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Impact of nutrient management through different bulky manures and their combination on growth, yield and economics of wheat-mustard intercropping in Bundelkhand

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ABSTRACT

The experiment was conducted in the Karguaji Organic Research Farm, Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi. The study was undertaken to evaluate the effect of different bulky manures and their combinations on the growth, yield attributes, yield, productivity and economic returns of wheat and mustard under intercropping conditions. The study included nine treatments, viz., T_1 - Control (No external organic input- baseline), T_2 - FYM 100%, T_3 Green Manure 100%, T_4 - Compost 100%, T_5 - FYM 50% + G.M 50%, T_6 - FYM 50% + Compost 50%, T_7 - G.M 50% + Compost 50%, T_8 - FYM 33% + G.M 33% + Compost 33% arranged in a Randomized Block Design with three replications. Wheat variety Super 303 was used as the main crop and mustard variety DRMRIJ-36 as the intercrop. Observations were recorded for important agro-morphological, yield and economic parameters and the data were subjected to statistical analysis. The results showed that organic nutrient management significantly influenced crop growth and yield performance. Among the treatments, FYM 33% + green manure 33% + compost 33% (T_8) consistently recorded the highest values for plant height, number of leaves, leaf length, fresh weight, dry weight, biological yield and seed yield in both wheat and mustard, whereas the control treatment recorded the lowest values. T_8 also produced the highest harvest index, indicating better partitioning of assimilates towards economic yield. The combined application of FYM, green manure and compost was found to be the most effective organic nutrient-management treatment under the conditions of the present wheat-mustard intercropping system. The findings indicate that integrated use of bulky organic manures can improve crop growth, productivity and the overall performance of wheat-mustard intercropping under Bundelkhand conditions.

Keywords: Wheat, Mustard, Intercropping, Bulky manures, FYM, Green manure, Compost, Organic nutrient management, Bundelkhand

Introduction

Wheat (*Triticum aestivum* L.) ($2n = 42$) is one of the most important cereal crops cultivated worldwide. It is an allohexaploid species with three genomes, A, B and D (AABBDD), comprising 21 pairs of chromosomes. Bread wheat originated through hybridization between tetraploid wheat (*Triticum turgidum*, AABB) and the diploid wild species *Aegilops tauschii* (DD). The A genome is mainly related to *Triticum urartu*, while the B and D genomes are associated with *Aegilops speltoides* and *Aegilops tauschii*, respectively. Wheat was domesticated in the Fertile Crescent and later spread to diverse agro-climatic regions worldwide (Dub-covsky and Dvorak, 2007; Matsuoaka, 2011) [1].

Mustard (*Brassica juncea* L. Czern. & Coss.) ($2n = 36$) is an important oilseed crop belonging to the family Brassicaceae. It is an allotetraploid species with an AABB genome constitution, originating through inter-specific hybridization between *Brassica rapa* (AA) and *Brassica nigra* (BB), followed by chromosome doubling. Indian mustard is widely cultivated in the Indian subcontinent and is valued mainly for its edible oil, condiment and vegetable uses. It is also well adapted to relatively dry and heat-prone environments, making it an important crop for diverse agro-climatic conditions.

Wheat-mustard intercropping is an important *rabi* cropping system widely practiced in India, particularly under irrigated and rainfed conditions. The combination of wheat (*Triticum aestivum* L.) and Indian mustard (*Brassica juncea* L. Czern. & Coss.) facilitates efficient utilization of land, sunlight, water, nutrients and other environmental resources due to differences in their growth habit, rooting pattern, canopy structure and duration. Intercropping can increase total productivity per unit area, improve land-use efficiency, reduce production risk and provide additional economic returns compared with sole cropping. However, the performance of wheat-mustard intercropping is influenced by row ratio, planting geometry, plant population, sowing time, cultivar, nutrient management and competition between component crops. Therefore, identification

of suitable row arrangements and management practices is essential for achieving higher productivity, resource-use efficiency and profitability under Indian conditions (Francis *et al.*, 1976; Willey, 1979; Mead and Willey, 1980) [2, 3].

Material and methods

The present investigation was conducted during the *rabi* season 2025–26 at the Organic Research Farm, Karguaji, Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh (26°44' N latitude, 79°25' E longitude; 284 m above mean sea level), situated under Agro-climatic Zone VIII (Central Plateau and Hill Region).

The treatments used under different organic nutrient management practices were, T₁- Control (No external organic input- baseline), T₂- FYM 100%, T₃ Green Manure 100%, T₄- Compost 100%, T₅- FYM 50% + G.M 50%, T₆- FYM 50% + Compost 50%, T₇- G.M 50% + Compost 50%, T₈- FYM 33% + G.M 33% + Compost 33%. The organic manures were applied as per the treatment combinations before sowing and thoroughly mixed into the soil to ensure proper nutrient availability for the Intercrop (Wheat + mustard) crop.

The observations recorded on different growth, yield and economic parameters of wheat and mustard under the wheat – mustard intercropping system were subjected to statistical analysis to assess the effects of different organic nutrient management treatments. The growth and yield observations included plant height (cm), number of leaves plant⁻¹, leaf length (cm), fresh weight plant⁻¹ (g), dry weight plant⁻¹ (g), biological yield plant⁻¹ (g), seed yield plant⁻¹ (g) and harvest index (%). In wheat, number of tillers plant⁻¹, ear length (cm) and number of grains ear⁻¹ were additionally recorded, whereas in mustard, number of primary branches plant⁻¹, siliqua length (cm) and number of seeds siliqua⁻¹ were recorded at the appropriate stages of crop growth and at maturity.

The recorded data were analyzed using analysis of variance (ANOVA) appropriate for an RBD following the statistical procedure described by Cochran and Cox (1950). The significance of treatment effects was determined on the basis of the *F*-test. Wherever the treatment effects were found significant, treatment means were compared using Critical Difference (CD) at the 5% level of significance. Standard Error of Mean *S.E.m*_± Standard Error of Difference *S.E.d*_± and Coefficient of Variation (CV%) were also calculated to assess the precision and variability of the experimental data.

For economic evaluation of the intercropping system, cost of cultivation (₹ ha⁻¹), wheat gross return (₹ ha⁻¹), mustard gross return (₹ ha⁻¹), total gross return (₹ ha⁻¹), net return (₹ ha⁻¹) and benefit-cost ratio were calculated for each treatment. Net return was obtained by deducting the cost of cultivation from the total gross return, while the benefit-cost ratio was calculated as the ratio of total gross return to the cost of cultivation.

Results and discussion

The present investigation was conducted to evaluate the effect of different bulky organic manures and their combinations on the growth, development, yield attributes, yield and economic performance of wheat–mustard intercropping under the agro-climatic conditions of Bundelkhand. The experiment was conducted during the *rabi* season of 2025–26 at the Organic Research Farm, Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi. The results revealed that organic nutrient management treatments considerably influenced the growth and yield performance of both wheat and mustard. Among the eight treatments, T₈: FYM 33% + Green Manure 33% + Compost 33% consistently recorded the highest values for most of the characters studied, whereas the lowest values were generally observed under T₁: Control.

Growth parameters

Plant height

Plant height of both wheat and mustard was significantly influenced by different organic nutrient management treatments. In wheat, plant height ranged from 67.60 to 92.90 cm. The minimum plant height of 67.60 cm was recorded under T₁ (Control), whereas the maximum height of 92.90 cm was recorded under T₈ (FYM 33% + Green Manure 33% + Compost 33%). T₆ (FYM 50% + Compost 50%) ranked second with 89.97 cm, followed by T₄ (Compost 100%) with 87.53 cm. Similarly, in mustard, plant height varied from 127.50 to 181.23 cm, with the minimum under T₁ and maximum under T₈. T₆ and T₄ recorded 175.77 and 170.57 cm, respectively.

Number of leaves plant⁻¹

The number of leaves plant⁻¹ showed significant variation among the nutrient management treatments. In wheat, the number of leaves ranged from 10.20 to 17.33 plant⁻¹. The lowest value (10.20) was recorded under T₁, whereas the highest value (17.33) was obtained under T₈. T₆ recorded 16.60 leaves plant⁻¹, followed by T₄ with 15.76 leaves plant⁻¹. In mustard, the number of leaves ranged from 32.39 to 76.23 plant⁻¹. The maximum number of leaves (76.23) was recorded under T₈, followed by T₆ (71.83) and T₄ (66.57), while the minimum (32.39) was observed under T₁.

Leaf length

Leaf length was also significantly affected by different organic nutrient management treatments. In wheat, leaf length ranged from 16.34 to 25.96 cm, with the minimum value under T₁ and maximum under T₈. T₆ recorded 24.77 cm, followed by T₄ with 23.90 cm. In mustard, leaf length ranged from 14.03 to 22.90 cm. The highest leaf length (22.90 cm) was recorded under T₈, followed by T₆ (22.00 cm) and T₄ (21.13 cm), while the minimum was recorded under T₁.

Biomass production

Fresh weight plant⁻¹

Fresh weight plant⁻¹ was significantly influenced by the different organic nutrient management treatments. In wheat, fresh weight ranged from 33.76 to 69.27 g plant⁻¹, with the minimum value under T₁ and maximum under T₈. T₆ and T₄ recorded 65.13 and 61.53 g plant⁻¹, respectively. In mustard, fresh weight varied from 81.57 to 168.97 g plant⁻¹, with the highest value under T₈, followed by T₆ (158.87 g) and T₄ (149.73 g).

Dry weight plant⁻¹

Dry weight plant⁻¹ also differed significantly among the treatments. In wheat, dry weight increased from 8.60 g under T₁ to 19.33 g under T₈, while in mustard it increased from 17.60 to 39.86 g plant⁻¹. T₆ recorded the second-highest dry weight in both crops, with 18.10 g in wheat and 37.27 g in mustard, followed by T₄.

Yield attributes

Number of tillers plant⁻¹ in wheat

The number of tillers plant⁻¹ was significantly influenced by organic nutrient management. The number of tillers increased from 2.77 under T₁ to 6.01 plant⁻¹ under T₈. T₆ recorded the next highest value, followed by T₄. Greater tiller production provided a larger number of productive shoots, contributing to increased grain yield.

Ear length

Ear length of wheat increased from 7.63 cm under T₁ to 12.50 cm under T₈. The superior ear length under T₈ may be attributed to better plant vigour and greater nutrient availability during reproductive development.

Number of grains ear⁻¹

The number of grains ear⁻¹ increased from 28.10 under T₁ to 50.40 under T₈. The higher number of grains ear⁻¹ under T₈ indicates better reproductive development and efficient assimilate supply to the de

veloping ear. Similar findings have been reported by Chaudhry *et al.* (2017) [4] for wheat under integrated nutrient management.

Number of primary branches plant⁻¹ in mustard

The number of primary branches plant⁻¹ in mustard increased from 3.50 under T₁ to 7.70 under T₈. The greater branching under T₈ may have resulted from improved nutrient availability and enhanced vegetative growth. Similar positive effects of nutrient management on mustard growth and yield attributes have been reported by Bhanuwanti *et al.* (2022) [5] and Awasthi *et al.* (2024) [6].

Siliqua length

Siliqua length of mustard increased from 3.70 cm under T₁ to 6.04 cm under T₈. The greater siliqua length under T₈ may be attributed to improved plant nutrition and enhanced assimilate availability during reproductive development.

Number of seeds siliqua⁻¹

The number of seeds siliqua⁻¹ increased from 10.40 under T₁ to 16.63 under T₈. The maximum seed number under T₈ suggests improved reproductive efficiency under the combined application of FYM, green manure and compost. Adequate nutrient availability during flowering and siliqua development may have promoted better fertilization and seed filling.

Yield parameters

Seed yield plant⁻¹

Seed yield plant⁻¹ was considerably improved by organic nutrient management. In wheat, seed yield increased from 6.00 g under T₁ to 15.20 g plant⁻¹ under T₈, while in mustard it increased from 7.70 to 22.03 g plant⁻¹. T₆ ranked second with 13.93 g in wheat and 20.13 g in mustard, followed by T₄.

Wheat yield

Wheat yield ranged from 21.33 to 54.04 q ha⁻¹. The minimum yield was recorded under T₁ (Control), whereas the maximum yield (54.04 q ha⁻¹) was recorded under T₈. T₆ ranked second with 49.54 q ha⁻¹, followed by T₄. The increase in wheat yield under T₈ was associated with the improvement in growth and yield-contributing attributes, particularly tillers plant⁻¹, ear length, grains ear⁻¹ and seed yield plant⁻¹.

Mustard yield

Mustard seed yield also showed a marked response to organic nutrient management. The maximum mustard yield was recorded under T₈ (6.53 q ha⁻¹), followed by T₆ (5.97 q ha⁻¹), whereas the minimum yield was recorded under T₁.

Harvest index

Harvest index was influenced by the different organic nutrient management treatments. In wheat, harvest index ranged from 36.89 to 42.82%, with the highest value under T₈ and the lowest under T₁. T₆ recorded 42.06%, while T₄ recorded 41.33%. In mustard, harvest index ranged from 22.35 to 28.34%, with the maximum value under T₈ and minimum under T₁. Similar improvement in yield efficiency under suitable nutrient management has been reported in wheat and mustard by Chaudhry *et al.* (2017) [4], Bhanuwanti *et al.* (2022) [5] and Awasthi *et al.* (2024) [6].

Economic parameters

Wheat gross return

Wheat gross return varied significantly among the treatments. The minimum gross return of ₹55,146.67 ha⁻¹ was recorded under T₁, whereas the maximum gross return of ₹1,39,702.02 ha⁻¹ was ob-

tained under T₈. T₆ ranked second with ₹1,28,060.90 ha⁻¹, followed by T₄ with ₹1,17,031.57 ha⁻¹. The higher gross return under T₈ was primarily due to the higher wheat productivity obtained under this treatment.

Mustard gross return

Mustard gross return ranged from ₹14,136.00 ha⁻¹ under T₁ to ₹40,465.33 ha⁻¹ under T₈. T₆ recorded ₹36,993.33 ha⁻¹, followed by T₄ with ₹33,314.67 ha⁻¹. The higher return from mustard under T₈ was a direct consequence of its higher seed productivity.

Total gross return

The total gross return of the wheat–mustard intercropping system ranged from ₹69,282.67 to ₹1,80,167.35 ha⁻¹. The lowest total gross return was recorded under T₁, whereas the highest value (₹1,80,167.35 ha⁻¹) was obtained under T₈. T₆ ranked second with ₹1,65,054.23 ha⁻¹.

Net return

Net return varied from ₹25,115.63 ha⁻¹ under T₁ to ₹1,23,701.77 ha⁻¹ under T₈. T₆ recorded the second-highest net return of ₹1,04,935.10 ha⁻¹. The higher net return under T₈ indicates that the additional expenditure associated with organic nutrient inputs was compensated by the substantial increase in crop productivity and gross income.

Benefit-cost ratio

The benefit-cost ratio ranged from 1.57 to 3.19. The highest B ratio of 3.19 was obtained under T₈, followed by T₆ with 2.75, whereas the lowest ratio (1.57) was recorded under T₁. The higher B ratio under T₈ demonstrates the superior economic efficiency of the integrated organic nutrient management treatment. Similar improvements in economic returns from wheat–mustard intercropping through suitable nutrient management have been reported by Kondaguri and Sudha (2020) [7], Sudha *et al.* (2020) [8], Shyamsunder *et al.* (2024) [9] and Kumbhare *et al.* (2025) [10].

Conclusion

Based on the results of the present investigation, it may be concluded that organic nutrient management treatments significantly influenced the growth, yield and economic performance of wheat–mustard intercropping under the agro-climatic conditions of Bundelkhand. Among the organic nutrient management treatments evaluated, T₈: FYM @ 33% + Green Manure @ 33% + Compost @ 33% proved to be the most effective treatment, followed by T₆: FYM @ 50% + Compost @ 50%. Treatment T₈ recorded the highest performance for major growth parameters, biomass production, yield attributes, seed yield and harvest index in both wheat and mustard. The treatment recorded maximum plant height of 92.90 cm in wheat and 181.23 cm in mustard, along with the highest seed yield plant⁻¹ of 15.20 g and 22.03 g, respectively. Similarly, the highest wheat yield (54.04 q ha⁻¹) and mustard yield (6.53 q ha⁻¹) were obtained under T₈. The superior biological performance of T₈ was also reflected in economic parameters, recording the highest total gross return (₹1,80,167.35 ha⁻¹), net return (₹1,23,701.77 ha⁻¹) and benefit-cost ratio (3.19). Therefore, the application of FYM @ 33% + Green Manure @ 33% + Compost @ 33% may be recommended as an effective organic nutrient management practice for improving growth, productivity and profitability of wheat–mustard intercropping under the agro-climatic conditions of Bundelkhand.

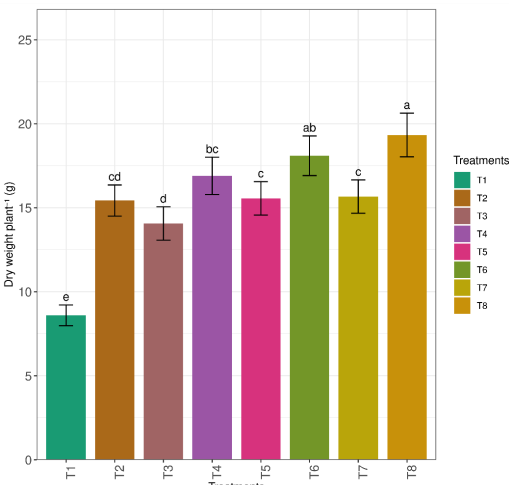
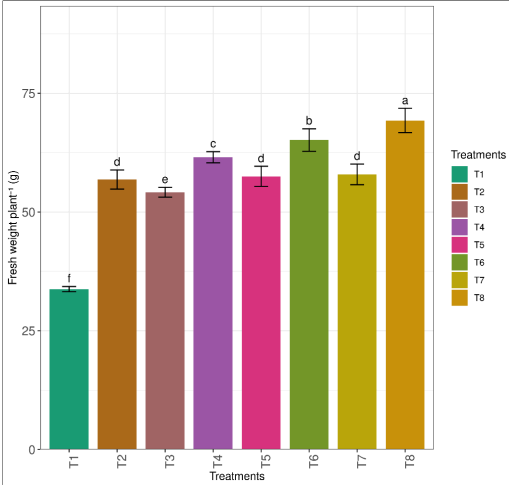
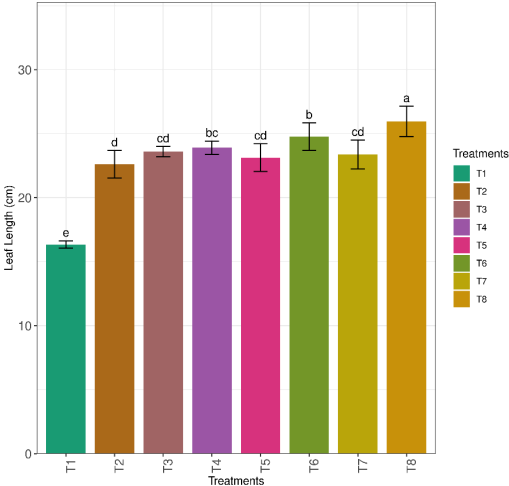
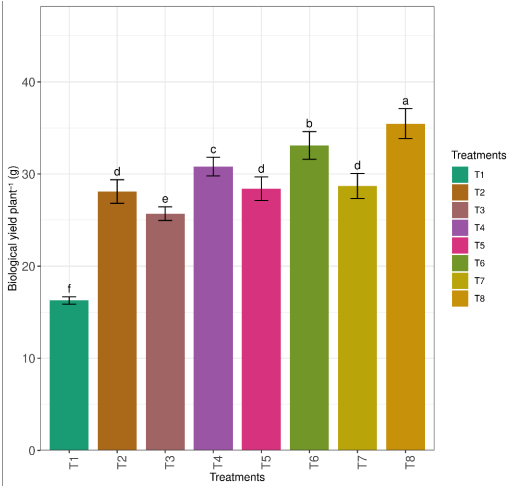
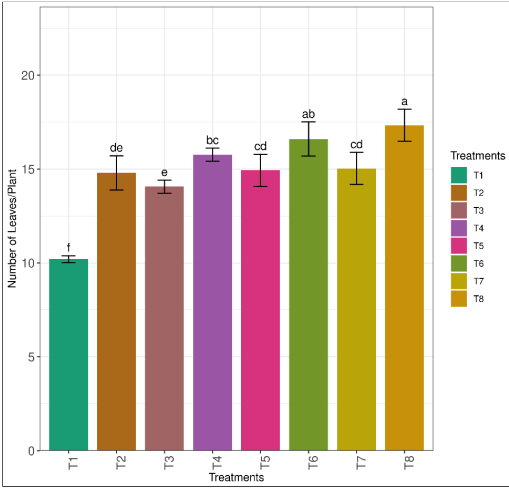
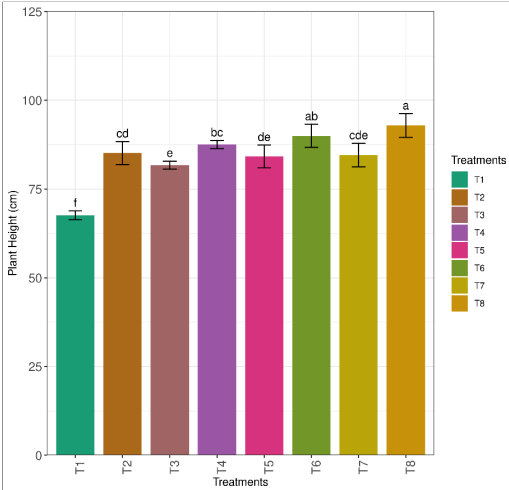


Table. Growth and biomass parameters of wheat as influenced by different nutrient-management treatments

Treatment details	Plant height (cm)	Leaves plant ⁻¹	Leaf length (cm)	Fresh weight plant ⁻¹ (g)	Dry weight plant ⁻¹ (g)	Biological yield plant ⁻¹ (g)
T ₁ -Control	67.60 ± 1.02 ^f	10.20 ± 0.14 ^f	16.34 ± 0.23 ^e	33.76 ± 0.44 ^f	8.60 ± 0.50 ^e	16.27 ± 0.32 ^f
T ₂ -FYM 100%	85.14 ± 2.62 ^{cd}	14.80 ± 0.73 ^{de}	22.60 ± 0.87 ^d	56.84 ± 1.63 ^d	15.43 ± 0.75 ^{cd}	28.10 ± 1.03 ^d
T ₃ -Green Manure 100%	81.73 ± 0.93 ^e	14.06 ± 0.28 ^e	23.60 ± 0.32 ^{cd}	54.17 ± 0.83 ^e	14.07 ± 0.80 ^d	25.70 ± 0.60 ^e
T ₄ -Compost 100%	87.53 ± 0.93 ^{bc}	15.76 ± 0.28 ^{bc}	23.90 ± 0.42 ^{bc}	61.53 ± 0.96 ^c	16.90 ± 0.90 ^{bc}	30.80 ± 0.81 ^c
T ₅ -FYM 50% + Green Manure 50%	84.20 ± 2.58 ^{de}	14.93 ± 0.69 ^{cd}	23.13 ± 0.87 ^{cd}	57.50 ± 1.71 ^d	15.57 ± 0.80 ^c	28.40 ± 1.03 ^d
T ₆ -FYM 50% + Compost 50%	89.97 ± 2.63 ^{ab}	16.60 ± 0.73 ^{ab}	24.77 ± 0.87 ^b	65.13 ± 1.93 ^b	18.10 ± 0.95 ^{ab}	33.10 ± 1.22 ^b
T ₇ -Green Manure 50% + Compost 50%	84.57 ± 2.67 ^{cde}	15.03 ± 0.69 ^{cd}	23.37 ± 0.91 ^{cd}	57.93 ± 1.76 ^d	15.67 ± 0.80 ^c	28.70 ± 1.10 ^d
T ₈ -FYM 33% + Green Manure 33% + Compost 33%	92.90 ± 2.71 ^a	17.33 ± 0.69 ^a	25.96 ± 0.95 ^a	69.27 ± 2.07 ^a	19.33 ± 1.05 ^a	35.47 ± 1.31 ^a
S.Em±	1.07	0.28	0.37	0.77	0.49	0.52
S.Ed±	1.52	0.40	0.52	1.09	0.69	0.73
CD (<i>P</i> = 0.05)	3.26	0.86	1.11	2.34	1.48	1.58
CV (%)	2.21	3.31	2.76	2.35	5.45	3.18

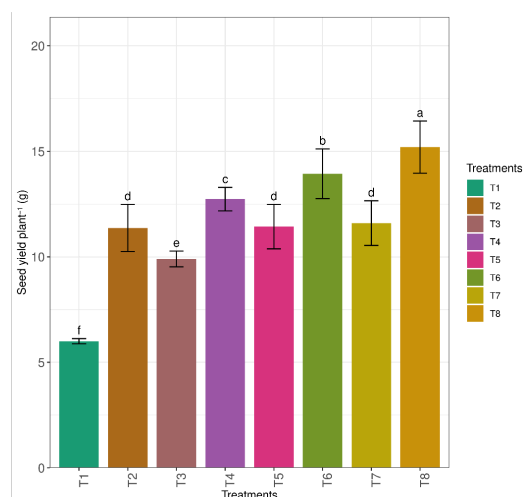


Table. Yield and yield-attributing characters of wheat as influenced by different nutrient-management treatments

Treatment details	Seed yield plant ⁻¹ (g)	Harvest index (%)	Tillers plant ⁻¹	Ear length (cm)	Grains ear ⁻¹	Yield q/ha
T ₁ -Control	6.00 ± 0.10 f	36.89 ± 0.17 d	2.77 ± 0.11 f	7.63 ± 0.15 e	28.10 ± 0.52 f	21.33 ± 0.35 f
T ₂ -FYM 100%	11.37 ± 0.90 d	40.41 ± 1.72 b	4.61 ± 0.20 d	10.53 ± 0.47 c	42.77 ± 2.27 d	40.41 ± 3.21 d
T ₃ -Green Manure 100%	9.90 ± 0.30 e	38.52 ± 0.30 c	4.27 ± 0.11 e	9.67 ± 0.15 d	39.66 ± 0.56 e	35.20 ± 1.07 e
T ₄ -Compost 100%	12.73 ± 0.45 c	41.33 ± 0.37 ab	5.14 ± 0.15 c	11.27 ± 0.24 b	45.80 ± 0.74 bc	45.27 ± 1.60 c
T ₅ -FYM 50% + Green Manure 50%	11.43 ± 0.85 d	40.22 ± 1.54 b	4.71 ± 0.20 d	10.40 ± 0.51 c	43.00 ± 2.23 d	40.65 ± 3.02 d
T ₆ -FYM 50% + Compost 50%	13.93 ± 0.95 b	42.06 ± 1.32 a	5.57 ± 0.18 b	11.83 ± 0.55 b	48.00 ± 2.32 ab	49.54 ± 3.38 b
T ₇ -Green Manure 50% + Compost 50%	11.60 ± 0.85 d	40.38 ± 1.43 b	4.67 ± 0.18 d	10.53 ± 0.55 c	43.27 ± 2.24 cd	41.24 ± 3.04 d
T ₈ -FYM 33% + Green Manure 33% + Compost 33%	15.20 ± 1.00 a	42.82 ± 1.24 a	6.01 ± 0.20 a	12.50 ± 0.59 a	50.40 ± 2.32 a	54.04 ± 3.56 a
S.Em±	0.36	0.50	0.09	0.21	0.86	1.29
S.Ed±	0.51	0.71	0.13	0.30	1.22	1.82
CD (P = 0.05)	1.10	1.52	0.28	0.65	2.61	3.91
CV (%)	5.45	2.16	3.42	3.52	3.50	5.45

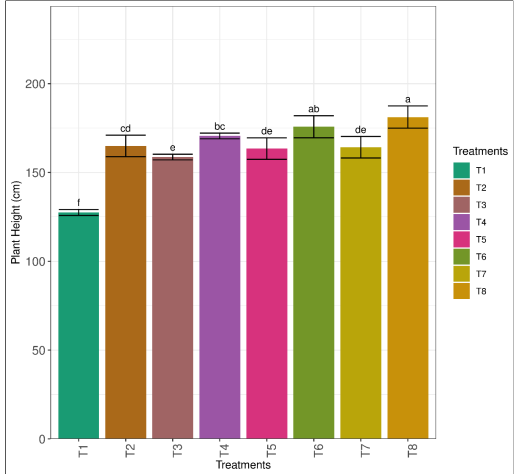
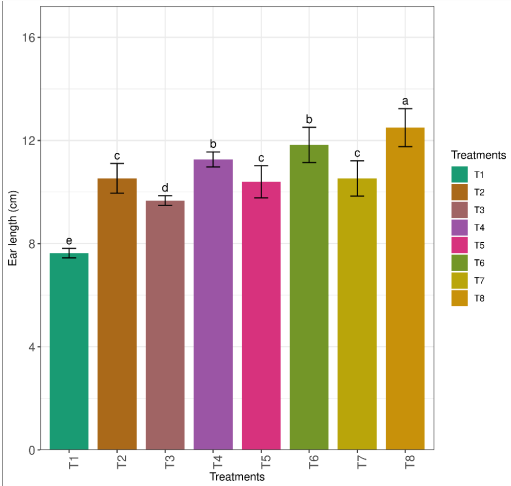
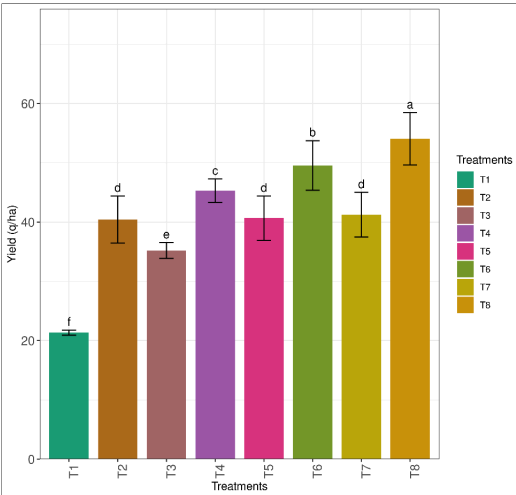
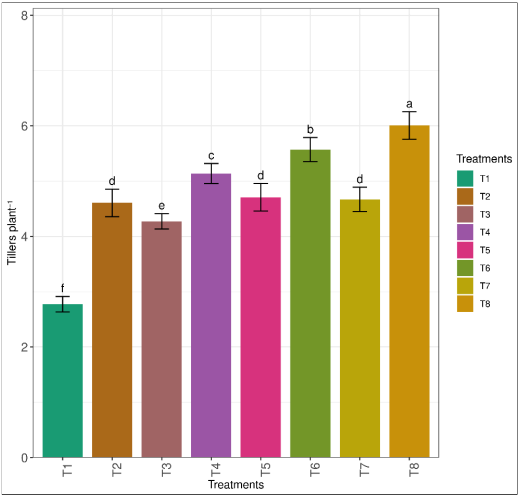
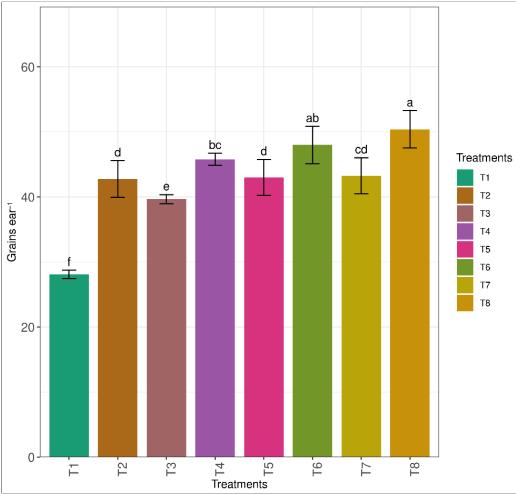
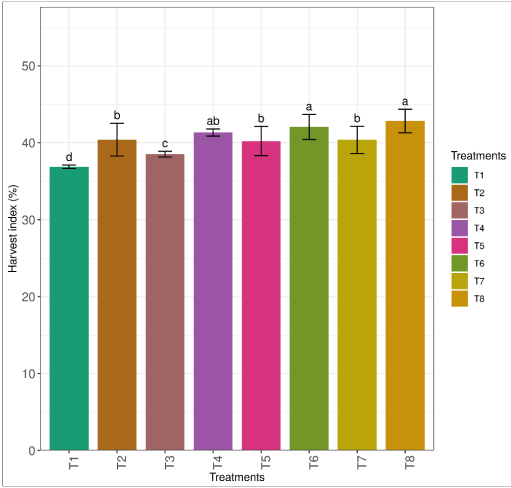
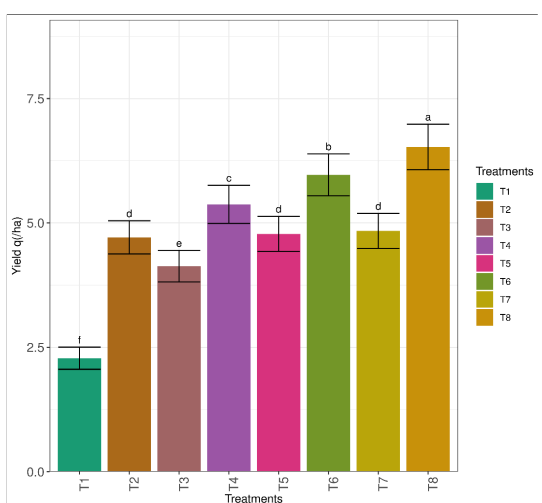
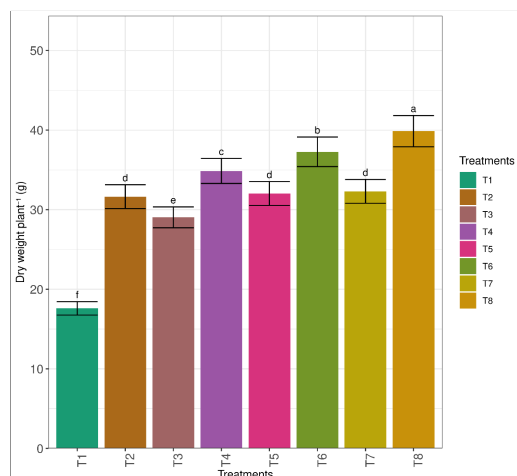
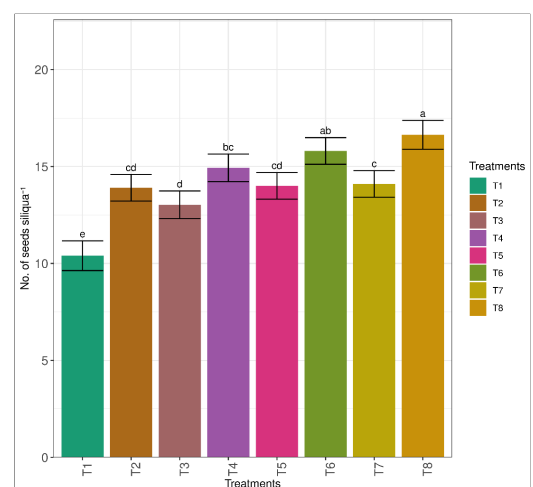
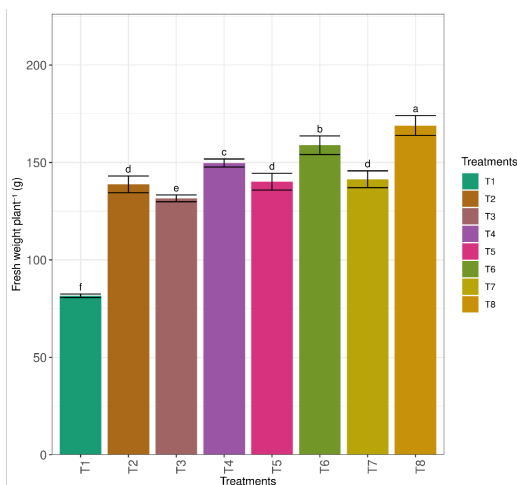
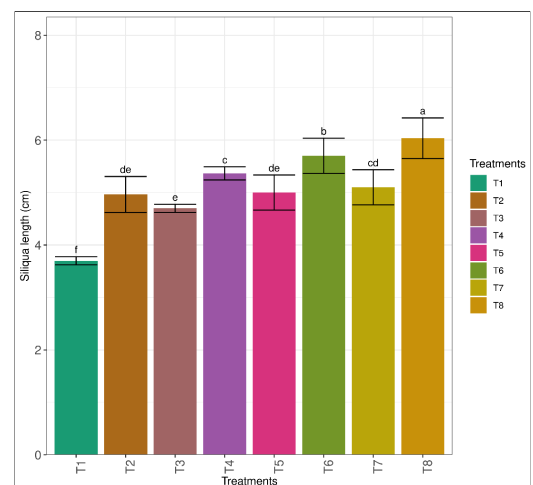
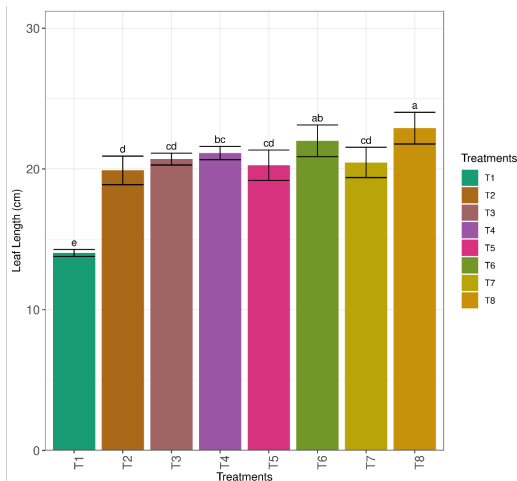
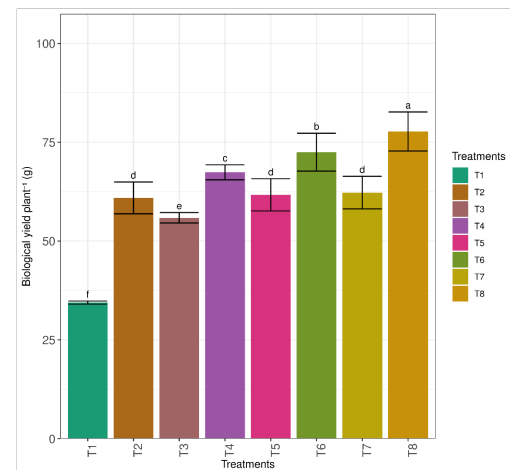
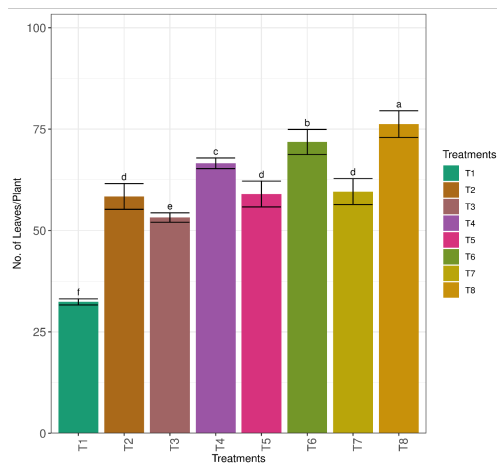
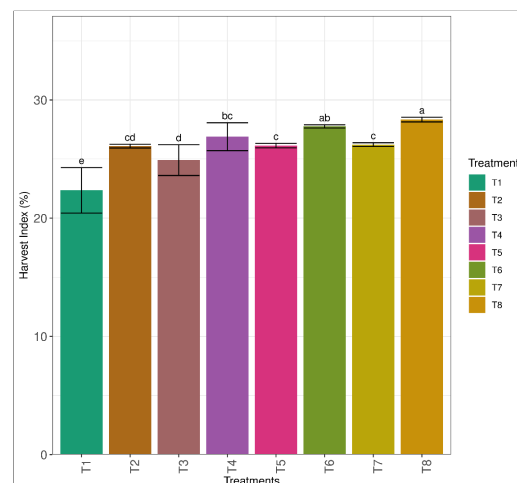
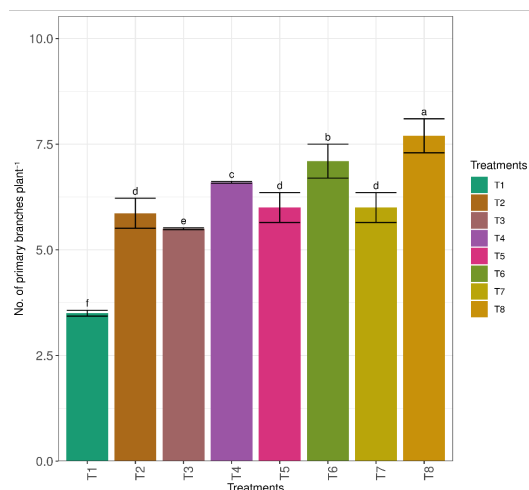


Table. Growth and biomass parameters of mustard as influenced by different nutrient-management treatments

Treatment details	Plant height (cm)	Leaves plant ⁻¹	Leaf length (cm)	Fresh weight plant ⁻¹ (g)	Dry weight plant ⁻¹ (g)	Biological yield plant ⁻¹ (g)
T ₁ -Control	127.50 ± 1.36 f	32.40 ± 0.60 f	14.03 ± 0.20 e	81.57 ± 0.74 f	17.60 ± 0.68 f	34.43 ± 0.32 f
T ₂ -FYM 100%	164.97 ± 4.89 cd	58.40 ± 2.57 d	19.90 ± 0.82 d	138.77 ± 3.46 d	31.63 ± 1.21 d	60.93 ± 3.25 d
T ₃ -Green Manure 100%	158.70 ± 1.29 e	53.20 ± 0.94 e	20.70 ± 0.34 cd	131.60 ± 1.42 e	29.03 ± 1.06 e	55.90 ± 1.06 e
T ₄ -Compost 100%	170.57 ± 1.30 bc	66.57 ± 1.06 c	21.13 ± 0.38 bc	149.73 ± 1.66 c	34.87 ± 1.27 c	67.40 ± 1.54 c
T ₅ -FYM 50% + Green Manure 50%	163.47 ± 4.89 de	59.00 ± 2.57 d	20.27 ± 0.87 cd	140.17 ± 3.49 d	32.03 ± 1.21 d	61.70 ± 3.29 d
T ₆ -FYM 50% + Compost 50%	175.77 ± 5.02 ab	71.83 ± 2.50 b	22.00 ± 0.91 ab	158.87 ± 3.85 b	37.27 ± 1.50 b	72.50 ± 3.87 b
T ₇ -Green Manure 50% + Compost 50%	164.23 ± 4.89 de	59.60 ± 2.57 d	20.47 ± 0.87 cd	141.40 ± 3.48 d	32.30 ± 1.21 d	62.27 ± 3.33 d
T ₈ -FYM 33% + Green Manure 33% + Compost 33%	181.23 ± 5.06 a	76.23 ± 2.67 a	22.90 ± 0.91 a	168.97 ± 4.10 a	39.86 ± 1.59 a	77.73 ± 4.00 a
S.Em±	2.29	1.26	0.43	1.83	0.87	1.67
S.Ed±	3.24	1.78	0.61	2.58	1.23	2.36
CD (<i>P</i> = 0.05)	5.68	3.11	1.08	4.52	2.16	4.14
CV (%)	1.99	2.98	3.05	1.86	3.87	3.84
Treatment details	Seed yield plant ⁻¹ (g)	Harvest index (%)	Primary branches plant ⁻¹	Silique length (cm)	Seeds silique ⁻¹	Yield q/ha
T ₁ -Control	7.70 ± 0.60 f	22.35 ± 1.55 e	3.50 ± 0.06 f	3.70 ± 0.06 f	10.40 ± 0.62 e	2.28 ± 0.18 f
T ₂ -FYM 100%	15.90 ± 0.90 d	26.09 ± 0.13 cd	5.87 ± 0.29 d	4.96 ± 0.28 de	13.90 ± 0.56 cd	4.71 ± 0.27 d
T ₃ -Green Manure 100%	13.93 ± 0.85 e	24.91 ± 1.05 d	5.50 ± 0.02 e	4.70 ± 0.06 e	13.03 ± 0.58 d	4.13 ± 0.26 e
T ₄ -Compost 100%	18.13 ± 1.05 c	26.89 ± 0.95 bc	6.60 ± 0.02 c	5.37 ± 0.10 c	14.93 ± 0.58 bc	5.37 ± 0.31 c
T ₅ -FYM 50% + Green Manure 50%	16.13 ± 0.95 d	26.14 ± 0.15 c	6.00 ± 0.28 d	5.00 ± 0.27 de	14.00 ± 0.56 cd	4.78 ± 0.28 d
T ₆ -FYM 50% + Compost 50%	20.13 ± 1.15 b	27.76 ± 0.11 ab	7.10 ± 0.33 b	5.70 ± 0.27 b	15.80 ± 0.56 ab	5.97 ± 0.34 b
T ₇ -Green Manure 50% + Compost 50%	16.33 ± 0.95 d	26.23 ± 0.13 c	6.00 ± 0.28 d	5.10 ± 0.27 cd	14.10 ± 0.56 c	4.84 ± 0.28 d
T ₈ -FYM 33% + Green Manure 33% + Compost 33%	22.03 ± 1.25 a	28.34 ± 0.16 a	7.70 ± 0.33 a	6.04 ± 0.31 a	16.63 ± 0.60 a	6.53 ± 0.37 a
S.Em±	0.70	0.49	0.10	0.13	0.42	0.21
S.Ed±	0.98	0.70	0.14	0.18	0.60	0.29
CD (<i>P</i> = 0.05)	1.72	1.23	0.25	0.32	1.05	0.51
CV (%)	6.04	2.68	2.37	3.63	4.24	6.07





Effect of different bulky manures and their combinations on wheat gross return under intercropping condition (₹ ha⁻¹)

Table. Yield and yield-attributing characters of mustard as influenced by different nutrient-management treatments

Particulars (₹ ha ⁻¹)	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈
	Control	FYM 100%	GM 100%	Compost 100%	FYM 50% + GM 50%	FYM 50% + Comp 50%	GM 50% + Comp 50%	FYM 33% + GM 33% + Comp 33%
A. DIRECT COST								
Human labour (28 man-days @ ₹320)	8,960.00	8,960.00	8,960.00	8,960.00	8,960.00	8,960.00	8,960.00	8,960.00
Machine labour (Tractor 7.5 hrs @ ₹900)	6,750.00	6,750.00	6,750.00	6,750.00	6,750.00	6,750.00	6,750.00	6,750.00
Wheat seed (90 kg @ ₹42)	3,780.00	3,780.00	3,780.00	3,780.00	3,780.00	3,780.00	3,780.00	3,780.00
Mustard seed (1.5 kg @ ₹120)	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00
Farmyard Manure (FYM)	0.00	15,000.00	0.00	0.00	7,500.00	7,500.00	0.00	5,000.00
Green Manure (<i>Sesbania</i> in-situ)	0.00	0.00	4,850.00	0.00	2,425.00	0.00	2,425.00	1,617.00
Compost	0.00	0.00	0.00	16,000.00	0.00	8,000.00	8,000.00	5,333.00
(Enriched/Vermicompost)								
Chemical Fertilizers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plant protection (Bio-agents/Neem)	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00
Irrigation charges (3 irrigations)	3,300.00	3,300.00	3,300.00	3,300.00	3,300.00	3,300.00	3,300.00	3,300.00
Harvesting & Threshing operations	6,200.00	6,200.00	6,200.00	6,200.00	6,200.00	6,200.00	6,200.00	6,200.00
Produce Transportation (to Mandi)	1,100.00	1,100.00	1,100.00	1,100.00	1,100.00	1,100.00	1,100.00	1,100.00
Miscellaneous field contingencies	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
Total Direct Cost (A)	32,470.00	47,470.00	37,320.00	48,470.00	42,395.00	47,970.00	42,895.00	44,420.00
B. INDIRECT COST								
Rental value of land (Seasonal lease)	8,000.00	8,000.00	8,000.00	8,000.00	8,000.00	8,000.00	8,000.00	8,000.00
Interest on fixed capital	450.00	450.00	450.00	450.00	450.00	450.00	450.00	450.00
Interest on working capital (7% p.a., 5 months)	947.04	1,384.54	1,088.50	1,413.71	1,236.52	1,399.13	1,251.10	1,295.58
Depreciation on farm implements	650.00	650.00	650.00	650.00	650.00	650.00	650.00	650.00

(continued on next page)

Imputed family supervisory labour	1,600.00	1,600.00	1,600.00	1,600.00	1,600.00	1,600.00	1,600.00	1,600.00
Land revenue / local cess	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Total Indirect Cost (B)	11,697.04	12,134.54	11,838.50	12,163.71	11,986.52	12,149.13	12,001.10	12,045.58
TOTAL COST OF CULTIVATION (A + B)	44,167.04	59,604.54	49,158.50	60,633.71	54,381.52	60,119.13	54,896.10	56,465.58

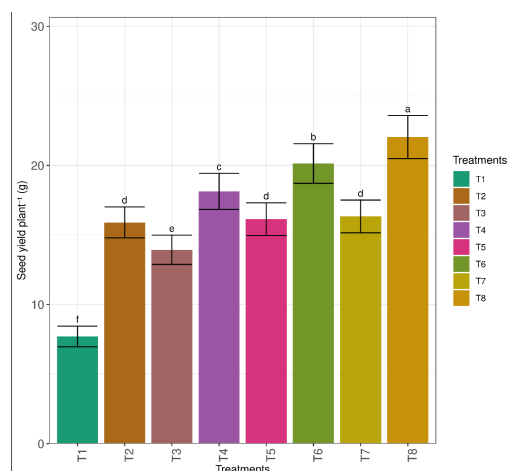


Table. Treatment-wise cost of cultivation (₹ ha⁻¹) of wheat + mustard (8:1 row ratio) intercropping under different organic nutrient management treatments

Treatments	Symb	Wheat Gross Return (₹ ha ⁻¹)
Control	T ₁	55146.667 ± 917.705 ^f
FYM 100%	T ₂	104468.467 ± 8288.476 ^d
Green Manure 100%	T ₃	90992.000 ± 2765.950 ^e
Compost 100%	T ₄	117031.567 ± 4143.775 ^c
FYM 50% + Green Manure 50%	T ₅	105080.250 ± 7811.321 ^d
FYM 50% + Compost 50%	T ₆	128060.900 ± 8741.429 ^b
Green Manure 50% + Compost 50%	T ₇	106614.017 ± 7846.671 ^d
FYM 33% + Green Manure 33% + Compost 33%	T ₈	139702.017 ± 9189.678 ^a
MSE		33258901.53
S.Em±		3329.61
S.Ed±		4708.779
CD (P = 0.05)		10099.327
CV (%)		5.446

Effect of different bulky manures and their combinations on mustard return under intercropping condition (₹ ha⁻¹)

Treatments	Symb	Mustard Return (₹ ha ⁻¹)
Control	T ₁	14136.000 ± 1116.000 ^f
FYM 100%	T ₂	29202.000 ± 1674.000 ^d
Green Manure 100%	T ₃	25606.000 ± 1581.912 ^e
Compost 100%	T ₄	33314.667 ± 1923.333 ^c
FYM 50% + Green Manure 50%	T ₅	29636.000 ± 1767.816 ^d
FYM 50% + Compost 50%	T ₆	36993.333 ± 2108.304 ^b
Green Manure 50% + Compost 50%	T ₇	30008.000 ± 1767.816 ^d
FYM 33% + Green Manure 33% + Compost 33%	T ₈	40465.333 ± 2294.279 ^a

Treatments	Symb	Mustard Return (₹ ha ⁻¹)
MSE		3297579.96
S.Em±		1048.42
S.Ed±		1482.70
CD (P = 0.05)		3180.07
CV (%)		6.07

Treatments	Symb	Gross Return (₹ ha ⁻¹)
Control	T ₁	69282.667 ± 2033.689 ^f
FYM 100%	T ₂	133670.467 ± 9959.708 ^d
Green Manure 100%	T ₃	116598.000 ± 4347.282 ^e
Compost 100%	T ₄	150346.233 ± 6066.728 ^c
FYM 50% + Green Manure 50%	T ₅	134716.250 ± 9579.125 ^d
FYM 50% + Compost 50%	T ₆	165054.233 ± 10849.572 ^b
Green Manure 50% + Compost 50%	T ₇	136622.017 ± 9610.892 ^d
FYM 33% + Green Manure 33% + Compost 33%	T ₈	180167.350 ± 11483.756 ^a
MSE		57436237.69
S.Em±		4375.55
S.Ed±		6187.96
CD (P = 0.05)		13271.85
CV (%)		5.58

Effect of different bulky manures and their combinations on total gross return under intercropping condition (₹ ha⁻¹).

Effect of different bulky manures and their combinations on net return under intercropping condition (₹ ha⁻¹).

Treatments	Symb	Net Return (₹ ha ⁻¹)
Control	T ₁	25115.627 ± 2033.689 ^f
FYM 100%	T ₂	74065.927 ± 9959.708 ^{de}
Green Manure 100%	T ₃	67439.500 ± 4347.282 ^e
Compost 100%	T ₄	89712.523 ± 6066.728 ^c
FYM 50% + Green Manure 50%	T ₅	80334.730 ± 9579.125 ^{cde}
FYM 50% + Compost 50%	T ₆	104935.103 ± 10849.572 ^b
Green Manure 50% + Compost 50%	T ₇	81725.917 ± 9610.892 ^{cd}
FYM 33% + Green Manure 33% + Compost 33%	T ₈	123701.770 ± 11483.756 ^a
MSE		57436237.69
S.Em±		4375.55
S.Ed±		6187.96
CD (P = 0.05)		13271.85
CV (%)		9.37

Effect of different bulky manures and their combinations on benefit-cost ratio (B:C ratio) under intercropping condition.

Treatments	Symb	B:C Ratio
Control	T ₁	1.567 ± 0.045 ^e
FYM 100%	T ₂	2.240 ± 0.165 ^d
Green Manure 100%	T ₃	2.370 ± 0.090 ^{cd}
Compost 100%	T ₄	2.477 ± 0.100 ^c
FYM 50% + Green Manure 50%	T ₅	2.477 ± 0.180 ^c
FYM 50% + Compost 50%	T ₆	2.747 ± 0.180 ^b
Green Manure 50% + Compost 50%	T ₇	2.487 ± 0.176 ^c
FYM 33% + Green Manure 33% + Compost 33%	T ₈	3.190 ± 0.200 ^a
MSE		0.018
S.Em±		0.08
S.Ed±		0.11
CD (P = 0.05)		0.24
CV (%)		5.49

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