International Journal of Research in Agronomy 2024; SP-7(10): 386-389

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
www.agronomyjournals.com
2024; SP-7(10): 386-389
Received: 15-07-2024
Accepted: 22-08-2024

Vikash Dadrwal
Research Scholar, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Harish Kumar Bijarnia
Assistant Professor, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

OP Sharma
Professor & Head, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Mukesh Kumar Jat
Assistant Professor, Department of Plant Pathology, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Atul Sharma
Assistant Professor, Department of Horticulture, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Corresponding Author:
Vikash Dadrwal
Research Scholar, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Effect of organic and inorganic fertilizers on growth, yield attributes and yield of barley (*Hordeum vulgare* L.)

Vikash Dadrwal, Harish Kumar Bijarnia, OP Sharma, Mukesh Kumar Jat and Atul Sharma

DOI: https://doi.org/10.33545/2618060X.2024.v7.i10Sf.1797

Abstract
A field experiment was conducted during *rabi* season of 2023-24 at Research Farm, School of Agriculture, Suresh Gyan Vihar University Jaipur, to study the "Performance of Barley (*Hordeum vulgare*) under Application of Organic and Inorganic Fertilizer". The experiment was consisting ten treatments *viz*., control (T_1), 50% RDN (40 kg ha^{-1}) (T_2), 50% RDN + 5 t FYM ha^{-1} (T_3), 50% RDN + 0.5 t Neem cake ha^{-1} (T_4), 75% RDN (60 kg ha^{-1}) (T_5), 75% RDN + 5 t FYM ha^{-1} (T_6), 75% RDN + 0.5 t Neem cake ha^{-1} (T_7), 100% RDN (80 kg ha^{-1}) (T_8), 100% RDN + 5 t FYM ha^{-1} (T_9) and 100% RDN + 0.5 t Neem cake ha^{-1} (T_{10}). The barely variety used for study was DWRB-137.
The experimental results showed that application of 100% RDN + 0.5 t Neem cake ha^{-1} (T_{10}) produced significantly higher plant height, dry matter accumulation at 45, 90 DAS and harvest, total number of tillers plant^{-1} at harvest, number of effective tillers plant^{-1}, number of grains ear^{-1}, ear length, test weight, grain, straw and biological yield over application of 75% RDN, 75% RDN + 5 t FYM ha^{-1}, 75% RDN + 0.5 t Neem cake ha^{-1}, 50% RDN, 50% RDN + 5 t FYM ha^{-1}, 50% RDN + 0.5 t Neem cake ha^{-1} and control but it was remained at par with the application of 100% RDN and 100% RDN + 5 t FYM ha^{-1}.

Keywords: Barley, FYM, neem cake, yield

Introduction

Barley (*Hordeum vulgare* L.) is one of the most ancient crops among cereals and has played a significant role in the development of agriculture in the world. It is one of the most important, economically valuable and widely used cereal crops, which belongs to the family Poaceae with a diploid chromosomes number (Alnarp, 2013) [2].

The most important factors that reduce yield of barley are poor soil fertility, water logging, drought, frost, soil acidity (low soil pH), diseases and insects, poor crop management practices, limited availability of improved varieties and weed competition (Assefa *et al*., 2017) [4]. Poor soil fertility and use of low yielding varieties are among the most important constraints that threaten barley production in Ethiopia. Assefa *et al*. (2017) [4] reported that, soils in the highlands of Ethiopia usually have low levels of essential plant nutrients, especially low availability of nitrogen and it is the major constraint to cereal crop production. To maximize yield and quality of barley, it has been shown that nutrient management practices should be adjusted according to anticipated availability of nutrients to the crop (Edney *et al*., 2014) [9]. Integrated soil fertility management (ISFM) can give benefit to production and livelihood of farmers; the resilience of cropping system to climate change impacts and mitigation of greenhouse gas from fertilizers and soil (Melle *et al*., 2015) [18].

Organic agriculture is a production system which relies on ecosystem management and ecological processes rather than on the external flow of agricultural inputs (Foissy *et al*., 2013) [11]. Maintenance and improvement of soil potential fertility are closely related to the maintenance of soil organic matter and organic carbon balance (Baksiene *et al*., 2014) [6]. On organic farms, where the importation of materials to build and maintain soil fertility is restricted, it is important that a balance between inputs and outputs of nutrients is achieved to ensure both short-term productivity and long-term sustainability (Foissy *et al*., 2013) [11]. Farmyard manures are the major source of nutrient supply also on small farm holdings (Fageria, 2012) [10].

Ibrawuchi *et al*. (2007) [14] reported that the application of FYM in soil modified the pH of soil from acidic condition to neutral.

Fertilizers are concentrated sources of essential nutrients in a form that is readily available for plant uptake (Fairhurst, 2012) [10]. Abedi *et al*. (2010) [1] inorganic fertilizers are fertilizers, either natural or manufactured, containing nutrients essential for the normal growth and development of plants. Moreover, the common fertilization system is focused on providing a limited number of macronutrients, while it is scientifically known that plants need at least 13 available minerals in the soil (Atiyeh *et al*., 2000) [5].

Integrated plant nutrient management is the application of inorganic fertilizer in combination with organic fertilizer to maintain soil fertility and to balance nutrient supply in order to boost up the crop yield per unit area (Roberts, 2010) [21].

Materials and Methods

The experiment was laid out at Research Farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan) which is situated at an altitude of 432 metre above mean sea level with 26°48’35” N latitude and 75°51’44” E longitude. This region falls under agro-climatic zone IIIa (Semi-Arid Eastern Plain Zone) of Rajasthan. The average annual rainfall of this tract ranges between 400-500 mm, most of which is contributed by the south-west monsoon during July and August. There is hardly any rain during winter months. The maximum and minimum temperatures during the crop season ranged between 30.2 °C to 35.2 °C and 9.9 °C to 23.0 °C, respectively. A total of 365.5 mm rainfall was recorded during the crop season.

The sandy loam texture of the experimental field soil had a pH of 8.5, which was slightly alkaline in reaction, very low amount of organic carbon (0.42%), very low in available nitrogen (135.66 kg ha^{-1}), medium in available phosphorus (20.93 kg ha^{-1}) and high in available potassium (234.23 kg ha^{-1}) and low in available sulphur (16.35 kg ha^{-1}). On November 18, 2023, the crop was sown with variety of DWRB-137. There were three replications and ten treatments *viz*., control (T_1), 50% RDN (40 kg ha^{-1}) (T_2), 50% RDN + 5 t FYM ha^{-1} (T_3), 50% RDN + 0.5 t Neem cake ha^{-1} (T_4), 75% RDN (60 kg ha^{-1}) (T_5), 75% RDN + 5 t FYM ha^{-1} (T_6), 75% RDN + 0.5 t Neem cake ha^{-1} (T_7), 100% RDN (80 kg ha^{-1}) (T_8), 100% RDN + 5 t FYM ha^{-1} (T_9) and 100% RDN + 0.5 t Neem cake ha^{-1} (T_{10}), which were laid out in randomized block design.

Five plants were selected randomly from each plot and tagged permanently. Height of these five plants was measured at 45, 90 DAS and at harvest from the base of the plant to the top of the flag lead by metre scale and their mean was expressed as plant height (cm). Dry matter accumulation (g $plant^{-1}$) was recorded at 45, 90 DAS and at harvest and plants were uprooted randomly from sample rows of each plot. After removal of the root portion, the samples were first air-dried for some days and finally dried in an electric oven at 68 °C till a constant weight was achieved. The weight was recorded and expressed as g $plant^{-1}$. The number of tillers (m^{-1} row length) at harvest was counted on five randomly selected place in each plot and then average was recorded as number of tillers as m^{-1} row length. The number of effective tillers (m^{-1} row length) of five plants randomly selected from each plot was counted at harvest and average number of effective tillers m^{-1} row length was worked out. Number of spikelets ear^{-1} was recorded at harvest by counting the spikelets of the five randomly collected ear from each plot and the average value was estimated. The length of ear of each plant was measured from the five selected (tagged) plants and their mean was taken and expressed in cm. Number of grains ear^{-1} was counted from the five selected (tagged) plant’s spike and their mean was taken. Were drawn randomly from produce of each plot and one thousand seeds were counted from each sample and weighed to record test weight. After threshing and winnowing of the seeds from each net plot were weighed in kg $plot^{-1}$ and converted in kg ha^{-1} for grain yield. Straw yield was obtained by subtracting the grain yield (kg ha^{-1}) from biological yield (kg ha^{-1}). The harvest index was calculated by using following formula and expressed as percentage (Singh and Stoskoff, 1971) [25].

$$\text{HI (\%)} = \frac{\text{Economic yield (kg ha}^{-1}\text{)}}{\text{Biological yield (kg ha}^{-1}\text{)}} \times 100$$

Experimental data recorded in various parameters were statistically analyzed with the help of Fisher's analysis of variance technique.

Results and Discussion

Growth parameters

The highest plant height, dry matter accumulation at 45, 90 DAS and at harvest and number of total tillers $plant^{-1}$ at harvest was recorded with application of 100% RDN + 0.5 t Neem cake ha^{-1} (T_{10}) which was significantly higher rest of the treatments but remained at par with the application of 100% RDN + 5 t FYM ha^{-1} (T_9) and 100% RDN (80 kg ha^{-1}) (T_8) (Table 1 to 3). Increase in level of nitrogen significantly increased the plant height, dry matter accumulation at 45, 90 DAS and at harvest and number of total tillers $plant^{-1}$ at harvest. The significant improvement in various growth parameters might be attributed to the fact that nitrogen helps in maintaining higher auxin level which might have resulted in better plant height, dry matter accumulation at 45, 90 DAS and at harvest and number of total tillers $plant^{-1}$ at harvest. This might have resulted into better interception, absorption and utilization of radiant energy, leading to higher photosynthetic rate and finally more accumulation of fresh as well as dry matter by the plants. The increases in growth parameters with increasing levels of nitrogen have also been reported.

It has been widely documented that a like environment factors, mineral nutrition particularly nitrogen plays an important regulative functional role in the plant system through synthesis and translocation of growth harmones which generally act as stimuli for certain steps of growth and development (Beringer, 1980). Nitrogen is considered to be an essential consistent required for synthesis of protein, chlorophyll and other organic compounds of physiological significane in the plant system (Havlin *et al*., 2016) [13]. The possible reason for the increase in the growth parameters by application of higher level of nitrogen might be due to more accumulation of nitrogen content in plant which in turn resulted in more synthesis of nucleic acids, amino acids, amide substances in growing regions of meristematic tissues ultimately enhanced multiplication of cell division and there by increased in the growth attributes. Similar results were recorded by Goswami and Pandey (2018) [12], Sunag *et al*. (2021) [28], Singh *et al*. (2021) [24], Kumar and Niwas (2022) [17], Solanki *et al*. (2022) [27], Shahajahan *et al*. (2022) [22] and Singh *et al*. (2024) [26].

Table 1: Effect of organic and inorganic fertilizer on growth parameters at growth stages of barley

Treatments	Plant height (cm)			Dry matter accumulation (g plant^{-1})			Number of tillers at harvest (m^{-1} row length)
	45 DAS	90 DAS	Harvest	45 DAS	90 DAS	Harvest	
Control	34.31	52.45	60.78	5.69	54.51	63.45	65.26
50% RDN (40 kg ha^{-1})	39.40	60.19	69.94	6.67	60.79	71.88	72.89
50% RDN + 5 t FYM ha^{-1}	40.24	61.31	71.34	6.81	62.22	73.60	74.51
50% RDN + 0.5 t Neem cake ha^{-1}	40.42	61.70	71.61	6.84	62.52	73.96	74.64
75% RDN (60 kg ha^{-1})	45.32	69.37	79.99	7.76	68.70	82.28	81.98
75% RDN + 5 t FYM ha^{-1}	45.53	69.72	80.55	7.78	68.95	82.58	82.27
75% RDN + 0.5 t Neem cake ha^{-1}	45.69	69.84	81.06	7.80	69.22	82.97	82.72
100% RDN (80 kg ha^{-1})	50.47	77.27	88.97	8.62	75.38	91.26	89.98
100% RDN + 5 t FYM ha^{-1}	50.56	77.36	89.21	8.61	76.08	91.54	90.67
100% RDN + 0.5 t Neem cake ha^{-1}	50.71	77.55	89.78	8.63	76.69	92.84	91.26
SEm±	1.57	2.33	2.48	0.25	2.05	2.77	2.41
CD (p=0.05)	4.68	6.92	7.38	0.74	6.09	8.22	7.17
CV (5%)	6.16	5.96	5.49	5.70	5.25	5.94	5.18

Table 2: Effect of organic and inorganic fertilizer on yield attributes of barley

Treatments	Yield attributes				
	Number of effective tillers at harvest (m^{-1} row length)	Number of spikelets ear^{-1}	Length of ear	Number of grains ear^{-1}	Test weight (g)
Control	61.86	14.21	6.18	35.86	43.12
50% RDN (40 kg ha^{-1})	68.89	15.62	7.39	39.73	47.25
50% RDN + 5 t FYM ha^{-1}	70.51	15.94	7.71	40.57	48.19
50% RDN + 0.5 t Neem cake ha^{-1}	70.64	16.01	7.78	40.75	48.39
75% RDN (60 kg ha^{-1})	77.34	17.39	8.86	44.56	52.46
75% RDN + 5 t FYM ha^{-1}	77.63	17.45	8.92	44.71	52.63
75% RDN + 0.5 t Neem cake ha^{-1}	78.08	17.51	8.98	44.87	52.81
100% RDN (80 kg ha^{-1})	84.77	18.88	10.00	48.60	56.85
100% RDN + 5 t FYM ha^{-1}	85.46	19.04	10.16	49.01	57.32
100% RDN + 0.5 t Neem cake ha^{-1}	86.05	19.18	10.30	49.38	57.72
SEm±	2.24	0.46	0.30	1.20	1.35
CD (p=0.05)	6.65	1.36	0.90	3.58	4.01
CV (5%)	5.09	5.64	6.09	5.76	5.52

Table 3: Effect of organic and inorganic fertilizer on yield of barley

Treatments	Yield (kg ha^{-1})			Harvest index (%)
	Grain	Straw	Biological	
Control	3493	4704	8197	42.62
50% RDN (40 kg ha^{-1})	3959	5242	9201	43.03
50% RDN + 5 t FYM ha^{-1}	4051	5358	9409	43.05
50% RDN + 0.5 t Neem cake ha^{-1}	4073	5383	9456	43.08
75% RDN (60 kg ha^{-1})	4507	5913	10420	43.26
75% RDN + 5 t FYM ha^{-1}	4524	5934	10457	43.29
75% RDN + 0.5 t Neem cake ha^{-1}	4543	5956	10499	43.27
100% RDN (80 kg ha^{-1})	4966	6484	11450	43.37
100% RDN + 5 t FYM ha^{-1}	5015	6545	11560	43.38
100% RDN + 0.5 t Neem cake ha^{-1}	5059	6599	11658	43.40
SEm±	138	177	241	0.96
CD (p=0.05)	411	525	715	NS
CV (5%)	5.42	5.26	4.07	3.85

Yield attributes and yield

Application of 100% RDN + 0.5 t neem cake ha^{-1} (T_{10}), 100% RDN + 5 t FYM ha^{-1} (T_9), 100% RDN (T_8), 75% RDN + 0.5 t Neem cake ha^{-1} (T_7), 75% RDN + 5 t FYM ha^{-1} (T_6), 75% RDN (T_5), 50% RDN + 0.5 t Neem cake ha^{-1} (T_4), 50% RDN + 5 t FYM ha^{-1} (T_3) and 50% RDN (T_2), significantly increased yield attributes *viz*., number of effective tillers plant^{-1}, number of grains ear^{-1}, ear length and test weight over control (T_1). Sources of nitrogen significantly affected the yield components. The beneficial effect of organic manure *i.e.* FYM and neem cake decreases nitrogen losses and provides slow release of nitrogen to plant. Higher recovery of nitrogen may be possible when the nitrogen is made available to the plant over longer periods and by reducing nitrogen losses.

Maximum grain, straw and biological yield was recorded with application of 100% RDN + 0.5 t neem cake ha^{-1} (T_{10}) which was significantly higher over control (T_1), 50% RDN(T_2), 50% RDN + 5 t FYM ha^{-1} (T_3), 50% RDN + 0.5 t Neem cake ha^{-1} (T_4), 75% RDN (T_5), 75% RDN + 5 t FYM ha^{-1} (T_6) and 75% RDN + 0.5 t Neem cake ha^{-1} (T_7) but it was remained at par with the application of 100% RDN + 5 t FYM ha^{-1} (T_9) and 100% RDN (T_8). The higher grain and straw yield with application N through different neem cake with fertilizers might be due to enhancement of growth parameters attributed to higher yield parameters due to higher availability and steady supply of nutrients in these treatments. These results indicated that the increase in grain and straw yield was related to availability of nutrient mainly nitrogen by neem coated urea was helped in reducing the leaching and volatilization losses there by accelerated the availability. Similar results were recorded by Rai *et al*. (2013) [19], Chavarekar *et al*. (2014) [8], Goswami and Pandey (2018) [12], Randhawa *et al*. (2020) [20], Singh *et al*. (2021) [24], Jat *et al*. (2021) [15], Sunag *et al*. (2021) [28], Kumar and Niwas (2022) [17], Solanki *et al*. (2022) [27] and Singh *et al*. (2024) [26].

Conclusion

The field experiment conducted during the 2023-24 Rabi season at Suresh Gyan Vihar University revealed that the application of 100% RDN (Recommended Dose of Nitrogen) combined with 0.5 t/ha Neem cake (T_{10}) significantly enhanced the growth and yield of barley compared to other treatments. The T_{10} treatment resulted in higher plant height, dry matter accumulation, tiller count, number of grains per ear, ear length, test weight, and grain, straw, and biological yields. The improvements in growth and yield attributes were attributed to the increased availability of nitrogen and a steady nutrient supply provided by Neem cake, which helped reduce nutrient losses and ensured prolonged nutrient availability. However, T_{10} was statistically similar to treatments with 100% RDN alone and 100% RDN + 5 t/ha FYM (Farmyard Manure), indicating that integrating organic supplements like Neem cake or FYM with nitrogen fertilizers can optimize barley productivity.

References

1. Abedi T, Alemzadeh A, Kazemeini SA. Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. Aust J Crop Sci. 2010;4(6):384-389.
2. Alnarp. Doctoral Thesis on Barley Genetic Resources. Swedish University of Agricultural Sciences; c2013.
3. Arif M, Tasneem M, Bashir F, Yaseen G, Iqbal RM. Effect of integrated use of organic manures and inorganic fertilizers on yield and yield components of rice. J Agric Res. 2014;52(2):197-206.
4. Assefa F, Maqsood M, Akbar M, Yousaf N. Effect of urea fertilizer on growth response of food barley. Int J Agric Biol. 2017;1:359-360.
5. Atiyeh RM, Subler S, Edwards CA, Bachman G, Metzger JD, Shuster W. Effects of vermicomposts and composts on plant growth in horticultural container media and soil. Pedobiologia. 2000;44(5):579-590.
6. Baksiene E, Razukas A, Repeekiene J, Titova J. Influence of different farming systems on the stability of low productivity soil in Southeast Lithuania. Zemdirbyste-Agriculture. 2014;101(2):115-124.
7. Beringer H. Nutritional and environmental effect on yield formation and physiological aspects of crop productivity. Int Potash Inst. 1980;15:155-173.
8. Chavarekar S, Thakral SK, Meena RK. Effect of organic and inorganic nitrogen fertilizers on quality of barley (*Hordeum vulgare* L.). Ann Agric Res., 2014, 34(2).
9. Edney M, MacLeod A, LaBerge D. Evolution of a quality testing program for improving malting barley in Canada. Can J Plant Sci. 2014;94:56-62.
10. Fairhurst T. Handbook for integrated soil fertility management. Technical Centre for Agricultural and Rural Cooperation; c2012.
11. Foissy D, Vian JF, David C. Managing nutrient in organic farming system: reliance on livestock production for nutrient management of arable farmland. Org Agric. 2013;3(3-4):183-199.
12. Goswami RK, Pandey M. Effect of integrated use of nutrients and FYM on yield, quality and uptake of nutrients by barley (*Hordeum vulgare*). Ann Plant Soil Res. 2018;20(4):422-427.
13. Havlin JL, Tisdale SL, Nelson WL, Beaton JD. Soil Fertility and Fertilizers - An Introduction to Nutrient Management. 8th ed. Pearson Education India; c2016.
14. Ibrawuchi II, Opara FA, Tom CT, Obiefuna JC. Graded replacement of inorganic with organic manure for sustainable maize production in Owerri, Imo State, Nigeria. Life Sci J. 2007;4(2):82-87.
15. Jat ML, Chaplot PC, Bairwa DD, Meena SN, Dhayal BC. Effects of integrated nutrient management on yield and economics of barley (*Hordeum vulgare*). Indian J Agron. 2021;66(4):425-429.
16. Kaur T, Brar BS, Dhillon NS. Soil organic matter dynamics as affected by long-term use of organic and inorganic fertilizers under maize-wheat cropping system. Nutr Cycl Agroecosyst. 2008;81(1):59-69.
17. Kumar G, Niwas R. Effect of organic and inorganic fertilizers on growth and yield of wheat (*Triticum aestivum* L.). Pharma Innov. J. 2022;11(7):1005-1009.
18. Melle T, Asfaw A, Getachew T. Participatory evaluation and promotion of improved food barley varieties in the highlands of northwestern Ethiopia. Wudpecker J Agric Res. 2015;4(3):50-53.
19. Rai KN, Kumar A, Pathak RK, Rai TN, Pandey P. Yield, nutrient uptake and quality of barley (*Hordeum vulgare*) with integrated use of farmyard manure and inorganic fertilizers. Curr Adv Agric Sci (An Int J). 2013;5(1):121-123.
20. Randhawa JS, Sharma R, Chhina GS, Kaur M. Effect of integrated nutrient management on productivity and quality of malt barley (*Hordeum distichon* L.). Agric Sci Dig. 2020;40(3):265-269.
21. Roberts TL. Nutrient best management practices: Western perspectives on global nutrient stewardship. In: 19th World Congress of Soil Science, Soil Solutions for a Changing World; c2010. p. 172-175.
22. Shahajahan M, Shirale ST, Gourkhede PH. Impact of different nutrient sources on yield, nutrient uptake and quality of wheat (*Triticum aestivum*). Pharma Innov. J. 2022;11(2):1083-1087.
23. Shahidur R, Gashaw A, Solomon L, James W, Lulsegged K, Nicholas M, *et al*. Barley value chain in Ethiopia: research for Ethiopia agriculture policy analytical support for the Agricultural Transformation Agency (ATA); c2015.
24. Singh H, Daniel S, Kishore P, Ekka P. Effect of different levels of organic fertilizers and inorganic fertilizers on growth and yield of barley (*Hordeum vulgare*) under Poplar (*Populus deltoides*) based agroforestry system. Pharma Innov J. 2021;10(7):311-314.
25. Singh ID, Stoskopf YC. Harvest index in cereals. Agron J. 1971;63:224-226.
26. Singh R, Maurya DK, Pal RK, Ranjan R. An investigation into the impacts of preparatory tillage and nutrient management on barley yield and economic viability in the context of water stress conditions. Int. J Environ Clim. Change. 2024;14(2):601-607.
27. Solanki SK, Patel HK, Raval CH. Response of integrated nutrient management on irrigated wheat. Int J Plant Soil Sci. 2022;34(22):55-60.
28. Sunag MN, Singh RP, Singh R, Singh K. Effect of integrated nutrient management on the performance of barley (*Hordeum vulgare* L.). Pharma. Innov. J. 2021;10(9):1492-1496.