 60% + FYM20% + VC 20%	24.33	48.56	91.76	89.20
T8 - RDF = 50% + FYM25% +VC 25%	24.77	52.17	93.22	91.78
T9 - Control (No. Fertilizer)	22.20	42.12	78.21	78.16
SEm±	0.255	0.496	0.960	0.853
C.D. (P=0.05)	NS	1.499	2.904	2.578

Table 2: Number of tillers(m^{-2}) -

Treatments	Number of tillers(m^2)Row			
	30DAS	60DAS	90DAS	At harvesting
T1 - RDF 100% (UREA, D.A.P, M.O.P)	66.18	93.87	94.19	92.24
T2 - VC 100%	51.49	81.59	81.49	78.29
T3 - FYM 100%	52.56	82.46	85.36	79.49
T4 - RDF = 90% + FYM 10%	53.94	85.71	86.71	81.32
T5 - RDF = 80% + FYM 10% + VC =10%	55.36	86.88	87.25	83.45
T6 - RDF = 70% + FYM 15% + VC 15%	56.45	87.82	87.64	86.96
T7 - RDF = 60% + FYM20% +VC 20%	59.71	89.92	89.72	89.70
T8 - RDF = 50% + FYM25% +VC 25%	64.49	92.99	92.49	90.46
T9 - Control (No. Fertilizer)	51.17	81.32	80.20	78.16
SEm±	0.830	0.942	0.946	0.958
C.D. (P=0.05)	2.508	2.848	2.859	2.896

Table 3: Yield Attributing parameters -

Treatments	No. of grains ear[1]
T1 - RDF 100% (UREA, D.A.P, M.O.P)	38.16
T2 - VC 100%	33.50
T3 - FYM 100%	33.79
T4 - RDF = 90% + FYM 10%	35.67
T5 - RDF = 80% + FYM 10% + VC =10%	35.83
T6 - RDF = 70% + FYM 15% + VC 15%	35.88
T7 - RDF = 60% + FYM20% + VC 20%	36.08
T8 - RDF = 50% + FYM25% + VC 25%	36.42
T9 - Control (No. Fertilizer)	32.34
SEm±	0.363
C.D. (P=0.05)	1.097

Table 4: Effect of different treatment combinations on productivity parameters -

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological Yield (q ha^{-1})
T1 - RDF 100% (UREA, D.A.P, M.O.P)	55.48	84.02	139.50
T2 - VC 100%	44.29	75.68	119.97
T3 - FYM 100%	44.46	76.49	120.95
T4 - RDF = 90% + FYM 10%	45.53	77.48	123.01
T5 - RDF = 80% + FYM 10% + VC 10%	46.97	77.94	124.91
T6 - RDF = 70% + FYM 15% + VC 15%	49.21	78.98	128.19
T7 - RDF = 60% + FYM 20% +VC 20%	50.36	79.59	129.95
T8 - RDF = 50% + FYM 25% +VC 25%	53.87	80.81	134.68
T9 - Control (No. Fertilizer)	44.16	74.23	118.39
SEm±	0.575	0.796	1.365
C.D. (P=0.05)	1.739	NS	4.128

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