Effect of varieties and nutrient management on growth and yield of wheat crop under irrigated condition (*Triticum Aestivum* L.)

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 during the rabi season of 2022–2023 at Lovely Professional University's Agriculture Research Farm in Jalandhar, Punjab, 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 (Unnat PBW 550 and WH 1105) and four nutritional levels: N1 (control), N2 (100% RDF Recommended dose of fertilizer), N3 (85% RDF & 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. WH 1105 exhibited superior growth, with greater plant height (93.6 cm), leaf count (24.1 leaves/plant), and dry matter accumulation (54.57 g at 90 DAS).Yield attributes such as the number of effective tillers per plant, grains per spike, and 1000-grain weight were highest in the N3 treatment, with WH 1105 again outperforming Unnat PBW 550. Specifically, N3 treatment resulted in the highest number of effective tillers (6.0), grains per spike (58.16), and 1000-grain weight (39.40 g). Grain yield was maximized with the N3 treatment (57.15 q/ha), with WH 1105 producing a significantly higher grain yield (50.5 q/ha) compared to Unnat PBW 550. Additionally, the N3 treatment led to the highest straw yield (78.96 q/ha) and biological yield (136.11 q/ha). The harvest index was highest with the N2 treatment (42.35%), while WH 1105 showed a higher harvest index (41.97%) than Unnat PBW 550. These findings underscore the importance of nutrient management and variety selection in optimizing wheat growth and yield.

Keywords : Recommended dose of fertilizer, Vermicompost, Specifically, Findings, Nutrient management.

1. 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 [2,35,36,37,38]. 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% [3]. 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 [4]. 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 [5]. 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 [6]. 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 [7]. 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 [8]. 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 [9]. 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.

2. MATERIALS AND METHODS

The experiment was carried out during the Rabi season in the research fields of the School of Agriculture at Lovely Professional University in Jalandhar, Punjab, in 2022–2023. 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).

Punjab is located in the Trans-Gangetic Plains Zone, the sixth agro-climatic zone. The district is situated between the Sutlej and Beas rivers in the center of Punjab. The plot's location is at 31.2560°N, 75.7051°E, with an average elevation of 252 meters above mean sea level. Punjab receives rainfall from both the southwest and northeast monsoons, primarily during the monsoon period from June to August. Typically, the winter season begins around the end of October and lasts through the end of February. The first two weeks of November see a decrease in temperature, reaching its lowest point in December or January, making those months the coldest of the year.

Summer begins in mid-February and lasts until the first two weeks of June, with May being the warmest month.

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 and 8 nutrient treatments: Control (N0P0K0) (N1), 100% RDF (N150P60K40) (N2), 85% RDF (N127.5P60K40) + VC (@1.5 t ha-1) (N3), 70% RDF (N105P60K40) + VC (@3 t ha-1) (N4), Control (N0P0K0) (N5), 100% RDF (N150P60K40) (N6), 85% RDF (N127.5P60K40) + VC (@1.5 t ha-1) (N7), and 70% RDF (N105P60K40) + VC (@3 t ha-1) (N8).

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, as well as yield parameters such as the number of effective tillers per plant, grains per spike, 1000-grain weight, grain yield (q/ha), straw yield (q/ha), biological yield (q/ha), and harvest index (%), were measured.

3. RESULTS AND DISCUSSION

a. Growth studies

3.1. Plant height

Table 1 and Figure 1 illustrate the average plant height of wheat, impacted by various treatments and recorded at different growth stages. The heights at 30, 60, 90 days after sowing (DAS), and at harvest were 14.04 cm, 53.53 cm, 83.95 cm, and 91.83 cm, respectively. Rapid growth occurred between 60 and 90 DAS, then slowed towards maturity. The data show a consistent increase in plant height at each growth stage, with significant differences attributed to the various treatments.

The significantly greater plant height was recorded with the N_3 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 N_2 and N_4. The impact of various nutrients on plant height was evident, with N_3 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 [10], [11], [12], [13] and [14].

The effect of varieties on mean plant height was significant at all growth stages except at 30 DAS. The WH 1105 (V_2) variety consistently recorded higher plant height, significantly surpassing Unnat PBW 550 (V_1). At harvest, WH 1105 reached a maximum height of 93.6 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 [15], [16] and [10]. The interaction effects in respect to plant height were found to be non-significant at all growth stages of crop.

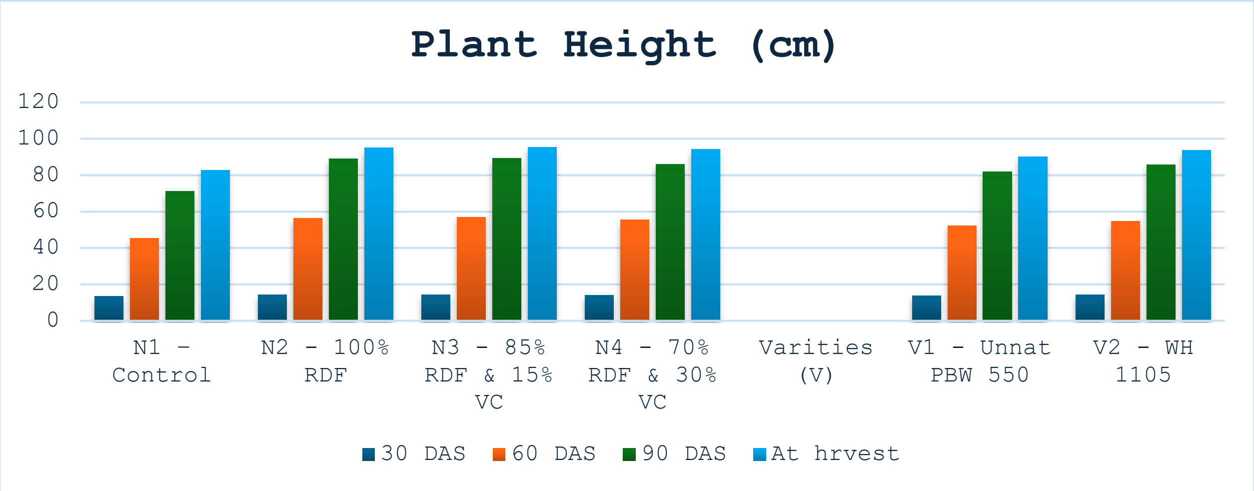

Fig. 1. Plant height (cm) as affected by different treatments at harvest.

3.2 Number of leaves per plant

The number of leaves per plant recorded at different growth stages is presented in Table 1 and illustrated in Figure 2. The average number of leaves per plant was 4.03 at 30 DAS and 22.75 at 60 DAS. Data presented in Table 2 indicated that the mean number of leaves per plant increased continuously from 30 DAS to 60 DAS. A significant effect of various nutrient doses on the number of leaves per plant was evident at all stages of crop growth. The nutrient treatment of 85% RDF & 15% VC (N_3) produced a significantly higher number of leaves per plant (24.1) compared to other nutrient treatments, while 100% RDF (N_2) and 70% RDF & 30% VC (N_4) were found to be at par with each other.

The notable impact of various nutrients on the number of leaves per plant was evident, with the treatment of 85% RDF & 15% VC (N_3) yielding the maximum number of leaves at

24.1, 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 [17] and [18].

Table 1: Influence of Various Treatments on Growth and Growth Parameters of Winter Wheat at Different Crop Growth Stages.

	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**	**30 DAS**	**60 DAS**	**90 DAS**	**At harvest**
Nutrient (N)												
N1 - Control	13.36	45.33	71.23	82.76	3.66	18.9	1.06	3.4	0.73	3.64	40.06	34.2
N2 - 100% RDF	14.38	56.33	89.13	94.96	4.23	24.03	2.33	5.7	0.77	5.08	56.28	46.32
N3 - 85% RDF & 15% VC	14.4	57	89.3	95.3	4.26	24.1	2.36	6.08	0.78	5.13	57.91	51.33
N4 - 70% RDF & 30% VC	14	55.43	86.13	94.28	3.93	23.96	2.3	5.56	0.76	4.99	54.46	45.52
SEm ±	0.42	1.07	1.7	1.63	0.16	0.3	0.06	0.15	0.026	0.15	1.49	0.79
CD at 5%	NS	3.25	5.16	4.96	NS	0.93	0.2	0.47	NS	0.46	4.52	2.4
Varities (V)												
V1 - Unnat PBW 550	13.85	52.35	82.01	90.05	3.88	22.38	1.91	4.9	0.75	4.53	49.79	43.44
V2 - WH 1105	14.22	54.7	85.88	93.6	4.16	23.11	2.11	5.47	0.77	4.89	54.57	45.24
SEm ±	0.3	0.75	1.2	1.15	0.11	0.21	0.04	0.11	0.018	0.1	1.05	0.56
CD at 5%	NS	2.3	3.64	3.51	NS	0.65	0.14	0.33	NS	0.32	3.2	1.7
Interaction (N X V)												
SEm ±	0.6	1.51	2.4	2.31	0.23	0.43	0.09	0.22	0.03	0.21	2.11	1.12
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

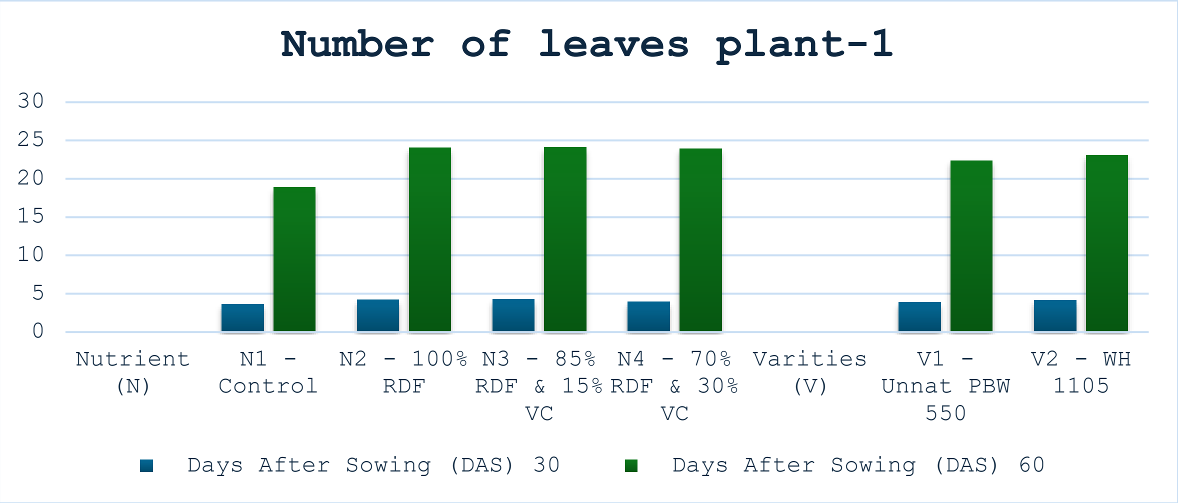

Fig. 2. Number of leaves per plant affected by various treatments at 60 DAS.

Data presented in Table 1 revealed that the mean number of leaves plant^{-1}. Among the both of varieties, the WH 1105 (V_2) was found to be superior with Unnat PBW 550 (V_1) 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 23.11. 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 [10] and [19]. The interaction between nutrients and varieties were not found significant at any growth stages of crop.

3.3 Number of tillers per plant

The numbers of tillers plant^{-1} recorded at various growth stages are shown in Table 1. The mean number of tillers plant-^{1} were 2.02 and 5.19 at 60 and 90 DAS, respectively. Data presented in Table 1 indicated that the mean numbers of tillers plant^{-1} were increased continuously at 60 DAS to 90 DAS.

The maximum numbers of tillers plant^{-1} (2.36 and 6.08) was observed with N_3 - 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 (N_4) 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 treatment with N_3 - 85% recommended fertilizer dose (RDF) and 15% vermicompost (VC) resulted in the highest number of tillers per plant (6.08) at 90 days after sowing. This treatment showed a significant improvement compared to using N_2 - 100% RDF and N_4 - 70% RDF with 30% VC, except for the N_1 - 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 [20] and [21].

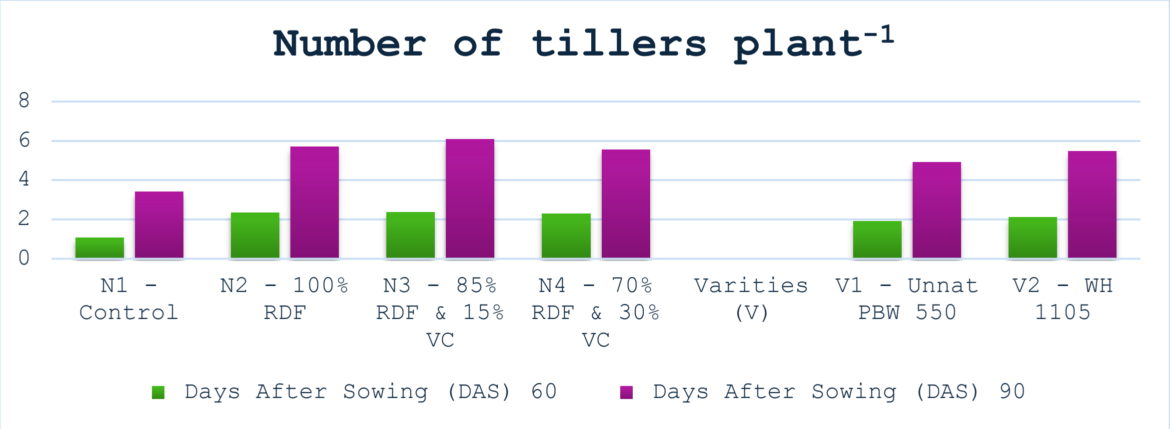

Fig. 3. Number of tillers per plant affected by various treatments at 90 DAS.

The significantly highest number of tillers plant^{-1} were obtained with variety WH 1105 (V_2) at all growth stages of crop.

Throughout all stages of crop growth, WH 1105 (V_2) consistently produced more tillers per plant at 90 days after sowing compared to Unnat PBW 550 (V_1). 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 [15], [16] and [19]. No significant results were found due to treatment interaction at any growth stage of crop.

3.4 Mean dry matter accumulation plant^{-1}

The data on periodic production of mean dry matter per plant among various parts, as affected by different treatments, is shown in Table 1 and graphically represented in Figure 4. The mean dry matter accumulation at 30, 60, 90 DAS, and at harvest were 0.75 g, 4.71 g, 52.18 g, and 44.51 g, respectively. The rate of mean dry matter production was very high between 30 to 90 DAS, with a continuous increase that decreased slightly at harvest.

The maximum dry matter production per plant was observed in the 85% RDF & 15% VC (N_3) treatment, with values of 0.78 g, 5.13 g, 57.91 g, and 51.33 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 N_3 treatment (85% RDF and 15% VC) resulted in the highest dry matter accumulation (57.91 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 [22], and [23].

The WH 1105 (V_2) treatment recorded the highest dry matter accumulation per plant at all growth stages, with values of 0.77 g, 4.89 g, 54.57 g, and 45.24 g at 30, 60, and 90 DAS, and at harvest, respectively. It was significantly superior to Unnat PBW 550 (V_1) at 60, 90 DAS, and at harvest. The superior dry matter production of WH 1105 (54.57 g at 90 DAS and 45.24 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 [24] and [25]. Interaction due to different treatments of nutrients and varieties did not reach to level of significance.

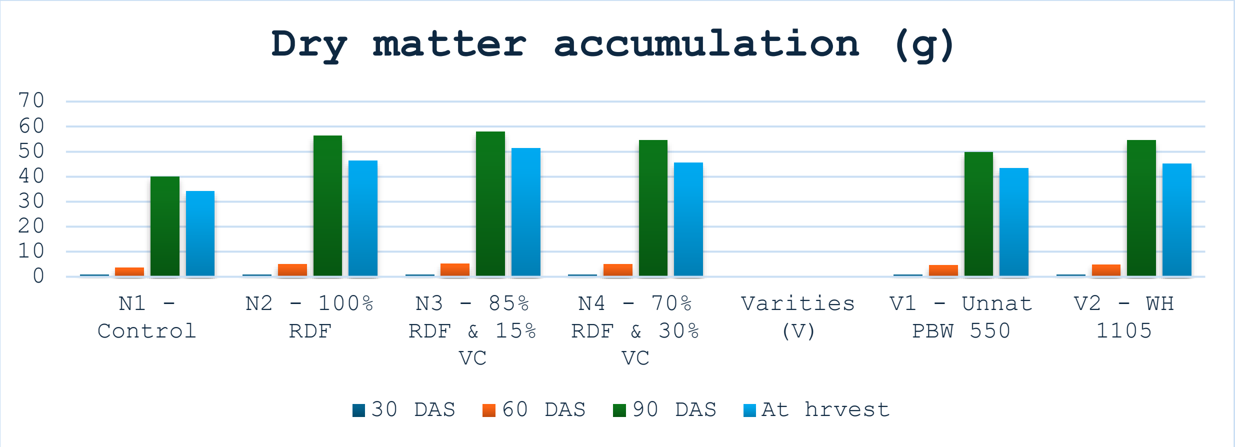

Fig. 4. Dry matter production per plant (g) as influenced by different treatments at harvest.

b. Yield attributes

3.5 Number of effective tillers per plant

The number of effective tillers per plant recorded at the harvest stage is presented in Table 2. The average number of tillers per plant at harvest was 5.34. The highest number of effective tillers per plant (6) was observed at the harvest stage with the 85% RDF & 15% VC treatment (N_3). This was followed by the 100% RDF treatment (N_2) with 5.9 tillers and the

70% RDF & 30% VC treatment (N_4) with 5.86 tillers at the harvest stage. The reduction in the number of effective tillers could be attributed to variations in nutrient availability and their uptake by the plants under different treatments. Similar results were documented by previous studies by [21] and [22].

The significantly highest number of effective tillers plant^{-1} were obtained with variety WH 1105 (V_2) at harvest stage of crop. The data on number of effective tillers per plant clearly showed that the WH 1105 wheat variety produced significantly higher number of effective tillers (5.6 at harvest) compared to the Unnat PBW 550 variety. This could be attributed to inherent genetic differences between the two varieties, where WH 1105 likely possesses traits that promote greater tillering capacity. These findings are consistent with those of earlier studies by [16] and [19]. No significant results were found due to treatment interaction at harvest stage of crop.

3.6 Number of grains per spike

The maximum number of grains per spike was observed with 85% RDF and 15% VC (N_3), achieving 58.16 grains per spike, which was significantly superior to the other nutrient treatments (N_2 and N_4), which had (56.33 and 55.33) grains per spike, respectively. The N_1 control treatment was found to be non-significant. This might be due to the optimal balance of nutrients provided by the combination of 85% RDF and 15% VC, enhancing nutrient availability and uptake, leading to better spike development and grain filling compared to other treatments. Similar results were reported by [26] and [27].

Among both of varieties the WH 1105 (V_2) was recorded the maximum number of grains per spike (55.41 grains / spike) and it was observed to be significantly higher than Unnat PBW 550 (V_1). This is likely due to the genetic traits of WH 1105 that promote more efficient nutrient utilization and better spike development, resulting in a higher grain count per spike compared to Unnat PBW 550. Similar findings were reported by previous researchers *i.e.,* [28] and [29]. Interaction effect was not evident due to treatment effect in number of grains per spike.

3.7 1000 grain weight

Data presented in Table 2 revealed that the test weight (g) was not significantly influenced by the various nutrient treatments and wheat varieties. However, the maximum test weight recorded was 38.39 g. The higher test weight (39.40 g) was observed with 85% RDF and 15%

VC (N_3). This is likely due to the optimal nutrient balance provided by this treatment, which may enhance grain filling and development, resulting in heavier grains. Similar results reported by [13] and [30].

The maximum test weight value (39.08 g) was observed with WH 1105 (V_2). This might be attributed to inherent genetic traits of WH 1105 that promote better grain filling and denser kernels, resulting in higher test weight compared to other wheat varieties.These results are consistent with those reported by previous studies by [29] and [31]. No significant interaction effect was found in test weight (g). This could be due to the independent influence of nutrient treatments and wheat varieties on test weight, without any notable combined effect between the two factors.

3.8 Grain yield (q/ha)

The treatment of 85% RDF and 15% VC (N_3) resulted in the maximum grain yield of 57.15 q ha^{-1}, which was significantly higher than the adjacent nutrient treatments (N_2 and N_4). The remaining nutrient treatments were comparable to each other, with N_2 producing 55.43 q ha^{-1} and N_4 producing 54.2 q ha^{-1}. This discrepancy in yield could be attributed to the synergistic effect of 85% RDF and 15% VC, which likely optimized nutrient uptake and utilization by the plants, leading to enhanced grain production compared to the other treatments. Similar results were documented in previous studies by [13] and [27].

The maximum grain yield of 50.5 q ha^{-1} was produced by WH 1105 (V_2) and was significantly superior to Unnat PBW 550 (V_1). This might be attributed to inherent genetic traits of WH 1105 that contribute to higher yield potential, such as better adaptation to environmental conditions, improved disease resistance, or enhanced photosynthetic efficiency, among other factors. Similar findings were also reported by [31] and [32]. Grain yield was not significantly influenced by any interaction. This could be due to the independent effects of the factors being studied, such as wheat varieties and nutrient treatments, on grain yield. It suggests that the performance of each factor (variety and nutrient treatment) in terms of grain yield was consistent across different combinations, without any notable combined effect or interaction between them.

3.9 Straw yield (q/ha)

The maximum straw yield of 78.96 q ha^{-1} was obtained by adopting 85% RDF and 15% VC (N_3). This treatment was significantly superior to other nutrient treatments except the Control (N_1), which was not at par and recorded a straw yield of 40.3 q ha^{-1}. The remaining nutrient treatments were comparable to each other, with N_2 producing 75.45 q ha^{-1} and N_4 producing 75.01 q ha^{-1}. This difference in straw yield could be attributed to the balanced nutrient availability provided by the combination of 85% RDF and 15% VC, which likely optimized plant growth and biomass production compared to other nutrient treatments. These findings are consistent with those of earlier studies by [12] and [25].

Higher straw yield of 69.80 q ha-1 was recorded with WH 1105 (V_2), which was found to be significantly superior to Unnat PBW 550 (V_1). This might be due to the genetic characteristics of WH 1105 that promote greater biomass production and better adaptation to growing conditions, leading to increased straw yield compared to Unnat PBW 550. Comparable results were also observed by [32]. None of the interactions was significantly superior in straw yield, likely due to the independent effects of nutrient treatments and wheat varieties, with no notable combined effect influencing the results.

3.10 Biological yield (q/ha)

A higher biological yield of 136.11 q ha^{-1} was attained with 85% RDF and 15% VC (N_3), significantly outperforming adjacent nutrient treatments except for the control (N_1). Nutrient treatments of 100% RDF (130.88 q ha^{-1}) and 70% RDF and 30% VC (129.21 q ha^{-1}) yielded comparable biological yields to 85% RDF and 15% VC. This could be attributed to the balanced nutrient composition and enhanced nutrient uptake facilitated by the combination of 85% RDF and 15% VC, resulting in increased biological yield compared to other treatments. Similar results were found in other studies conducted by [12].

Among the two varieties, WH 1105 exhibited the maximum biological yield of 120.31 q ha^{-1}, significantly surpassing the Unnat PBW 550 variety. This difference in yield may be attributed to the genetic traits of WH 1105, which potentially promote higher biomass production and better adaptation to environmental conditions compared to Unnat PBW 550. Our findings align with those of [33]. Interaction was not evident in biological yield of wheat crop.

Table 2: Influence of Various Treatments on Yield Attributes and Yield of Winter Wheat at Different Crop Growth Stages

Treatment	Number of effective tillers per plant (no)	Grains per spike (no)	1000 grains weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
Nutrient (N)							
N1 - Control	3.6	46.66	36.82	26.96	40.3	67.26	40.08
N2 - 100% RDF	5.9	56.33	38.88	55.43	75.45	130.88	42.35
N3 - 85% RDF & 15% VC	6	58.16	39.40	57.15	78.96	136.11	41.98
N4 - 70% RDF & 30% VC	5.86	55.33	38.45	54.2	75.01	129.21	41.94
SEm ±	0.19	1.04	1.10	1.75	1.71	2.65	-
CD at 5%	0.6	3.15	NS	5.32	5.21	8.05	-
Varities (V)							
V1 - Unnat PBW 550	5.08	52.83	37.70	46.36	65.05	111.42	41.6
V2 - WH 1105	5.6	55.41	39.08	50.5	69.8	120.31	41.97
SEm ±	0.14	0.73	0.71	1.24	1.21	1.87	-
CD at 5%	0.42	2.23	NS	3.76	3.68	5.69	-
Interaction (N X V)							
SEm ±	0.28	1.47	1.43	2.48	2.43	3.75	-
CD at 5%	NS	NS	NS	NS	NS	NS	-

3.11 Harvest index (%)

The data on harvest index indicated that the highest index of 42.35% was observed with 100% RDF (N_2), followed by the nutrient control (N_1), 85% RDF and 15% VC (N_3), and 70% RDF and 30% VC (N_4). This pattern could be due to the optimal nutrient supply provided by 100% RDF, leading to better conversion of biomass into grain yield, followed by similar trends in nutrient control and varying combinations of RDF and VC. These findings align with those previously reported in other studies by [19].

Between the two varieties, WH 1105 (V_2) achieved the maximum harvest index of 41.97%, surpassing the Unnat PBW 550 variety (V_1). This difference could be due to the genetic characteristics of WH 1105, which may contribute to better partitioning of assimilates towards grain production, resulting in a higher harvest index compared to Unnat PBW 550. These results are consistent with findings reported in previous studies by [34].

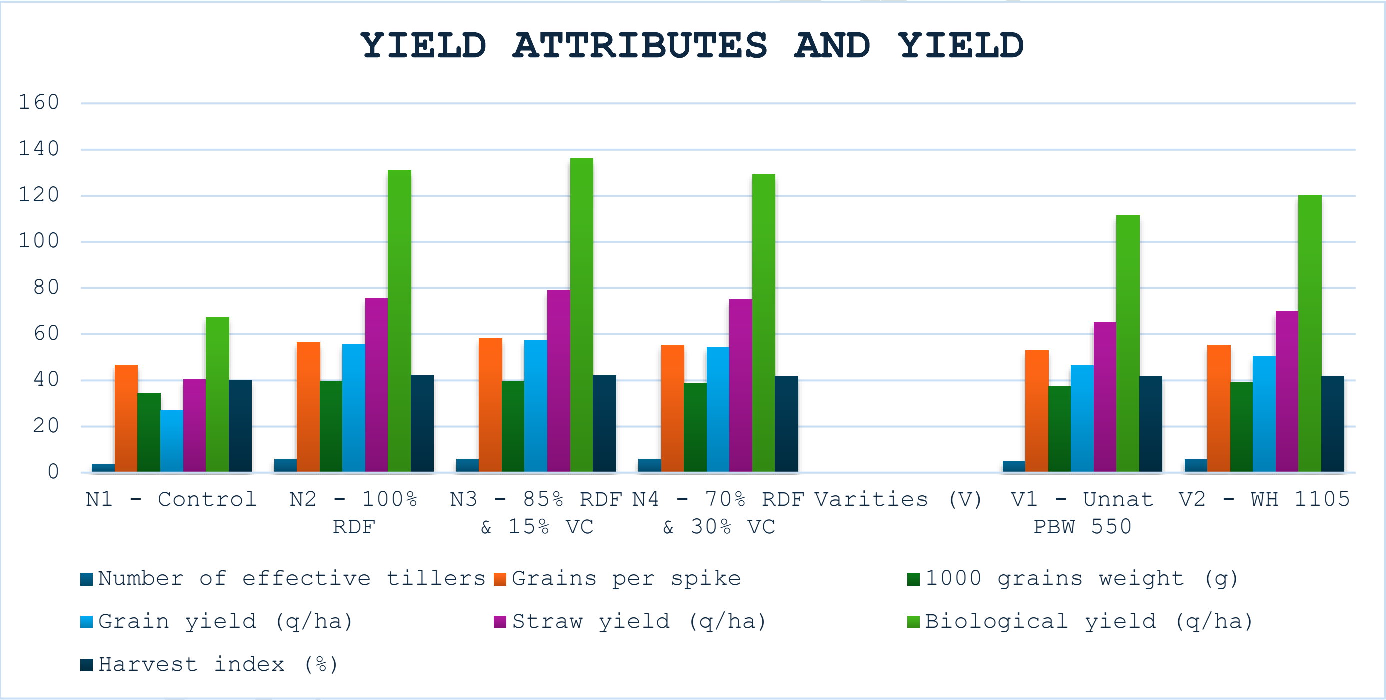

Fig 5. Effects of various treatments and wheat varieties on yield attributes, yield, and harvest index.

4. CONCLUSION

The results showed that the nutrient treatment of 85% RDF and 15% VC (N_3) significantly enhances the growth, yield, and economic returns of wheat. The wheat variety WH 1105 (V_2) consistently outperformed Unnat PBW 550 (V_1) in terms of growth and yield. The 85% RDF and 15% VC (N_3) 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.

5. ACKNOWLEDGEMENT

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Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

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