

Outcome of Diverse Nitrogen Applications and Seed Rates for Attaining Quantitative and Qualitative Wheat Crop Production

Syed Anas Shah Bacha¹, Hamza Iftikhar², Wajid Ali Shah¹, Ranra Jalal³, Salman Khan¹, Saddam Hussain⁴, Syed Majid Rasheed^{5*}.

Abstract

The application rates of nitrogen and seed can significantly improves the quality of nutrients and productivity is wheat (*Triticum aestivum* L.) crops. To discourse it, an experiment in field was conducted in Khyber Pakhtunkhwa, Mardan District (SCRI) Sugar Crop Research Institute, Pakistan with the name of "Effect of Different Seed Rates and Nitrogen Application for Obtaining Qualitative and Quantitative Production in Wheat Crop". This research assessed (150, 120, 90 and 60 Kg ha⁻¹) rates of seeds and different (165, 120, 75, 30 Kg ha⁻¹ and control) levels of nitrogen on the wheat variety Pirsabak-2015. The source of nitrogen was urea and 9 m² plots were used. The uniform applications of standard practices of agronomy were followed. The outcome illustrates significant impact on the parameters by treatments apart from the emergence days. The rates of seeds from 120 -150 Kg ha⁻¹ showed the greater index of harvest (42%), yield of grain (4,010 kg ha⁻¹), biological yields (10,829 kg ha⁻¹), weight of thousand grains (42g), spikes per m² (414), grains per spike (52), length of spike (10 cm), height of plant (93 cm), index of leaf area (4.9), tiller per m² (399) and emergence per m² (131). The levels of nitrogen from 120 – 165 kg ha⁻¹ produced higher index of harvest (41%), yield of grains (4,139 kg ha⁻¹), biological yields (10, 109 kg ha⁻¹), weight of thousand grains (42g), spikes per m²(381), grains per spike (53), length of spike (11cm), height of plant (98 cm), index of leaf area (4.9) and tiller per m² (437). The protein of straw (2.9%), protein of grain (11.8%), nitrogen of straw (0.51%) and nitrogen of grain (2.08%) were significantly enhanced by the rates of nitrogen. Interaction of nitrogen x seed rates was substantial for yield, components of yield, canopy traits and tillering. The joint use of nitrogen 120 kg ha⁻¹ and seed rate 120 kg ha⁻¹ is suggested for the enhancement of the productivity of wheat crops in Mardan region.

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Received Date: February 05, 2026

Accepted Date: February 10, 2026

Published Date: February 26, 2026

Citation: Syed Anas Shah Bacha, Hamza Iftikhar, Wajid Ali Shah, Ranra Jalal, Salman Khan, Saddam Hussain, Syed Majid Rasheed. Outcome of Diverse Nitrogen Applications and Seed Rates for Attaining Quantitative and Qualitative Wheat Crop Production. International Journal of Plant Biotechnology. 2026; 12(1): 31-47p.

Keywords: wheat, seed rate, nitrogen application, yield components, Pirsabak-2015, Mardan, SCRI, protein content

INTRODUCTION

The wheat crop (*Triticum aestivum* L.) is a significant staple crop globally consumed and providing calories of 20 % totally and protein diet of 20 %. The requirement of the stable production of wheat crop is to maintain both quality and quantity of grains, the crop of wheat significantly fulfill the human requirement of nutrition [1]. The straw of wheat is also a vital resource of feed of the livestock in Pakistan [2]. In world, Pakistan stands on eighth position in the producers of wheat crop and this crop significantly contributes around 14 % (GDP) gross domestic product of the country. In the year 2019 to 2020 the total yield of wheat crop

touched three metrics tons among which Pakistan rendered alone twenty five million tons [3]. In the province Khyber Pakhtunkhwa, twenty different wheat varieties are cultivated on around twenty one million acres of land, aiming an assessed production of wheat around twenty five million tons. The timely and early sowing significantly improves tillering and emergence that ultimately contributes to greater yields [4]. The window of sowing in Khyber Pakhtunkhwa is from 25th Oct. to 15th Dec. and specifically for Peshawar it is 1st Nov. to 15th Dec., with 150 Kg ha⁻¹ seed rate recommendation. The reduction in yield is because of the short reproductive and vegetative phases experienced due to delay in sowing [5].

The pandemic (COVID-19) also significantly created severe issues for the economy of Pakistan, risking food security and livelihoods [6]. However, the markets of cereals endured fair stability; disturbance in transportation imposes threats to the availability of food [7]. In agriculture, the contribution of wheat is 8.7 % and to GDP it is 1.7 %, confirming its production important [8]. The production of wheat is increased significantly from around twenty four million tons in 2020 which is 25 % greater than previous years because of the expansion in the cultivation lands and enhancement in the grains development [9]. The increase in the cultivation of wheat and adaptation of enhanced practices of cultivation contributes meaningfully to the food security of nation [10]. The increase in the yields can benefit the population as well as the farmers because wheat is directly or indirectly playing its role in the stability of the economy of Pakistan [11].

Satisfactory population of plants, balance of fertilizers, appropriate seed rates, ideal time of sowing and varieties of high yields are some of the important agronomic practices that could be followed for the achievement of constant wheat yield [12]. In Pakistan, the low yields of wheat are because of poor germination of seed, irregular application of fertilizers and late sowing periods. The productivity of wheat can be significantly improved by enhancing these factors [13]. Seed rates are specifically vital; increased population of plants can increase struggle for water, light and nutrients [14]. Ecological variations further obscure wheat yield, growth and phenology. Sowing on time with proper rates of seeds ensure worthy productivity under climate change [15]. The researches on agronomy and plant breeding endure to emphasis on the varieties capable for high yields and better practices of management [16]. The yields are influenced directly by the seed rates which are evident by experiments, although its effects on components of yields are ignored [17]. The cost of production is minimized by optimum seed rates while increases efficiency of resources [18]. Wheat is great source of fibers, vitamins, minerals and protein, which makes it an important nutritional plant [19].

The window of sowing in Punjab is from 1st Nov to 25th Nov and for the Faisalabad district its 10th Nov to 25th Nov [20], with 125 Kg ha⁻¹ recommended rate of seeds [21]. The delay in the sowing can significantly reduce the reproductive duration and vegetative growth and ultimately lowers the yield. While very higher seed rate may significantly decrease tillering and germination, and moderate seed rates can improve the population of plants and reduce competition of weeds [22]. For resources the intra and inter competitions can be influenced by the seed rates. The low seed rates can reduce preliminary vegetative competitions but later on increase intra plant competitions because of per plant more tiller [23]. Different studies illustrate that reduction in seed rates from 625 to 325 seeds per meter increases number of kernel [24]. The most common suggested seed rate per hectare is 150 kg. Overall yield, weight of 1000 grains, populations of plant, spikes count and number of tillers are significantly affected by the seed rates [25]. However date of sowing has significant effects on quality and yield, while the rate of seed is an important factor of management [26].

The agricultural sector of Pakistan has a labor force of 42.3 % that contributes up to 18.9 % GDP [27]. Monthly flour wheat in the household are consumed up to 13 % [28], while production of wheat per capita annual capacity is 135 Kg [29]. The per person wheat consumption 124 Kgs which is globally the highest number [30]. The availability of wheat at national, provincial and house hold level is center to food security. Wheat supplies variations affects significantly the farmers, consumers, taxpayers and various groups indirectly or directly connected to agriculture [31].

For the production of wheat the most vital nutrient is nitrogen across rain fed and irrigated regions [32]. Ample nitrogen fertilization is important for obtaining greater yields and enhanced content of protein [33]. Low protein in wheat grains is an important problem in Pakistan [34]. In unfertilized soil, the important limited nutrient is nitrogen globally [35]. Formation of floret, leaf developments and initiation of roots are promoted by the early application of nitrogen [36]. Nitrogen is involved in the process of photosynthesis including chlorophyll [37]. Vegetative vigor, uptake of nutrients, growth of roots and utilization of carbohydrates are enhanced by the nitrogen [38]. The quality of grain, content of protein, yield of grains and biomass is increased by the application of nitrogen. Good management of nitrogen also enhances the baking and milling characteristics of the grains of wheat crop [39].

Specified the vital roles of nitrogen application and seed rates, this research were conducted to assess their interactive impact for enhancing production of wheat. The research intended to evaluate suitable nitrogen and seed levels to improve quality of grain, components of yields and growth of wheat crop.

Aims and Objectives

To discover other suitable seed rate and nitrogen and their collaborative levels for upholding advanced yield and the protein proportion in straw and in grains.

OBJECTIVES

- To examine the ideal standard quantity of nitrogen for improved wheat productivity.
- To determine the best wheat crop seed rate for improved wheat production.
- To inspect the percentage of protein in straw and grains of wheat under nitrogen different levels.

MATERIALS AND METHODS

Experimental Location and Timing

The research was directed at the Sugar Crops Research Institute (SCRI), Mardan, Khyber Pakhtunkhwa, Pakistan, to evaluate the impacts of seed rate and nitrogen on wheat.

Treatments and Materials

The Research Intricate Two Factors

- *Seed Rates*: 60, 90, 120, and 150 kg ha⁻¹.
- *Nitrogen Rates*: 0(control), 30, 75, 120, and 165 kg ha⁻¹.
- Nitrogen source was urea. *Pir Sabak-2015* wheat variety was propagated in plots 5×1.8m (9 sq. meter) sized. Regular field and agronomic managing practices were applied.

Experimental Design

Randomized Complete Block (RCB) design with three replications was followed

Factor A

- (*Seed Rate*): S1= 60 kg ha⁻¹, S2= 90kg ha⁻¹, S3= 120kg ha⁻¹, S4= 150kg ha⁻¹

Factor B

- (*Nitrogen*): N0 = 0, N1= 30 kg ha⁻¹, N2= 75 kg ha⁻¹, N3=120 kg ha⁻¹, N4 = 165 kg ha⁻¹

DATA COLLECTION

Data Collected Included

- Emergence Days [40].
- Emergence meter-2 [41].
- Tillers meter-2 [42]
- Leaf area index (LAI) [43]
- Plant height (cm) [44]
- Spike length (cm) [45]
- Grains spike meter-1 [46]
- Spikes meter-2 [47]

- 1000-grains weight (g) [48]
- Biological yields (kg ha-1) [49]
- Grains yield (kg ha-1) [50]
- Harvest index (%) [51]
- Protein and Nitrogen Analysis

Grains nitrogen Concentration: Evaluated with Kjeldahl method [52].

- 0.2g of ground sample was absorbed in concentrated H₂SO₄ with K₂SO₄-CuSO₄-Se with ratio of (100:10:1) for 4 to 5 hours
- Purified in indicator solution of boric acid consuming 40% NaOH, and then titrated with 0.1 N HCl.
- (1mL 1NHCl=14gN)
- *Straws Nitrogen Concentration:* Evaluated with Kjeldahl method [52].
- *Straw and Grains percentage of Protein:* Evaluated by near-infra red reflectance spectroscopy (NIRS) at Oilseed Quality Lab, Crop Breeding Division, NIFA Peshawar [53].

Statistical Analysis

Data was analyzed by suitable techniques for RCBD. Means were associated using LSD at 5% probability level where dissimilarities were significant [54].

Physico-chemical Properties of Study Area

The soil which was designated for the trials was examined for diverse physico-chemical assets as revealed in the Table 1.

Table 1. This table shows different physio-chemical properties of soil.

Parameters	Units	Value
Potassium	mg kg-1	155.9-159.23
Nitrogen	mg kg-1	0.24-0.29
Phosphorus	mg Kg ha-1	1.24-1.30
Organic Matter	%(m/m)	0.51-0.77
E.C	dSm-1	0.17-0.23
Soil pH	-	6.53-6.71

RESULTS AND DISCUSSION

Emergence Days

Levels of nitrogen and diverse rates of seed application were having no significant impact of the emergence days (Figure 1). However the emergence happened primary at 9th day in all treatments, the absence of significant variations is because of the circumstances of seeds which rely initially on the reserved food stored while germination and was not dependent on the nutrient of soil at that phase. Similar outcomes in the emergence of wheat were narrated by [55].

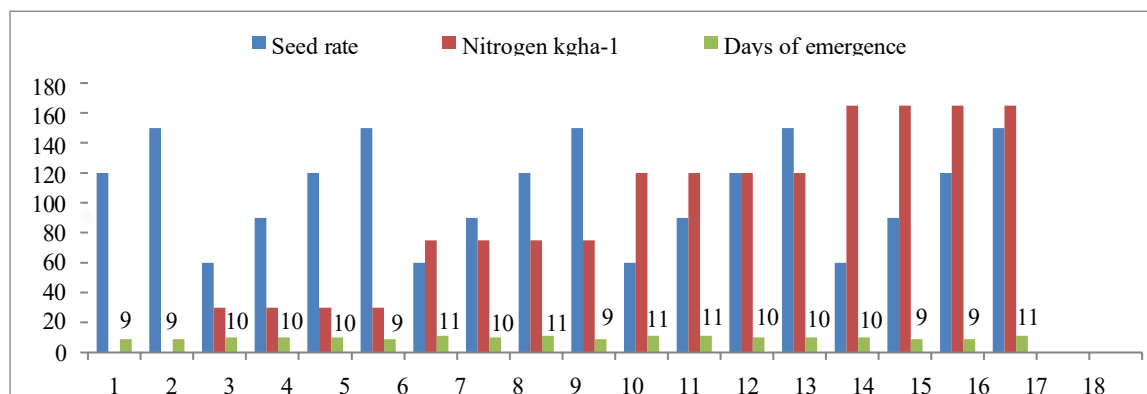


Figure 1. Emergence Days of wheat crops as impacted by seed rate and nitrogen application different rates.

Emergence Meter -2

Early vigor and uniform stand are ensured by the important factor in wheat crop known as emergence, which is very important for acquiring greater yields. The statistical analysis revealed that on emergence m-2 seed rates have significant impact, while the nitrogen kg/ha and N x SR were resulted as non-significant in (Table 2). Greater seed rates significantly increases emergence in wheat crops that ranges from 80-131 meter² at the seed rates of 60-150 kg ha⁻¹. This is because the direct impact of seed rates on the emergence which is directly proportional to the quantity of sown seeds- greater population of plants is resulted by higher rates of seeds and vice versa. Similar outcomes were reported from the study [56].

Table 2. Emergence m-2 as affected by nitrogen application and seed application with multiple rates.

Seed rates (Kg/ha)	Nitrogen (Kg/ha)					Total
	0	30	75	120	165	
60	76	79	84	76	84	80d
90	89	89	88	85	85	87c
120	121	121	121	126	125	123b
150	134	132	129	132	127	131a
Total	105	105	105	105	106	

LSD at $P < 0.05$ for seed rates = 3.189

Tillers Meter-2

In wheat crop, tillers are considered to be the most determining component regarding yield, higher number of tillers are directly proportional to higher production of grains. Data in Figure 2 illustrates the level of nitrogen, rates of seeds and their cross interactions (N x SR) have significant impact on the tiller per meter². The higher count of tiller was 399 at the seed rate of 120kg per hectare, followed by the 365 at the seed rate of 90kg ha⁻¹, while the minimum 329 was recorded on 60 kg per hectare. This results trend shows direct relation between population of plants and quantity of seeds, as reported by [57]. The tillering was also influenced by nitrogen application as 120 kg per hectare created high tillers 437, followed by 165 kg per hectare nitrogen application rendering 395 tillers, 75 kg per hectare nitrogen application rendering 341 tillers, tillering of 329 was recorded at 30 kg per hectare and the lowest was at control with no nitrogen application which was 288 tillers. Their interactions further illustrate that combining 120 kg ha⁻¹ seed rate and nitrogen application came with highest tillers of 493. These results were also reported by [58], and also stated that crop stand and vigor of seedlings are improved by the nitrogen appropriate applications.

Leaf Area Index Centimeter -2

The development of leaf area is significantly enhanced by the nitrogen, which shows the vegetative growth of plants and health resultantly supports high yields. Data of Figure 3 illustrates seed rates, nitrogen and their interaction (N x SR) have significant impact on the leaf area index (LAI). On seed rate of 150 kg ha⁻¹ higher LAI was recorded of (4.6 cm²) followed by 120 kg ha⁻¹ and 90 kg ha⁻¹ which was (4.3 cm²) and the lowest data was recorded at 60 kg ha⁻¹ which was (4.1 cm²), similar results were stated by [59]. The LAI is further increased by the application of nitrogen in research highest LAI which was recorded at 165 kg ha⁻¹ nitrogen application that rendered (4.9 cm²), followed by 120 kg ha⁻¹, 75 kg ha⁻¹ and 30 kg ha⁻¹ that ranges from 4.5 to 4.3cm².

The controlled plot rendered the lowest LAI of 3.6 cm². These impacts are because of the nitrogen influence on the vegetative growth of the plant, as narrated by the [60]. The interaction of seed rates and nitrogen showed highest LAI on 150 kg ha⁻¹ x 165 kg ha⁻¹ nitrogen application which was 5.3cm², while 60 kg ha⁻¹ x 0 Kg ha⁻¹ (Control) rendered 3.2 cm² LAI.

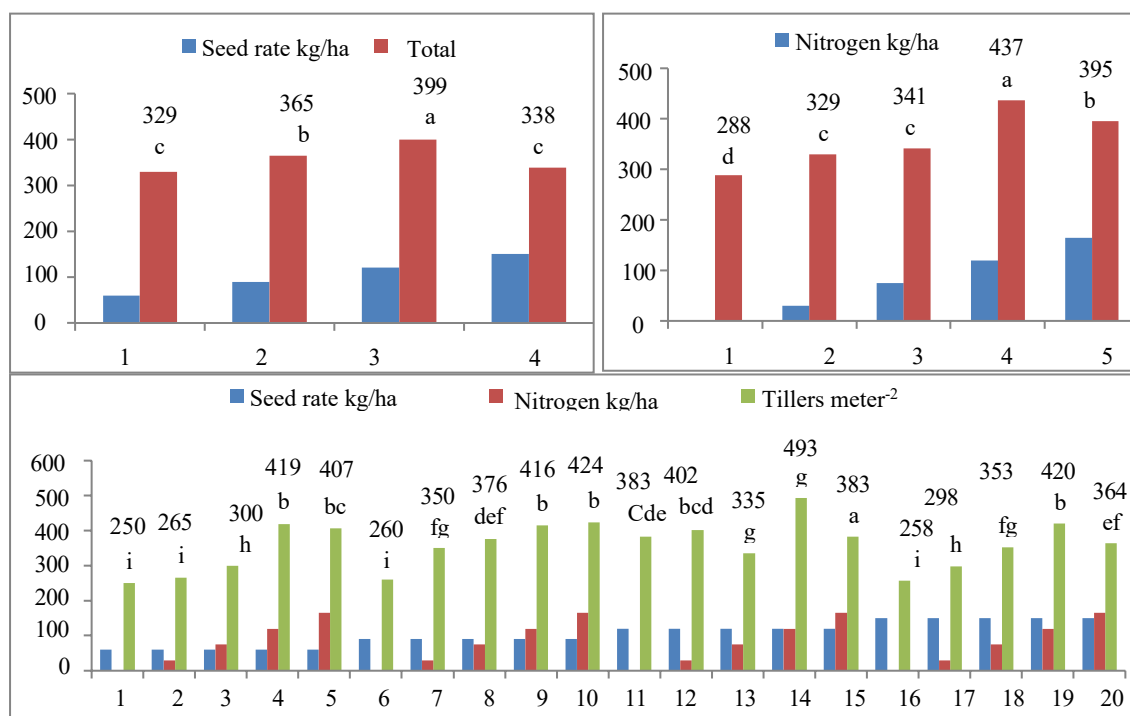


Figure 2. Tillers per meter² of wheat impacted by seed rate and nitrogen application with different rates. LSD at $P < 0.05$ for seed rates, nitrogen and SRxN are 11.843, 13.241 and 25.921 respectively.

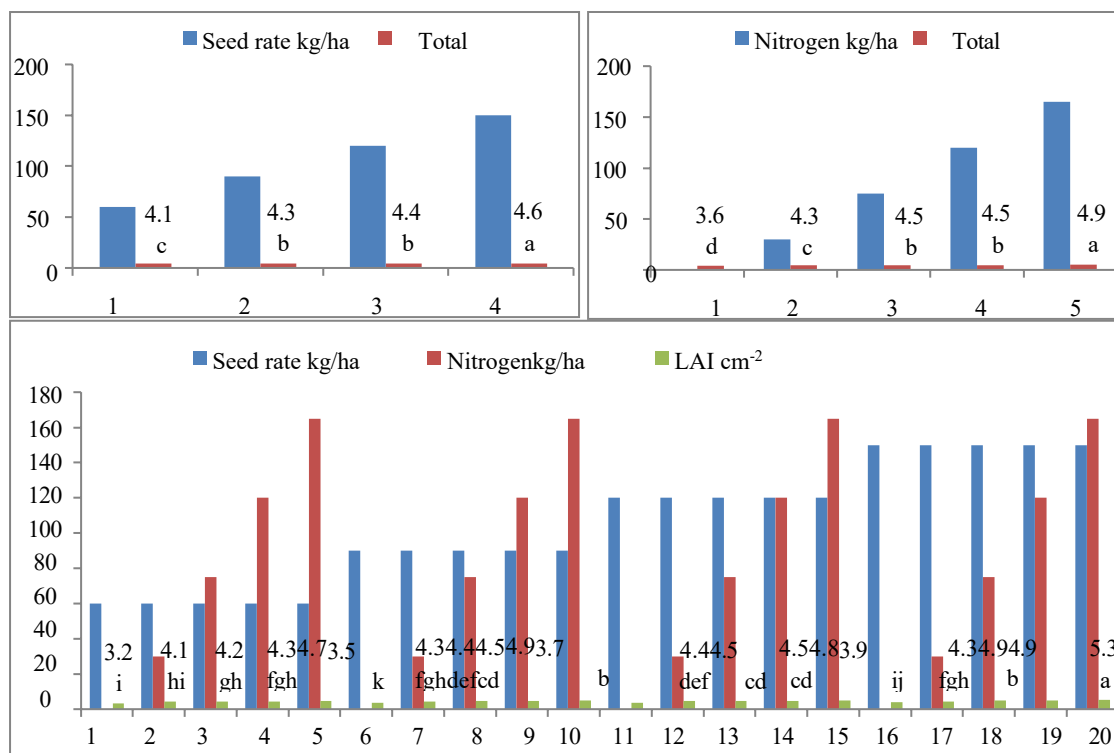


Figure 3. Leaf area index of wheat crops influenced by different rates of seed and nitrogen application. LSD at $P < 0.05$ for seed rates, nitrogen and SRxN are 0.090, 0.101 and 1.285, respectively

Height of Plant in Centimeters

Wheat performance can be significantly indicated by the height of the plant because it is associated with the maturity of plant, life span, weight of seed and eventually yield of grains. The SR x N

interaction, nitrogen and seed rates are significantly having impact on the height of the plant in Figure 4. Amongst the rates of seed, tall plants were recorded on 150 kg/ha which was 93 cm, followed by 120 kg/ha 91 cm and the small plants were recorded at 90 kg/ha and 60 kg/ha of 90 cm. The differences is related to intra and inter competition of plants; population of plant low allows more growth of weeds and they significantly compete for nutrients against wheat crops, eventually leads to weaker and smaller plants as stated earlier by [60]. Strong impacts are also been shown by the application of nitrogen. 165 kg/ha application rendered the tallest plants of 98 cm, followed by 120 kg/ha and 90 kg/ha that rendered 89 cm and 84 cm plants respectively. The control plot came with the minimum height plants of 82 cm. at the interaction of nitrogen application and seed rates 165 kg/ha x 150 kg/ha rendered the tall plants. the differences in heights of the plant significantly illustrates the impact of nitrogen in improving the vegetative growths, support to plants that are healthier and contributes significantly to the yields of grain as narrated by [61].

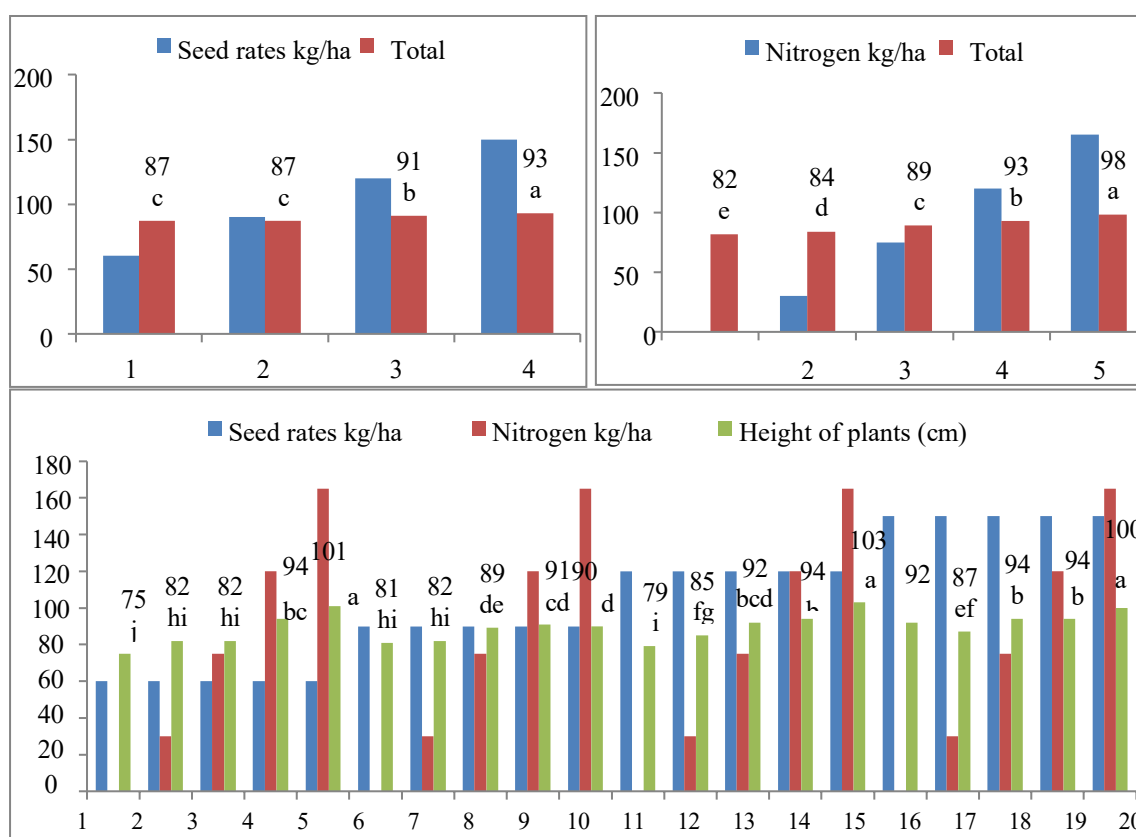


Figure 4. Plant height (cm) of wheat crops influenced by different seed rates and nitrogen application. *LSDat<0.05forseedrates, nitrogenandSRxNare1.249,1.396and2.748respectively.*

Length of Spike (cm)

Length of the spikes are considered to be a vital component of good yield as lengthy spikes have extra spikelets and provides more space for the development of grains. Figure5 illustrates the SR x N interaction, nitrogen kg/ha and seed rates kg/ha which have ultimately impact on the length of spikes. Seed rates of 120 kg/ha produces long spikes of 10.0 cm, followed by 150 kg/ha 9.6 cm and 90 kg/ha 9.4 cm, while the shortest spikes where recorded at 60 kg/ha. Such results were also acquired by [60]. The application of nitrogen at the rate of 120 kg/ha provided spikes with maximum length of 11.0 cm followed by 75 kg/ha and 165 kg/ ha of 9.8 cm and the minimum length of spikes were recorded at control plot of 8.3 cm. SR x N interaction rendered longest spikes when rates of seeds 150 kg/ha or 120 kg/ha combines with 120 kg/ha nitrogen application that rendered 11.5 cm spikes, similar results were stated by [62].

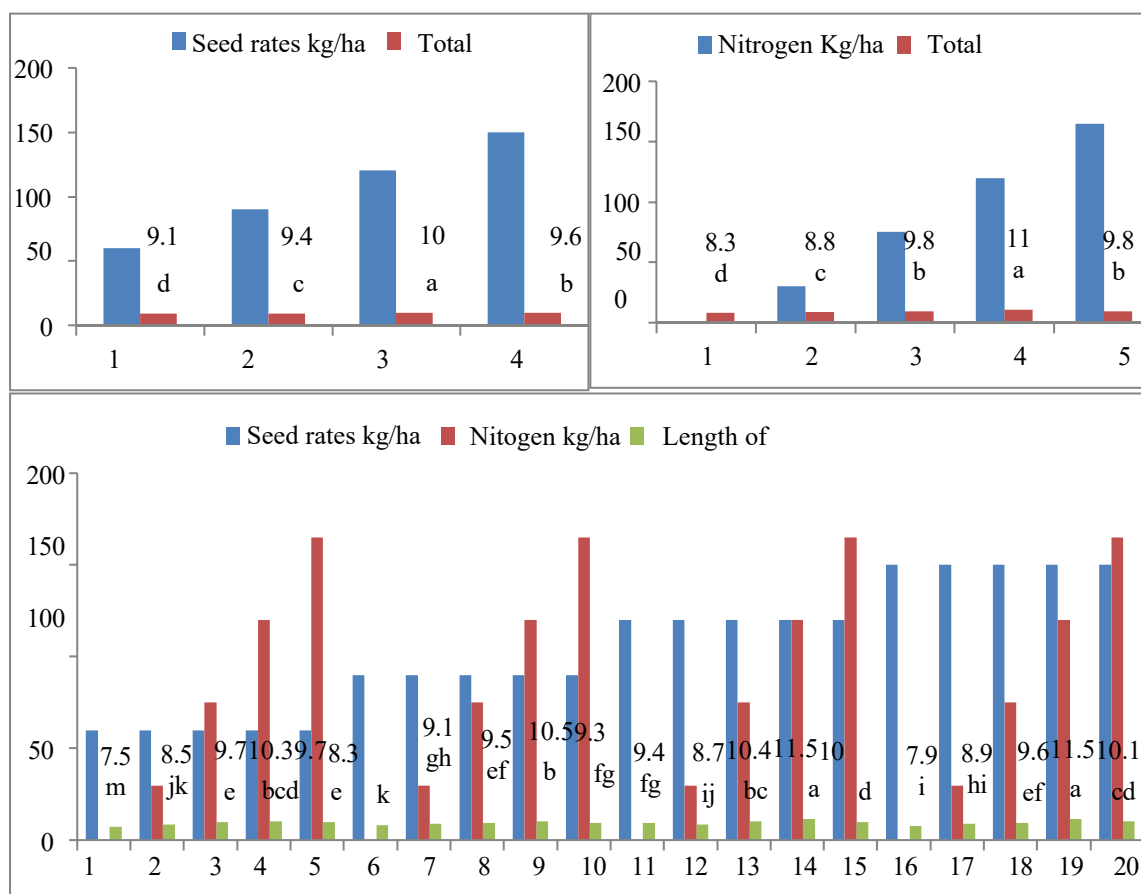


Figure 5. Length of spikes of wheat crop influenced by seeds rate and nitrogen application. LSD at $P < 0.05$ for seed rates, nitrogen and SRxN are 0.133, 0.149 and 0.640, respectively

Grains Spike-1

Grains per spike are an important component of yield. Figure 6 shows nitrogen, rates of seed and SR x N interaction significantly influences grains per spike. On 120 kg/ha nitrogen application 53 grains per spikes were recorded, followed by 165 kg/ha and 75 kg/ha which were 51 grains per spikes and 50 grains per spikes, while the minimum grains per spikes were recorded at control application of nitrogen which were 42 grains per spike. The formations of grains are significantly enhanced by the nitrogen application as stated by [63]. 120 kg/ha rate of seeds rendered most grains per spike which were 52, followed by 150 kg/ha seed rates rendering 49 grains per spikes and then 90 kg/ha seed rates producing 47 grains per spike, while the lowest grains per spikes were recorded at 60 kg/ha. The 120 kg/ha nitrogen application and seed rates interaction rendered highest grains per spikes which were 57 and the minimum were recorded on 60 kg/ha seed rate x 0 nitrogen application rendering 40 grains per spikes, which were evident from [64].

Spikes Meter-2

Spikes meter-2 are vital indicators of yields are more space is required by spikes for the formation of grains. Figure 7 illustrates significant impact of nitrogen, rate of seeds and SR x N interaction on spikes per meter². Spikes per meter² were maximum recorded on 150 kg/ha rate of seeds which were 414m⁻², followed by 120 kg/ha rendering 382 m⁻² and 90 kg/ha producing 332 m⁻². Higher rates of seed significantly increase number of spikes narrated by [65]. 120 kg/ha nitrogen application rendered highest spikes 381 m⁻², followed by 75 kg/ha producing 369 m⁻², then 165 kg/ha rendering 363 m⁻², while 346 m⁻² spikes were recorded on control application of nitrogen. In SR x N interaction the nitrogen application of 120 kg/ha x 150 rate of seeds produces maximum spikes 451 m⁻², same results were stated by [66].

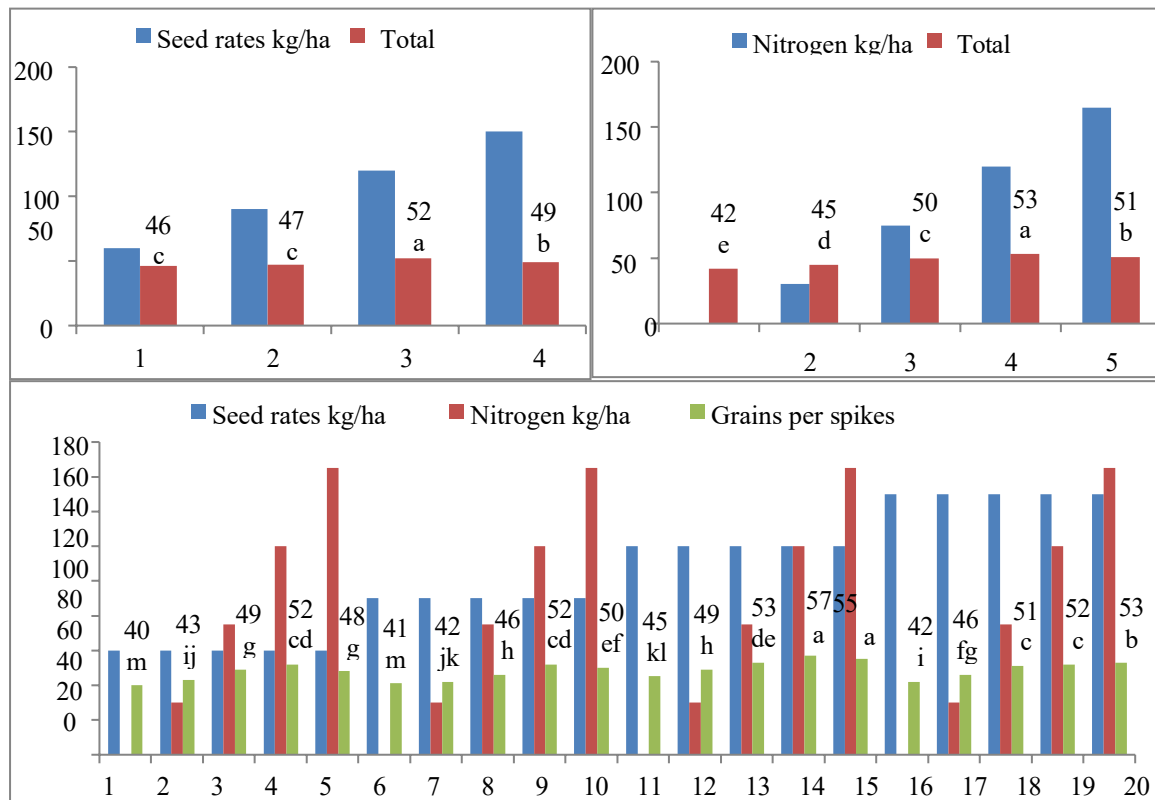


Figure 6. Grains per spikes of wheat crops influences by seed rates and nitrogen application. LSD at $P < 0.05$ for seed rates, nitrogen and SRxN are 0.510, 0.571 and 1.155, respectively

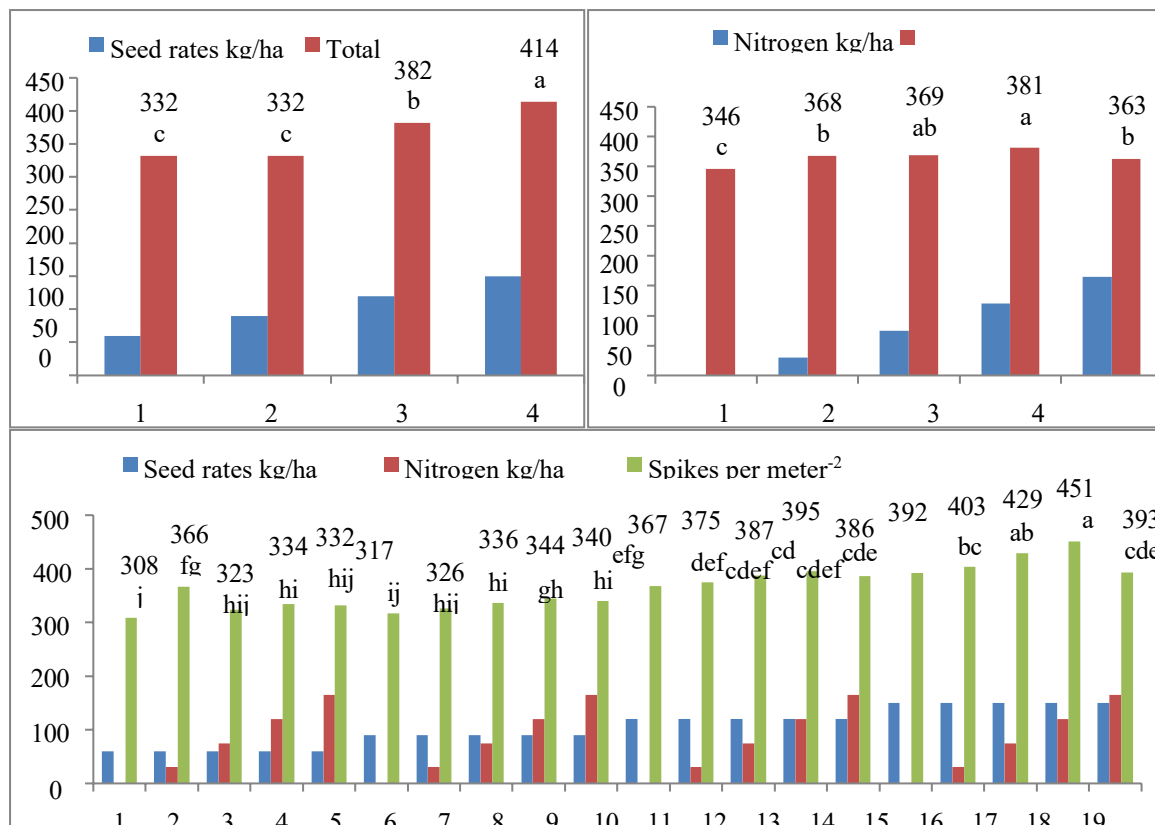


Figure 7. Spike m² of wheat crops influenced by rate of seeds and nitrogen application. LSD at $P < 0.05$ for seed rates, nitrogen and SRxN are 11.542, 12.905 and 25.264, respectively

Weight of 1000 Grains (g)

Yield of wheat crops can be significantly indicated by the weight of 1000 grains, as greater grains yields can be contributed by the heavier grains application. Figure 8 illustrates nitrogen, rate of seeds and SR x N interactions that significantly influence this trail. Greater weight of 1000 grains has been recorded on seed rates of 150 kg/ha which was 42 grams, followed by 120 kg/ha 41 grams and 90 kg/ha 39 grams, while 60 kg/ha rendered the lowest weights which were 38 grams, such results were rendered by [67], who related the high rates of seeds with greater yields. Grain weights can also be improved by the application of nitrogen. 120 kg/ha application of nitrogen produced 1000 grains weight upto 42 grams, followed by 41 and 40 grams, while the control nitrogen rendered 38 grams of 1000 grains of wheat crop. SR x N interaction of 120 kg/ha of nitrogen application with 150 kg/ha rate of seeds rendered 45 grams whereas the lowest was recorded at 60 kg/ha rate of seeds x 0kg/ha nitrogen application was 35grams, parallel with [68].

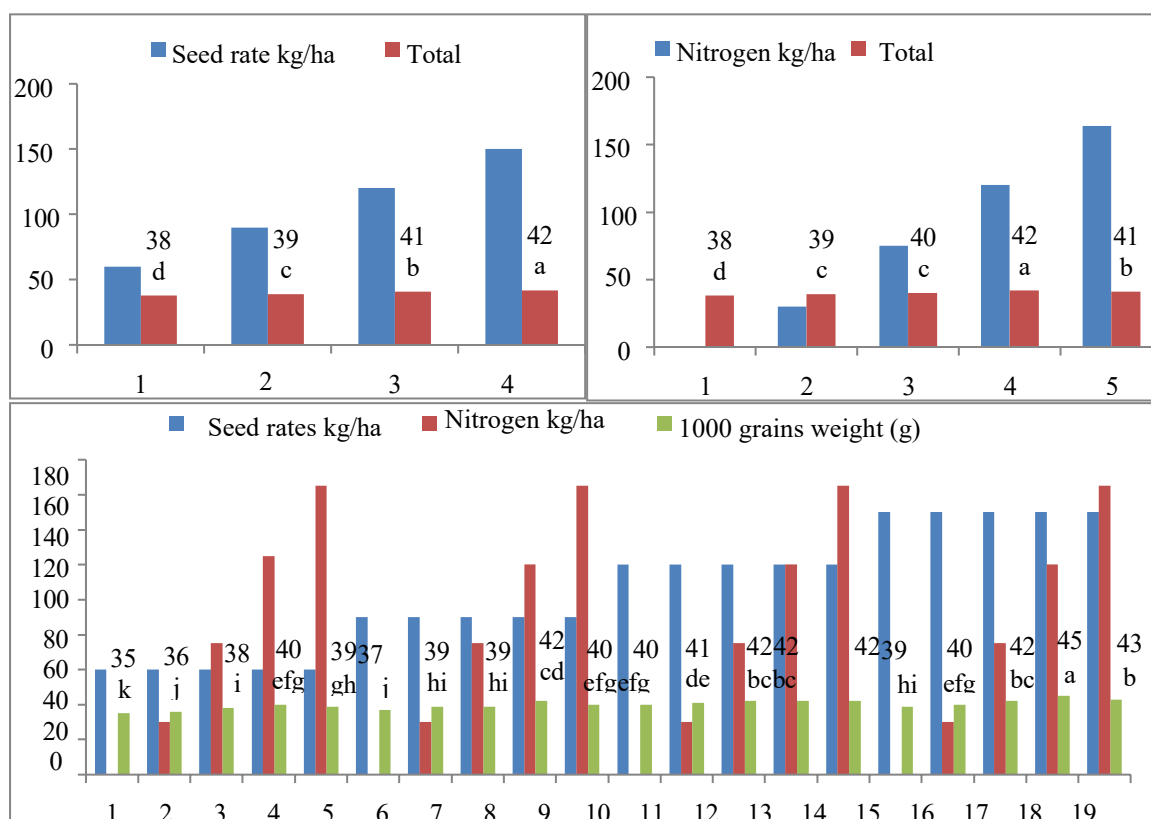


Figure 8. 1000 grains weight of wheat crop impacted by seeds rate and nitrogen application. LSD at $P < 0.05$ for seed rates, nitrogen and SRxN are 0.425, 0.476 and 0.979, respectively

Biological Yield

The biological yields differ significantly with the application of nitrogen, rate of seeds and SR x N interactions in Figure 9. Seed rate of 120 kg/ha renders high yield of 10,829 kg/ha, followed by 150 kg/ha seed rate yielding 9,190 kg/ha yield than 90 kg/ha seed rate yielding 8218 kg/ha, while the low yield of 7686 kg/ha were recorded at 60 kg/ha seed rates. 120 kg/ha nitrogen application yield 10,109 kg/ha yield, followed by 165 kg/ha nitrogen application 9,332 kg/ha than 75 kg/ha nitrogen application yielded 9,004 kg/ha while the control application yielded 7,927 kg/ha. The SR x N interactions of 120 nitrogen application x 120 rate of seeds yielded the maximum yield 11,922 kg/ha [69].

Grains Yield Kg ha-1

Grains yield per hectare significantly vary with nitrogen application, rate of seeds and SR x N interaction in Figure 10. 120 kg/ha seed rate yielded highest grains 4010 kg, followed by 150 kg/ha seed rate yielding 3873 kg grains, 90 kg/ha seed rates yielded 3307 kg grains and 60 kg/ha seed rates

yielded the lowest results which were 3025 kg. 120 kg/ha application of nitrogen yielded maximum 4139 kg, followed by 165 kg/ha yielded 3685 kg, 75 kg/ha yielded 3561 kg and the control recorded the lowest results 3056 kg. SR x N interactions 120 nitrogen application x 150 rate of seeds yielded significant result of 4444 kg, which was also evident from [70].

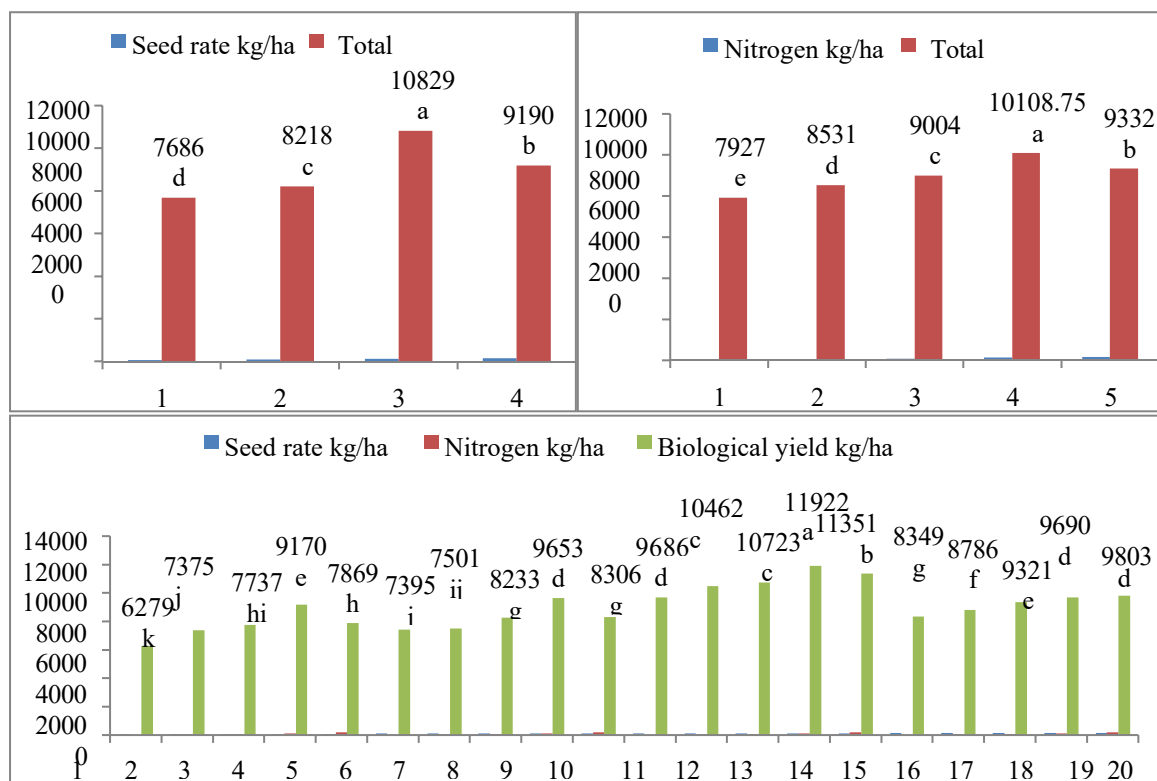


Figure 9. Biological yield of wheat crop influenced by seed rates and nitrogen application.
 LSD at $P < 0.05$ for seed rate, nitrogen and SRxN are 139.119, 155.540 and 304.478, respectively

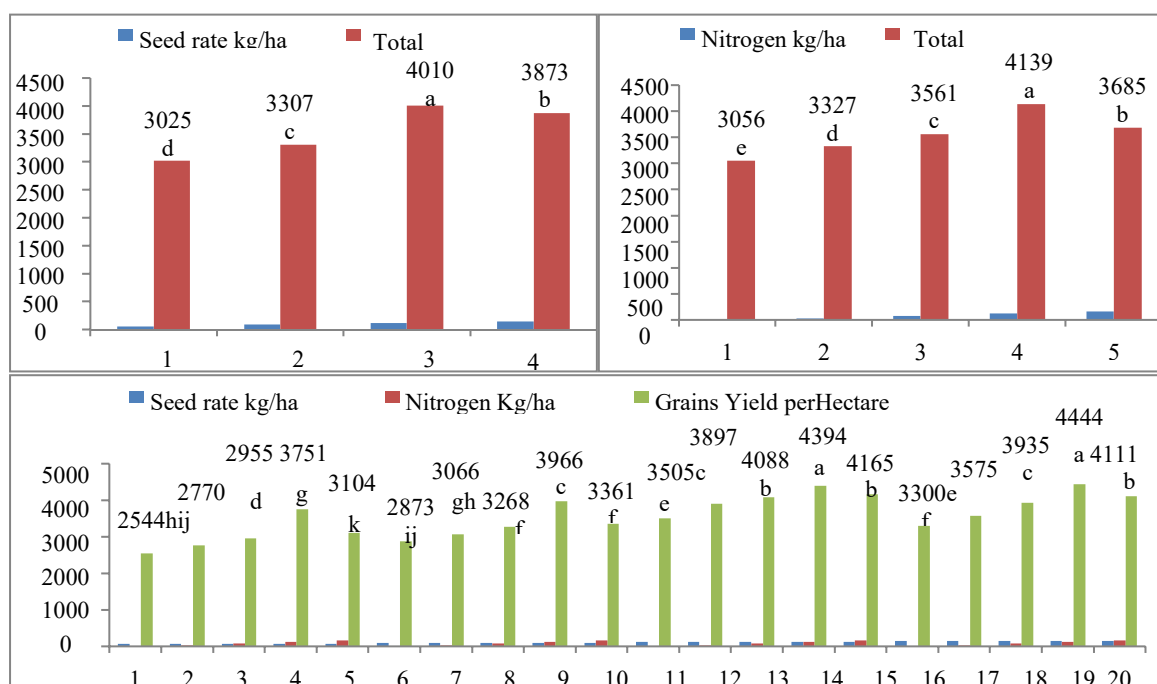


Figure 10. Grain yield of wheat crop influenced by seeds rate and nitrogen application.
 LSD at $P < 0.05$ for seed rates, nitrogen and SRxN are 49.760, 55.634 and 108.907, respectively.

Harvest Index Percentage

The percentage of harvest index varies because of the application of nitrogen, seed rates and SR x N interaction differences as shown in Figure 11. 150 kg/ha rate of seeds showed high percentage of harvest index of about 42%, followed by 90 kg/ha resulting in 40 % and the 60 kg/ha rate of seeds rendered lowest percentage that was 39 % also evident from [71]. 120 kg/ha application of nitrogen yield 41% of harvest index followed by 165kg/ha nitrogen application producing 40 %, than 75 kg/ha nitrogen application rendering 39 %. The SR x N interaction 120 nitrogen application x 150 rate of seeds kg/ha produces 46 % harvest index which is the maximum index also reported by [72].

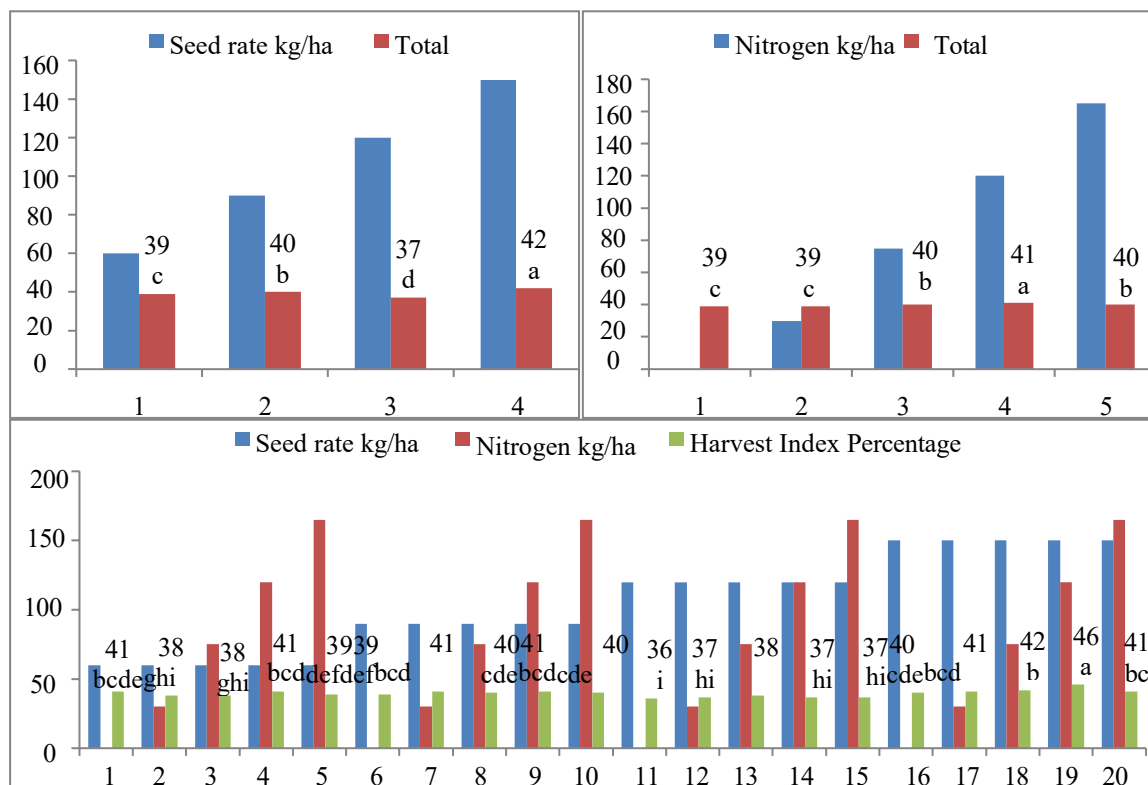


Figure 11. Harvest index percentage of wheat crop influenced by seed rate and nitrogen application. LSD at $P < 0.05$ for seed rate, nitrogen and SRxN are 0.764, 0.854 and 1.697, respectively

Percentage of Nitrogen Concentrations in Grains

Nitrogen applications showed significant impact on the concentration of nitrogen in grains while the interaction of SR x N and rate of seeds showed not significant effects, significant results are in Table 3. The concentration of nitrogen was highest in 120 kg/ha application of nitrogen 2.08 %, followed by 165 kg/ha 2.07 %, than 75 kg/ha 2.03 % and the minimum concentration was recorded at control kg/ha 1.92 % such results were evident from [73].

Table 3. Nitrogen concentration percentage in grains of wheat crops influences by nitrogen application, rate of seeds and SR x N interaction.

Seed rates (Kg/ha)	Nitrogen (Kg/ha)					Total
	0	30	75	120	165	
60	1.93	1.95	2.00	2.08	2.08	2.01
90	1.92	1.98	2.02	2.07	2.08	2.01
120	1.91	1.98	2.02	2.07	2.07	2.01
150	1.93	1.97	2.10	2.09	2.06	2.03
Total	1.92d	1.97c	2.03b	2.08a	2.07ab	

LSD at $P < 0.05$ for nitrogen=0.854

Percentage of Nitrogen Concentrations in Straw

The concentration of nitrogen in straws by rate of seeds and nitrogen application are shown in Table 4. The content of nitrogen in straws is significantly influenced by the application of nitrogen, while the rate of seed and SR x N interactions shows non-significant impact. The concentration of nitrogen was maximum in 165 kg/ha nitrogen application which was 0.51 %, followed by 120 kg/ha of 0.42 % same as 75 kg/ha. While the lowest nitrogen concentration was recorded at control plot, the results match to [74].

Table 4. Percentage of nitrogen concentrations in straws of wheat crop influenced by seed rate, nitrogen application and SR x N interactions with several rates.

Seed rates (Kg/ha)	Nitrogen (Kg/ha)					Total
	0	30	75	120	165	
60	0.42	0.44	0.49	0.50	0.51	0.47
90	0.41	0.45	0.50	0.50	0.51	0.48
120	0.41	0.45	0.50	0.49	0.51	0.47
150	0.43	0.46	0.50	0.50	0.50	0.48
Total	0.42c	0.45b	0.50a	0.50a	0.51a	

LSD at $P < 0.05$ for nitrogen = 0.854

Percentage of Protein Concentrations in grains

The percentage of protein in the grains of wheat crops is shown in Table 5. The content of protein is significantly affected by the application of nitrogen while the rate of seeds and SR x N interactions showed non-significant impacts. 165 kg/ha nitrogen application and 120 kg/ha application of nitrogen rendered 11.8 % protein content in wheat crops followed by 75 kg/ha application of nitrogen 11.4% and the least concentration was recorded at control plots of 10.9 %. The protein content in grains and growth of plants are significantly enhanced by the nitrogen evident from [75].

Table 5. Percentage of grains protein concentrations of wheat crops influenced by seed rate, nitrogen application and SR x N interactions.

Seed rates (Kg/ha)	Nitrogen (Kg/ha)					Total
	0	30	75	120	165	
60	10.9	11.3	11.4	11.8	11.9	11.4
90	10.9	11.2	11.4	11.8	11.9	11.4
120	10.9	11.2	11.4	11.8	11.8	11.4
150	11.0	11.3	11.3	11.8	11.8	11.4
Total	10.9d	11.3c	11.4b	11.8a	11.8a	

LSD at $P < 0.05$ for nitrogen = 0.854 Percentage of Protein concentrations in straw

The content of protein concentrations in the straws of wheat crops are illustrated in Table 6. The application of nitrogen significantly affects the content of protein concentrations in straws, whereas rate of seeds and SR x N interactions shows non-significance. The maximum content of protein concentration percentage was at 165kg/ha and 120kg/ha of 11.8% while followed by 75 kg/ha application of nitrogen rendering 11.4 %, than 30 kg/ha showing 11.3 and the lowermost percentage of protein concentration was recorded at control plot of 10.9 % evident from [76].

Table 6. Percentage of straw protein concentrations of wheat crops influenced by seed rate, nitrogen application and SR x N interactions.

Seed rates (Kg/ha)	Nitrogen (Kg/ha)					Total
	0	30	75	120	165	
60	10.9	11.3	11.4	11.8	11.9	11.4
90	10.9	11.2	11.4	11.8	11.9	11.4
120	10.9	11.2	11.4	11.8	11.8	11.4
150	11.0	11.3	11.3	11.8	11.8	11.4
Total	10.9d	11.3c	11.4b	11.8a	11.8a	

LSD at $P < 0.05$ for nitrogen = 0.854

CONCLUSION

- Increased seed rate improves growth of wheat and yields.
- Application of nitrogen enhances production and growth of wheat crops.
- Nitrogen and rate of seeds supplementary lifts crops performances.

Recommendations

- 120-150kg/ha rate of seeds are suggested for better wheat crop yields.
- Application of nitrogen of 120kg/ha is ideal to higher productions.
- The combine use of 120x120kg/ha nitrogen and rate of seeds are very effective for acquiring maximum wheat crop yields.

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