Journal of Scientific Research and Reports

Volume 30, Issue 4, Page 170-178, 2024; Article no.JSRR.113663
ISSN: 2320-0227

Unveiling the Potential of Wheat (*Triticum aestivum* L.) Varietal Performance Evaluation through Organic Nutrient Management

Richa Singh [a*], R.P. Sahu [a], P.B. Sharma [a], Vinay Sahu [a], Satyendra Thakur [b*], Raghav Patel [a], Sonali Singh [c] and Rohit Kumar Kumawat [b]

[a] *Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, 482004 - Jabalpur (MP), India.*
[b] *Department of Plant Physiology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, 482004 - Jabalpur (MP), India.*
[c] *Department of Agronomy, College of Agriculture, Tikamgarh (MP), India.*

Authors' contributions

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

Article Information

DOI: 10.9734/JSRR/2024/v30i41902

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/113663

Original Research Article

Received: 23/12/2023
Accepted: 27/02/2024
Published: 02/03/2024

ABSTRACT

Wheat (*Triticum aestivum L.)* is second-most important food grain crop produced in India after rice. The Experiments was conducted during the Rabi season of the year 2020/21 at Instructional Research Farm, Krishi Nagar, Adhartal, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) to study the performance of different wheat varieties under organic nutrient management in Kymore Plateau and Satpura Hills Zone. The soil of the region favour high input intensive farming for

---

**Corresponding author: E-mail: richasinght12@gmail.com, thakursatyendrasing@gmail.com;*

producing a maximum yield per unit of land area. Frequent use of agrochemicals, such as fertilizers, pesticides, weedicides etc. and other techniques were extremely taxing, that depletes the physical, chemical, and biological properties of the soil and causing a considerably larger loss of nutrients than its replenishment. The standardization of organic manure application is the need of the hour to sustain crop productivity and soil health in the region. Selection of a variety plays a crucial role under organic farming as it has a direct effect on yield and economics of a crop than conventional farming. Organic farming requires regionally adapted varieties that are well suited to regional soil, climate, and production systems. The existing cultivars have to be appraised for the specific characteristics needed in organic farming**.** As a result, treatments consisted of twelve varieties of wheat viz., JW 17, JW 3020, JW 3173, JW 3269, JW 3288, C 306, HI 1500, HI 1531, HI 1418, HD 2987, HW 2004 and HD 4672 were tested in randomized complete block design with three replications. The highest grain yield of 3787 kg ha^{-1} recorded from JW 17 followed by varieties C 306 and JW 3269. While HI 1418 variety was the lowest yielder with a grain yield of 2796 kg ha^{-1} among all tested varieties. Thus, the performance of variety JW 17 was found superior concerning growth parameters, yield attributing characters and yield closely followed by varieties C 306, JW 3269 and JW 3288.

Keywords: Morpho-physiological traits; organic nutrient management; varieties; wheat; yielding performance.

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is India's second-most important food grain crop after rice with an area of 29.5 million hectares. In order to maximize a crop's potential for production, it is crucial that the crop or cropping system receive an optimum nutrient supply [1]. Globally, 766.5 million tons of wheat is produced on an area of about 217.02 million hectares [2]. India cultivated wheat on area around 31.45 million hectares in 2019/20, with crop produce of 107.59 metric tons [3]. In Madhya Pradesh, it is the most important crop during the *Rabi* season, occupying 10.02 million hectare area and producing 16.52 metric tons with productivity of 3298 kg ha^{-1}. During the start of the green revolution, wheat production and productivity in India surged significantly. This was mostly because high-yielding varieties were used and chemical fertilizers, pesticides were applied in large quantities, and agricultural mechanization was expanded. All of these factors put an unprecedented strain on our natural resources [4]. Frequent use of agrochemicals like fertilizers, pesticides and other techniques were extremely taxing, depleting the physical, chemical, and biological properties of the soil and causing considerably larger loss of nutrients than its replenishment. Those factors reduced the soil fertility and productivity of the land [5]. The persistent nature of pesticide residues in food products has begun to raise concerns for the health of both humans and animals. Moreover, chemical residues destroy flora, fauna, and beneficial soil microbes, which ultimately lower soil fertility [6,7]. Because of this, farming techniques have changed recently, and organic agriculture has become a competitive long-term agricultural choice. The present focus is on complementing or replacing inorganic fertilizers with low-cost nutrition sources like organic compost and manures due to declining factor productivity, global energy crises, and a considerable increase in the price of synthetic fertilizers [8]. In 2017, the area under organic cereal in the world was 4.5 million hectares, equivalent to 0.6% of the total cereal area (718 million ha in 2016 [9]).

In India a significant crop like wheat was started to be produced organically. However, compared to wheat grown through chemical farming, yield decreases of 20–40% have been observed in organic wheat production [10]. Organic farming may not always be a good fit for trendy high-yielding cultivars that react well to chemical inputs [10,11]. The productivity of wheat is regulated by improved varieties coupled with the appropriate production technologies. The most important factor in achieving potential output of a variety is how well-suited it is to a particular agro-climate [12]. There is a greater degree of confusion exist around the selection of a suitable crop variety for high yield in organic farming than in conventional farming. The selection of a variety plays a crucial role in organic farming as it has a more direct effect on the yield and economics of a crop than conventional farming [13]. Organic farmers rely heavily on conventionally developed varieties, but for further organic farming optimization, varieties that are better suited to organic farming systems are needed. Some traits that are associated with conventional varieties are incompatible with the organic farming system. So organic farming requires regionally adapted varieties that are well suited to regional soil, climate, and production systems. Keeping the above facts in mind, this experiment was performed with the obectives to evaluate the morpho-physiological and yielding performance of different wheat varieties under organic nutrient management and to recommend 1 to 4 varieties in the study area of Kymore Plateau and Satpura Hills Zone.

2. MATERIALS AND METHODS

2.1 Experimental Materials Used

The field experiment was conducted at the Instructional Research Farm in Krishi Nagar, Adhartal, JNKVV, Jabalpur (MP) during the 2020–21 *Rabi* season. Twelve different varieties of wheat were sown in a randomized block design with three replications under organic nutrient management practices for that (FYM, Vermicompost, and Neem Cake were used). The varieties included JW 17, JW 3020, JW 3173, JW 3269, JW 3288, C 306, HI 1500, HI 1531, HI 1418, HD 2987, HW 2004 and HD 4672. The recommended dose of NPK @ 120:60:40 kg per ha respectively was applied through FYM, Neem Cake and Vermicompost each 1/3rd on the basis of nitrogen content. Out of total recommended dose of Nitrogen (120 kg), 40 kg supplied through FYM, 40 kg through Vermicompost and remaining 40 kg through Neem cake. So to supply 120 kg N 8 ton/ha FYM, 2.6 ton/ ha Vermicompost and 7.6 qn/ha Neem cake was applied as basal dose. Requirement of P and K were fulfilled through applied FYM, Vermicompost and Neem Cake. All of them were mixed and applied at once.

2.2 Soil Sample Analysis

The soil of the experimental site was sandy loam, neutral in reaction (pH 7.25) with normal EC (0.34 dS m^{-1}), medium in OC contents (0.71%), low in available N (272 kg ha^{-1}), medium in available P (20.72 kg ha^{-1}), and high in available K (345 kg ha^{-1}) contents.

2.3 Experimental Procedure

The experimental farm had all the necessary resources, including irrigation water, available to conduct the field experiment. Three randomly chosen plants from each treatment and replication were used for the observations, and the data was acquired by averaging the values in order to calculate the value of the morpho-physiological and yield-attributing characteristics.

3. RESULTS AND DISCUSSION

3.1 Morphological Traits

The one key factor influencing wheat production, sustainability, and yield is plant height [14]. It is also an important objective for agronomic breeding and a critical indicator to represent the status of crop growth and nitrogen absorption in the vegetative state [15]. Optimal plant height under given environmental conditions is vital for the adaptability, productivity, and yield stability of the wheat cultivars [16,17]. It is obvious from the data that (Fig. 1) the plant height and tillers per square meter were significantly varied among varieties, and the maximum plant height (93.75 cm) and tillers (501 tillers/m^2) were recorded in the variety JW 17, which was found at par with the variety C 306. The genetic characteristics of the various cultivars, as well as their varying climate requirements, may also contribute to the variation in plant height between cultivars [18]. Similar to this, variety JW 17 has more tillers, which provides the variety with the extra stalks that are needed for a good yield [19].

3.2 Physiological Traits

According to [20,21,22], a proper leaf area index (LAI) balances the growth of each crop organ and is a key indicator of high crop output by coordinating the link between the crop's source and sink. Moreover, dry matter is accumulated in leaves up to a leaf area index of 5; thereafter, further increases in dry matter were trans-located to the stem [23]. [24] reported that the, LAI as an essential parameter of wheat growth, and it, can provide dynamic information during its growth. It is a critical metric for assessing crop growth and is closely related to the aboveground biomass and yield [25]. Results revealed that (Fig. 1) maximum LAI (3.95) was calculated under the variety JW 17, which was significantly superior to the rest of the varieties used in this research study. It might result from better coordination in the crop's source and sink relationships under variety JW 17 [20].

[26] reported that the degree to which stem reserves are mobilized during grain filling and their percentage in the final grain mass are determined by cultivar characteristics, such as the source-sink ratio, and are also greatly impacted by the surrounding environmental factors. Dry matter production is basically a measure of plant photosynthetic efficiency, which is influenced by balanced nutrient availability and environmental factors [23]. Analysis of the data revealed that (Fig. 1) dry matter accumulation increased progressively with the advancement of crop age up to harvest. Variety JW 17 recorded its distinct superiority over other varieties and achieved the highest value for this trait (1175 g m^{-2}) but failed to express significant variation in dry matter accumulation with varieties C 306, JW 3269, JW 3288, and HI 1500 and found themselves at par among them. These results showed that variety JW 17 is capable of performing photosynthesis more efficiently and that the environmental factors of Kymore Plateau and Satpura Hills Zone are in favor of variety JW 17. It might be due to this particular variety was developed by JNKVV for this region and along with this the field was being maintained organically for past 4 years that helped in many ways. In this way environmental conditions along with organic management favoured growth of that variety and enhance its ability to do more photosynthesis.

3.3 Yield Attributes and Yield

The grain yield of a crop depends on the source-sink relationship [27] and the combined function of different growth parameters and yield-attributing characters, viz., effective tillers per meter square, length of ear head, grains per ear head and test weight, which are affected by different crop management practices and various growing conditions. Any factor affecting these growth and yield components will finally affect the economic and biological yield of the crop [28]. The data about yield-attributing characters and yield have been presented in (Fig. 2).

The data revealed that a significantly higher number of effective tillers per m^2, grains per ear head, grain yield, and harvest index (%) were recorded with the variety JW 17 under recommended dose of fertilizers provided organically. Effective tillers per meter square were maximum (477 tillers m^{-2}) under the variety JW 17, which is closely followed by variety C 306 and significantly superior over the rest of the varieties. Better plant growth parameters, *i.e.,* superiority in plant height, tillers per meter square, and LAI (contributed to the maximum photosynthetic area), were noticed in the variety JW 17, which was attributed to producing a significantly greater number of effective tillers per meter square than other varieties.

These growth parameters were remarkably poor under the variety HI 1418; thus, it gave the lowest number of effective tillers per meter square (361 tillers m^{-2}). Variability concerning a number of effective tillers among different varieties might be due to their genetic makeup. It was noted that variety (JW 17) with large-sized ear heads that is 13.67 cm and also have a greater number of grains per ear head. The maximum number of grains per ear head (49 grains per ear head) was counted in the variety JW 17, which was found at par with varieties C 306, JW 3269, and JW 3288. However, minimum grains per ear head were recorded under the variety HI 1418 (34 grains per ear head). The grain yields of varieties are the final product for which varieties have evolved. Data showed that the variety JW 17, with a grain yield of 3787 kg ha^{-1} (under recommended dose of nutrient is 120:60:40 kg ha-1 NPK which were supplied through fym, vermicomposting and neem cake) excelled all of the varieties but was closely followed by varieties C 306 and JW 3269. While HI 1418 was the lowest yielder with a grain yield of (2796 kg ha^{-1}) among all the varieties tested. Economic yield (grain yield) was significantly higher in the variety JW 17 than in the rest of the varieties and its harvest index was also higher (45.68%) than rest of the varieties, followed by varieties C 306 and JW 3269. Whereas the variety HI 1418 produced the minimum grain yield in comparison to the rest of the varieties, so its harvest index was the lowest among all the varieties tested.

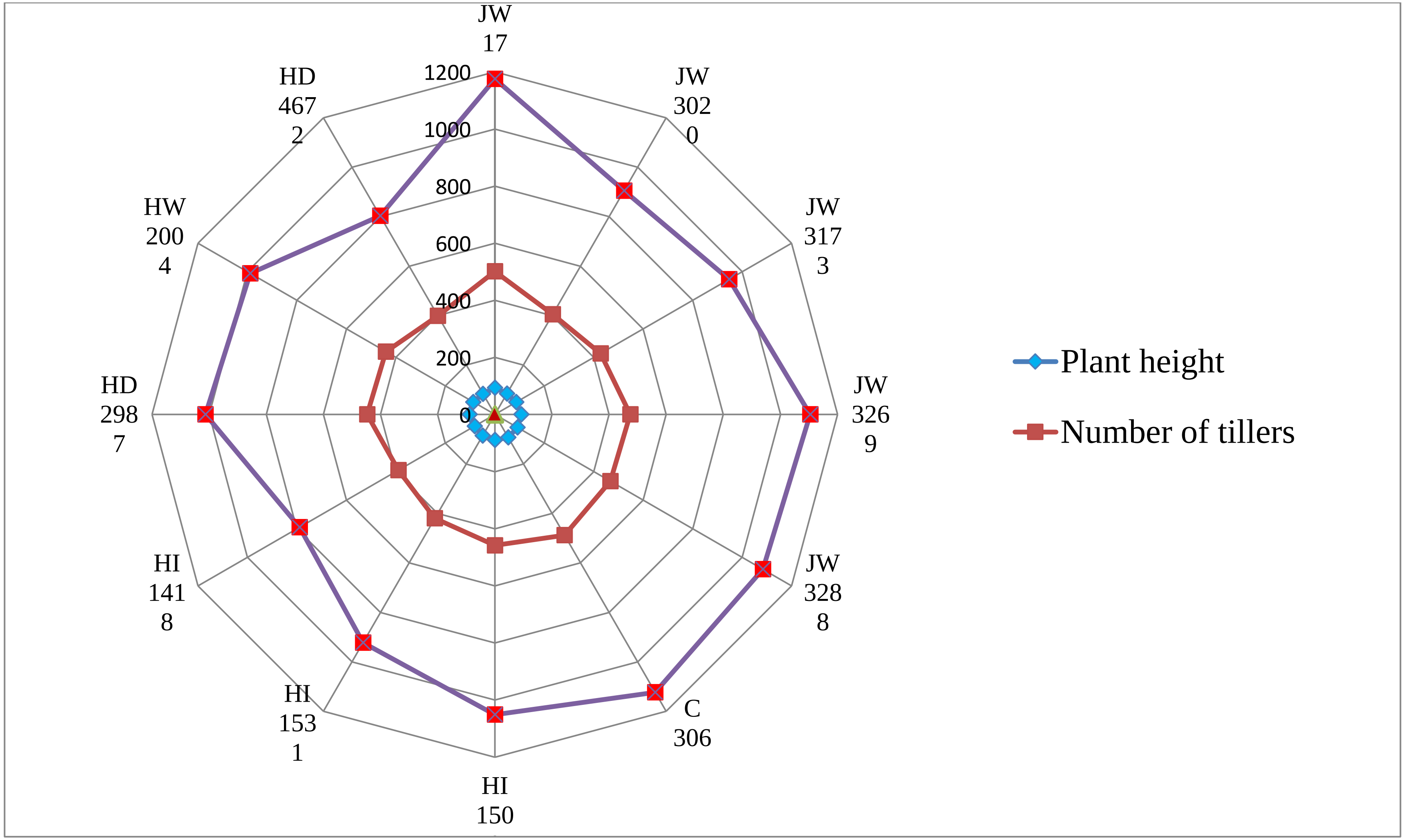

Fig. 1. Morpho-physiological traits of different wheat varieties grown under organic nutrient management

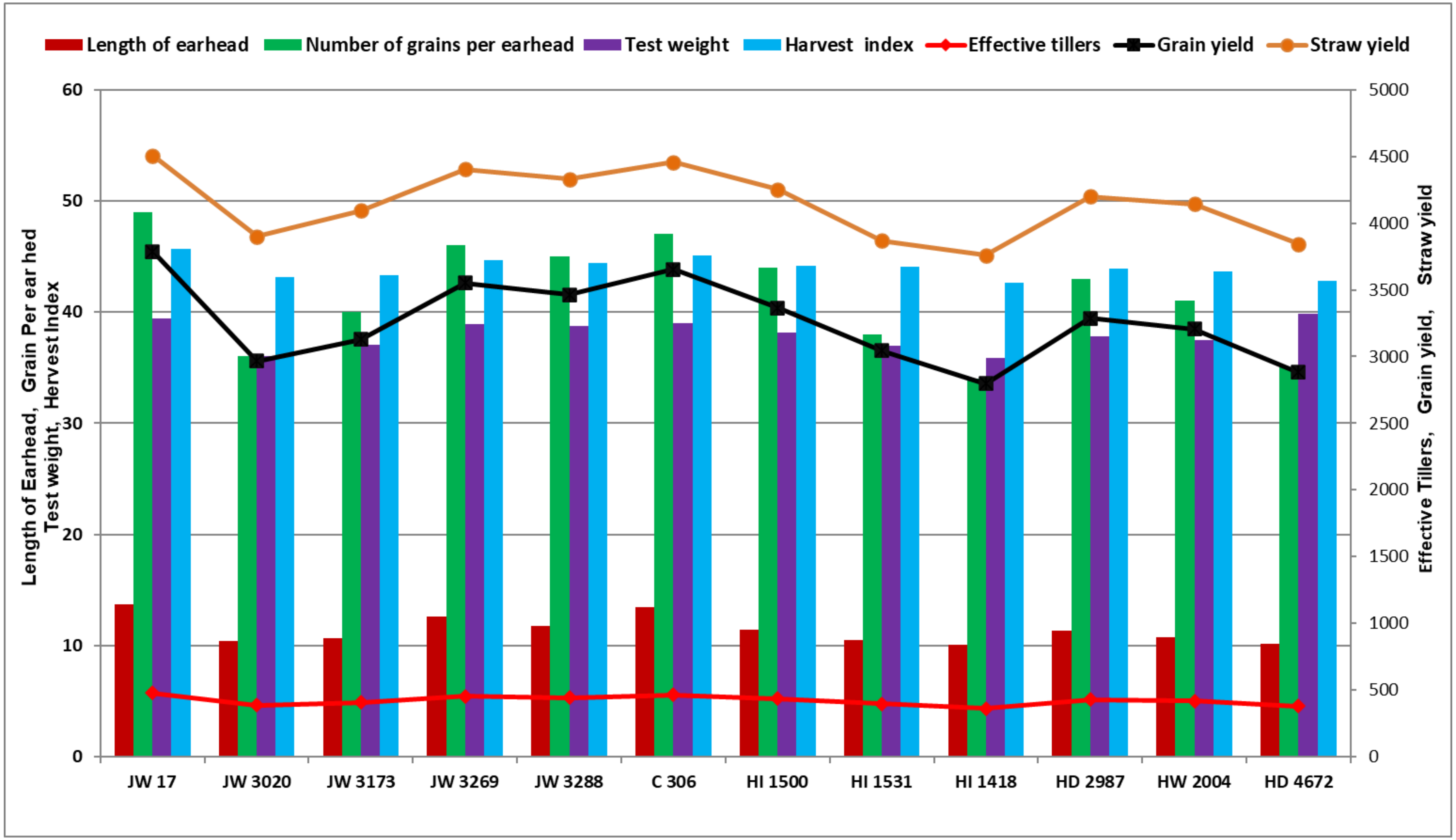

Fig. 2. Yield and yield attributing traits of different wheat varieties grown under organic nutrient management

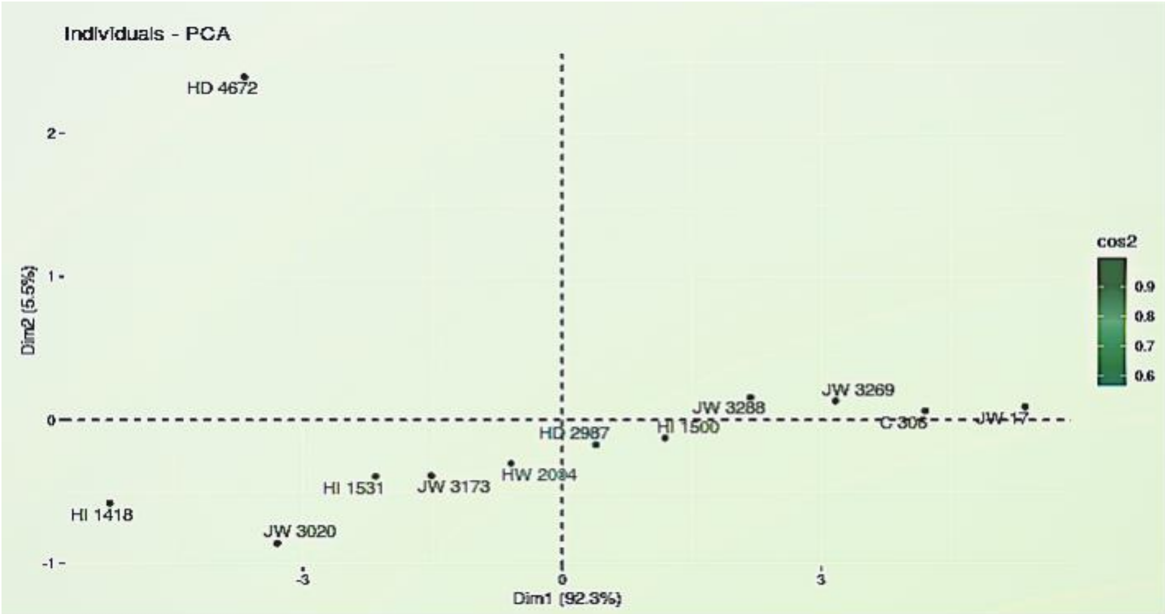

Fig. 3. This is a PCA showing the suitability of variety JW 17 along with varieties C 306, JW 3269 and JW 3288 under organic nutrient management in the Kymore Plateau and Satpura Hills zone

4. CONCLUSION AND RECOMMENDATIONS

Based on experimental results, with respect to growth parameters, yield attributing characters and grain yield, it can be concluded that wheat variety JW 17 followed by varieties C 306, JW 3269 and JW 3288 were found superior and suitable for cultivation in Kymore Plateau and Satpura Hills Zone under organic nutrient management practices. Thus, it can be suggested that according to prevailing cropping conditions varieties JW 17, C 306, JW 3269 and JW 3288 can be promoted for organic cultivation in Kymore Plateau and Satpura Hills Zone of Madhya Pradesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hatti V, Ramachandrappa BK, Mudalagiriyappa. Influence of conservation tillage and nutrient management practices on performance of rainfed finger millet (*Eleusine coracana* (L.) Gaertn.) in Alfisols. Indian Journal of Dryland Agricultural Research and Development. 2018;33(1):14-23.
2. FAO (Food and Agriculture Organization of the United Nations); 2020. Available:http://www.fao.org/worldfoodsituation/csdb/en/
3. IIWBR. Indian institute of wheat and barley research. Available:https://iiwbr.icar.gov.in/director-desk/
4. Charyulu DK, Biswas S. Organic input production and marketing in India – efficiency, issues, and policies. Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad. CMA Publication No 239; 2010.
5. Kumawat Rohit Kumar, Gyanendra Tiwari, Shiv Ramakrishnan R, Supriya Debnath, Satyendra Thakur, Ankit Bharti, Parikha Prakash, Divya Bhayal Singh, and Laita Bhayal. Plant growth regulators and their spray schedules affect growth, leaf area development and dry matter production under normal and late sown condition in wheat. The Pharma Innovation Journa, 2023;12(7):1908-1913.
6. Meena RK, Singh YV, Nath CP, Bana RS Lal B. Importance, prospects and constraints of organic farming in India. Popular Kheti. 2013;1(4):26-31.
7. Kumar A and Bohra B. Green technology in relation to sustainable agriculture. In: Kumar A. and Dubey P. (eds) Green

Technologies for sustainable agriculture. Daya Publishing House, Delhi. pp. 1- 16.
8. Prasad R. 2005. Rice-wheat cropping system. Advances of Agronomy. 2006;86: 255-339.
9. FAOSTAT; 2019. Available:https://www.organicworld.net/fileadmin/documents/yearbook/2019/FiBL-2019-Crops-2017.pdf
10. Ceccarelli SS. Adaptation of varieties to low/high input cultivation. Euphytica. 1996;92:203–214.
11. Murphy KM, Campbell KG, Lyon SR and Jones SS. Evidence of varietal adaptation to organic farming systems. Field Crops Research. 2007;102:172-177.
12. Maqsood M, Shehzad MA, Yaser R, Sattar A. Effect of nitrogen on growth, yield and radiation use efficiency of different wheat (*Triticum aestivum* L.) Cultivars. Pakistan Journal of Agricultural Science. 2014;51(2):441-448.
13. Revilla P, Landa L, Rodriguezi VM, Romay Q and Malvar RA. Maize for bread under organic agriculture. Spanish Journal of Agricultural Research. 2008;6(2):241-247.
14. Kumawat, Rohit Kumar, Gyanendra Tiwari, R. Shiv Ramakrishnan, Divya Bhayal, Supriya Debnath, Satyendra Thakur, and Lalita Bhayal. Remote sensing related tools and their spectral indices applications for crop management in precision agriculture. International Journal of Environment and Climate Change. 2023;13(1):171-188.
15. Jiang Tengcong, Liu Jian, Gao Yujing, Sun Zhe, Chen Shang, Yao Ning, Ma Haijiao, Feng Hao, Yu Qiang, He Jianqiang. Simulation of plant height of winter wheat under soil Water stress using modified growth functions, Agricultural Water Management. 2020;(232):106066.
16. Thakur S, Tiwari G, Kumawat RK, Kumhare A, Singh S, Singh R. Synthetic PGR's modify phenology, stress tolerance and mean productivity in wilt and cold stressed chickpea (*Cicer arietinum* L.). International Journal of Environment and Climate Change. 2023;17,13(11):1055-68.
17. Bognár Z, Láng L, Bedő Z. Effect of environment on the plant height of wheat germplasm. Cereal Res. Commun. 2007;35:281-284.
18. Pal Ravikesh Kumar, Singh AK, Raj Prithvi, Kumar Pramod, Kumar Anshuman, Kumar Ajay, Yadav Pushpendra. Effect of direction of sowing on growth and yield of different wheat (*Triticum aestivum* L.) cultivar in Eastern Uttar Pradesh The Pharma Innovation Journal. 2021;10(10):917-920.
19. Santos Fernando and Diola Valdir. Chapter 2 - Physiology, Sugarcane, Academic Press. 2015;13-33. ISBN 9780128022399, Available:https://doi.org/10.1016/B978-0-12-802239-9.00002-5
20. Yin W, Chai Q, Guo Y, Feng F, Zhao C, Aizhong Y, Falong H. Analysis of leaf area index dynamic and grain yield components of intercropped wheat and maize under straw mulch combined with reduced tillage in arid environments. Journal of Agricultural Science. 2016; 8(4).
21. Thakur S, Gontia AS, Kumawat RK. physiological investigations on response of post emergence application of weedicides in maize [*Zea mays* (L.)]. Int. J. Curr. Microbiol. App. Sci. 2020; 9(12):797-803.
22. Tiwari PN, Tiwari S, Sapre S, Tripathi N, Payasi DK, Singh M, Thakur S, Sharma M, Tiwari S, Tripathi MK. Prioritization of physio-biochemical selection indices and yield-attributing traits toward the acquisition of drought tolerance in chickpea (*Cicer arietinum* L.). Plants. 2023;5-12(18):3175.
23. Khan S, Khan A, Jalal F, Khan M, Khan H. Dry matter partitioning and harvest index of maize crop as influenced by integration of sheep manure and urea fertilizer. Adv Crop Sci Tech. 2017;5: 276.
24. Qiao K, Zhu W, Xie Z, Li P. Estimating the seasonal dynamics of the leaf area index using piecewise LAI-VI relationships based on phenophases. Remote Sens. 2019;11:689.
25. Kumawat RK, Samaiya RK, Singh Y, Thakur S. Response of post emergence application of herbicides on phenophases, yield, biochemical components and economic analysis of maize [*Zea mays* (L.)]. Journal of Pharmacognosy and Phytochemistry. 2021;10(2):276-9.
26. Hokmalipour S, Darbandi M. Investigation of nitrogen fertilizer levels on dry matter remobilization of some varieties of corn (*Zea mays* L.). World Applied Sci. J. 2011;12:862-870.

27. Li X, Zhou Y, Shuai P, Wang X, Peng S, Wang F. Source-sink balance optimization depends on soil nitrogen condition so as to increase rice yield and N use efficiency. Agronomy. 2023;13(3):907.

28. Zou Ying-Bin, Jiang Peng, Xia Bing. Relationship between grain yield and yield components in super hybrid rice. Agricultural Sciences in China - AGRIC SCI CHINA. 2011;10: 1537-1544.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/113663