EFFECT OF VARIETIES AND NUTRIENT MANAGEMENT ON GROWTH OF WHEAT CROP UNDER IRRIGATED CONDITION (TRITICUM AESTIVUM L.)

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ABSTRACT

Wheat (Triticum aestivum L.) is the third most crucial staple food globally, providing essential nutrients and being widely utilized in various applications. A field experiment was conducted at Rama University's agricultural farm, Uttar Pradesh, India during rabi season of 2023-24 to investigate the impact of different wheat varieties and nutrient treatments on growth and grain yield. The study utilized a factorial randomized block design with three replications and eight treatment combinations involving two wheat varieties: V1 (Unnat PBW 550) V2 (WH 1105) and four nutritional levels: N1 (control), N2 (100% RDF Recommended dose of fertilizer), N3 & 15% VC (Vermicompost), and N4 (70% RDF & 30% VC). The results showed that the N3 treatment significantly enhanced growth parameters, including plant height, number of leaves, tiller count, and dry matter accumulation. V2 (WH 1105) exhibited superior growth, with greater plant height (93.65 cm), and dry matter accumulation (54.57 g at 90 DAS). These findings underscore the importance of nutrient management and variety selection in optimizing wheat growth and yield.

Keywords: Wheat; nutrients; varieties; growth and yield.

INTRODUCTION

Wheat (Triticum aestivum L., 2n = 42) ranks as the third most essential staple food globally, after rice (Oryza sativa) and maize (Zea mays). As the most widely cultivated crop worldwide, it offers vital nutrients such as proteins, carbohydrates, minerals (including selenium, manganese, phosphorus, and copper), and vitamins (B1, B2, B3, and E). Wheat is versatile in its uses, serving as a raw material for animal feed, starch, straw, industrial products like alcoholic beverages, and as a significant food source [1]. There are primarily two types of wheat grown for commercial purposes i.e. durum wheat (Triticum turgidum) and bread wheat (Triticum aestivum). These varieties vary in terms of genetic complexity, adaptation and application. These days, both kinds of wheat are used to make and consume a vast array of products. India is the second-largest wheat producer in the world, having made significant strides in wheat output over the past 40 years [2,3,4,5,6]. Wheat, rice, maize, sorghum, and millets are crucial for global nutrition. To address challenges like rising food prices, climate change and resource loss, comprehensive research is essential. India urgently needs to enhance wheat production to meet growing demand while managing resources and adapting to environmental changes. The escalating issues underscore the necessity for research focusing on disease resistance, drought tolerance, and quality output. Wheat provides over 50% of nationwide calorie intake, with 95% as bread wheat, and the rest divided between durum wheat and dicoccum wheat into 4% and 1% [7]. Optimal planting speed is a crucial factor in maximizing wheat yield and is particularly significant in wheat production because it can be controlled within cropping systems. Ideal plant densities vary widely depending on factors such as location, climate, soil type, sowing time, and crop variety [8]. Lower soil temperatures adversely affect the number of productive tillers and seed germination potential. The primary determinant of wheat's economic yield is the number of productive tillers per plant or unit area. Wheat requires long daylight hours to produce spikes (inflorescence), so under optimal photoperiod conditions, even late-sown wheat can flower [9]. Organic manures not only provide essential nutrients but also enhance the soil's physical, chemical, and biological properties. They can increase the effectiveness of applied fertilizers and the availability of natural soil nutrients. When farmyard manure (FYM) is judiciously combined with chemical fertilizers, it improves the soil's physical, chemical, and biological characteristics, resulting in increased crop productivity [10]. Achieving high crop yields necessitates significant nitrogen (N) inputs, yet excessive N can contaminate waterways. Therefore, high Nitrogen Use Efficiency (NUE) is crucial for optimal crop productivity. Improving NUE involves selecting suitable growth conditions, such as soil type and climate, for the crop. This can be achieved through crop genetic enhancements and strategic management practices, including optimizing planting dates, rates, and timing of N applications [11]. Vermicompost involves the transformation of biodegradable organic waste into nutrient-rich granular compost using earthworms. This process produces worm casts abundant in nutrients and microorganisms, surpassing traditional compost in quality. Worm secretions and associated microbes serve as growth promoters and provide essential nutrients. Vermicomposting has gained significant attention due to earthworms' pivotal role in soil enhancement, organic matter breakdown, and promotion of plant growth [12]. When combined in appropriate ratios with chemical fertilizers, vermicompost can serve as a valuable nutrient source for field crops. Research indicates that incorporating vermicompost into highly productive legumes yields positive outcomes. However, compost and vermicompost exhibit diverse physical and chemical characteristics due to variations in their processing methods, influencing plant development differently. Despite this, their combined application with chemical fertilizers has been shown to enhance crop biomass and grain production [13]. The latest forecast for world wheat production for 2023– 2024, as per the United States Department of Agriculture (USDA), stands at 783.43 million metric tonnes, showing a decrease of approximately 3.91 million tonnes compared to the previous month's estimate. In 2022, global wheat production amounted to 789.50 million tonnes. Between the crop years 2015–16 and 2023–24, Punjab state's Gross State Domestic Product (GSDP) witnessed a Compound Annual Growth Rate (CAGR) of 7.54%. Notably, in the crop year 2022–2023 (July–June), wheat production soared to an unprecedented 110.55 million tonnes, a significant rise from the 107.7 million tonnes recorded in 2021-2022. Considering the information provided, an experiment was undertaken to investigate the impact of different wheat varieties and nutrient treatments on the growth and grain yield of wheat.

MATERIALS AND METHODS

The experiment was carried out during the Rabi season of 2023-24 at the Research Farm, Rama University's agricultural farm in 2023-24 Kanpur, 209217, Uttar Pradesh, India... The study involved sowing two wheat varieties: Unnat PBW 550 and WH 1105, which were chosen for their high yield potential, disease resistance, and adaptability to various growing conditions, making them reliable and popular choices for farmers in different regions. The recommended fertilizer dosage was 120:60:40 kg/ha (N:P:K).

The soil of the experimental plot was sandy loam in texture, moderately low in organic carbon (0.34%), medium in available nitrogen (175.2 kg/ha), low in available phosphorus (25.2 kg/ha), and available potassium (217.8 kg/ha). The experiment was conducted in a Factorial Randomized Block Design with 3 replications. The treatment were consisting of two different factors; one was nutrient and the other was varieties with their symbols are given as follows: A)First factor – Nutrient (N): N1 – Control, N2 – 100% RDF,N3 – 85% RDF& 15% VC N4 – 70% RDF & 30% VC B)Second factor – Varieties (V): V1 – Unnat PBW – 550 V2 – WH -1105 Observations were recorded by randomly selecting 5 plants in each net plot. Plant growth parameters such as plant height, number of leaves per plant, dry matter accumulation, and number of tillers, were measured.

RESULTS AND DISCUSSION

Plant height

A significantly greater plant height was recorded with the N3 treatment (85% RDF & 15% VC) at all growth stages except at 30 DAS. During 60 and 90 DAS, this treatment was found on par with N2 and N4. The impact of various nutrients on plant height was evident, with N3 yielding the tallest plants at 95.3 cm, significantly surpassing other nutrient doses. The rapid increase in height between 60 and 90 DAS, followed by steady growth until maturity, suggests that this treatment provided optimal conditions for sustained growth. The incorporation of 15% VC with 85% RDF likely facilitated enhanced nutrient uptake and utilization, promoting vigorous growth and resulting in taller plants. Similar results were also recorded by Hussain [14,15,16,17 and 18].

The effect of varieties on mean plant height was significant at all growth stages except at 30 DAS. The WH 1105 (V2) variety consistently recorded higher plant height, significantly surpassing Unnat PBW 550 (V1). At harvest, WH 1105 reached a maximum height of 93.65 cm. This superior height is likely due to the genetic traits of WH 1105, which promote vigorous growth and development. Observations indicated a positive relationship between plant height and maturity; early-maturing genotypes produced shorter plants, while late-maturing genotypes achieved greater heights, likely because a longer growth period allows for increased height. These results are consistent with the findings previously reported by Hussain [19,20 and 14]. The interaction effects in respect to plant height were found to be non-significant at all growth stages of crop.

Table 1. Influence of Various Treatments on Growth and Growth Parameters of Winter Wheat at

	Plant height (cm)			**Number of leaves plant^{-1}(no)**		**Number of tillers plant^{-1} (no)**		**Dry matter accumulation plant^{-1}(g)**			
Treatments	**30 DAS**	**60 DAS**	**90 DAS**	**At harvest**	**30 DAS**	**60 DAS**	**60 DAS**	**90 DAS**	**30DAS**	**60 DAS**	**90DAS**
Nutrient (N)											
N1-Control	12.36	44.33	70.23	81.76	3.65	18.98	1.05	3.3	0.72	3.65	40.07
N2-100%RDF	14.37	56.32	89.12	94.95	4.22	24.02	2.32	5.70	0.78	5.07	56.27
N3-85%RDF& 15% VC	14.94	57	89.3	95.3	4.27	24.11	2.36	6.18	0.79	5.14	57.92
N4-70%RDF& 30% VC	14.05	54.43	85.13	94.23	3.92	23.95	2.32	5.53	0.76	4.95	54.44
SEm±	**0.42**	**1.07**	**1.7**	**1.63**	**0.16**	**0.3**	**0.06**	**0.15**	**0.026**	**0.15**	**1.49**
CDat5%	**NS**	**3.25**	**5.16**	**4.96**	**NS**	**0.93**	**0.2**	**0.47**	**NS**	**0.46**	**4.52**
Nutrient(N)											
V1-UnnatPBW 550	13.84	52.35	82.41	90.25	3.82	22.37	1.92	4.91	0.76	4.54	49.78
V2 -	14.	54.	85.	93.6	4.1	23.	2.1	5.4	0.78	4.88	54.58

WH1105	22	7	88	5	6	11	1	7			
SEm±	**0.3**	**0.75**	**1.2**	**1.15**	**0.11**	**0.21**	**0.04**	**0.11**	**0.018**	**0.1**	**1.05**
CDat5%	**NS**	**2.3**	**3.64**	**3.51**	**NS**	**0.65**	**0.14**	**0.33**	**NS**	**0.32**	**3.2**
Interaction (NXV)											
SEm±	**0.6**	**1.51**	**2.4**	**2.31**	**0.23**	**0.43**	**0.09**	**0.22**	**0.03**	**0.21**	**2.11**
CDat5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Number of Leaves per Plant

The notable impact of various nutrients on the number of leaves per plant was evident, with the treatment of 85% RDF & 15% VC (N3) yielding the maximum number of leaves at 24.11, significantly surpassing other nutrient doses. This might be due to the synergistic effect of the balanced nutrient supply from both the recommended dose of fertilizers (RDF) and vermicompost (VC), enhancing overall plant growth and leaf production. These findings align with those previously reported in other studies by Meena [21 and 22].m

Data presented in Table 1 revealed that the mean number of leaves plant-1. Among the both of varieties, the WH 1105 (V2) was found to be superior with Unnat PBW 550 (V1) at all stages of crop growth.

The highest number of leaves was observed and recorded as significantly superior at all growth stages of the crop, with the maximum number of leaves per plant being 24.11. This might be due to the optimal nutrient availability and favorable growing conditions provided during the experiment. The results of the present study are in accordance with the findings of previous research by Hussain [14 and 23]. The interaction between nutrients and varieties were not found significant at any growth stages of crop.

Number of Tillers per Plant

The maximum numbers of tillers plant-1 (2.36 and 6.08) was observed with N3 - 85% RDF & 15% VC at 60 and 90 DAS respectively. This treatment was found significantly superior over rest of the nutrients. The significantly lowest number of tillers plant-1 were produced by (N4) 70% RDF & 30% VC at all the crop growth stages. The number of tillers per plant increased from 60 to 90 days after sowing. The treatmentwith N3 - 85% recommended fertilizer dose (RDF) and 15% vermicompost (VC) resulted in the highest number of tillers per plant (6.18) at 90 days after sowing. This treatment showed a significant improvement compared to using N2 - 100% RDF and N4 - 70% RDF with 30% VC,except for the N1 - control treatment. This could be because this particular combination of nutrients helped the soil and its microorganisms thrive, making it easier for the plants to absorb nutrients and grow more tillers.

The current study's findings were consistent with previous research conducted by Kakraliya [24 and 25].

The significantly highest number of tillers plant-1 were obtained with variety WH 1105 (V2) at all growth stages of crop.

Throughout all stages of crop growth, WH 1105 (V2) consistently produced more tillers per plant at 90 days after sowing compared to Unnat PBW550 (V1). The maximum number of tillers recorded at 90 DAS was 5.47 tillers. This variation in tiller quantity between the two varieties is likely due to genetic differences. Our findings align with those of Hussain [19,20 and 23]. No significant results were found due to treatment interaction at any growth stage of crop.

Dry Matter Accumulation Plant^{-1}

The maximum dry matter production per plant was observed in the 85% RDF & 15% VC (N3) treatment, with values of 0.79 g, 5.14 g, 57.92 g, and 51.34 g at 30, 60, 90 DAS, and at harvest, respectively. This treatment was significantly superior to the other treatments at all stages of crop growth.

Total dry matter accumulation per plant increased continuously with crop age, peaking before decreasing at harvest. This was driven by photosynthesis and photomorphogenesis. Initially slow up to 30 days after sowing (DAS), the accumulation rate accelerated between 60 and 90 DAS. The N3 treatment (85% RDF and 15% VC) resulted in the highest dry matteraccumulation (57.92 g), likely due to an increased number of leaves and tillers per plant, which enhanced photosynthesis and photosynthate accumulation. The results of this study were consistent with those previously recorded by Kalia [26 and 27].

The WH 1105 (V2) treatment recorded the highest dry matter accumulation per plant at all growth stages, with values of 0.78 g, 4.88 g,54.58 g, and 45.25 g at 30, 60, and 90 DAS, and at harvest, respectively. It was significantly superior to Unnat PBW 550 (V1) at 60, 90 DAS, and at harvest. The superior dry matter production of WH 1105 (54.58 g at 90 DAS and 45.25 g at harvest) is likely due to its taller stature and greater number of leaves and tillers, enhancing its overall dry matter accumulation. Similar reports were made by Arduini [28 and 29]. Interaction due to different treatments of nutrients and varieties did not reach to level of significance.

CONCLUSION

The results showed that the nutrient treatment of 85% RDF and 15% VC (N3) significantly enhances the growth, yield, and economic returns of wheat. The wheat variety WH 1105 (V2) consistently outperformed Unnat PBW 550 (V1) in terms of growth and yield. The 85% RDF and 15% VC (N3) treatment resulted in the highest gross returns in wheat production. Since these results are based on a single season, more research may be necessary to provide greater assurance.

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