Research Article

Response of different wheat varieties to various seed rates

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Abstract

Experiment was conducted to study the response of different wheat varieties to various seed rates. The experiment consists of five different wheat varieties (V_1 = Nasir - 2k, V_2 = Salim - 2k, V_3 = Bakhtawar-92, V_4 = Fakhre-e-Sarhad and V_5 = Lucky J-03) were sown at five various seed rates (S_1 = 60 kg ha⁻¹, S_2 = 80 kg ha⁻¹, S_3 = 100 kg ha⁻¹, S_4 = 120 kg ha⁻¹ and S_5 = 140 kg ha⁻¹). Data recorded from the varieties treatments revealed that maximum tillers m⁻² (377), leaf area index (4.10), grains spike⁻¹ (68), 1000-grain weight (45.24 g), grain yield (4022 kg ha⁻¹), biological yield (16660 kg ha⁻¹), net income (Rs. 61921), BCR (4.99 %) and MRR % (499.49) was noted from the plots sown with variety Fakhre-e-Sarhad. Statistical analysis of the data also revealed that seed rates were significantly affected all parameters except biological yield and harvest index. It can be inferred from the data showed that maximum ((369) tillers m⁻², grains spike⁻¹ (65), leaf area index (4.03), 1000-grain weight (45.30 g), grain yield (4222 kg ha⁻¹), biological yield (15030 kg ha⁻¹), net income (Rs. 62119), BCR (5.18 %) and MRR % (518.03) was noted from the plots seeded with 120 kg ha⁻¹. In case of interaction between varieties and seed rate it was observed that maximum (420.25) tillers m⁻², leaf area index (4.79), grains spike⁻¹ (74), 1000-grain weight (47.33 g), grain yield (4676 kg ha⁻¹), biological yield (19535 kg ha⁻¹), net income (Rs. 66863), BCR (5.47 %) and MRR % (546.95) was noted from the plots sown with FakhreSarhad and seed rate was used at 120 kg ha⁻¹.

Key words: Seed rates; Leaf area index; Yield and yield components; Economic analysis

Introduction

The yielding ability of a variety is the result of its interaction with the environment. The cultivar and environmental interactions are of major importance in developing improved varieties for a certain locality. The variations in environments have been used effectively to reduce the cultivar-environment interaction. The region for which an agronomist is developing a variety can often be so sub-divided that all the environments in the region are somewhat similar. This change usually is

based on such macro-environmental differences as temperature gradients, rainfall distribution and soil types.

Plant density is one of the major factors determining the ability of the crop to capture resources. It is of particular importance in wheat production because it is under the farmer's control in most cropping systems. Optimum plant densities vary greatly between areas according to climatic conditions, soil, sowing time, and varieties. Consequently, there is value in defining relationships between density and

wheat yield to establish optimum seeding rates for various regions. Therefore, this study was conducted at Agricultural Research Station, Serai Nourang (Bannu), to check the best performance of wheat varieties sown under different seed rates.

Materials and methods

The main objective of this study was to evaluate the performance of different wheat varieties using various seed rates for better yield under suitable environmental condition in District Bannu–Khyber Pukhtoonkhwa – Pakistan. Five wheat varieties (V_1 = Nasir - 2k, V_2 = Salim - 2k, V_3 = Bakhtawar-92, V_4 = Fakhre-e-Sarhad, and V_5 = Lucky J-03) were allotted to main plots. While five different seed rates (S_1 = 60, S_2 = 80, S_3 = 100, S_4 = 120, and S_5 = 140 kg ha⁻¹) were allocated to subplots. The experiment was laid out in a split plot design with four replications. Experiment was conducted on a well prepared seedbed. Net plot size of 4 x 1.8 m² was kept with six rows per plot. The fertilizer dose of 90 kg Phosphorus and 120 kg N ha⁻¹ was applied in the form of D.A.P and Urea. The nitrogen level (120 kg ha⁻¹) was split in two equal doses at 60 kg ha⁻¹. First dose of nitrogen (60 kg ha⁻¹) was applied to whole experimental plot uniformly with full dose of phosphorus (90 kg ha⁻¹) at the time of land preparation. 2nd dose of nitrogen (60 kg ha⁻¹) was applied at tillering stage.

Adequate plant protection measures were made during the crop growing period. Keeping in view the soil condition and physical appearance of crop, five numbers of irrigations were applied to all the plots uniformly so that the wheat crop may not be damaged. Hand weeding was done to keep the crop free of weeds. Data was recorded on number of tillers, grains spike⁻¹, leaf area index, thousand grains weight, biological and grain yields. For net income economic analysis was performed. At maturity four rows of the plot were harvested and tied into small bundle for sun drying for about one week. The dried bundles were threshed for collection of grain yield.

Statistical analysis of the data was done at 1 % level of probability using Duncan's Multiple Range Test (DMRT) to test the difference between the individual means.

[1]

Results

Tillers m⁻²

Data presented in table 1 indicated that different wheat varieties had significant ($P \leq 0.05$) effect on tillers m⁻². Data showed that maximum (377) tillers m⁻² were noted sown with variety Fakhre-e-Sarhad (V_4), followed by plots sown with Bakhtawar-92 and Lakki J03, which remained statistically similar to V_4 , while minimum (263) tillers m⁻² were produced when plots were sown with Nasir-2K (V_1). The data further showed that different seed rates had significant affected tillers m⁻². It is evident from the data that maximum tillers m⁻² (369) were noted when plots were seeded with 120 kg ha⁻¹ (S_4), while minimum tillers m⁻² (314) were recorded when 60 kg ha⁻¹ seed rate was used (S_1). The data also indicated that interaction between wheat varieties and seed rate was significantly affected. Data showed that maximum (420.25) tillers m⁻² were noted when variety Fakhre-e-Sarhad sown at the rate of 120 kg ha⁻¹ seed rate (V_4S_4), while minimum tillers m⁻² were noted from variety Nasir-2K and seeded with 60, 80 and 100 kg ha⁻¹ (235, 245 and 252), which were statistically similar. Wheat varieties had significant effect on tillers. These results are in agreement with [2]. The differences among tillers m⁻² of the varieties may be due to the inherent genetic potential for tillering as well as differences in the number of plants emerged per unit area. The data further showed that different seed rates had significant effect on tillers. These results are also reported by Khokar *et al.* [3] and Yoon *et al.* [4] who found maximum tillering at higher seed rates than at lower seed rates. The tillering potential was much higher at higher seed rate, when compared to lower seed rate. It might be due to that the number of tillers m⁻² decreased with increase in seeding rate, because, by

increasing seed rate per unit area, the inter plant competition for space, nutrient, moisture and sun light increases which results in lower tillers m^{-2} . The data also

indicated that interaction between wheat varieties and seed rate was significantly affected. [5] also reported similar results.

Table 1. Tillers m^{-2} , number of grains spike $^{-1}$ and leaf area index as affected by various wheat varieties and different seed rates

Treatments	Tillers m^{-2}	Number of grains spike $^{-1}$	Leaf area index
A: Varieties			
V ₁ (Nasir - 2k)	263.50 C	54.40 C	2.76 C
V ₂ (Salim - 2K)	319.75 B	59.15 B	3.44 B
V ₃ (Bakhtawar-92)	372.30 A	61.85 B	3.84 AB
V ₄ (Fakhre-e-Sarhad)	377.30 A	68.05 A	4.10 A
V ₅ (Lakki J-03)	368.50 A	67.05 A	3.59 B
LSD (P ≤ 0.05)	9.39	2.84	0.46
B: Seed Rate			
S ₁ (60 kg ha $^{-1}$)	314.05 D	59.55 C	2.92 B
S ₂ (80 kg ha $^{-1}$)	329.90 C	60.15 BC	3.50 A
S ₃ (100 kg ha $^{-1}$)	334.80 C	63.10 AB	3.79 A
S ₄ (120 kg ha $^{-1}$)	369.20 A	65.30 A	4.03 A
S ₅ (140 kg ha $^{-1}$)	353.40 B	62.40 A-C	3.50 A
LSD (P ≤ 0.05)	11.66	3.30	0.58
C: Interaction(AxB)			
V ₁ S ₁	235.75 L	50.25 L	2.17 H
V ₁ S ₂	245.75 L	52.50 KL	2.48 F-H
V ₁ S ₃	252.50 L	55.00 J-K	2.85 E-H
V ₁ S ₄	293.25 K	58.25 H-K	3.15 C-H
V ₁ S ₅	290.25 K	56.00 I-L	2.99 C-H
V ₂ S ₁	291.25 K	56.00 I-L	2.34 CH
V ₂ S ₂	308.25 JK	58.25 H-K	3.66 A-F
V ₂ S ₃	319.75 IJ	58.50 H-K	4.06 A-E
V ₂ S ₄	343.00 F-H	61.75 F-I	3.96 A-E
V ₂ S ₅	336.50 HI	61.25 F-J	3.36 B-H
V ₃ S ₁	357.25 D-H	66.25 C-E	3.36 B-H
V ₃ S ₂	368.75 C-E	63.25 E-H	3.42 B-H
V ₃ S ₃	372.75 B-D	64.00 D-H	3.99 A-E
V ₃ S ₄	395.00 B	59.50 G-J	4.79 A
V ₃ S ₅	367.75 C-E	56.25 I-L	3.66 A-F
V ₄ S ₁	346.25 E-H	65.75 C-G	3.2 C-H
V ₄ S ₂	365.00 C-F	65.00 C-G	4.16 A-D
V ₄ S ₃	368.75 C-E	67.25 B-F	4.27 A-C
V ₄ S ₄	420.25 A	74.00 A	4.28 A-C
V ₄ S ₅	386.25 BC	68.25 A-E	4.61 AB
V ₅ S ₁	339.75 G-I	59.50 G-J	3.51 A-G
V ₅ S ₂	361.75 D-G	61.75 E-I	3.79 A-E
V ₅ S ₃	360.25 D-G	70.75 A-C	3.78 A-F
V ₅ S ₄	394.50 B	73.00 AB	3.99 A-E
V ₅ S ₅	386.25 BC	70.25 A-D	2.89 D-H
LSD (P ≤ 0.05)	11.66	6.34	1.30

Means followed by different letters are significantly different from one another at P ≤ 0.05

Number of grains spike $^{-1}$

Statistical analysis of the data perused in

table 1 revealed that different wheat varieties were significantly affected

number of grains spike⁻¹. Highest number of grains (68) were noted sown with variety Fakhre-e-Sarhad (V₄), followed by plots sown with Lakki J03 (67 number of grains spike⁻¹), which was statistically similar to V₄, while lowest (54) number of grains spike⁻¹ were produced when plots were sown with Nasir-2K (V₁). Data further revealed that different seed rates had significant effect on number of grains spike⁻¹. It is evident from the data that during 2003-04, maximum (65) number of grains spike⁻¹ were noted when plots were seeded with 120 kg ha⁻¹ (S₄), while minimum number of grains spike⁻¹ (59) were recorded when 60 kg ha⁻¹ seed rate was used (S₁). The data also indicated that interaction between wheat varieties and seed rate was significantly affected. The potential of wheat spike is determined by the number of grains spike⁻¹ which is an important yield component of grain yield. Statistical analysis of the data revealed that different wheat varieties were significantly affected number of grains spike⁻¹. The greater differences in number of grains spike⁻¹ of the five varieties showed greater genetic variability among the varieties for reproductive sink capacities of the varieties and differences in ear size [6]. Data further revealed that different seed rates had significant effect on number of grains spike⁻¹. Similar results were also reported by [7-9] who reported that higher seed rates produced significant decrease in the number of grains spike⁻¹. The increase in number of grains spike⁻¹ with decrease in seed rate might be due to the plant nutrients present in the soil were enough for the vegetative growth and grain formation when there were less number of plants unit area⁻¹. They were less competitive for all essential elements as compared to the greater number of plants unit area⁻¹. The data also indicated that interaction between wheat varieties and seed rate was significantly affected. These results are in agreement with [6]

Leaf area index

Analysis of data presented in table 1

showed that different wheat varieties had significant ($P \leq 0.05$) effect on leaf area index. Maximum leaf area index (4.10) was noted from plots sown with variety Fakhre-e-Sarhad (V₄), while minimum leaf area index (2.76) was recorded when plots were sown with Salim-2K (V₂). The data further showed that different seed rates had significant effect on leaf area index. It is evident from the data that maximum leaf area index (4.03) was noted when plots were seeded with 120 kg ha⁻¹ (S₄), while minimum leaf area index (2.92) was recorded when 60 kg ha⁻¹ seed rate was used (S₁). Data also indicated that interaction between wheat varieties and seed rate was significantly affected. Data showed that maximum leaf area index (4.79) was noted when variety Fakhre-e-Sarhad sown at the rate of 120 kg ha⁻¹ seed rate (V₄S₄), while minimum leaf area index (2.17) was noted by variety Nasir-2K seeded with 60 kg ha⁻¹ (V₁S₁). Analysis of data showed that different wheat varieties had significant effect on leaf area index. These results are also reported by [2]. The difference among leaf area index may be the genetic potential and duration of its stages for vegetative and reproductive development. The data further showed that different seed rates had significant effect on leaf area index. Similar results were also reported by [10]. This might be due to long vegetation growth in low seeded plots than higher seeded ones. The seeding rate at 140 kg ha⁻¹ decreased the leaf area index due to greater competition among the plants for the limited sunlight and available nutrients in the soil. Data also indicated that interaction between wheat varieties and seed rate was significantly affected. It may be due to greater competition among the plants to the limited sunlight and available nutrients in the soil for leaf area index. As leaf area index depend upon tillers m⁻² and leaf area tiller⁻¹, the differences in leaf area of the crop under different irrigation and seed rates may be due to interaction of internal genetic factors with environmental factor especially light and water status of the soil.

1000-grain weight (g)

Different wheat varieties showed a significant ($P \leq 0.05$) effect on 1000-grain weight presented in table 2. Heaviest grains (45.24 g) were recorded sown with variety Fakhre-e-Sarhad (V_4), statistically similar to variety Lakki J03 (44.90 g), while lightest grains (40.43 g) were recorded by varieties Nasir-2K (V_1). Analysis of the data further revealed that different seed rates had significant effect on leaf area index. Maximum 1000-grains weight (45.33 g) was noted when plots were seeded with 120 kg ha⁻¹ (S_4), while minimum 1000-grains weight (41.45 g) was recorded when 60 kg ha⁻¹ seed rate was used (S_1). The data also indicated that interaction between wheat varieties and seed rate was significantly affected. Maximum 1000-grains weight (47.33 g) was obtained when variety Fakhre-e-Sarhad sown at the rate of 120 kg ha⁻¹ seed rate (V_4S_4), while minimum 1000-grains weight (38.35 g) was noted from variety Nasir-2K and seeded with 60 kg ha⁻¹ (V_1S_1). Different wheat varieties showed a significant effect on 1000-grain weight. Similar results are also stated by [6]. The differences in varieties may be due to variation in the potential grain size of the varieties, variation in leaf area specially the flag leaf area and may be due to variation in reproductive sink intensity as a result of physiological parameters which determined seed size in different varieties.

Analysis of the data further revealed that different seed rates had significant effect on leaf area index. The results obtained agree with findings of [11] who also reported that 1000 grain weight decreased with increasing in seeding densities.

It may be due to the variation in spikes m⁻², because as spikes population increase, the amount of assimilates to be translocated to spike by each plant per unit area decrease and thus resulted in less 1000 grain weight under light seeding densities. The data also indicated that interaction between wheat

varieties and seed rate was significantly affected. Similar results were also reported by [6].

Grain yield (kg ha⁻¹)

Statistical analysis of the data perused in table 2 revealed that different wheat varieties had significant ($P \leq 0.05$) effect on grain yield. Highest grain yield (4022 kg ha⁻¹) was produced by variety Fakhre-e-Sarhad (V_4), while all other varieties recorded lowest grain yield which were statistically similar to each other. Data further revealed that different seed rates had significant effect on grain yield. It is evident from the data that maximum grain yield (4222 kg ha⁻¹) was recorded when plots were seeded with 120 kg ha⁻¹ (S_4), while minimum grain yield (3037 kg ha⁻¹) was recorded when 60 kg ha⁻¹ seed rate was used (S_1). The data also indicated that interaction between wheat varieties and seed rate was significantly affected. Data showed that maximum grain yield (4676 kg ha⁻¹) was obtained when variety Fakhre-e-Sarhad sown at the rate of 120 kg ha⁻¹ seed rate (V_4S_4), while minimum grain yield (2932 kg ha⁻¹) was recorded from variety Nasir-2K seeded with 140 kg ha⁻¹. Data revealed that different wheat varieties had significant effect on grain yield. Similar results were also reported by, [12-14]. The differences among grain yields of the 5-varieties may be due to the variation in genetic makeup of the varieties and may have resulted from differences in yield components and partitioning of assimilates to grains. Data further revealed that different seed rates had significant effect on grain yield. These results are in agreement with [8-16] who reported that grain yield increased as seed rate increased and the highest grain yield was noted in plots seeded at of 120 kg ha⁻¹. The data also indicated that interaction between wheat varieties and seed rate was significantly affected. Similar results were also reported by [6].

Table 2. 1000-grain weight, grain yield and biological yield as affected by various wheat varieties and different seed rates

Treatments	1000-grain weight	Grain yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)
A: Varieties			
V ₁ (Nasir - 2k)	40.43 D	3542.30 B	6333.84 D
V ₂ (Salim - 2K)	43.48 C	3524.90 B	10474.93 C
V ₃ (Bakhtawar-92)	44.27 B	3519.60 B	13590.18 B
V ₄ (Fakhre-e-Sarhad)	45.24 A	4022.50 A	16660.92 A
V ₅ (Lakki J-03)	44.90 A	3460.15 B	16041.03 AB
LSD (P ≤ 0.05)	0.51	331.30	2582.00
B: Seed Rate			
S ₁ (60 kg ha ⁻¹)	41.45 C	3037.15 C	9540.00 C
S ₂ (80 kg ha ⁻¹)	43.89 B	3381.10 BC	11959.61 B
S ₃ (100 kg ha ⁻¹)	44.11 B	3673.00 B	12353.24 B
S ₄ (120 kg ha ⁻¹)	45.30 A	4222.80 A	15030.53 A
S ₅ (140 kg ha ⁻¹)	43.55 B	3855.40 B	12549.57 B
LSD (P ≤ 0.05)	1.16	357.60	2416.00
C: Interaction (A x B)			
V ₁ S ₁	38.35 G	2932.50 I	5164.53 J
V ₁ S ₂	40.40 FG	3306.25 E-I	5913.53 II
V ₁ S ₃	41.08 EF	3756.25 B-H	6807.38 H-J
V ₁ S ₄	42.25 D-F	4059.00 A-E	6903.00 H-J
V ₁ S ₅	40.05 FG	3657.50 B-I	6880.78 H-J
V ₂ S ₁	41.23 EF	2972.75 HI	8767.25 G-J
V ₂ S ₂	43.78 B-D	3237.25 F-I	10509.63 E-J
V ₂ S ₃	43.83 B-D	3617.50 C-I	11124.75 D-I
V ₂ S ₄	45.30 A-C	4188.75 A-D	11732.97 C-H
V ₂ S ₅	43.25 C-E	3608.25 C-I	10240.05 F-J
V ₃ S ₁	41.03 EF	3036.00 HI	12366.88 C-G
V ₃ S ₂	44.80 BC	3197.00 G-I	11049.75 D-I
V ₃ S ₃	44.28 B-D	3363.75 E-I	13013.88 B-G
V ₃ S ₄	45.85 AB	4163.75 A-D	18203.25 AB
V ₃ S ₅	45.38 A-C	3837.50 B-G	13317.13 B-G
V ₄ S ₁	42.20 D-F	3191.25 G-I	16376.88 A-D
V ₄ S ₂	45.45 A-C	3473.75 D-I	15589.38 A-F
V ₄ S ₃	45.85 AB	4350.00 A-C	15136.69 A-F
V ₄ S ₄	47.33 A	4676.25 A	19535.16 A
V ₄ S ₅	45.38 A-C	4421.25 AB	16666.50 A-C
V ₅ S ₁	44.46 B-D	3053.25 G-I	13364.25 B-G
V ₅ S ₂	45.03 BC	3191.25 G-I	16735.75 A-C
V ₅ S ₃	45.53 A-C	3277.50 E-I	15683.50 A-E
V ₅ S ₄	45.78 AB	4026.25 A-F	17778.28 AB
V ₅ S ₅	43.70 B-D	3752.50 B-H	15643.38 A-E
LSD (P ≤ 0.05)	2.27	799.60	5402.00

Means followed by different letters are significantly different from one another at P ≤ 0.05

Biological yield (kg ha⁻¹)

Statistical analysis of data given in table 3 showed that different wheat varieties had significant ($P \leq 0.05$) effect on biological yield. It is clear from the data that maximum biological yield (16660 kg ha⁻¹) was recorded from plots sown with variety Fakhre-e-Sarhad (V₄), while minimum biological yield (6333 kg ha⁻¹) was recorded when plots were sown with Nasir-2K (V₁). The data further showed that different seed rates had significantly ($P \leq 0.05$) affected biological yield. It is evident from the data that maximum biological yield (15030 kg ha⁻¹) was noted when plots were seeded with 120 kg ha⁻¹ (S₄), while minimum biological yield (9540 kg ha⁻¹) was recorded when 60 kg ha⁻¹ seed rate was used (S₁). The same trend was followed. Data also indicated that interaction between wheat varieties and seed rate was affected. Data showed that maximum biological yield (19535 kg ha⁻¹) was noted when variety Fakhre-e-Sarhad sown at the rate of 120 kg ha⁻¹ seed rate (V₄S₄), while minimum biological yield (5164 kg ha⁻¹) was produced by variety Nasir-2K seeded with 60 kg ha⁻¹ (V₁S₁). Statistical analysis of data showed that different wheat varieties had significant effect on biological yield. The differences in biological yield of varieties may be due to variation in their genetic potential for seasonal dry matter accumulation. The data further showed that different seed rates had significantly affected biological yield. These results are in agreement with [7] stated that the increase in biological yield with higher seed rate might be due to more number of plants per unit area, though with reduced tillers. Data also indicated that interaction between wheat varieties and seed rate was affected. Biological yield is a product of number of tillers m⁻² and tillers weight including spike weight and grain weight. The differences in biological yield could be variation in tillers m⁻² and tiller weight. Both of these have been differentially affected by the soil and environmental conditions.

Economic analysis

Data presented in table 3 indicate the economic analysis of wheat as affected by various varieties and different seed rates. Wheat varieties showed a significant increase in net monetary grain presented in table 3. It is clear from the data of the growing season that when plots were sown with variety Fakhre-e-Sarhad produced maximum (Rs. 61921.00) net income, while variety Nasir-2K noted minimum (Rs. 40109.00) net profit. When plots were seeded with 120 kg ha⁻¹ produced maximum (Rs. 62119.00) net income, while plots in which seed rate was used at 60 kg ha⁻¹ noted minimum (Rs. 30755.00) net profit. In case of interaction between varieties and seed rate, maximum (Rs. 66719.00) net profit was noted in the combination of variety Fakhre-e-Sarhad and 120 kg ha⁻¹ seed rate, while minimum (Rs. 30755.00) was noted from plots in which variety Nasir 2k seeded with 120 kg ha⁻¹ and no nitrogen fertilizer was applied. The data also revealed that BCR (benefit cost ratio) was higher when variety Fakhre-e-Sarhad was sown produced maximum (4.99) BCR, while variety Nasir-2K get minimum (3.98) BCR. When seed rate was applied at 120 kg ha⁻¹ gave (5.18) BCR, while when plots were seeded with 60 kg ha⁻¹ noted minimum (3.77) BCR. When the interaction studied, it was observed that when variety Fakhre-e-Sarhad seeded with 120 kg ha⁻¹ and fertilized with 120 kg N ha⁻¹ produced maximum (5.83) BCR, while minimum (3.28) BCR was noted when plots were seeded with 60 kg ha⁻¹ with variety Nasir-2K.

Highest (499.49) marginal rate of return was noted from variety Fakhre-e-Sarhad, while lowest (397.54) marginal rate of return was recorded by variety Nasir-2K. Similarly when plots were seeded with 120 kg ha⁻¹ noted maximum (5.18) marginal rate of return, while minimum (377.24) marginal rate of return was obtained from those pots in which seed rate was used at 60 kg ha⁻¹. The data further revealed that interaction showed a significant variation among varieties and seed rate. Maximum

(582.57) marginal rate of return was noted from the combination of variety Fakhre-e-Sarhad and 120 kg ha⁻¹ seed rate, while

minimum (328.15) marginal rate of return was noted from variety Nasir-2K seeded with 60 kg ha⁻¹.

Table 3. Economic analysis of wheat as affected by various irrigation and nitrogen levels

Treatment s	Wheat Yield (kg ha ⁻¹)		Income (Rs. ha ⁻¹)		Gross Income (Rs.ha ⁻¹)	Total Expendit ure (Rs. ha ⁻¹)	Net Income (Rs. ha ⁻¹)	BCR	MRR %
A: Varieties	Grai n	Straw	Grain	Straw					
V ₁	3542	6334	42504	11085	53589	13480	40109	3.98	397.54
V ₂	3525	10475	42300	18331	60631	14320	46311	4.23	423.40
V ₃	3520	13590	42240	23783	66023	14960	51063	4.41	441.33
V ₄	4022	16661	48264	29157	77421	15500	61921	4.99	499.49
V ₅	3460	16041	41520	28072	69592	16040	53552	4.34	433.87
B: Seed rate (kg ha ⁻¹)									
S ₁ (60)	3037	11208	36444	19614	56058	14860	41198	3.77	377.24
S ₂ (80)	3281	11960	39372	20930	60302	14860	45442	4.06	405.80
S ₃ (100)	3673	12353	44076	21618	65694	14860	50834	4.42	442.09
S ₄ (120)	4223	15030	50676	26303	76979	14860	62119	5.18	518.03
S ₅ (140)	3856	12550	46272	21963	68235	14860	53375	4.59	459.19
C: Interaction (A x B)									
V ₁ S ₁	2933	5165	35196	9039	44235	13480	30755	3.28	328.15
V ₁ S ₂	3306	5914	39672	10350	50022	13480	36542	3.71	371.08
V ₁ S ₃	3756	6807	45072	11912	56984	13480	43504	4.23	422.73
V ₁ S ₄	4059	6903	48708	12080	60788	13480	47308	4.51	450.95
V ₁ S ₅	3658	6881	43896	12042	55938	13480	42458	4.15	414.97
V ₂ S ₁	2973	8767	35676	15342	51018	14320	36698	3.56	356.27
V ₂ S ₂	3237	10510	38844	18393	57237	14320	42917	4.00	399.70
V ₂ S ₃	3618	11125	43416	19469	62885	14320	48565	4.39	439.14
V ₂ S ₄	4189	11733	50268	20533	70801	14320	56481	4.94	494.42
V ₂ S ₅	3608	10240	43296	17920	61216	14320	46896	4.27	427.49
V ₃ S ₁	3036	12367	36432	21642	58074	14960	43114	3.88	388.20
V ₃ S ₂	3197	11050	38364	19338	57702	14960	42742	3.86	385.71
V ₃ S ₃	3364	13014	40368	22775	63143	14960	48183	4.22	422.08
V ₃ S ₄	4164	18203	49968	31855	81823	14960	66863	5.47	546.95
V ₃ S ₅	3838	13317	46056	23305	69361	14960	54401	4.64	463.64
V ₄ S ₁	3191	16377	38292	28660	66952	15500	51452	4.32	431.95
V ₄ S ₂	3474	15589	41688	27281	68969	15500	53469	4.45	444.96
V ₄ S ₃	4350	15137	52200	26490	78690	15500	63190	5.08	507.68
V ₄ S ₄	4676	19535	56112	34186	90298	15500	74798	5.83	582.57
V ₄ S ₅	4421	16667	53052	29167	82219	15500	66719	5.30	530.45
V ₅ S ₁	3053	13364	36636	23387	60023	16040	43983	3.74	374.21
V ₅ S ₂	3191	16736	38292	29288	67580	16040	51540	4.21	421.32
V ₅ S ₃	3278	15684	39336	27447	66783	16040	50743	4.16	416.35
V ₅ S ₄	4026	18778	48312	32862	81174	16040	65134	5.06	506.07
V ₅ S ₅	3753	15643	45036	27375	72411	16040	56371	4.51	451.44

Grain Price = Rs. 12/- kg,
V1 = Nasir 2K,

Straw = Rs. 1.75/- kg,
V2 = Salim 2k,

BCR = (Benefit Cost Ratio),
V3 = Bakhtawar-92,

MRR % = Marginal Rate of Return,
V4 = FakhreSarhad,

V5 = Lakki J03

Authors' contribution

Conceived and designed the experiments: WA Shah, Performed the experiments: WA Shah, Z Hayat & Ikramullah, Analyzed the data: WA Shah, Contributed reagents/materials/ analysis tools: S Anwar & B Iqbal, Wrote the paper: WA Shah

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