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Performance of Barley (*Hordeum vulgare* L.) under different fertility levels and organic mulching

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Abstract

A field experiment was conducted during Rabi 2025–26 at the Research Farm, Suresh Gyan Vihar University, Jaipur. The experiment was laid out in a split plot design with four fertility levels in main plots [100% RDF (F₁), 75% RDF + FYM @ 3 t ha⁻¹ (F₂), 50% RDF + FYM @ 6 t ha⁻¹ (F₃) and 50% RDF + FYM @ 9 t ha⁻¹ (F₄)] and three levels of organic mulch in sub plots [control (M₀), organic mulch @ 2 t ha⁻¹ (M₁) and organic mulch @ 4 t ha⁻¹ (M₂)], replicated thrice. The study aimed to assess the influence of integrated nutrient management and organic mulching on yield components and overall productivity of barley. The findings revealed that fertility levels significantly affected plant growth and yield parameters throughout the crop growth period. Among fertility treatments, F₂ (75% RDF + FYM @ 3 t ha⁻¹) consistently recorded superior performance with maximum plant height of 93.61 cm and dry matter accumulation of 156.83 g 0.5 m⁻¹ row length at harvest. The same treatment also produced higher grain yield (3567 kg ha⁻¹), straw yield (4753 kg ha⁻¹) and biological yield (8320 kg ha⁻¹) as compared to other fertility levels. Improvement in crop performance under F₂ indicated the beneficial role of integrated nutrient management through combined use of inorganic fertilizers and FYM. Organic mulch treatments also exerted a significant influence on growth and yield of barley. Application of organic mulch @ 4 t ha⁻¹ (M₂) recorded the highest plant height (93.59 cm) and dry matter accumulation (156.79 g 0.5 m⁻¹ row length) at harvest. The treatment also resulted in maximum grain yield (3486 kg ha⁻¹), straw yield (4637 kg ha⁻¹) and biological yield (8094 kg ha⁻¹), followed by M₁, whereas the lowest values were observed under control treatment (M₀). The study clearly demonstrated that integrated nutrient management coupled with organic mulching improved growth and productivity of barley. Therefore, application of 75% RDF + FYM @ 3 t ha⁻¹ along with organic mulch @ 4 t ha⁻¹ may be considered an effective and sustainable approach for enhancing barley performance under semi-arid conditions.

Keywords: Barley, fertility levels, farmyard manure, organic mulch, integrated nutrient management, grain yield, productivity

Introduction

Barley cultivation under semi-arid environments frequently encounters constraints associated with poor soil fertility, erratic rainfall and limited soil moisture availability. Under such conditions, maintaining a favourable soil environment for crop growth becomes challenging. The sole application of inorganic fertilizers often provides immediate nutrient availability but may not sustain long-term soil productivity. Excessive dependence on chemical fertilizers may deteriorate soil structure, reduce microbial activity and lower nutrient use efficiency over time. Therefore, there is an increasing need for integrated approaches that combine efficient nutrient management with agronomic practices aimed at conserving soil resources and improving sustainability.

Organic amendments and moisture conservation practices have gained considerable attention due to their positive influence on soil quality and crop performance. Farmyard manure not only serves as a nutrient source but also contributes to the improvement of soil physical and biological properties. Similarly, organic mulching modifies the soil microenvironment by conserving moisture, minimizing evaporation losses and regulating soil temperature. The decomposition of mulch materials also enriches soil organic carbon and supports beneficial microbial activity. Such improvements may create favourable conditions for enhanced nutrient

availability and uptake by crops. In addition, mulching practices reduce weed infestation and improve water use efficiency, particularly under moisture-deficit conditions.

The combined use of fertility management and organic mulching may generate synergistic effects on crop growth and productivity. While adequate fertilizer application ensures the supply of essential nutrients required for crop development, organic mulch helps in conserving soil moisture and reducing nutrient losses. Improved moisture conditions under mulched environments may facilitate greater nutrient absorption and translocation within plants, thereby enhancing physiological processes and biomass production. Consequently, integrated use of these practices can improve crop growth parameters, yield attributes and grain quality while simultaneously sustaining soil health.

Several researchers have reported the beneficial role of nutrient management and mulching practices in enhancing crop performance under different agro-climatic conditions. However, most previous investigations have largely focused on the independent effects of fertilizer management or mulching practices. Limited information is available regarding the interactive influence of varying fertility levels and organic mulching on barley cultivation under semi-arid regions. Furthermore, crop response to nutrient levels and mulching may vary considerably with climatic conditions, soil characteristics and management practices. Therefore, findings generated under one region may not necessarily be applicable to other agro-ecological situations.

In Rajasthan, where water scarcity and climatic variability are major constraints to agricultural production, adoption of resource-efficient crop management practices has become increasingly important. Improving nutrient use efficiency and soil moisture conservation simultaneously may provide a sustainable pathway for enhancing barley productivity. Identifying suitable combinations of fertility levels and organic mulch may not only improve growth and yield performance but may also contribute towards maintaining soil fertility and ensuring economic sustainability.

Considering the limited research information on the combined effect of fertility levels and organic mulching practices in barley under semi-arid conditions, there exists a need to generate scientific evidence regarding their influence on crop growth, productivity and quality. Such information would be useful for developing suitable management recommendations for sustainable barley production under resource-limited environments. Therefore, the present investigation was undertaken to study the performance of barley (*Hordeum vulgare* L.) under different fertility levels and organic mulching treatments with respect to growth, yield, quality and economic performance under the agro-climatic conditions of Rajasthan.

Materials and Methods

Experimental site

The experiment was carried out at Research Farm, School of Agriculture, Suresh Gyan Vihar University Jaipur. The site is situated in eastern part of Rajasthan at an altitude of 579.5 m above mean sea level, at 75.8624° E longitude and 26.8100° N latitude.

Soil of the experimental field

In order to know the physical and chemical properties of soil, the soil samples from 0-15 cm depth were drawn randomly from different spots of the experimental field and a representative composite sample was prepared. This composite sample was

analysed to determine the physico-chemical properties of the soil. The soil of the experimental field was sandy loam in texture and slightly alkaline in reaction. From the fertility point of view soil was medium in N, P, K and have sufficient level of DTPA extractable Fe, Mn, Zn and Cu

Details of experiment and treatments

The experiment was laid out in split plot design with four fertility levels that is, 100% RDF (F₁), 75% RDF + FYM @ 3 ton ha⁻¹ (F₂), 50% RDF + FYM @ 6 ton ha⁻¹ (F₃) and 50% RDF + FYM @ 9 ton ha⁻¹ (F₄) in main plot treatment and three levels of Organic mulch in sub plot treatment i.e., Control (M₀), Organic mulch @ 2 ton ha⁻¹ (M₁) & (M₂) and replicated thrice. Recommended dose of fertilizer (60 kg ha⁻¹ N, 40 kg ha⁻¹ P₂O₅ and 30 kg ha⁻¹ K₂O) The plan of layout has been given in table 3.1. The treatments were assigned to the experimental plots with the help of random number tables of Fisher (1950) ^[11].

Treatment application

In the main plot FYM applied at 15 days before sowing as per treatment while organic mulch applied after sowing of crop as per the treatment in the field.

Fertilizer was given through Urea (N), SSP (P) and MOP (K) in each plot as per treatment. SSP and MOP applied at the time of sowing whereas urea applied three split doses.

Table 1: Details of the experiment as follows

Season	:	Rabi, 2025-26
Test crop	:	Barley
Design	:	Split Plot Design
Total no. of treatments	:	12
Main Plot	:	4
Sub Plot	:	3
Total no. of replications	:	3
Total no. of plots	:	36
Gross plot size	:	4.0 m × 3.0 m = 12 m ²
Net plot size	:	3.0 m × 2.6 m = 7.8 m ²
Variety	:	DWRB-160
Seed rate	:	100 kg/ha
Spacing	:	22.5 cm row to row

Observations for treatment evaluation

To evaluate the effect of different treatments on yields of barley crop, observations were recorded periodically following standard procedures. Grain yield from each net plot was recorded after threshing and converted into kg ha⁻¹, while straw yield was obtained by subtracting grain yield from biological yield. Biological yield was recorded from the net plot produce after proper drying.

Statistical analysis

The experimental data recorded for various observations were statistically analyzed using Fisher's analysis of variance (ANOVA) technique (Fisher, 1950) ^[11]. The significance of treatment effects was tested by F-test at 5 per cent level of significance. Wherever treatment effects were found significant, critical difference (CD) values were calculated for comparison of treatment means and results were presented along with S.E.m.± and CD (P=0.05).

Results

Effect of fertility levels on plant height

Plant height of barley was significantly influenced by different fertility levels at all growth stages (Table 2). At 30 DAS,

treatment F₂ (75% RDF + FYM @ 3 t ha⁻¹) recorded the maximum plant height (20.80 cm), which was 10.87 per cent higher over F₄ (18.76 cm), however, it remained statistically at par with F₁ (20.60 cm). The minimum plant height was observed under F₄. Similar trends were observed at 60 DAS, where F₂ attained the highest plant height (55.08 cm), exceeding F₄ by 10.88 per cent and remaining statistically comparable with F₁ (54.56 cm). At 90 DAS, the tallest plants were recorded under F₂ (78.28 cm), which registered an increase of 10.86 per cent over F₄ (70.61 cm), while F₁ (77.53 cm) remained statistically at par with F₂. At harvest, F₂ maintained its superiority and produced the highest plant height (93.61 cm), showing an enhancement of 10.87 per cent over F₄ (84.44 cm). However, treatment F₁ (92.72 cm) was found statistically at par with F₂. The lowest plant height at all growth stages was consistently noted under F₄.

Effect of organic mulch on plant height

Organic mulch levels also exerted a significant effect on plant

height at different growth stages. At 30 DAS, application of organic mulch @ 4 t ha⁻¹ (M₂) resulted in maximum plant height (20.79 cm), which was 13.42 per cent higher than control (M₀: 18.33 cm). Treatment M₂ remained statistically at par with M₁ (20.42 cm). At 60 DAS, M₂ recorded the highest plant height (55.07 cm), surpassing control by 13.45 per cent, though it was statistically at par with M₁ (54.09 cm). Similar observations were recorded at 90 DAS, where M₂ produced the tallest plants (78.25 cm), exhibiting 13.44 per cent higher plant height over M₀ (68.98 cm) and remained statistically similar to M₁ (76.87 cm). At harvest, mulch application at 4 t ha⁻¹ (M₂) continued to show superiority with plant height of 93.59 cm, which represented a 13.44 per cent increase over control (82.50 cm). However, M₂ and M₁ were statistically at par. The lowest plant height throughout all stages was observed under the control treatment (M₀).

Table 2: Effect of fertility levels and organic mulch on plant height

Treatments	Plant height (cm)			
	At 30 DAS	At 60 DAS	At 90 DAS	At harvest
Main plot (fertility levels)				
100% RDF (F ₁)	20.60	54.56	77.53	92.72
75% RDF + FYM @ 3 ton ha ⁻¹ (F ₂)	20.80	55.08	78.28	93.61
50% RDF + FYM @ 6 ton ha ⁻¹ (F ₃)	19.23	50.94	72.40	86.58
50% RDF + FYM @ 9 ton ha ⁻¹ (F ₄)	18.76	49.68	70.61	84.44
SEm ±	0.16	0.41	0.59	0.70
CD @ 5%	0.54	1.43	2.04	2.44
Sub plot (Organic mulch)				
Control (M ₀)	18.33	48.54	68.98	82.50
Organic mulch @ 2 ton ha ⁻¹ (M ₁)	20.42	54.09	76.87	91.93
Organic mulch @ 4 ton ha ⁻¹ (M ₂)	20.79	55.07	78.25	93.59
SEm ±	0.17	0.44	0.62	0.75
CD @ 5%	0.50	1.32	1.87	2.23

Effect of fertility levels on dry matter accumulation

Dry matter accumulation of barley was significantly influenced by different fertility levels at all growth stages (Table 3). At 30 DAS, the highest dry matter accumulation was recorded under F₂ (75% RDF + FYM @ 3 t ha⁻¹) with 7.05 g 0.5 m⁻¹ row length, which was 10.85 per cent higher than F₄ (6.36 g 0.5 m⁻¹ row length). However, F₂ remained statistically at par with F₁ (6.99 g 0.5 m⁻¹ row length). The lowest dry matter accumulation was observed under F₄. A similar pattern was noticed at 60 DAS, where F₂ produced maximum dry matter accumulation (47.32 g 0.5 m⁻¹ row length), showing an increase of 10.87 per cent over F₄ (42.68 g 0.5 m⁻¹ row length), while F₁ (46.87 g 0.5 m⁻¹ row length) was statistically comparable with F₂. At 90 DAS, treatment F₂ continued to maintain superiority by recording maximum dry matter accumulation (94.87 g 0.5 m⁻¹ row length), which exceeded F₄ (85.57 g 0.5 m⁻¹ row length) by 10.87 per cent. Nevertheless, F₁ (93.96 g 0.5 m⁻¹ row length) remained statistically at par with F₂. Similar findings were also evident at harvest, where F₂ registered the highest dry matter accumulation (156.83 g 0.5 m⁻¹ row length), representing an enhancement of 10.86 per cent over F₄ (141.46 g 0.5 m⁻¹ row length). However, F₁ (155.33 g 0.5 m⁻¹ row length) remained statistically at par with F₂.

Effect of organic mulch on dry matter accumulation

Different levels of organic mulch also exerted a significant effect on dry matter accumulation at various crop growth stages. At 30 DAS, maximum dry matter accumulation was recorded under M₂ (Organic mulch @ 4 t ha⁻¹) with 7.05 g 0.5 m⁻¹ row length, which was 13.34 per cent higher than control (M₀: 6.22 g 0.5 m⁻¹ row length). However, M₂ was statistically at par with M₁ (6.93 g 0.5 m⁻¹ row length). At 60 DAS, M₂ recorded the highest dry matter accumulation (47.31 g 0.5 m⁻¹ row length), registering a 13.45 per cent increase over M₀ (41.70 g 0.5 m⁻¹ row length), while M₁ (46.47 g 0.5 m⁻¹ row length) remained statistically comparable with M₂. Likewise, at 90 DAS, dry matter accumulation under M₂ (94.84 g 0.5 m⁻¹ row length) was 13.44 per cent greater than M₀ (83.60 g 0.5 m⁻¹ row length), though it remained statistically at par with M₁ (93.16 g 0.5 m⁻¹ row length). At harvest also, M₂ registered the highest dry matter accumulation (156.79 g 0.5 m⁻¹ row length), which was 13.45 per cent higher than control (138.21 g 0.5 m⁻¹ row length). However, M₁ (154.01 g 0.5 m⁻¹ row length) remained statistically at par with M₂. The lowest dry matter accumulation throughout the crop growth period was observed under control (M₀).

Table 3: Effect of fertility levels and organic mulch on dry matter accumulation

Treatments	Dry matter accumulation (g 0.5 m ⁻¹ row length)			
	At 30 DAS	At 60 DAS	At 90 DAS	At harvest
Main plot (fertility levels)				
100% RDF (F ₁)	6.99	46.87	93.96	155.33
75% RDF + FYM @ 3 ton ha ⁻¹ (F ₂)	7.05	47.32	94.87	156.83
50% RDF + FYM @ 6 ton ha ⁻¹ (F ₃)	6.52	43.77	87.74	145.05
50% RDF + FYM @ 9 ton ha ⁻¹ (F ₄)	6.36	42.68	85.57	141.46
SEm ±	0.05	0.36	0.71	1.18
CD @ 5%	0.18	1.23	2.47	4.09
Sub plot (Organic mulch)				
Control (M ₀)	6.22	41.70	83.60	138.21
Organic mulch @ 2 ton ha ⁻¹ (M ₁)	6.93	46.47	93.16	154.01
Organic mulch @ 4 ton ha ⁻¹ (M ₂)	7.05	47.31	94.84	156.79
SEm ±	0.06	0.38	0.76	1.25
CD @ 5%	0.17	1.13	2.26	3.74

Effect of fertility levels on yield

Yield of barley was significantly influenced by different fertility levels with respect to grain yield, straw yield and biological yield (Table 5). Among the fertility treatments, F₂ (75% RDF + FYM @ 3 t ha⁻¹) recorded the highest grain yield (3567 kg ha⁻¹), which was 15.10 per cent higher than F₄ (3099 kg ha⁻¹). However, F₂ remained statistically at par with F₁ (3338 kg ha⁻¹). The lowest grain yield was observed under F₄. The improvement in grain yield under F₂ may be attributed to better nutrient

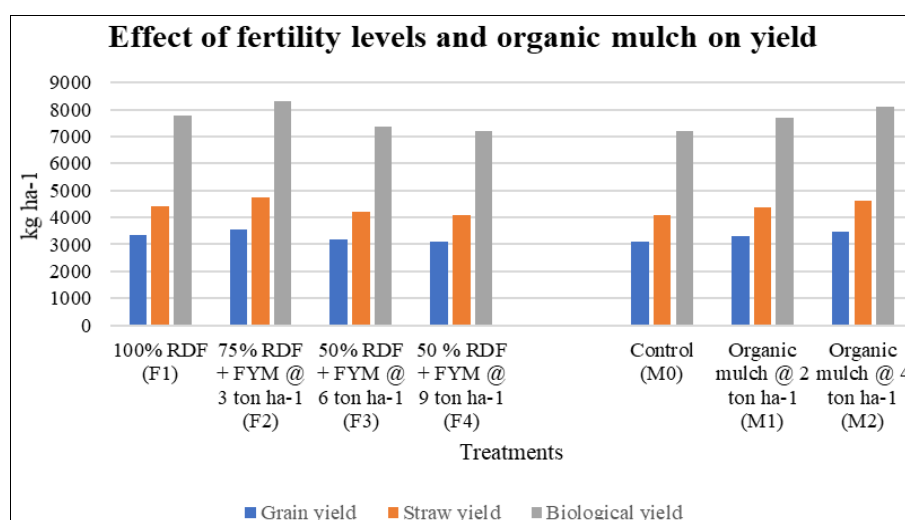
availability and enhanced growth and yield attributes resulting from the combined application of inorganic fertilizers and FYM. A similar response was observed for straw yield. Treatment F₂ registered the maximum straw yield (4753 kg ha⁻¹), which exceeded F₄ (4084 kg ha⁻¹) by 16.38 per cent and remained statistically at par with F₁ (4426 kg ha⁻¹). The increased straw production under F₂ might be associated with improved vegetative growth, dry matter accumulation and higher tiller production.

Table 5: Effect of fertility levels and organic mulch on yield

Treatments	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)
Main plot (fertility levels)			
100% RDF (F ₁)	3338	4426	7764
75% RDF + FYM @ 3 ton ha ⁻¹ (F ₂)	3567	4753	8320
50% RDF + FYM @ 6 ton ha ⁻¹ (F ₃)	3180	4199	7379
50% RDF + FYM @ 9 ton ha ⁻¹ (F ₄)	3099	4084	7183
SEm ±	27	39	66
CD @ 5%	94	135	230
Sub plot (Organic mulch)			
Control (M ₀)	3110	4098	7208
Organic mulch @ 2 ton ha ⁻¹ (M ₁)	3293	4361	7683
Organic mulch @ 4 ton ha ⁻¹ (M ₂)	3486	4637	8094
SEm ±	27	38	70
CD @ 5%	80	114	211

Likewise, biological yield was significantly affected by fertility levels and attained the highest value under F₂ (8320 kg ha⁻¹), which represented an enhancement of 15.83 per cent over F₄ (7183 kg ha⁻¹). However, F₁ (7764 kg ha⁻¹) remained

statistically comparable with F₂. The increase in biological yield under integrated fertility management may be due to efficient utilization of nutrients and sustained nutrient release through FYM, resulting in greater biomass production.



Effect of organic mulch on yield

Organic mulch treatments also exerted a significant influence on grain, straw and biological yield of barley (Table 5). Application of organic mulch @ 4 t ha⁻¹ (M₂) produced the highest grain yield (3486 kg ha⁻¹), which was 12.09 per cent higher than control (M₀: 3110 kg ha⁻¹). However, M₂ remained statistically at par with M₁ (3293 kg ha⁻¹). The enhanced grain yield under M₂ might be due to better soil moisture conservation and improved crop growth under favourable soil conditions.

The highest straw yield was also obtained under M₂ (4637 kg ha⁻¹), showing an increase of 13.15 per cent over control (4098 kg ha⁻¹), while M₁ (4361 kg ha⁻¹) remained statistically at par with M₂. Increased straw yield under mulched conditions may be attributed to improved vegetative growth and dry matter accumulation as a result of better soil hydrothermal conditions. Similarly, biological yield followed the same trend and reached its maximum under M₂ (8094 kg ha⁻¹), which was 12.29 per cent higher than M₀ (7208 kg ha⁻¹). However, treatment M₁ (7683 kg ha⁻¹) remained statistically comparable with M₂. The higher biological yield under organic mulch treatments may be associated with improved moisture availability, efficient nutrient uptake and reduced competition from weeds, which collectively contributed to greater biomass accumulation.

Discussion

Effect of Fertility Levels on Plant Height and Dry Matter Accumulation

Plant height and dry matter accumulation were significantly influenced by different fertility levels. Among the treatments, application of 75% RDF + FYM @ 3 ton ha⁻¹ (F₂) recorded superior performance over other fertility levels. The improvement under integrated nutrient management might be due to balanced nutrient supply through combined application of inorganic fertilizers and FYM as also reported by Kumar and Sharma (2023) [18] and Meena *et al.* (2022) [19]. Nitrogen, phosphorus and potassium supplied through RDF play important roles in chlorophyll synthesis, root development, energy transfer and assimilate translocation. Simultaneously, FYM acts as a slow-release nutrient source and improves soil physical, chemical and biological properties. Similar findings were also reported by Reganold and Wachter (2016) [23] and Seufert and Ramankutty (2017) [25]. The integrated use of RDF and FYM possibly improved soil aggregation, porosity, aeration and water holding capacity, resulting in better root growth and nutrient uptake. Increased nutrient availability and improved photosynthetic activity enhanced plant height and dry matter accumulation. Similar observations regarding enhanced crop growth under integrated nutrient management were also reported by Singh and Kaur (2023) [27]. Lower growth parameters under F₄ might be due to slow nutrient release from higher FYM substitution, which may not adequately meet crop nutrient demand during critical stages. Similar findings were also reported by Bhusal (2025) [4], Singh *et al.* (2024) [30], Kumar and Sharma (2023) [18] and Yadav *et al.* (2023) [33].

Organic mulch significantly influenced plant height and dry matter accumulation during the investigation. Application of organic mulch @ 4 ton ha⁻¹ (M₂) recorded higher plant height and dry matter accumulation over control. The beneficial effects of mulching may be attributed to improved soil moisture conservation, moderation of soil temperature and favorable soil physical conditions. Similar observations were reported by Hingonia *et al.* (2019) [15] and Górski *et al.* (2025) [13]. Mulching reduced evaporation losses and maintained continuous moisture availability, thereby improving nutrient transport and uptake.

Better hydration under mulched conditions may have maintained physiological activities such as photosynthesis and enzymatic processes, resulting in improved crop growth. Similar findings were reported by Ramos *et al.* (2024) [22], El-Beltagi *et al.* (2022) [9] and Akter *et al.* (2018) [1]. Higher dry matter accumulation under mulch might also be due to improved nutrient utilization and reduced crop stress. Similar observations were supported by Kaur *et al.* (2017) [17], Araya and Stroosnijder (2020) [2], Salim and Karim (2011) [26] and Chakraborty *et al.* (2010) [6].

Effect of Fertility Levels on Yield

Yield was significantly influenced by fertility levels and maximum grain yield, straw yield and biological yield were recorded under F₂. Higher yield under integrated nutrient management may be attributed to improved source-sink relationship under adequate nutrient supply as reported by Karol *et al.* (2023) [16] and Singh *et al.* (2021) [28]. Balanced nutrition through RDF and FYM possibly enhanced photosynthate production and translocation towards reproductive organs. Nitrogen, phosphorus and potassium play vital roles in grain development and carbohydrate translocation, as reported by Gir and Tiwari (2021) [12] and Singh *et al.* (2017) [31]. Enhanced dry matter accumulation under F₂ also contributed towards higher grain, straw and biological yield. Similar findings were observed by Fazily *et al.* (2021) [10] and Karol *et al.* (2023) [16]. Higher yield under integrated nutrient management may also be attributed to synchronized nutrient release, improved nutrient use efficiency and enhanced microbial activity. Similar observations were reported by Bhusal (2025) [4] and Reganold and Wachter (2016) [23]. Lower grain and straw yield under F₄ might be due to inadequate nutrient availability during critical crop stages. Similar findings were reported by Karol *et al.* (2023) [16], Gir and Tiwari (2021) [12], Singh *et al.* (2017) [31] and Fazily *et al.* (2021) [10].

Application of organic mulch significantly improved yield of barley. Organic mulch @ 4 ton ha⁻¹ (M₂) recorded superior values compared to control treatment. The beneficial effects may be attributed to improved moisture conservation, nutrient availability and favorable hydrothermal conditions. Similar findings were reported by Hingonia *et al.* (2019) [15] and Górski *et al.* (2025) [13]. Mulching maintained better soil moisture status, reduced plant stress and improved nutrient uptake, which ultimately enhanced growth and biomass production. Similar results were reported by Ramos *et al.* (2024) [22], El-Beltagi *et al.* (2022) [9], Akter *et al.* (2018) [1], Badaruddin *et al.* (2019) [3] and Meena *et al.* (2019) [19]. Reduced weed competition and gradual addition of organic matter through mulch decomposition may also have contributed to improved productivity. Similar observations were supported by Kaur *et al.* (2017) [17], Araya and Stroosnijder (2020) [2], Salim and Karim (2011) [26] and Chakraborty *et al.* (2010) [6].

Conclusion

The study revealed that growth and yield of barley were significantly influenced by different fertility levels and organic mulch treatments. Among fertility levels, application of 75% RDF + FYM @ 3 t ha⁻¹ (F₂) recorded superior plant height, dry matter accumulation, grain yield, straw yield and biological yield. Similarly, organic mulch @ 4 t ha⁻¹ (M₂) proved most effective in improving crop growth and productivity over control. Integrated use of inorganic fertilizers, FYM and organic mulch improved moisture conservation, nutrient availability and overall crop performance. Therefore, application of 75% RDF +

FYM @ 3 t ha⁻¹ along with organic mulch @ 4 t ha⁻¹ may be recommended for enhancing barley productivity under semi-arid conditions.

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