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Economic evaluation of wheat (*Triticum aestivum* L.) under the influence of fertilizer placement and nutrient management

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Abstract

Wheat crop is the most important food crop in northern India which faces several constraints such as nutrient use efficiency, food demand and production costs. During this era, reduction in cost of production is major issue for doubling farmer income and food production. So, concerning these issues, a research was conducted with objective of assessing wheat economics with fertilizer placement and nutrient management. The experiment conducted with six nutrient management (100 percent RDF (150:60:40 NPK kg/ha), 75 percent RDF, 75 percent RDF + Vermicompost, 75 percent RDF + Vermicompost + PSB, 75 percent RDF + Poultry manure, and 75 percent RDF + Poultry manure + PSB) and three fertilizer placement options (Deep placement, Band placement and Broadcasting) with addition control in factorial randomized block design, and replicated thrice. The research findings reveals that combining approach of deep placement and 75 percent RDF + Vermicompost/poultry manure + PSB found suitable for reduction of cost of production and enhancing crop production. It may be attributed due to reduction of fertilizer doses and addition of organic manure with PSB.

Keywords: Wheat, fertilizer placement, nutrient management, economics

Introduction

A system of Rice-wheat production is one of the world's biggest, with over 26 million acres under cultivation. It offers food for more than 20% of the people in South-East Asia (Khalofah *et al*., 2021) [12]. The Continuous production of rice and wheat has caused in a variety of socioeconomic, edaphic, and environment issues. However, the crop outputs of these cropping system is diminishing owing to reducing ground water resources, rising energy costs, depleting soil OM, uneven fertility status of soil, herbicidal resistance, and inadequate crop residue disposal practices (Tiwari *et al*., 2009; Hira, 2009; Ládha *et al*., 2000; Humphreys *et al*., 2010) [23, 6, 7]. All this circumstance has compelled cultivators to cultivate alternate crops that use less water in order to address the food security issue (Jat *et al*., 2015) [10].

With proper administration, inorganic fertilisers increase soil production. However, management approaches degrade the geo-bio-chemical soil qualities (Rosènzweig *et al*., 2014) [19]. Continues usage of chemical fertilisers depletes SOC, lowering agricultural yields (Pathak *et al*., 2003; Ladha *et al*., 2003) [17, 13]. Climate, agricultural practises, and soil types all have a substantial impact on the SOC (Saikia *et al*., 2015; Chabbi *et al*., 2009; Miller *et al*., 2004; Jagadamma and Lal, 2010) [20, 4, 14, 8]. The majority of farmers in India burn agricultural leftovers, making trash a key source of organic matter. Soil organic matter (SOM) may be considerably improved by incorporating agricultural wastes (Jarécki and Lál, 2003) [9]. Chemical fertilisers boost soil health in the near term but have a detrimental impact on soil health over time (Yang *et al*., 2015) [25]. Organic manures, rather than artificial fertilisers, should be used in crop production for long-term sustainability. Several research studies have found that organic manures boost crop productivity, soil condition, and SOM (Sáikia *et al*., 2015) [20]. Manures provide important nutritional elements for plant development; yet, not generated in sufficient quantities to fulfil production demands. As a result, integrated nutrient management appears to be an appealing alternative for improving soil health and crop yields.

In integrated nutrient management, organic and chemical fertilisers are used in tandem to meet plant nutritional demands (Bharti *et al*., 2016) [3]. Rice growth, yield, and soil fertility status have all increased as a result of the use of microbial-fortified compost (Ng *êt al*., 2016) [16]. Combined approach of fertilizer management improves soil biological, physical, and chemical

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qualities. The use of Nitrogen and FYM together boosts soil health and plant output considerably (Sârma *et al*., 2015) [21]. The manure applied in conjunction with chemical fertiliser boosted crop output (Katterer *et al*., 2011) [11]. Un-fortunately, intense farming and the indiscriminate use of chemical fertilisers are most common agronomic methods in India, both of which have a severe impact on soil health. Due to high temperatures, India's soils are poor in organic matter, necessitating special attention for long-term agricultural development.

Furthermore, economic analysis is a vital component in determining the inputs utilised that is especially important in growing nations such as India (Shâh *et al*., 2013) [22]. The soil health not only enhanced plant health but, also resulted in increased benefits, which may be the out appealing reason for cultivators (Naeêm *et al*., 2021) [15]. All these findings also indicated that cultivators can enhance the productivity of systems using integrated Nitrogen fertilisers while saving valuable variables (Khalðfah *et al*., 2021) [12]. This approach is environmentally favourable since system waste may be utilised in a beneficial way, hence reducing carbon emissions. Farmers may achieve a decent return from inorganic and organic fertilisation, as demonstrated by economics assessment, with a sustainable method of crop production.

Materials and Methods

A field experiment was carried out in block D-3, N. E. B. Crop Research Centre, Govind Ballabh Pant University of agriculture and technology, Pantnagar, dist. Udham Singh Nagar (Uttarakhand) during year 2017-18 and 2018-19.

The study was laid in FRBD design with 3 fertilizer placement options *viz* Surface application, Deep placement, and Band placement methods and 6 nutrient management options *viz* 100 percent RDF (150:60:40 Kg NPK/ha), 75 percent RDF, 75% RDF+ Vermicompost (2 q), 75% RDF + Vermicompost (2 q) + PSB (10kg/ha), 75% RDF +Poultry manure(2 q), 75% RDF + Poultry manure (2 q) +PSB (10 kg/ha) and replicated thrice. One addition control treatment was also used. All 19 treatment combinations were tested. The experimental soil was clay loam having high OC, medium in available N, high in available P and medium in available K with neutral pH during the *rabi* season, 2017-18 and 2018-19. Sowing of wheat variety (WH-1105) during *rabi* 2017-18 and 2018-19 was done at a row to row spacing of 20 cm on November, 24. 2017 and November, 29. 2018.

Studies on Economics

To analyse economics, the government of India's proclaimed minimum support price (MSP) for wheat for the corresponding years was used.

Cost of cultivation

For the purposes of cost analysis, the terms 'Cost of Cultivation' and 'Cost of Production' are used interchangeably. Wheat cultivation costs were computed using current local rates for various inputs such as labour, equipment, seeds, fertilisers, pesticides, and others during the crop season based on the weed control regimens used. Wheat harvesting and threshing costs were determined using combine and wheat straw reaper charges. The total cost of wheat cultivation was calculated by combining the individual cultivation costs together. It was given in rupees per hectare.

Gross return

Wheat economic yield was converted to gross return Rs/ha) using the minimum support price and local produce prices (straw). The entire straw yield was converted to net straw yield before the returns were added to the gross revenue.

Net return

Net returns were estimated by the gross returns minus cost of cultivation.

Benefit to cost (B: C) ratio

The B: C ratio was assessed by dividing the net return by the cost of cultivation individually for each treatment.

Statistical Analysis

According to Rangaswamy's processes, the data collected from numerous observations was statistically evaluated using a factorial randomised block design approach and conventional techniques of Analysis of Variance (ANOVA). Wherever the 'F' test was significant, the critical difference (CD) was calculated at the 5% level of probability to examine the significance of any difference between two means. Each net plot yielded a single sample of perfect control. As a result, total 3 samples of absolute control were compared with differential fertiliser placement practices with and without nutrient management using the'student F' test according to Rangaswamy approach (Rangaswamy, 2006) [18]. The difference between the experimental treatments was significant everywhere the estimated 'f-value' exceeded the tabulated value (2.028).

Results and discussion

Economics of wheat

Table 1 provides information on the cost of cultivation, net return, and gross return of wheat under various fertiliser placement methods and nutrient management.

Cost of cultivation

The cost involvement was incurred minimum under Surface application method (Rs 31728.4 and Rs 32928.4) and maximum under deep placement (Rs 32648 and Rs 33848) that was similar to band placement (Rs 32648 and Rs 33848) during year 2017-18 and 2018-19, respectively. Treatment Surface application had a lower cultivation cost since there were no placement activities, which saved money that would have been spent on localised application. Cost increases during the second year were caused by increased winter rain, which produces a problem of increased weed and insect infestation. Localized fertiliser application during sowing, on the other hand, not only saves farmers money by increasing fertiliser usage efficiency by distributing nutrients where root contact is most probable. Localized fertiliser delivery increased crop output and reduced nutrient losses, lowering the cost of nutrient addition. According to Ali *et al*. (2012) [2], implementing fertiliser placement technology for wheat can provide farmers with a profit of Rs 2626/ha. The results are in line with Ahmad *et al*., (2004) [1].

The cost of cultivation got increased with the management of wheat nutrients. In case of absolute control was recorded lesser cost of cultivation (Rs 24120 and Rs 25320) due to no application of fertilizers and placement during year 2017-18 and 2018-19, respectively.

Gross return and net return

During both years of research, fertiliser placement strategies impacted the net return. According to the data in table 1, the maximum net return was acquired through deep placement and the lowest net return was gained by surface application during the fiscal years 2017-18 and 2018-19. Deep treatment placement yielded a higher net return than surface application. This could be attributed to an increase in wheat crop yield.

Fertilizer placement strategies had a substantial impact on gross return in 2017-18 and 2018-19. During the fiscal years 2017-18 and 2018-19, deep placement had the best gross return, outperforming surface application and band placement. These findings are consistent with Ahmad *et al*. (2004) [1], who found that implementing fertiliser placement technology for wheat increased wheat output. The findings are consistent with those of Ali *et al* (2012) [2].

During both the 2017-18 and 2018-19 fiscal years, nutrient management had an impact on both the net and gross returns. The addition of nutrients to the soil increased crop yield and fertiliser use efficiency, resulting in a higher gross and net return on wheat. Greater cultivation costs were offset by increased yield in placement strategies. Verma *et al*., (2014) [24] and Devi *et al*., (2011) [5] both reported similar findings.

Due to poor fertiliser usage efficiency and crop production over the years 2017-18 and 2018-19, the control plot was shown to be less efficient in improving gross and net returns.

B: C ratio

The data pertaining to B: C ratio is depicted in the table 1.

During both years, there was variation in the B: C ratio due to fertiliser placement strategies. During the years 2017-18 and 2018-19, the deep implantation therapy yielded the greatest B: C ratio. During 2017-18 and 2018-19, treatment deep placement (2.3 and 2.4) had a greater B: C ratio than surface application (2.2 and 2.3) and band placement (2.2 and 2.3). Increased net returns were attributable to the higher B: C ratio in deep placement. Localized fertiliser application not only saves farmers money by increasing fertiliser efficiency by putting nutrients where root contact is most probable. Localized application was more efficient in terms of production enhancement and nutrient cost reduction. The results are in line Ahmad *et al*., (2004) [1] and Ali *et al*., (2012) [2].

The B: C ratio meals was modified by nutrient management over both years of research. During the years 2017-18 and 2018-19, the 75 percent RDF + VC + PSB had the greatest B: C ratio, followed by the remainder of the nutrient management alternatives. Increases in the B:C ratio of wheat had the greatest impact on yield. The highest B:C ratio was obtained with 75 percent RDF + Vermicompost + PSB due to enhanced yield, which compensated for the higher production cost. Devi *et al*., (2011) [5] and Verma *et al*., (2014) [24] found similar results.

In the instance of control vs. rest, the control plot had the lowest B: C ratio due to the lowest effective wheat output in 2017-18 and 2018-19.

Conclusion and future outlook

Economic uplift of farmers by doubling farmer income via increased crop yield and lowering production costs are two critical elements in social development. The results of the preceding experiments demonstrated that combining deep placement with 75 percent RDF (112.5:40:30 kg NPK/ha) + Vêrmicompost/Poultry mânure (2 q) + PSB (10 kg/ha) increased wheat crop economics and crop yield. It might be attributable to fertiliser dosage decrease with the addition of organic manure and phosphate solubilizing bacteria. These impacts will be amplified by scientifically planned and field-tested procedures for economic upliftment of farmers' social backgrounds and decrease of environmental pollutions.

Table 1: Effect of rhizospheric management on Economics in wheat

Treatments	**Economics**							
	Cost Of Cultivation (Rs)		**Gross Return** (Rs)		**Net Return** (Rs)		**B:C Ratio**	
	2017-18	**2018-19**	**2017-18**	**2018-19**	**2017-18**	**2018-19**	**2017-18**	**2018-19**
Placement methods								
Deep placement	32648.0	33848.0	108490.0	114960.0	75842.1	81112.0	2.32	2.40
Surface application	31728.4	32928.4	101331.8	108233.3	69603.4	75304.9	2.20	2.29
Band placement	32648.0	33848.0	105369.2	111966.8	72721.3	78118.9	2.23	2.31
Nutrient management								
100% RDF	31659.7	32859.7	103509.9	109744.4	71850.3	76884.7	2.27	2.34
75% RDF	30517.8	31717.8	97294.7	104068.7	66776.9	72350.9	2.19	2.28
75% RDF + VC	33017.8	34217.8	106543.6	113639.1	73525.8	79421.3	2.22	2.32
75% RDF + VC + PSB	33917.8	35117.8	113970.5	118951.4	80052.8	83833.6	2.36	2.40
75% RDF + PM	32017.8	33217.8	101549.2	109804.7	69531.4	76586.9	2.20	2.31
75% RDF + PM + PSB	32917.8	34117.8	107514.1	114111.9	74596.3	79994.1	2.26	2.34
Control vs rest								
Control	24120.0	25320.0	70510.5	70082.8	46390.5	44762.8	1.92	1.77
Rest	32341.4	33541.4	105063.7	111720.0	72722.3	78178.6	2.25	2.33

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Conflict of interest

There is no conflict of interest for the author.

References

1. Ahmad M. Development and evaluation of fertilizer band placement drill for wheat. Journal of Engineering and Applied Sciences (India), 2004.
2. Ali A, Ayesha Hameed S, Imran A, Iqbal M, Iqbal J, *et al*. Functional characterization of a soybean growth stimulator Bradyrhizobium sp. strain SR-6 showing Acylhomoserine lactone production. FEMS Microbiol Ecol, 2012.

http://www.ncbi.nlm.nih.gov/pubmed/ 27242370.

3. Bharti N, Barnawal D, Shukla S, Tewari SK, Katiyar RS, Kalra A. Integrated application of Exiguobacterium oxidotolerans, Glomus fasciculatum, and vermicompost improves growth, yield and quality of Mentha arvensis in salt-stressed soils. Industrial Crops and Products. 2016;83:717-728.
4. Chabbi A, Kögel-Knabner I, Rumpel C. Stabilised carbon in subsoil horizons is located in spatially distinct parts of the soil profile. Soil Biology and Biochemistry. 2009;41(2):256-261.
5. Devi KN, Singh MS, Singh NG, Athokpam HS. Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.). Journal of Crop and Weed. 2011;7(2):23-27.
6. Hira GS. Water management in northern states and the food security of India. Journal of Crop Improvement. 2009;23(2):136-157.
7. Humphreys E, Kukal SS, Christen EW, Hira GS, Sharma RK. Halting the groundwater decline in north-west India-which crop technologies will be winners?. Advances in agronomy. 2010;109:155-217.
8. Jagadamma S, Lal R. Distribution of organic carbon in physical fractions of soils as affected by agricultural management. Biology and Fertility of Soils. 2010;46(6):543-554.
9. Jarecki MK, Lal R. Crop management for soil carbon sequestration. Critical Reviews in Plant Sciences. 2003;22(6):471-502.
10. Jat HS, Singh G, Singh R, Choudhary M, Jat ML, Gathala MK, *et al*. Management influence on maize–wheat system performance, water productivity and soil biology. Soil Use and Management. 2015;31(4):534-543.
11. Katterer T, Bolinder MA, Andrén O, Kirchmann H, Menichetti L. Roots contribute more to refractory soil organic matter than above-ground crop residues, as revealed by a long-term field experiment. Agriculture, Ecosystems & Environment. 2011;141(1-2):184-192.
12. Khalofah Khan MI, Arif M, Hussain A, Ullah R, Irfan M, Mahpara S, *et al*. Deep placement of nitrogen fertilizer improves yield, nitrogen use efficiency and economic returns of transplanted fine rice PLoS One. 2021;16(2): p. e0247529.
13. Ladha JK, Pathak H, Tirol-Padre A, Dawe D, Gupta RK. Productivity trends in intensive rice–wheat cropping systems in Asia. Improving the Productivity and Sustainability of Rice-Wheat Systems: Issues and Impacts. 2003;65:45-76.
14. Miller AJ, Amundson R, Burke IC, Yonker C. The effect of climate and cultivation on soil organic C and N. Biogeochemistry, 2004;67(1):57-72.
15. Naeem M, Mehboob N, Farooq M, Farooq S, Hussain SM, Ali H, *et al*. Impact of different barley-based cropping systems on soil physicochemical properties and barley growth under conventional and conservation tillage systems. Agronomy. 2021;11(1):8.
16. Ng LC, Sariah M, Radziah O, Zainal Abidin MA, Sariam O. Development of microbial-fortified rice straw compost to improve plant growth, productivity, soil health, and rice blast disease management of aerobic rice. Compost Science & Utilization. 2016;24(2):86-97.
17. Pathak H, Ladha JK, Aggarwal PK, Peng S, Das S, Singh Y, *et al*. Trends of climatic potential and on-farm yields of rice and wheat in the Indo-Gangetic Plains. Field crops research. 2003;80(3):223-234.
18. Rangaswamy NS. Book Chapter (in press), 2006.
19. Rosenzweig C, Elliott J, Deryng D, Ruane AC, Müller C, Arneth A, *et al*. Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison. Proc. Natl. Acad. Sci. USA., 2014.
20. Saikia P, Bhattacharya SS, Baruah KK. Organic substitution in fertilizer schedule: Impacts on soil health, photosynthetic efficiency, yield and assimilation in wheat grown in alluvial soil. Agriculture, Ecosystems & Environment. 2015;203:102-109.
21. Sarma I, Phookan DB, Boruah S. Influence of manures and biofertilizers on carrot (*Daucus carota* L.) cv. early Nantes growth, yield and quality. Journal of Eco-friendly Agriculture. 2015;10(1):25-27.
22. Shah MA, Manaf A, Hussain M, Farooq S, Zafar-ul-Hye M. Sulphur fertilization improves the sesame productivity and economic returns under rainfed conditions. Int. J Agric Biol. 2013;15:1301-1306.
23. Tiwari VM, Wahr J, Swenson S. Dwindling groundwater resources in northern India, from satellite gravity observations. Geophys. Res. Lett. 2009, 36.
24. Verma VK, Sanjai C, Vihsram S, Gupta SK, Harvansh K. Effect of integrated soil fertility management practices on production and productivity of wheat (*Triticum aestivum*) in alluvial soils of central plain zone of Uttar Pradesh. International Journal of Agricultural Sciences. 2014;10(2):735-738.
25. Yang ZC, Zhao N, Huang F, Lv YZ. Long-term effects of different organic and inorganic fertilizer treatments on soil organic carbon sequestration and crop yields on the North China Plain. Soil and Tillage Research. 2015;146:47-52.