A STUDY OF THE EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON YIELD ATTRIBUTES AND YIELDS OF WHEAT AND ITS RESIDUAL EFFECT ON SUCCEEDING GREEN GRAM

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Abstract

The sandy loam soil and gentle slope of the test plot allowed for adequate water drainage. The top fifteen centimetres of the soil in the experimental field had a slightly alkaline response, was low in organic carbon and accessible nitrogen, and was medium in available phosphorus and potassium. In both 2018 and 2019, integrated nutrition management treatments had no detectable influence on plant population (per metre of row length) at either 30 DAS or harvest. There was no significant difference in plant height at 30 DAS between the integrated nutrition management treatments in either 2018–19 or 2019–20, or in the pooled result.

Keywords: *Integrated Nutrient, Management, Attributes, Wheat, Residual, Green Gram.*

1. Introduction

Cereals, which come from the grass family (Poaceae), are cultivated for their starchy seeds. About half of the world's arable land is devoted to growing the main grains. 56% of the dietary calories and 50% of the protein eaten on Earth come from wheat, rice, maize, barley, oat, rye, sorghum and millet. Three-quarters of the world's grain supply is comprised of three staples: wheat, rice, and maize. The world's remaining cereal grain output consists of sorghum, barley, millet, rye, and oat.[1]

After rice, wheat is India's most widely grown and consumed staple grain. India accounts for around 12% of global wheat production. Wheat is cultivated in India over 31.61 million hectares, yielding 109.52 million metric tonnes at a productivity of 3,502 kilos per hectare. Gujarat's 1.35 million hectares of wheat fields yield 3.40 million tonnes annually at productivity of 3019 kilogrammes per hectare. It is important to note that the states of Uttar Pradesh, Punjab, Haryana, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, New Delhi, and Bihar are all major wheat producing regions in India.[2]

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During 2018-19, wheat yields in Uttar Pradesh were 30.25 million tonnes, in Punjab they were 17.04 million tonnes, in Madhya Pradesh they were 13.93 million tonnes, and in Gujarat they were 3.65 million tonnes. The most important districts in Gujarat for wheat production are Junagadh, Rajkot, Ahmedabad, and Sabarkantha. In order to catch up to Punjab's production (5-6 t ha-1), the productivity of wheat in Gujarat is predicted to improve by 10% (3.5 t ha-1).[3]

Wheat, as compared to other cereals, has a relatively high nutrient content. It has 11.80% protein, 1.50% fat, 1.500% carbohydrates, 1.500% minerals, 0.05% calcium, and 0.32% phosphorus. Wheat grain is also used in the production of alcohol, oil, and gluten among other things. Wheat straw is used for a wide variety of purposes, including but not limited to animal feed, bedding, hats, paper, and even art.[4]

The Triticum aestivum, Triticum durum, and Triticum dicoccum species of wheat are the most widely grown types. Both Triticum aestivum and Triticum durum are major crops in Gujarat. The Bhal tract of the state is where Triticum durum, commonly known as Bhalia wheat, is produced, whereas the Mehsana, Banaskantha, Sabarkantha, Kheda, and Saurashtra regions are where Triticum aestivum (Bread wheat) is mostly farmed. Triticum durum wheat is the standard for making suji and semya. South Indian granular food "Uppumav" is traditionally made from Triticum dicoccum, which is grown and harvested in the Ghed area.[5]

Cereal-cereal cropping is the most important system that contributes to the national food supply. However, when cereals and other crops are grown in the same year on the same plot of land, the soil fertility becomes unbalanced and the output of both crops decreases. Increasing the use of fertilizers every year to produce the greatest harvest possible degrades the soil. In recent years, the value of crop and legume residues in maintaining soil fertility has increased. The cereal-legume farming approach has damaged soil health because it does not leave enough crop residues to sustain the necessary level of organic matter. The kharif and summer seasons are ideal for growing green grame (Vigna radiata L.), making it a double-crop. Soil fertility is increased by biological nitrogen fixing and organic matter decomposition. The crop is most suited for growing on residual fertility following wheat harvest, since it can survive on marginal areas with little inputs, such as fertilisers and water.[6-7]

2. Literature review

Desai, H. A. & Patel, H. K. (2020) For two growing seasons (2016–17 and 2017–18), researchers at the Students Instructional Farm (SIF) of the College of Agriculture at the Chandra Shekhar Azad University of Agriculture and Technology in Kanpur observed wheat growth and found that applying 100% of the soil test recommendation (STR) for nitrogen, phosphorus, and potassium (NPK) plus 5% of the annual fertiliser yield (FYM) increased plant height (79.07 cm) and dry matter accumulation (18.27 cm). Dry matter production was highest under 100% STR + PSB+ FYM @ 5 t ha-1, perhaps as a result of an increase in leaf area, photosynthetic rate, and carbohydrate buildup in plants.[8]

Bhawana, S. (2019) The present research were carried out over the course of two consecutive rabi seasons (2013-14 and 2014-15) at SIF, C.S. Azad University of Agriculture and Technology, Kanpur to ascertain the effect of vermicompost, FYM, and chemical fertiliser on the growth of late-sown wheat. RDF (100%) + vermicompost @ 5.0 t ha-1 produced the tallest plants (78.78 cm) as compared to other treatments. Increases in both fresh (28.80 g) and dried (22.27 g) plant weight were seen when the optimal dose of fertiliser (100%) was combined with vermicompost @ 5.0 t ha-1.[9]

Fazily, T. & Sharma, M. K. (2018) Researchers in the rabi season of 2011-12 examined the effects of several nutrient management techniques on the growth of wheat at the agricultural farm of Palli Siksha Bhavana, Visva- Bharati, Sriniketan (West Bengal). At harvest time, the 125% RDF treatment produced the tallest plants, followed by the 75% and 100% RDF treatments. The similar trend was seen for the accumulation of dry materials. Dry matter accumulation was highest for 125% RDF, followed by PSB+ Azotobacter, and lowest for PSB and Azotobacter.[10]

Chandrakumar, K. & Pujari, B. T. (2017) The utilization of organic manure as a sustainable source of plant nutrients is gaining relevance due to the ongoing global energy crisis and the skyrocketing price of artificial fertilizer. Soil health and crop yields both depend on using the right proportions of organic manure and inorganic fertilizer in this endeavour. Soil deterioration caused by farmers' persistent use of chemical fertilizers is having a negative impact on harvests. Incorporating organic matter into soils in addition to inorganic fertilisers has been shown to boost crop yields, improve fertiliser efficiency, and maintain soil health over the long term . Since fertiliser is one of the most expensive inputs in crop production, figuring out how to utilise it economically is crucial.[11]

Essam, A., & Lattief, A. E. (2016) The cereal wheat (Triticum aestivum) is grown in more places than any other plant. After rice, it is India's second-most-important food crop, producing over 25% of the country's total food grain. Wheat has played a significant role in maintaining the country's food grain production during the last several years. Wheat production has increased significantly, although it is still much below the potential yield of 11.2 tha-1. India is able to satisfy its food grain requirements, but the country has not yet reached its primary goal of providing food and nutritional security to all of its citizens. More individuals are predicted to enter the middle class as a result of economic and social progress, driving up demand for staple foods.[12]

3. Methodology

3.1 Experimental site

To achieve these aims, a field experiment was conducted in 2019–20 and 2020–21 during the Rabi (Wheat) and summer (Green gramme) seasons at Gujarat research center.

3.2 Varietal description

3.2.1 Wheat

The Central Sub Committee on crop standards, notification and release of varieties for agricultural crops (CVRC) notified the new high-yielding wheat variety GW 452 in S.O. 2239 (E) dated 29th June 2019 for timely sowing in irrigated circumstances in the state of Gujarat.

3.2.2 Green gram

This type features a green stem with purple splashes and a semi-erect growing habit. The leaves are a deep green shade, and each one has a purple vein running through it. It's an early-ripening cultivar (60-65 days) with a tall pod and a high seed count (10-12 seeds per pod). It can withstand Yellow Mosaic Virus (YMV) attacks quite well. The cultivar has a weight of 5.1 grammes per hundred seeds. When compared to the control GM-4, the grains had a greater concentration of total carbs (24.33%) and total soluble sugar (17.62%).

3.3 Experimental Design

A Randomised Block Design (RBD) including four replicates was used to plan the experiment. Forty plots were used to assess the residual impact of 10 treatments of integrated nutrient management on the summer crop of green gramme that followed the rabi wheat. Both spring and autumn trials were done at the same location, with the only difference being the timing of the randomization of the medications. The experimental field was left barren throughout the summer months.

3.4 Statistical analysis

Using the randomised block design method described by Cocharan and Cox (1958), statistical analysis was performed on data pertaining to several elements of the wheat crop. At the 5% level of significance, the derived "F" values were compared to the "F" values in the table. We also determined the standard error of the mean (S. Em) and the coefficient of variation (C.V.%).

4. Results

Effect of integrated nutrient management on yield attributes and yield of wheat (Triticum aestivum L.) and its residual effect on succeeding green gramme (Vigna radiata L.)," the current study was conducted during the rabi-summer seasons of 2018-2019 and 2018-19. Data from both individual years and a summary of all four showed that integrated nutrient managements had no meaningful effect on plant population at 30 DAS or at harvest (Table 4.1).

Table 4.1: The effect of comprehensive nutrition management treatments on the population of wheat plants at 15 DAS and harvest

Treatment	Plantpopulation (Numberofplantspermetrerowlength)					
	15DAS			Harvest		
	2018-19	2019-20	Pooled	2018-19	2019-20	Pooled
T_1:120:60:00NPkgha^{-1}(RDF)	44.84	44.91	44.87	41.65	41.38	41.51
T_2:120:60:40NPKkgha^{-1}	44.85	44.97	44.91	41.70	41.45	41.58
T_3: 120:60:00 NP kg ha^{-1} (RDF)+FYM@10 tha^{-1}	45.23	45.37	45.30	42.14	41.68	41.91
T_4:120:60:00NPkgha^{-1}(RDF) +FYM@5tha^{-1}+NPK consortium	46.12	47.13	46.63	43.33	42.90	43.11

T_5:120:60:00NPkgha^{-1}(RDF) +FYM@5tha^{-1}+NPK consortium + Sulphur @ 20kgha^{-1} (gypsum)+10kgha^{-1}$ZnSO_4$	50.90	49.54	50.22	45.30	44.51	44.91
T_6:90:45:40NPKkgha^{-1}+ FYM @1.5tha^{-1}	42.98	43.12	43.05	39.63	39.83	39.73
T_7:90:45:00NPkgha^{-1}+FYM @2.5tha^{-1}	43.33	43.86	43.59	39.83	40.28	40.05
T_8:90:45:00NPkgha^{-1}+FYM @10 t ha^{-1}	44.29	44.08	44.18	40.72	41.13	40.92
T_9:90:45:00NPkgha^{-1}+FYM @ 5 t ha^{-1} + NPKconsortium	44.25	43.91	44.08	40.65	40.75	40.70
T_{10}:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+NPK consortium+Sulphur@20kgha^{-1}(gypsum)+10 kgha^{-1}$ZnSO_4$	44.61	44.75	44.68	41.42	41.15	41.28
S.Em. ±	2.24	2.15	1.55	2.12	1.99	2.06
C.D.at5%	NS	NS	NS	NS	NS	NS
C.V.%	9.94	9.51	9.73	10.17	9.59	9.89
Y						
S.Em. ±			0.69			0.65
C.D.at5%			NS			NS
YxTInteraction						
S.Em. ±			2.20			1.45
C.D.at5%			NS			NS

Table 4.2 displays information for the 2018–19 and 2019–20 academic years and a pooled total for the impacts of integrated nutrient management treatments on electric conductivity of soil after wheat crop harvest.

Table 4.2 shows that after harvesting wheat in 2019 and 2020, there were no statistically significant variations in electric conductivity as a consequence of integrated nutrition management treatments. After two years of 120:60:00, there was a 0.327 dS m-1 increase in soil electric conductivity. NPK partnerships + 20 kg ha-1 gypsum + 10 kg ha-1 ZnSO4 (T5) + NP kg ha-1 (RDF) = 100 kg ha-1 total fertilizer. It was statistically inferior only to treatments T7, T8, and T9.

Table 4.2: Treatments for integrated nutrition management and their effects on electrical conductivity

Treatment	Electricalconductivity(dSm^{-1})		
(Initialvalue:0.321)	**2018-19**	**2019-20**	**Mean**
T_1:120:60:00NPkgha^{-1}(RDF)	0.324	0.322	0.323
T_2:120:60:40NPKkg ha^{-1}	0.324	0.323	0.323
T_3:120:60:00NPkgha^{-1}(RDF)+FYM@10 tha^{-1}	0.326	0.324	0.325
T_4:120:60:00NPkgha^{-1}(RDF)+FYM@5t ha^{-1}+NPKconsortium	0.328	0.324	0.326
T_5:120:60:00NPkgha^{-1}(RDF)+FYM@5t ha^{-1}+NPK consortium+Sulphur@20 kgha^{-1}(gypsum)+10kgha^{-1}$ZnSO_4$	0.328	0.325	0.327
T_6:90:45:40NPKkgha^{-1}+FYM@1.5tha^{-1}	0.317	0.318	0.317
T_7:90:45:00NPkgha^{-1}+FYM@2.5tha^{-1}	0.320	0.319	0.320
T_8:90:45:00NPkgha^{-1}+FYM@10tha^{-1}	0.321	0.321	0.321
T_9:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+ NPKconsortium	0.320	0.321	0.320
T_{10}:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+ NPKconsortium +Sulphur@20kgha^{-1} (gypsum)+10kgha^{-1}$ZnSO_4$	0.322	0.321	0.322
S.Em. ±	0.003	0.003	
C.D.at5%	NS	NS	
C.V.%	1.60	1.90	

In Table 4.3, we can see how the integrated nutrient management treatments affected the soil pH after the wheat crop was harvested in 2018–19, 2019–20, and on a mean of two-year basis.

Table 4.3 shows that in 2019 and 2020, after harvesting wheat, there were no statistically significant variations in pH caused by integrated nutrition management treatments.

Table 4.3: Effects of Integrated Nutrient Management on Soil pH

Treatment	pH		
(Initialvalue:7.11)	**2018-19**	**2019-20**	**Mean**
T_1:120:60:00NPkgha^{-1}(RDF)	7.61	7.54	7.58
T_2:120:60:40NPKkgha^{-1}	7.68	7.55	7.62
T_3:120:60:00NPkgha^{-1}(RDF)+FYM@10 tha^{-1}	7.75	7.62	7.68
T_4:120:60:00NPkgha^{-1}(RDF)+FYM@5t ha^{-1}+NPKconsortium	7.86	7.68	7.77
T_5:120:60:00NPkgha^{-1}(RDF)+FYM@5t ha^{-1}+ NPK consortium+ Sulphur@20kgha^{-1}(gypsum)+10kgha^{-1}$ZnSO_4$	7.99	7.69	7.84
T_6:90:45:40NPKkgha^{-1}+FYM@1.5tha^{-1}	7.16	7.17	7.17
T_7:90:45:00NPkgha^{-1}+FYM@2.5tha^{-1}	7.48	7.49	7.49
T_8:90:45:00NPkgha^{-1}+FYM@10tha^{-1}	7.56	7.50	7.53
T_9:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+ NPKconsortium	7.52	7.49	7.51
T_{10}:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+ NPK consortium +Sulphur@20kgha^{-1} (gypsum)+10kgha^{-1}$ZnSO_4$	7.57	7.50	7.54
S.Em. ±	0.16	0.15	
C.D.at5%	NS	NS	
C.V.%	4.27	4.10	

Table 4.4 displays the changes in soil electrical conductivity following green gramme harvest in 2019 and 2020, as well as the average of these two years, as a function of the integrated nutrient management treatments used.

Table 4.4 shows that there were no statistically significant variations in electrical conductivity of soil between 2019 and 2020 as a result of implementing integrated nutrient management. Electrical conductivity (0.354 dS m-1) was statistically similar with all the treatments except for T6 (90:45:40 NPK kg ha-1 + FYM @ 1.5 t ha-1) and T7 (90:45:00 NP kg ha-1 + FYM @ 2.5 t ha-1). This was based on the mean of two individual years of application.

Table 4.4: The impact of integrated nutrition management interventions on electrical conductivity after their application has worn off

Treatment	Electricalconductivity(dSm^{-1})		
(Initialvalue:0.32)	**2019**	**2020**	**Mean**
T_1:120:60:00NPkgha^{-1}(RDF)	0.345	0.348	0.346
T_2:120:60:40NPKkg ha^{-1}	0.347	0.350	0.348
T_3:120:60:00NPkgha^{-1}(RDF)+FYM@10 tha^{-1}	0.350	0.353	0.351
T_4:120:60:00NPkgha^{-1}(RDF)+FYM@5t ha^{-1}+NPKconsortium	0.353	0.353	0.353
T_5:120:60:00NPkgha^{-1}(RDF)+FYM@5t ha^{-1}+NPK consortium+Sulphur@ 20kgha^{-1}(gypsum)+10kgha^{-1}$ZnSO_4$	0.353	0.355	0.354
T_6:90:45:40NPKkgha^{-1}+FYM@1.5tha^{-1}	0.320	0.333	0.326
T_7:90:45:00NPkgha^{-1}+FYM@2.5tha^{-1}	0.335	0.335	0.335
T_8:90:45:00NPkgha^{-1}+FYM@10tha^{-1}	0.340	0.343	0.341
T_9:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+ NPKconsortium	0.338	0.340	0.339
T_{10}:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+ NPKconsortium+Sulphur@20kgha^{-1} (gypsum)+10kgha^{-1}$ZnSO_4$	0.345	0.345	0.345
S.Em. ±	0.008	0.008	
C.D.at5%	NS	NS	

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C.V.%	4.58	4.67	

Table 4.5: The impact of integrated nutrient management practises on pH levels after their application has worn off

Treatment	**pH**		
(Initialvalue:7.1)	**2019**	**2020**	**Mean**
T_1:120:60:00NPkgha^{-1}(RDF)	7.42	7.31	7.36
T_2:120:60:40NPKkg ha^{-1}	7.52	7.33	7.42
T_3:120:60:00NPkgha^{-1}(RDF)+FYM@10 tha^{-1}	7.55	7.41	7.48
T_4:120:60:00NPkgha^{-1}(RDF)+FYM@5t ha^{-1}+NPKconsortium	7.68	7.49	7.59
T_5:120:60:00NPkgha^{-1}(RDF)+FYM@5t ha^{-1}+ NPK consortium+ Sulphur@20kgha^{-1}(gypsum)+10kgha^{-1}$ZnSO_4$	7.76	7.49	7.63
T_6:90:45:40NPKkgha^{-1}+FYM@1.5tha^{-1}	6.95	7.00	6.97
T_7:90:45:00NPkgha^{-1}+FYM@2.5tha^{-1}	7.23	7.30	7.26
T_8:90:45:00NPkgha^{-1}+FYM@10tha^{-1}	7.31	7.31	7.31
T_9:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+ NPKconsortium	7.27	7.27	7.27
T_{10}:90:45:00NPkgha^{-1}+FYM@5tha^{-1}+ NPK consortium +Sulphur@20kgha^{-1} (gypsum)+10kgha^{-1}$ZnSO_4$	7.34	7.34	7.34
S.Em. ±	0.16	0.17	
C.D.at5%	NS	NS	
C.V.%	4.39	4.51	

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Table 4.5 presents the effects of green gramme harvest on soil pH as influenced by integrated nutrient management treatments in 2019, 2020 and a pooled analysis. Table shows that there were no significant variations in soil pH between 2019 and 2020 as a result of implementing integrated nutrient management.

5. Conclusion

Two years of field experimentation showed that integrated nutrient management improved the growth and yield quality of rabi wheat and the subsequent green grame grown on sandy loam soil in central Gujarat. Increased yield, better seed quality, and a better net return and benefit cost ratio were all achieved. In conclusion, wheat yield characteristics and yields benefit with the use of integrated nutrient management strategies. They are also beneficial to subsequent crops like green gram because of the nutrients they leave behind. Increased crop yields aren't the sole benefit of adopting these methods for the health of the soil.

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