Journal of Experimental Agriculture International

Volume 46, Issue 9, Page 1068-1073, 2024; Article no.JEAI.123090
ISSN: 2457-0591
(Past name: American Journal of Experimental Agriculture, Past ISSN: 2231-0606)

Effect of Integrated Nutrient Management on Growth Indices in Wheat Varieties (*Triticum aestivum* L.)

Gurvinder Kaur [a++*], Ishwar Singh [a#] and R. K. Behl [a#]

[a] *Department of Agriculture, Maharishi Markandeshwar (Deemed to be University), Mullana (Ambala), Haryana, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jeai/2024/v46i92903

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/123090

Original Research Article

Received: 16/07/2024
Accepted: 18/09/2024
Published: 21/09/2024

ABSTRACT

A field experiment was carried out at the Research Farm of the Department of Agriculture, Maharishi Markandeshwar University, Mullana, Ambala, during the Rabi season of 2022-2023. The study investigated the effects of integrated nutrient management, combining Hairamine (a protein hydrolysate derived from human hair) and inorganic fertilizers (NPK), on grain yield and related attributes across three wheat varieties. The soil at the site was sandy loam, well-drained, alkaline (pH 7.23), low in nitrogen, medium in phosphorus, and high in potassium, with an electrical conductivity of 0.89 dS/m. Four treatments were tested: T1: Recommended Dose of Fertilizer (RDF), T2: 75% RDF + 25% nutrients from Vermicompost, T3: 75% RDF + Foliar application of Hairamine at 30, 60, and 90 days after sowing (DAS) at 10 ml/l water, T4: 50% RDF + 25%

[++] *Ph. D Scholar (Agronomy);*
[#] *Professor;*
**Corresponding author: E-mail: gurvinderkaur1537628@gmail.com;*

Cite as: *Kaur, Gurvinder, Ishwar Singh, and R. K. Behl. 2024. "Effect of Integrated Nutrient Management on Growth Indices in Wheat Varieties (Triticum Aestivum L.)". Journal of Experimental Agriculture International 46 (9):1068-73. https://doi.org/10.9734/jeai/2024/v46i92903.*

Vermicompost + 3 foliar sprays of Hairamine at 30, 60, and 90 DAS at 10 ml/l water.These treatments were applied to three wheat varieties: “WH 1124,” “WH 1105,” and “WH 1184,” using a factorial randomized block design with three replications. The results showed that T4 (50% RDF + 25% Vermicompost + 3 foliar sprays of Hairamine) produced the highest plant height, number of tillers, and dry matter accumulation, and these results were statistically comparable to those from T2 (75% RDF + 25% Vermicompost). Therefore, incorporating Hairamine as a biostimulant with a reduced fertilizer dose is recommended for sustainable wheat production.

Keywords: Wheat; hairamine; vermicompost; plant height; INM.

1. INTRODUCTION

Wheat (*Triticum aestivum*) is a crucial staple crop globally, providing 21% of food calories, 20% of protein, and 55% of carbohydrates to over 4.5 billion people. It is cultivated on approximately 215.91 million hectares worldwide, yielding around 765.77 million tons annually [1]. In Haryana, the area under wheat cultivation for the 2022-23 season was 2,364.14 hectares, with a production of 12 million tons [2].

Wheat varieties vary in their phenology, thermal and photoperiod requirements, and growth habits, which affect their adaptation to different locations and sowing times. Therefore, evaluating varieties suitable for early, normal, and late sowing conditions is essential to identify those with growth patterns, physiological traits, and yield attributes that enhance grain yield and biomass under varying sowing conditions [3]. Grain and straw yields in wheat are influenced by both the variety and nutrient availability. To increase production, especially in irrigated regions, higher doses of inorganic fertilizers are often used. However, intensive fertilizer use can lead to environmental issues such as soil fertility degradation, reduced organic matter, decreased water retention, and inefficient nutrient uptake by roots.

Nutrients (N, P, K, and Zn) can be provided through fertilizers, organic manures, biofertilizers, biostimulants, and their combinations under integrated nutrient management [4]. Bio-fertilizers, consisting of live microorganisms, help mobilize plant nutrients in the soil. Hairamine, a protein hydrolysate derived from human hair, is a new-generation, highly effective natural organic fertilizer that enhances crop growth, yield, and resistance to various stresses [5]. Despite its potential, there is limited information available, and further research is needed. Previous studies have highlighted the benefits of integrated nutrient management [6], but the effectiveness of such management depends on the proportion of inorganic and organic components, such as vermicompost. The present studies aim to explore the feasibility of reducing chemical fertilizer doses without compromising the wheat production potential of various cultivars.

2. MATERIALS AND METHODS

A field experiment was carried out during the Rabi season of 2022-23 at the Research Farm of the Department of Agriculture, Maharishi Markandeshwar University, Mullana, Ambala, Haryana. The farm is located at a latitude of 30°17' N, longitude of 77°3' E, and an altitude of 264 meters above sea level. The soil at the experimental site was sandy loam, well-drained, alkaline (pH 7.23), low in nitrogen, medium in phosphorus, and had an electrical conductivity of 0.89 dS/m. The study was designed as a factorial randomized block design with three replications, involving two factors: three wheat varieties (WH 1124, WH 1105, and WH 1184) as Factor A, and four treatments as Factor B. The treatments were: T1: Recommended Dose of Fertilizer (RDF), T2: 75% RDF + 25% nutrients from Vermicompost, T3: 75% RDF + Foliar application of Hairamine at 30, 60, and 90 days after sowing (DAS) at 10 ml/l water. T4: 50% RDF + 25% Vermicompost + 3 foliar sprays of Hairamine at 30, 60, and 90 DAS at 10 ml/l water. Wheat plant height was measured from the base to the tip of the tallest leaf or panicle using a standard meter scale and recorded in centimeters. The number of tillers was counted by placing a ruler randomly between two rows of the crop and recording the tillers along each row on both sides of the ruler. Tillering is primarily influenced by the green photosynthetic area, which contributes to carbohydrate formation, grain filling, and overall grain yield. Dry matter accumulation correlates directly with the number of tillers and plant height. The plots measured 5 m × 1.5 m in gross size and 4.56 m × 1 m in net size, with row spacing of 22 cm and plant-to-plant spacing of 10 cm. Seeds were sown at a rate of 100 kg/ha.

3. RESULTS AND DISCUSSION

All investigational data (means) for different plant growth parameters from each treatment were statistically analyzed using analysis of variance (ANOVA) as stated by Panse and Sukhatme [7]. With the guidance of "F" variance ratio test the meaning of treatment effects (at 5%) was evaluated. For separating the effects of treatment from those of chance effects, appropriate typical errors and the critical difference (C.D.) at 5% level of significance were calculated. The salient features of results are presented here under:

3.1 Plant Height

Plant height is an important attribute of development that provides an idea of predictable biomass and so on crop productivity [8]. From the observations taken, it was observed that maximum plant height at 30, 60, 90 DAS and at harvest was found in the treatment T_4: 50% RDF + 25% vermicompost + 3 foliar sprays of hairamine at 30, 60 and 90 DAS @ 10 ml/l water followed by the treatment T_2: 75% RDF + 25% nutrients from vermicompost respectively (Table 1). Maximum number of tillers was recorded in cultivar WH 1105 and minimum number of tillers was recorded in cultivars WH 1124. Variation in plant height among cultivars might also be probably due to their genetic characters [9].

3.2 Number of Tillers

From the data taken**,** it was observed that maximum number of tillers at 30, 60, 90 DAS and at harvest was found in the treatment T_4: 50% RDF + 25% vermicompost + 3 foliar sprays of hairamine at 30, 60 and 90 DAS @ 10 ml/l water followed by the treatment T_2: 75% RDF + 25% nutrients from vermicompost respectively (Table 2). Maximum number of tillers was

Table 1. Effect of Integrated Nutrient Management on plant height (cm)

Treatments	30 DAS	60 DAS	90 DAS	At Harvest
T1: RDF (Recommended dose of fertilizer)	12.25	42.51	92.57	95.18
T2: 75% RDF + 25% nutrients from Vermicompost	14.87	45.07	94.07	97.01
T3: 75% RDF + Foliar application of Hairamine at 30, 60, 90 DAS @ 10 ml/l water	14.30	44.24	93.62	96.29
T4: 50% RDF + 25% Vermicompost + 3 foliar sprays of hairamine at 30, 60 and 90 DAS @ 10 ml/l water	16.86	47.13	96.81	99.24
S.Em ±	0.421	0.645	0.382	0.501
C D (5%)	1.242	1.322	1.218	1.303
Varieties				
V1-1124	15.59	44.06	87.20	95.54
V2-1105	18.45	45.72	99.60	97.88
V3-1184	16.92	44.42	96.01	97.36
S.Em ±	0.364	0.582	0.369	0.445
C D (5%)	1.075	1.110	1.028	1.089

Table 2. Effect of Integrated Nutrient Management on number of tillers m^{-2}

Treatments	30 DAS	60 DAS	90 DAS	At Harvest
T1: RDF (Recommended dose of fertilizer)	190.45	313.34	362.01	359.29
T2: 75% RDF + 25% nutrients fromVermicompost	226.94	352.48	379.04	376.75
T3: 75% RDF + Foliar application of Hairamine at30, 60, 90 DAS @ 10 ml/l water	214.42	328.77	371.24	369.52
T4: 50% RDF + 25% Vermicompost + 3 foliar	238.16	370.09	387.55	385.19

Treatments	30 DAS	60 DAS	90 DAS	At Harvest
sprays of hairamine at 30, 60 and 90 DAS @ 10 ml/l water				
S.Em ±	0.589	0.624	0.435	0.528
C D (5%)	1.326	1.384	1.219	1.309
V1-1124	216.34	331.71	360.95	357.09
V2-1105	219.48	346.26	399.81	397.74
V3-1184	216.65	345.54	383.61	380.48
S.Em ±	0.462	0.518	0.371	0.487
C D (5%)	1.149	1.189	1.072	1.163

Table 3. Effect of Integrated Nutrient Management on Dry matter accumulation (g) permeter row length

Treatments	30 DAS	60 DAS	90 DAS	At Harvest
T1: RDF (Recommended dose of fertilizer)	38.57	329.76	688.32	861.49
T2: 75% RDF + 25% nutrients from Vermicompost	41.20	342.08	709.34	873.46
T3: 75% RDF + Foliar application of Hairamine at 30, 60, 90 DAS @ 10 ml/l water	39.14	335.72	693.05	866.21
T4: 50% RDF + 25% Vermicompost + 3 foliar sprays of hairamine at 30, 60 and 90 DAS @ 10 ml/l water	42.16	344.45	712.64	877.49
S.Em ±	0.345	0.589	0.611	0.515
C D (5%)	1.332	1.274	1.321	1.264
Varieties				
V1-1124	39.08	327.87	695.32	859.82
V2-1105	41.77	342.52	707.09	870.73
V3-1184	39.95	339.61	702.60	867.43
S.Em ±	0.282	0.476	0.524	0.432
C D (5%)	1.158	1.051	1.172	1.089

recorded in cultivar WH 1105 and minimum number of tillers was recorded in cultivars WH 1124.Variation in plant height among cultivars might also be probably due to their genetic characters as well as climatic requirement of the different cultivars [9]. The results are corroborated with Bishnoi [10], Tripathi et. al. [11] and Sandhu et. al. [12].

3.3 Dry Matter Accumulation

The data of dry matter accumulation in Table 3 indicated that maximum dry matter accumulation at 30, 60, 90 DAS and at harvest was found in the treatment T4: 50% RDF + 25% vermicompost + 3 foliar sprays of hairamine at 30, 60 and 90 DAS @ 10 ml/l water followed by the treatment T2: 75% RDF + 25% nutrients from vermicompost respectively (Table 3). Maximum dry matter accumulation was recorded in cultivar WH 1105 and minimum dry matter accumulation was recorded in cultivars WH 1124. These findings are similar to Sirohi et. al. [13]. Keshiri et. al. [14] and Lakshamen [15] stated that during initial growth stages (30 DAS) of wheat crop, poor dry accumulation could be due to poor development of photosynthetic area, which peaks at flowering stage in cereals and then decreases due to mutual shading of the non-photosynthetic tissue [14,15].

4. CONCLUSION

The study concludes that the treatment of 50% RDF + 25% vermicompost + three foliar sprays of Hairamine at 30, 60, and 90 days after sowing (DAS) at 10 ml/l water yielded the highest growth parameters. This was followed by the treatment of 75% RDF + 25% nutrients from vermicompost (T2). Among the wheat varieties, WH-1105 demonstrated the best performance, while WH-1184 showed the lowest growth parameters. These findings suggest that Hairamine acts as an effective biostimulant, enhancing plant growth across all wheat varieties by positively influencing photosynthesis and other metabolic processes. Furthermore, integrated nutrient management combining mineral fertilizers, vermicompost, and Hairamine proves to be significantly more effective than using mineral fertilizers alone.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Anonymous. Agricultural statistics at a glance. Government of India. Ministry of Agriculture and Farmers' Welfare. 2023a; 19 (6):71-80.
2. Kaur G, Singh I, Behl RK, Dhankar A. Effect of different integrated nutrient management approaches on growth, yield attributes and yield of wheat crop: A Review. Asian Journal of Soil Science and Plant Nutrition. 2024;10(1): 457-468.
3. Nagora M, Shweta, Sewhag M, Chaudhary K, Kumar L, Kumar S, Anjeeta. Potential role of wheat varieties in Semi-Arid areas of India with diverse mulch materials. Biological Forum-An International Journal. 2023;15 (4):293-300.
4. Fazily T, Thakral SK, Dhaka AK. Effect of integrated nutrient management on growth, yield attributes and yield of wheat. International Journal of Advances in Agricultural Science and Technology. 2021;8 (1):106-118.
5. Mohan J, Singh I, Behl RK, Sharma PK, Bharti B, Arya R, Mittan S, Tomar V. Effect of Hairamin and fertilizer application on grain yield and its attributes in wheat (*Triticum aestivum L*.) varieties. Asian Journal of Soil Science and Plant Nutrition. 2024;10(1):389-396.
6. Sharma S, Kandel N, Chaudhary P, Rai P. A Review on Integrated Nutrient Management on wheat (*Triticum aestivum L*.). Reviews in Food and Agriculture (RFNA). 2020;1(1): 32-7.
7. Panse VG, Sukhatme PV. Statistical methods for Agricultural workers. ICAR, New Delhi. 1968;135-136.
8. Kumar N, Kamboj BR, Thakral SK, Singh M. Growth parameters and productivity of wheat as influenced by crop establishment methods and different seed rate. International Journal of Pure and Applied Bioscience. 2017;5 (4): 2134-2140.
9. Pal RK, Singh AK, Raj P, Kumar P, Anshuman K, Kumar A, Yadav P. Effect of direction of sowing on growth and yield of different wheat (*Triticum aestivum L*.) cultivar in Eastern Uttar Pradesh. The Pharma Innovation. 2021;10(10):917- 920.
10. Bishnoi OP. Impact of meteorological variables on the growth and development of wheat varieties. Journal Agromet. 2002; 4 (1): 9-15.
11. Tripathi P, Singh AK, Shabdadhar. Organizing researches on rice and wheat meteorology. Technical Bulletin, Department of Agricultural Meteorology, NDUAT. 2009;33.
12. Sandhu SK, Dhaliwal LK. Effect of row orientation on radiation interception and growth dynamics of wheat. International Journal of Agricultural Sciences. 2018;14 (1): 186-191.
13. Sirohi C, Bangarwa KS, Dhillon RS, Handa AK, Chavan SB, Arunachalam. Dry matter accumulation of winter wheat (*Triticum aestivum L*.) at different distances from tree line under Poplar (*Populus deltoids*) boundary plantation. Indian Journal of Agroforestry. 2021;23 (2): 30-38.

14. Keshiri M, Latifi N, Ghasemi M. Growth analysis of safflower varieties with different cropping pattern in rainfed condition. Agriculture and Natural Resources. 2003;10 (1): 85-94.

15. Lakshamen KP. Growth studies of yield variability in wheat (*Triticum aestivum L*.) under varying degree of shades. Journal of Hill Agriculture. 2014;5 (3): 525-530.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/123090