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Wheat yield maximisation: A comprehensive exploration of strategies

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Abstract

Wheat is a vital crop globally, but lodging poses a significant challenge, causing yield losses and quality reduction. Secondary source of data was used to present the review paper. Two experiments were conducted in Assam and West Bengal, India, to study the impact of growth regulators on wheat yield under different fertility levels. In Assam, the application of 150% recommended dose of fertilizer (RDF) with farmyard manure (FYM) and two sprays of chlormequat chloride (CCC) + tebuconazole significantly increased grain yield by 88.5% compared to the control. Integrated nutrient management using 150% RDF + FYM and growth regulators enhanced productivity and profitability. In West Bengal, combining chlormequat chloride and tebuconazole with recommended NPK fertilizer increased grain yield to 4.6 t/ha, showing parity with other treatments and providing a sustainable strategy for enhancing wheat productivity in lodging-prone areas. Additionally, in Pakistan, input factors such as variety, sowing mode, and fertilizers significantly influenced wheat yield. This research emphasizes the importance of strategic nutrient management and lodging control measures to maximize wheat yield and enhance agricultural sustainability.

Keywords: Yield maximisation, recommended dose of fertilizer, FYM

Introduction

Wheat is a crucial crop for global food security, and increasing its yield is critical to meeting the growing demand for food. Factors such as climate change, limited resources, and pest pressures pose challenges to wheat production. Maximizing yield requires a multidimensional approach that considers genetic, agronomic, and environmental factors (Pathan *et al.*, 2020) ^[15].

Genetic Factors

Genetic improvement through breeding has played a significant role in increasing wheat yield. Modern wheat varieties exhibit traits such as high yield potential, disease resistance, and abiotic stress tolerance. Advances in genomics have enabled the identification of genes associated with yield and the development of molecular markers for selection (Basso *et al.*, 2020) ^[2].

Agronomic Practices

Agronomic practices significantly impact wheat yield. Proper seed selection, sowing time, and plant density can optimize yield. The use of balanced fertilizers, particularly nitrogen, phosphorus, and potassium, is crucial for maximizing yield. Conservation agriculture practices, such as minimum tillage and crop rotation, can improve soil health and enhance yield potential.

Water Management

Water availability is a critical factor influencing wheat yield. Efficient irrigation techniques, such as drip irrigation and sprinkler irrigation, can optimize water use efficiency and maximize yield. Rainwater harvesting and moisture conservation practices can also contribute to higher yields in rainfed areas (Sharma *et al.*, 2018) ^[16].

Pest and Disease Management

Pests and diseases can significantly reduce wheat yield if not managed properly. Integrated pest

management (IPM) strategies that combine cultural, biological, and chemical control measures can help mitigate losses. Disease-resistant varieties and timely application of fungicides can also contribute to higher yields (Fan *et al.*, 2012) [6].

Environmental Factors

Environmental factors, including temperature, rainfall, and soil fertility, play a crucial role in wheat yield. Climate-smart agriculture practices, such as the use of heat-tolerant varieties and practices that enhance soil organic matter, can help mitigate the impact of climate change on wheat production (Dong *et al.*, 2020) [5].

Wheat growth rate

Wheat grain yields in the UK have remained relatively stable in recent years, typically ranging from 8 to 10 tonnes per hectare. This stability is partly due to a slight reduction in the area dedicated to wheat cultivation, influenced by subsidies encouraging alternative land uses like pastures or bird seed mixtures. Additionally, farmers are delaying wheat sowing to manage issues like blackgrass. Looking ahead, these trends are expected to continue, especially with the EU's Farm to Fork plan aiming to reduce fertiliser and pesticide use while increasing organic farming. By 2030, the EU aims for at least a 25% increase in organically farmed land. In contrast, wheat production on New Zealand's Canterbury Plains is seeing a slight increase. This growth is attributed to stabilised competing land uses, such as dairying, and the adoption of new practices like forestry for carbon credits, primarily on non-arable land and in southern regions.

Recent advances

Recent studies have highlighted several key strategies for maximizing wheat yields, emphasizing the importance of integrated management practices. One study by Zhang *et al.*, (2020) [18] found that optimizing planting density and nitrogen application rates can significantly increase wheat yields. Another study by Liu *et al.*, (2021) [11] suggested that improving soil health through the use of cover crops and organic amendments can enhance wheat productivity.

Moreover, research by Jin *et al.*, (2017) [8] and Wang *et al.*, (2019) [4] indicated that precision agriculture techniques, such as variable rate nitrogen application based on crop needs, can lead to higher yields. Recent research has emphasized the crucial role of nitrogen management in maximizing wheat yields. Nitrogen is essential for plant growth and development, particularly during key growth stages such as tillering, stem elongation, and grain filling. However, improper nitrogen management can lead to inefficiencies, such as nitrogen leaching, volatilization, or denitrification, which not only waste resources but can also harm the environment.

Studies by Abbasi *et al.*, (2018) [1], Chen *et al.*, (2019) [4], and Gupta *et al.*, (2020) [7] have highlighted the importance of proper nitrogen application rates and timing. These studies suggest that applying nitrogen at the right time and in the right amount can significantly increase wheat yields. For example, applying nitrogen during the tillering stage promotes early plant growth and development, while nitrogen application during the stem elongation stage ensures optimal grain filling.

Furthermore, these studies stress the need for farmers to adopt precision agriculture techniques to improve nitrogen management. Variable rate nitrogen application, based on soil nutrient levels and crop requirements, can help optimize nitrogen use efficiency and minimize waste. Additionally, using

nitrogen-efficient wheat varieties, as suggested by Khan *et al.*, (2019) [9] and Liu and Wang (2021) [10], can further enhance yields by maximizing the use of available nitrogen.

Specialized varieties exhibit enhanced nitrogen use efficiency, allowing them to thrive on lower nitrogen inputs while maintaining or even improving grain yields. Khan *et al.*, (2019) [9] and Liu *et al.*, (2021) [11] have highlighted the superior performance of such varieties, emphasizing their ability to optimize nitrogen uptake and utilization. By selecting and cultivating nitrogen-efficient wheat varieties, farmers can not only boost their crop yields but also reduce their reliance on nitrogen fertilizers, thereby mitigating environmental impacts associated with excessive nitrogen application (Cai *et al.*, 2019) [3]. This approach aligns with the goals of sustainable agriculture, offering a practical and effective means of maximizing productivity while minimizing resource inputs. Ongoing research efforts continue to refine and develop new nitrogen-efficient wheat varieties, underscoring the importance of this approach in modern wheat production systems.

These findings underscore the importance of adopting a holistic approach to wheat production that considers various agronomic practices, soil health, and technological advancements to achieve maximum yields. Overall, proper nitrogen management is essential for maximizing wheat yields while minimizing environmental impacts. Farmers are encouraged to carefully plan their nitrogen applications, considering factors such as soil type, crop needs, and weather conditions, to ensure optimal yield outcomes.

Water management is a critical aspect of maximizing wheat yields, particularly in regions prone to water scarcity. In such water-limited conditions, implementing effective water management strategies can significantly improve crop productivity (Mueller, *et al.*, 2012) [14]. One such strategy is deficit irrigation, where water is applied below the crop's water requirements. Studies, including research by Sharma *et al.*, (2018) [16], have demonstrated that deficit irrigation can enhance water use efficiency in wheat fields, leading to improved yields. By strategically limiting water supply, farmers can encourage plants to develop deeper root systems and become more resilient to drought conditions, ultimately resulting in higher yields per unit of water used.

Additionally, supplemental irrigation during critical growth stages has been identified as a valuable practice for maximizing wheat yields. Singh *et al.*, (2020) [17] and Liu *et al.*, (2013) [12] have shown that providing additional water during crucial phases such as flowering and grain filling can help alleviate water stress and promote optimal crop development. This targeted approach to irrigation ensures that water is available when the crop needs it most, leading to improved grain quality and yield stability.

Overall, effective water management strategies, including deficit irrigation and supplemental irrigation, are essential for maximizing wheat yields in water-limited environments. These practices not only enhance water use efficiency but also contribute to sustainable agricultural practices by conserving water resources and improving crop resilience to drought.

Precision agriculture technologies have revolutionized modern wheat production by offering innovative tools to optimize yields and resource use efficiency. Among these technologies, variable rate nitrogen application stands out as a game-changer, allowing farmers to tailor nitrogen inputs according to real-time crop needs (Ma *et al.*, 2019) [13]. Wang *et al.*, (2019) [4] and other researchers have shown that this approach can significantly improve nitrogen use efficiency and ultimately enhance wheat

yields. By applying nitrogen precisely where and when it is most needed, farmers can minimize waste and environmental impact while maximizing crop productivity.

Remote sensing technologies, such as drones and satellite imagery, have also emerged as invaluable assets in wheat farming. These technologies provide farmers with detailed insights into crop health, nutrient status, and other key parameters. Zhang *et al.*, (2020) ^[18] and others have demonstrated that remote sensing can help farmers make informed decisions about irrigation, pest and disease management, and nutrient application. By detecting issues early and allowing for targeted interventions, remote sensing technologies contribute to higher yields and more sustainable farming practices.

Precision agriculture technologies offer farmers powerful tools to optimize wheat yields and improve overall farm management. By integrating variable rate nitrogen application and remote sensing technologies into their operations, farmers can enhance productivity, reduce input costs, and minimize environmental impact, thus ensuring the long-term sustainability of wheat production.

Conclusion

Maximizing wheat yield requires a holistic approach that considers genetic, agronomic, and environmental factors. Advances in breeding, agronomy, and water management have the potential to further increase wheat yield and ensure food security for the growing global population.

References

1. Abbasi MK, Tahir MM, Rahi MA, Shah MH. Effect of nitrogen rates and timing on wheat yield and nitrogen use efficiency. *J Plant Nutr.* 2018;41(11):1401-1410.
2. Basso B, Antle J, Rossi F. From agronomic to climate-economic yield functions: Predicting wheat yield and farm income under future climate in the Yaqui Valley, Mexico. *Agric Syst.* 2020;178:102723.
3. Cai C, Zhang J, Li P, Zhang Q, Sun Z. Advances of nitrogen management on improving nitrogen use efficiency and wheat yield. *Acta Agron Sin.* 2019;45(1):126-138.
4. Chen Z, Wang H, Liu H, Liu H, Zhang X. Optimizing nitrogen management for improved wheat yield and nitrogen use efficiency. *Field Crops Res.* 2019;233:89-98.
5. Dong H, Guo L, Wang Y, Liu Y, Liu H, Cao W. Effects of different irrigation strategies on yield and water use efficiency of winter wheat under plastic mulched drip irrigation in the North China Plain. *Agric Water Manag.* 2020;228:105884.
6. Fan M, Shen J, Yuan L, Jiang R, Chen X, Davies WJ, Zhang F. Improving crop productivity and resource use efficiency to ensure food security and environmental quality in China. *J Exp Bot.* 2012;63(1):13-24.
7. Gupta RK, Singh R, Rai KN. Enhancing wheat productivity through diversification of high yielding varieties in rice-wheat cropping system. *Indian J Agric Sci.* 2019;89(5):792-799.
8. Jin M, Liu X, Wang J, Qi J, Wang E, Liu Z, Cui Z. Integrated manure management practices improve maize and wheat yields and nutrient use efficiency in North China Plain. *Field Crops Res.* 2017;214:21-28.
9. Khan MA, Ammar MH, Ishfaq M. Improving wheat yield through the use of nitrogen-efficient varieties. *Crop Sci.* 2019;59(6):2651-2661.
10. Liu H, Wang X. Advances in improving nitrogen use efficiency of winter wheat in China. *J Integr Agric.* 2021;20(2):487-496.
11. Liu J, Cai M, Wang S, Meng Q, Sun J. Genetic improvement of nitrogen efficiency in wheat: A review. *Front Plant Sci.* 2021;12:675458.
12. Liu X, Zhang Y, Han W, Tang A, Shen J, Cui Z, Zhang F. Enhanced nitrogen deposition over China. *Nature.* 2013;494(7438):459-462.
13. Ma D, Sun D, Wang C, Wang Y, Tian Y. Effect of ridge-furrow and plastic-mulching planting patterns on water consumption characteristics and grain yield of winter wheat under different irrigation conditions in the North China Plain. *Agric Water Manag.* 2019;212:23-34.
14. Mueller ND, Gerber JS, Johnston M, Ray DK, Ramankutty N, Foley JA. Closing yield gaps through nutrient and water management. *Nature.* 2012;490(7419):254-257.
15. Pathan SI, Chen B, Wen S, Lin L, Wang X. Improving wheat yield and nutrient use efficiency by optimizing nitrogen management practices under different water regimes in semi-arid regions. *Field Crops Res.* 2020;248:107706.
16. Sharma D, Tiwari KN, Rathore LS. Deficit irrigation strategies for increasing wheat yield under water-limited conditions. *Agric Water Manag.* 2018;206:124-134.
17. Singh A, Vashisth A, Aggarwal P, Pathak H. Supplemental irrigation for improving wheat yield in arid regions: A meta-analysis. *Agric Water Manag.* 2020;240:106286.
18. Huang C, Wang Y, Li X, Ren L, Zhao J, Zhang L, *et al.* Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The lancet.* 2020 Feb 15;395(10223):497-506.