Biological Forum – An International Journal **15(10): 1044-1046(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Assessment of the Economic Impact of various Treatments on Wheat (*Triticum aestivum* L.) Crop in Jaunpur, Uttar Pradesh

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(Received: 17 August 2023; Revised: 19 September 2023; Accepted: 02 October 2023; Published: 15 October 2023)
(Published by Research Trend)

ABSTRACT: This study aimed to assess the economic impact of various treatments on wheat (*Triticum aestivum* L.) crop in Jaunpur, Uttar Pradesh. The research was conducted during the winter season of 2018-19 to 2019-20 in factorial randomized block design comprising combination of three seed rate (S_1-100kg ha^{-1}, S_2 120kg ha^{-1} and S_3-140kg ha^{-1}) and nutrient supply system (F_1-100% RDF, F_2-125%RDF, F_3-75%RDF + 25%N through FYM and F_4-75% RDF + 25%N through vermicompst), replicated thrice. The study investigated the effect of different nutrient supply system practices and seed rates on the cost of cultivation, gross return, net return, and benefit cost ratio in a field experiment. The data analysis showed a linear relationship between the cost of cultivation and nutrient supply system practices. The treatment combination of 75% RDF + 25% N through VC ha^{-1} with all seed rates resulted in the highest cost of cultivation. The highest gross return was recorded at 125% RDF (NPK) with 140 kg ha^{-1} seed rate, followed by the gross return obtained at 125% RDF (NPK) with 120 kg ha^{-1} seed rate. The treatment combination of 125% RDF (NPK) with 140 kg ha^{-1} seed rate resulted in the highest net return, while the benefit cost ratio was highest for the treatment combination of 125% RDF (NPK) with the 140 kg ha^{-1} seed rate and 100% RDF (NPK) with 140 kg ha^{-1} seed rate. These findings suggest that optimizing nutrient supply system practices and seed rates can enhance crop yield and profitability for farmers.

Keywords: Factorial randomized, benefit cost ratio, profitability, gross return etc.

INTRODUCTION

Wheat (*Triticum aestivum* L.) stands as a cornerstone among cereal crops globally, serving as a vital sustenance for a substantial portion of the world's populace (FAO, 2020). In the Indian agricultural landscape, wheat claims the position of the second most pivotal food crop following rice, with Uttar Pradesh emerging as a key contributor to the nation's wheat production **(**Government of India, 2021).

However, the wheat cultivation endeavors in Uttar Pradesh grapple with multifaceted challenges, ranging from biotic to abiotic stresses, imposing a considerable threat to crop yield and quality (Singh *et al*., 2019). The economic viability and sustainability of wheat cultivation are influenced by various factors, including agricultural practices and treatments applied during the crop's growth stages. Understanding the economic impact of different treatments on wheat production is essential for optimizing agricultural practices, improving crop yield, and ensuring the livelihoods of farmers. Although these interventions have displayed promising outcomes in augmenting the yield and enhancing the quality of wheat crops, their precise economic implications on the income of farmers and the broader regional economy remain veiled in ambiguity.

Hence, the primary objective of this study is to meticulously evaluate the economic repercussions of employing various treatments in bolstering wheat crop yields within Jaunpur, Uttar Pradesh. This examination will delve into scrutinizing the cost-benefit ratio and net returns of diverse treatments, juxtaposing them against the conventional methodologies employed in cultivation. The findings of this study are anticipated to illuminate the economic feasibility of these treatments, empowering farmers with informed insights crucial for decision-making regarding their implementation. Moreover, this investigation will significantly contribute to the comprehensive comprehension of how agricultural practices influence the local economy

MATERIAL AND METHODS

The research trial was conducted in two consecutive Rabi seasons of 2018-2019 and 2019-2020. The experiment was carried out at Pili-Kothi Student Research Farm and in the Laboratory Department of Agronomy of T.D.P.G. College Jaunpur. The research plot was located at Pili-Kothi, which is about 5 km away from the institution. The plot was situated at an altitude of 83 meters above sea level, with a latitude of 25°43'58" N and a longitude of 82°41'10" E.

To conduct the experiment, plots with homogeneous fertility were selected from the field. The plots were well connected with an irrigation channel and a source of irrigation. There were a total of 12 treatment combinations, which included three seed rate treatments

(S_1: 100 kg ha^{-1}, S_2: 120 kg ha^{-1}, S_3: 140 kg ha^{-1}) and four nutrients management treatments (F_1: 100% RDF, F_2: 125% RDF, F_3: 75% RDF+25 % N through FYM, F_4: 75% RDF+N through Vermicompost). The experiment was laid out in a factorial randomized block design with three replications. The experimental field was divided into 36 plots. Each gross plot size was 3.6m × 5.0 m and net plot size was 2.88m × 4.5 m. The row to row spacing was maintained at 18 cm each.

RESULT

The data regarding the yield, gross return, cost of cultivation, net return and benefit cost ratio have been presented in Table 1 and 2.

Table 1: Economics of various treatment combinations 2018-2019.

Treatment	Total cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})			Net return ha^{-1} (Rs ha^{-1})	B:C Ratio
		Grain return ha^{-1}	Straw return ha^{-1}	Total ha^{-1}		
S_1F_1	30271.78	75075.00	19620.00	94695.00	64423.22	2.13
S_1F_2	31439.64	76230.00	19890.00	96120.00	64680.36	2.06
S_1F_3	35946.58	71995.00	19710.00	91705.00	55758.42	1.55
S_1F_4	44306.54	73150.00	19470.00	92620.00	48313.46	1.09
S_2F_1	31160.98	78732.50	19950.00	98682.50	67521.52	2.17
S_2F_2	32328.84	85085.00	20310.00	105395.00	73066.16	2.26
S_2F_3	36835.78	74112.50	19950.00	94062.50	57226.72	1.55
S_2F_4	45195.74	76422.50	20130.00	96552.50	51356.76	1.14
S_3F_1	32050.18	84122.50	20760.00	104882.50	72832.32	2.27
S_3F_2	33218.04	87010.00	21450.00	108460.00	75241.96	2.27
S_3F_3	37724.98	77000.00	20670.00	97670.00	59945.02	1.59
S_3F_4	46084.94	78732.50	20700.00	99432.50	53347.5	1.16

Table 2: Economics of various treatment combinations 2019-2020.

Treatment	Total cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})			Net return (Rs ha^{-1})	B:C Ratio
		Grain return ha^{-1}	Straw return ha^{-1}	Total ha^{-1}		
S_1F_1	30162.84	75195.36	19732.25	94927.61	64764.77	2.15
S_1F_2	31329.25	76352.00	20000.00	96352.00	65022.75	2.08
S_1F_3	35835.00	72105.00	19821.00	91926.00	56091.00	1.57
S_1F_4	44201.39	73261.00	19581.25	92842.25	48640.86	1.10
S_2F_1	31050.98	78841.00	20060.55	98901.55	67850.57	2.19
S_2F_2	32218.35	85195.00	20421.00	105616.00	73397.65	2.28
S_2F_3	36725.00	74222.00	20061.00	94283.00	57558.00	1.57
S_2F_4	45085.00	76532.00	20240.00	96772.00	51687.00	1.15
S_3F_1	31939.00	84232.00	20870.00	105102.00	73163.00	2.29
S_3F_2	33091.00	87285.00	21660.00	108945.00	75854.00	2.29
S_3F_3	39624.98	77110.00	20781.00	97891.00	58266.02	1.47
S_3F_4	44975.00	78842.00	20810.00	99652.00	54677.00	1.22

Table 1 offers a detailed overview of the economic parameters for the first year, revealing nuanced variations in the total cost of cultivation, gross return, net return, and benefit-cost ratio for each treatment combination. The total cost of cultivation ranged from 30,271.78 Rs ha^{-1} (S_1F_1) to 46,084.94 Rs ha^{-1} (S_3F_4), demonstrating the significant variability in expenses based on seed rates and nutrient management practices. Particularly noteworthy was the treatment combination of 75% RDF + 25% N through VC ha^{-1} (F_4) with all seed rates, incurring the highest cost of cultivation at 33,218.04 Rs ha^{-1}. This emphasizes the substantial economic implications of specific nutrient management strategies on overall cultivation expenses.

Gross returns exhibited considerable diversity across the treatment combinations. S_3F_2 (140 kg ha^{-1} seed rate with 125% RDF) stood out with the highest gross return at 108,460.00 Rs ha^{-1}, followed closely by S_3F_1 (140 kg ha^{-1} seed rate with 100% RDF) at 104,882.50 Rs ha^{-1}. In contrast, S_1F_1 (100 kg ha^{-1} seed rate with 100% RDF) recorded the lowest gross return at 75,075.00 Rs ha^{-1}. These variations highlight the significant impact of seed rates and nutrient management on crop productivity and the subsequent financial returns.

Net returns, a critical indicator of profitability, demonstrated a similar trend to gross returns. S_3F_2 (140 kg ha^{-1} seed rate with 125% RDF) exhibited the highest net return at 75,241.96 Rs ha^{-1}, emphasizing the economic viability of this particular combination. Conversely, S_1F_4 (100 kg ha^{-1} seed rate with 75% RDF + N through Vermicompost) recorded the lowest net return at 19,470.00 Rs ha^{-1}, underscoring potential economic challenges associated with specific treatment combinations.

The benefit-cost ratio (B:C Ratio), a key metric for assessing profitability, varied across treatments. S_3F_2 (140 kg ha^{-1} seed rate with 125% RDF) and S_3F_1 (140 kg ha^{-1} seed rate with 100% RDF) consistently demonstrated higher B:C Ratios, indicating favorable economic outcomes. In contrast, S_1F_4 (100 kg ha^{-1} seed rate with 75% RDF + N through Vermicompost) had the lowest B:C Ratio at 1.09, suggesting a less economically viable scenario. Similar results were observed in different studies by Skudra and Ruza (2017), Singh *et al.* (2020) and Patel *et al.* (2018).

Table 2 presents the economic parameters for the second year, reaffirming and expanding upon the trends observed in the first year. Similar to the initial year, the treatment combination of 75% RDF + 25% N through VC ha^{-1} (F_4) with all seed rates incurred the highest cost of cultivation, reaching 33,091.00 Rs ha^{-1}. S_3F_2 (140 kg ha^{-1} seed rate with 125% RDF) continued to exhibit the highest gross return at 108,945.00 Rs ha^{-1}, emphasizing the consistency of certain treatment combinations in maximizing crop yield and economic returns.

Net returns in the second year mirrored the patterns observed in the first year. S_3F_2 (140 kg ha^{-1} seed rate with 125% RDF) demonstrated the highest net return at 75,854.00 Rs ha^{-1}, reinforcing the economic viability of this specific combination. Conversely, S_1F_4 (100 kg ha^{-1} seed rate with 75% RDF + N through Vermicompost) recorded the lowest net return at 19,581.25 Rs ha^{-1}.

The B:C Ratios in the second year aligned with the previous findings. S_3F_2 (140 kg ha^{-1} seed rate with 125% RDF) and S_3F_1 (140 kg ha^{-1} seed rate with 100% RDF) consistently demonstrated higher benefit-cost ratios, emphasizing their economic feasibility. S_1F_4 (100 kg ha^{-1} seed rate with 75% RDF + N through Vermicompost) maintained the lowest B:C Ratio at 1.10. Similar results were observed in different studies by Akhtar *et al.* (2018), Singh *et al.* (2019) and Bairwa *et al.* (2020).

CONCLUSIONS

In conclusion, the study focused on assessing the economic impact of different treatments on wheat cultivation in Jaunpur, Uttar Pradesh. The factorial randomized block design included variations in seed rates and nutrient supply systems, and the research spanned two winter seasons. The analysis of the data revealed several key findings.

The higher cost of cultivation (₹ 33218.04 ha^{-1} during 2018-19 and 33091.00 during 2019-20) was computed at 75 % RDF + 25% N through VC ha^{-1} with all the seed rates.

The higher gross return (₹ 108460.00 ha^{-1} during 2018-19 and 108945.00 during 2019-20) was recorded under the treatment combination of 125% RDF (NPK) with the 140 kg seed rate followed by gross return obtained at 125% RDF (NPK) with 120 kg seed rate (₹ 105395.00 during 2018-19 and 105616.00 during 2019-20).

Highest net return (₹ 75241.96 ha^{-1} during 2018-19 and 75854.00 during 2019-20) was found under the treatment combination of 125% RDF (NKP) with 140 kg ha^{-1} seed rate. As regards benefit cost ratio, the higher benefit cost ratio (2.77 during 2018-19 and 2.29 during 2019-20) was obtained from treatment combination of 125% RDF (NPK) with the 140 kg ha^{-1} seed rate and 100% RDF (NPK) with 140 kg ha^{-1} seed rate followed by benefit cost ratio (2.26 during 2018-19 and 2.28 during 2019-20) obtained from treatment combination of 125% RDF (NPK) with 120 kg ha^{-1} seed rate.

FUTURE SCOPE

The study's future scope includes optimizing treatment combinations, assessing long-term impacts, exploring climate resilience, integrating technology, understanding farmers' adoption factors, evaluating socioeconomic impacts, conducting comparative studies, and informing agricultural policies. These avenues aim to enhance sustainability, efficiency, and economic resilience in wheat cultivation in Jaunpur, Uttar Pradesh and beyond.

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How to cite this article: Harivansh Singh, Anil Kumar Singh and Pradeep Kumar Yadav (2023). Assessment of the Economic Impact of various Treatments on Wheat (*Triticum aestivum* L.) Crop in Jaunpur, Uttar Pradesh. *Biological Forum – An International Journal*, *15*(10): 1044-1046.