Archives of Agriculture and Environmental Science 2(3): 134-140 (2017)

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: www.aesacademy.org

ORIGINAL RESEARCH ARTICLE

Effect of mulching and organic manure on growth and yield performance of wheat

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ARTICLE HISTORY

Received: 25 July 2017
Accepted: 24 August 2017

Keywords

Fertilizer
Harvest index
Irrigation
Poultry manure
Vermicompost
Wheat

ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh in *Rabi* season (dry season) of 2014 to study the effect of mulching and organic manure on growth and yield performance of wheat. Five mulching practices viz. M_1=1 irrigation at 17-21 days after sowing (DAS), M_2=2 irrigations at 17-21 and 55-60 DAS, M_3=3 irrigations at 17-21, 55-60 and 75-80 DAS, M_4=control, M_5=straw mulch (6 t ha^{-1}) and five organic manure managements viz. O_1=recommended chemical fertilizer (NPKS @ 100-23-20-16 kg ha^{-1}), O_2=poultry manure @ 6 t ha^{-1} (100% PM), O_3=vermicompost @ 8 t ha^{-1} (100% VC), O_4=50% chemical fertilizer+50% VC and O_5=50% chemical fertilizer+50% PM were used as experimental variables. The experiment was conducted in split-plot design with three replications. The results showed that mulching had significant influence on all attributes. The highest values of all attributes were found in straw mulch treatment. It was observed that organic manure had significant influences on all characters. The highest values of yield and yield attributes were found in O_5 (50% chemical fertilizer+50% PM) treatment. It was observed that effective tillers $hill^{-1}$, grain yield and straw yield were significantly affected by combined effect of mulching and organic manure. The highest values obtained from mulching and O_5 (50% chemical fertilizer+50% PM) treatment. Therefore, it can be inferred from the results of the study that highest production could be obtained from mulching and O_5 (50% chemical fertilizer+50% PM) treatment.

Citation of this article: Al-Amin, M.A., Hasan, A.K., Ali, M.H., Nessa, S. and Islam, M.N. (2017). Effect of mulching and organic manure on growth and yield performance of wheat. *Archives of Agriculture and Environmental Science,* 2(3): 134-140.

INTRODUCTION

Both organic and inorganic fertilizers have a potential role on the growth and development of crops. Integrated approach of fertilizer management could minimize leaching losses of nitrogen (N), phosphorus (P), potassium (K) and sulphur (S) to a great extent (Islam, 2009; Islam *et al.*, 2013a, 2013b, 2014 and 2016a). Mineral fertilizers of balanced doses increased the leaf area, photosynthetic productivity and yield of garlic (Borabash and Kochina, 1989). But indiscriminate use of chemical fertilizer changes the physical, chemical and biological properties of soils pollutes environment and also creates health hazards due to its toxic residual effects on crop production especially on vegetables. Manures supply all the essential nutrient elements as well as improve physical, chemical and biological properties of soils and may help in boosting up production of crop leaving a healthy environment at the end. Kamal *et al.* (2012) reported that organic fertilizer is effective in restoring the productivity of degraded soil. Islam *et al.* (2016b) found that rice straw with IPNS based chemical fertilizer gave better rice yield than rice yield with chemical fertilizer alone. Kumar and Chopra (2013) reported higher yield of wheat due to the effect of seasonal tillage. Kumar (2016) reported the higher agronomical performance of brinjal (*Solanum melongena* L.) due to the use of integrated nutrients. Moreover, Chopra *et al.* (2017) reported the significant effect of integrated nutrients on the agronomical growth and crop yield of tomato (*Lycopersicon esculentum* L.).

Water is one of the most important factors that are necessary for proper growth, balanced development and higher yield of all crops. Water deficiency affects plant growth and grain yield (Hussain *et al.*, 2004; Wajid *et al.*, 2002). Grain yield was reduced to 65% in the stressed plants compared to that of irrigated plants (Karim *et al.*, 2000) reported that wheat crop produced the highest grain yield by applying irrigation at all definable growth stages. He pointed out that irrigation is an expensive input therefore; farmer, agronomist, economist and engineer need to know the response of yield to irrigation. Organic mulching is an effective way to increase water use efficiency, increase crop yield and improve soil health. Mulching involves putting a barrier between soil and atmosphere, using different materials such as crop residue, such as straw, leaves, paper, old carpet, plastic or gravel. Mulching serves various purposes: increases soil temperature, reduces water evaporation, enhances fertilizer efficiency, improves solar light irradiation efficiency, improves soil physical and chemical properties and improves soil microbial activity (Van Der Zee *et al*., 2017).

Wheat is one of the world's most widely adapted food grain crops, which supplies more than 50% of the calorie need and nearly similar requirement of the protein need of one third of world population. Though wheat is an important cereal crop in Bangladesh, its average yield is low compared to that of the advanced countries of the world. The low yield of wheat in Bangladesh is attributable to a number of reasons such as poor field management, unavailability of quality seed, climatic hazards, intensive cropping, imbalance fertilizer use, improper water management and inadequate knowledge of using proper plant densities. Considering the above facts, an experiment was undertaken to study the effect of different types of organic manure and mulching on growth and yield performance of wheat (BARI GOM-26).

MATERIALS AND METHODS

Experimental sites and seasons: The experimental site was located at the 24.75°N latitude and 90.50°E longitude at elevation of 18m above the mean sea level. The soil belongs to the non-calcareous dark grey floodplain under the Agro-ecological region of the Old Brahmaputra Floodplain, AEZ-9 (UNDP and FAO, 1998). The soil of experimental plot was a medium high land with silty clay loam having pH 6.80. Physical and chemical properties of the soil at 0-15cm depth have been presented in Table 1. The experimental site belongs to the subtropical area characterized by heavy rainfall during *Kharif* season (April to September) and scanty in the *Rabi* season (October to March) associated with moderately low temperature and plenty of sunshine. The present study was carried out in *Rabi* season.

Experimental design and treatments: The following treatments were assigned in a split-plot design with three replications.

Main plot: Mulching

M_1 = 1 Irrigation at 17-21 days after sowing (DAS)

M_2 = 2 irrigations at 17-21 and 55-60 DAS

M_3 = 3 irrigations at 17-21, 55-60 and 75-80 DAS

M_4 = Control

M_5 = Straw mulch @ 6 t ha^{-1}

Sub-plot: organic manure

O_1 = recommended chemical fertilizer (NPKS @ 100-23-20-16 kg ha^{-1})

O_2 = poultry manure @ 6 t ha^{-1} (100% PM)

O_3 = vermicompost @ 8 t ha^{-1} (100% VC)

O_4 = 50% chemical fertilizer + 50% VC

O_5 = 50% chemical fertilizer + 50% PM

The unit plot size was 2.5m×2m. Replication to replication and plot to plot distance was 1.0m and 0.50m, respectively. BARI Gom-26 (variety of wheat) was used as tested crop. Seeds of BARI Gom-26 were sown in the well prepared plots on 19 November 2014. Prior to sowing seeds, the whole experimental area was divided into unit plots maintaining the desired spacing. The unit plot was spaded one day before planting for loosening the soils and incorporating the basal dose of fertilizers. The bunds around individual plots were made firm enough to control water movement between plots. Nitrogen, P, K and S were applied as triple superphosphate (TSP), muriate of potash (MoP) and gypsum, respectively. Full dose of TSP, MoP, gypsum, organic manures and one third of urea were applied in each plot at the time of final land preparation and fertilizers and manures were mixed with soil thoroughly by spading. The rest urea were top dressed in two equal splits, one at crown root initiation stage (20 days after sowing) and the other at booting stage (45 days after sowing).

Sampling and data collection: At maturity, the experimental crops (wheat) were harvested plot-wise on 6 March 2015. The harvested crop of each plot was bundled separately tagged properly and brought to the clean threshing floor. The bundles were dried to open sunshine, threshed and then grains were cleaned. The grain and straw yields were taken plot-wise and converted into t ha^{-1}. The grain and straw yields were recorded after sun drying to the constant weight. Plant height was measured from ground level to the tip to the upper most spikes and was expressed in cm. Tillers which had at least one leaf visible were counted. It included both productive and non-bearing tillers. The spikes which had at least one grain were considered as effective tillers. The tillers which had no spikes were regarded as non-effective tillers. Presence of any food materials in the spikelet was considered as grain and total number of grains presented in each spikelet was counted. Number of grains $spike^{-1}$ was counted taking ten spikes from the five selected plants of each plot and the average number was recorded. One thousand clean dried grain (14% moisture content) were randomly counted from the seeds obtained from the sample plants and weighted by as electrical balance and was expressed in gram. The grain was measured from 1 m^2 area in each plot (14% moisture content) and was converted into ton $hectare^{-1}$. The sun-dried straw was weighed from the same sample area harvested for grain yield and converted into ton $hectare^{-1}$.

Harvest index is the ratio of economic yield to biological yield and was calculated with the following formula.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Grain yield} + \text{Straw yield}} \times 100$$

Statistical analysis: The collected data were statistically analyzed using analysis of variance technique with the help of computer package programmed MSTAT and significance of mean difference was adjudged by Duncan's Multiple Range test (DMRT) as laid by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of mulching on chlorophyll content of wheat: The Chlorophyll content of wheat was significantly affected by mulching (Figure 1) at 35 and 55 DAT. At 35 DAT, the highest chlorophyll content (35.11) was observed in treatment M_5, which was statistically identical to treatment M_3 (32.33) and M_2 (31.25) and the lowest chlorophyll content (29.23) was obtained from M_4 treatment. At 55 DAT, the highest chlorophyll content (42.05) was observed in treatment M_5 which was statistically identical to treatment M_1 (40.53) and M_2 (39.19) and the lowest chlorophyll content (36.23) was obtained from M_4 treatment.

Effect of organic manure on chlorophyll content of wheat: The Chlorophyll content of wheat was significantly affected by of organic manure (Figure 2) at 35 and 55 DAT. At 35 DAT, the highest chlorophyll content (33.02) was observed in treatment O_5, which was statistically identical to treatment O_4 (32.45) and O_1 (31.78) and the lowest chlorophyll content (30.01) was obtained from O_3 treatment. At 55 DAT, the highest chlorophyll content (41.21) was observed in treatment O_5, which was statistically identical to treatment O_4 (40.29) and O_1 (39.32) and the lowest chlorophyll content (37.69) was obtained from O_3 treatment.

Combined effect of mulching and organic manure on chlorophyll content of wheat: The chlorophyll content of wheat was not significantly affected by combined effect of mulching and organic manure.

Effect of mulching on effective tillers hill^{-1}: Effective tillers hill^{-1} was significantly influenced by mulching (Table 2). The highest (3.85) effective tillers hill^{-1} were recorded in M_5 treatment followed by M_3 (3.14), M_2 (3.11) and M_1 (3.10) treatment and the lowest (2.47) effective tillers hill^{-1} were recorded in M_4 treatment.

Effect of organic manure on effective tillers hill^{-1}: Effective tillers hill^{-1} was significantly influenced by organic manure (Table 3). The highest numbers (3.45) of effective tillers hill^{-1} were recorded in O_5 treatment followed by O_4 treatment and the lowest (2.89) effective tillers hill^{-1} was recorded in O_3 treatment, which was statistically similar to O_2 (3.02).

Combined effect of mulching and organic manure on effective tillers hill^{-1}: Mulching and organic manure significantly affected effective tillers hill^{-1} (Table 4). The highest effective tillers hill^{-1} (4.56) was observed in treatment M_5O_5, while the lowest effective tillers hill^{-1} (2.00) was obtained from M_4O_3 treatment, which was identical to M_4O_2 treatment.

Effect of mulching on number of grains spike^{-1}: Number of grains spike^{-1} was significantly influenced by mulching (Table 2). The highest number of grains spike^{-1} (37.64) were recorded in M_5 treatment, while the lowest (27.37) number of grains spike^{-1} were recorded in M_4 treatment.

Effect of organic manure on number of grains spike^{-1}: Significant variation was observed due to variations in organic manure in terms of number of grains spike^{-1} (Table 3). It was evident that the highest number of grains spike^{-1} (34.50) was given by the treatment O_5, which was statistically similar to O_4 (33.51). The lowest number of grains spike^{-1} (29.53) was given by the treatment O_3.

Combined effect of mulching and organic manure on number of grains spike^{-1}: No significant variation was observed due to the interaction between mulching and organic manure in terms of grains spike^{-1} (Table 4).

Effect of mulching on 1000-grain weight: 1000-grain weight was significantly influenced by mulching (Table 2). The highest 1000-grain weight (46.17 g) was recorded in M_5 treatment, while the lowest 1000-grain weight (38.81 g) was recorded in M_4 treatment. This may occur due to the different water management among the plants.

Effect of organic manure on 1000-grain weight: 1000-grain weight was significantly influenced by organic manure (Table 3). The highest 1000-grain weight (43.32 g) was recorded in O_5 treatment, which was identical to O_4 (42.84 g) and O_1 (42.38 g) treatment and the lowest (39.38 g) 1000-grain weight was recorded in O_3 treatment. Other treatments gave the identical result. This may occur due to the different nutrient management among the plants. Similar result was obtained by Channabasanagowda *et al.* (2007) who reported that vermicompost @ 3.8 t per ha + poultry manure @ 2.45 t per ha recorded significantly higher plant height (86.30 cm), number of leaves (40.50) and higher number of tillers (94.60) at 90 DAS and it also recorded higher number of ear heads per meter square (160.10), 1000 seed weight (42.73 g) and seed yield (3043 kg/ha), vigour index (3223), seedling dry weight (311.27 mg) and protein content (13.41%) of wheat compared to other treatments.

Combined effect of mulching and organic manure on 1000-grain weight: There was no significant interaction effect between mulching and organic manure on the weight of 1000-grains (Table 4).

Effect of mulching on grain yield: Grain yield was significantly influenced by mulching (Table 2). The highest (4.13 t ha^{-1}) grain yield was recorded in M_5 treatment, which was identical to M_3 (4.10 t ha^{-1}), while the lowest (3.60 t ha^{-1}) grain yield was recorded in M_4 treatment. This may occur due to the different environmental factors and cultural management practices. Same result was obtained by Huang *et al.* (2005) who reported that straw mulch increased wheat (*Triticum aestivum* L.) yields significantly during both dry (1997) and wet (1998) years. It increased biomass and grain yield of spring wheat by 37 and 52%, respectively, in 1997, and by 20 and 26%, respectively, in 1998. Straw mulch also significantly decreased evapotranspiration ($P < 0.05$), soil water depletion ($P < 0.01$), and increased water-use efficiency ($P < 0.001$).

Effect of organic manure on grain yield: Grain yield was significantly influenced by mulch (Table 3). The highest (4.21 t ha^{-1}) grain yield was recorded in O_5 treatment, while the lowest (3.60 t ha^{-1}) grain yield was recorded in O_3 treatment. Similar result was found by Hammad *et al*. (2011) who observed that the combination of green manure (GM), farm yard manure (FYM), poultry litter (PL), press mud (PM) and sewage sludge (SS) each @ of 10 t ha^{-1} gave maximum economic yield (3.65 t ha^{-1}), which was 137% more from control. PL and SS each @ 10 t ha^{-1} followed by green manuring should be used as organic manure in wheat crop. Amanullah Jan *et al.* (2011) also reported that the plant height, productive tillers m^{-2}, grains $spike^{-1}$, grain yield, straw yield, and harvest index of wheat were significantly higher in plots which received 30 Mg FYM ha^{-1}.

Combined effect of mulching and organic manure on grain yield: Mulching and organic manure significantly affected Grain yield (Table 4). The highest grain yield (4.46 t ha^{-1}) was observed in treatment M_5O_5, which was statistically identical to treatment M_2O_5 (4.30 t ha^{-1}), M_3O_4 (4.30 t ha^{-1}) and M_3O_5 (4.40 t ha^{-1}). The lowest grain yield (3.20 t ha^{-1}) was obtained from M_4O_3 treatment combination.

Effect of mulching on straw yield: Like the grain yield, straw yield of wheat was also significantly influenced by mulching (Table 2). The highest (8.10 t ha^{-1}) straw yield was recorded in M_5 treatment, while the lowest (5.47 t ha^{-1}) straw yield was recorded in M_4 treatment. Other treatments (M_1, M_2 and M_3) hold the statistically second highest position. This may occur due to the different environmental factors and cultural management practices.

Effect of organic manure on straw yield: Straw yield was significantly influenced by organic manure (Table 3). The highest (7.35 t ha^{-1}) straw yield was recorded in O_5 treatment and the lowest (6.66 t ha^{-1}) straw yield was observed in O_3 treatment.

Combined effect of mulching and organic manure on straw yield: Mulching and organic manure significantly affected straw yield (Table 4). The highest straw yield (8.43 t ha^{-1}) was observed in treatment combination of M_5O_5, which was statistically identical to treatments M_5O_4 (8.34 t ha^{-1}) and M_5O_1 (8.31 t ha^{-1}). The lowest straw yield (5.26 t ha^{-1}) was obtained from M_4O_3 and M_4O_2 treatment combination, which was similar to M_4O_1 and M_4O_4 treatment combinations.

Effect of mulching on harvest index: Different levels of mulching practices exerted significance influence on harvest index (Table 2). The highest harvest index (39.69%) was recorded in M_4 treatment. On the other hand, the lowest value (33.76%) was found in M_5 treatment, which was identical to M_1 (33.95%).

Effect of organic manure on harvest index: Harvest index was significantly influenced by organic manure (Table 3). The highest (36.42%) harvest index was recorded in O_5 treatment, which was statistically similar to O_4 (36.09%) and O_1 (35.72%) treatment and the lowest (35.09%) harvest index was recorded in O_3 treatment, which was statistically similar to O_1 and O_2.

Combined effect of mulching and organic manure on harvest index: There was no significant interaction effect between mulching and organic manure on the harvest index (Table 4). Davari *et al.* (2012) applied the farmyard manure (FYM), vermicompost (VC), FYM + rice residue (RR), VC + RR, FYM + RR + biofertilisers (B), and VC + RR + B. FYM and VC on nitrogen basis (60 kg ha^{-1}), whereas RR was applied at 6 t ha^{-1}. The combinations of FYM + RR + B and VC + RR + B resulted in the highest increased growth and yield attributing characters of wheat and increased grain yield of wheat over the control by 81% and 89% in two successive years.

Table 1. Physical and chemical properties of initial soil (at 0-15cm depth) used for the cultivation of wheat.

Characteristics	Result
A. Physical properties	
Textural class	Silty loam
Sand (%)	15.46
Silt (%)	57.72
Clay (%)	24.85
Moisture (%)	4.08
Field capacity (%)	27.90
Water holding capacity (%)	57.2
Bulk density (g cm^{-3})	1.47
Partial density (g cm^{-3})	2.71
Porosity (%)	45.76
Hydraulic conductivity (cm hr^{-1})	0.68
B. Chemical properties	
pH	6.8
Total N (%)	0.11
Organic carbon	0.68
Available P (mg kg^{-1})	16.72
Available K (cmol kg^{-1})	0.12

Table 2. Effect of mulching on yield and yield contributing characters of wheat.

Mulching	Effective tillers hill^{-1}	No. of grains spike^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
M_1	3.10b	30.84c	42.29b	3.68c	7.16b	33.95c
M_2	3.11b	32.85b	41.41b	4.02b	7.17b	35.92b
M_3	3.15b	32.69b	41.47b	4.10a	7.25b	36.12b
M_4	2.47c	27.37d	38.81c	3.60d	5.47c	39.69a
M_5	3.85a	37.64a	46.17a	4.13a	8.10a	33.76c
CV (%)	6.48	8.90	4.86	2.48	2.06	3.82

Mean values in a column having the similar letter do not differ significantly whereas mean values in having the dissimilar letter differ significantly as per DMRT. M_1 = 1 Irrigation at 17-21 days after sowing (DAS); M_2 = 2 irrigations at 17-21 and 55-60 DAS; M_3 = 3 irrigations at 17-21, 55-60 and 75-80 DAS; M_4 = Control; M_5 = Straw mulch @ 6 t ha^{-1}.

Table 3. Effect of organic manure on yield and yield contributing characters of wheat.

Organic manure	Effective tillers hill^{-1}	No. of grains spike^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
O_1	3.06c	32.55bc	42.38ab	3.94c	7.09b	35.72ab
O_2	3.02cd	31.31c	41.63b	3.72d	6.85c	35.19b
O_3	2.89d	29.53d	39.98c	3.60e	6.66d	35.09b
O_4	3.25b	33.51ab	42.84ab	4.06b	7.19b	36.09ab
O_5	3.45a	34.50a	43.32a	4.21a	7.35a	36.42a
CV (%)	6.48	8.90	4.86	2.48	2.06	3.82

Mean values in a column having the similar letter do not differ significantly whereas mean values in having the dissimilar letter differ significantly as per DMRT; O_1 = recommended chemical fertilizer (NPKS @ 100-23-20-16 kg ha^{-1}); O_2 = poultry manure @ 6 t ha^{-1} (100% PM); O_3 = vermicompost @ 8 t ha^{-1} (100% VC); O_4 = 50% chemical fertilizer + 50% VC; O_5 = 50% chemical fertilizer + 50% PM.

Table 4. Combined effect of mulching and organic manure on yield and yield contributing characters of wheat.

Mulching × Organic manure		Effective tillers hill^{-1}	No. of grains spike^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
	O_1	3.00efg	30.53	42.63	3.80fg	7.30defg	34.22
	O_2	3.00efg	29.97	41.30	3.50h	6.90hi	33.66
M_1	O_3	3.00efg	28.84	40.43	3.40hi	6.67i	33.75
	O_4	3.16de	31.77	43.37	3.80fg	7.40cde	33.93
	O_5	3.33cde	33.10	43.73	3.90ef	7.50cd	34.20
	O_1	3.13def	33.87	41.97	4.00de	7.11fgh	36.58
	O_2	3.00efg	30.60	41.90	3.80fg	7.09gh	36.06
M_2	O_3	2.77fg	30.47	38.49	3.80fg	6.90hi	35.50
	O_4	3.17de	34.37	42.17	4.20bc	7.34cdefg	36.38
	O_5	3.47cd	34.97	42.52	4.30ab	7.37cdef	36.83
	O_1	3.16de	32.67	42.30	4.10cd	7.28defg	36.01
	O_2	3.16de	32.00	40.67	4.00de	7.17efg	35.79
M_3	O_3	3.00efg	31.20	39.12	3.70g	6.86hi	36.23
	O_4	3.16de	33.43	42.40	4.30ab	7.39cde	36.78
	O_5	3.23de	34.17	42.84	4.40a	7.53cd	37.90
	O_1	2.67gh	28.43	39.07	3.70g	5.44k	33.45
	O_2	2.33hi	27.37	38.83	3.30ij	5.26k	34.52
M_4	O_3	2.00i	23.20	37.50	3.20j	5.26k	32.85
	O_4	2.66gh	28.50	39.10	3.80fg	5.48k	33.96
	O_5	2.66gh	29.37	39.57	4.00de	5.89j	33.42
	O_1	3.33cde	37.23	45.93	4.10cd	8.31a	37.50
	O_2	3.60c	36.63	45.47	4.00de	7.83b	36.68
M_5	O_3	3.66c	33.93	44.36	3.90ef	7.59bc	36.77
	O_4	4.10b	39.50	47.17	4.20bc	8.34a	39.49
	O_5	4.56a	40.90	47.93	4.46a	8.43a	40.59
CV (%)		6.48	8.90	4.86	2.48	2.06	3.82

Mean values in a column having the similar letter do not differ significantly whereas mean values in having the dissimilar letter differ significantly as per DMRT. M_1 = 1 Irrigation at 17-21 days after sowing (DAS); M_2 = 2 irrigations at 17-21 and 55-60 DAS; M_3 = 3 irrigations at 17-21, 55-60 and 75-80 DAS; M_4 = Control; M_5 = Straw mulch @ 6 t ha^{-1}; O_1 = recommended chemical fertilizer (NPKS @ 100-23-20-16 kg ha^{-1}); O_2 = poultry manure @ 6 t ha^{-1} (100% PM); O_3 = vermicompost @ 8 t ha^{-1} (100% VC); O_4 = 50% chemical fertilizer + 50% VC; O_5 = 50% chemical fertilizer + 50% PM.

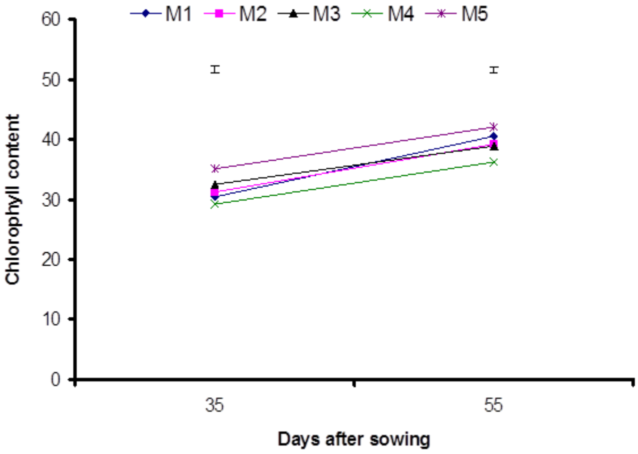

Figure 1. *Effect of mulching on chlorophyll content of wheat. M_1 = 1 Irrigation at 17-21 days after sowing (DAS); M_2 = 2 irrigations at 17-21 and 55-60 DAS; M_3 = 3 irrigations at 17-21, 55-60 and 75-80 DAS; M_4 = Control; M_5 = Straw mulch @ 6 t ha^{-1}.*

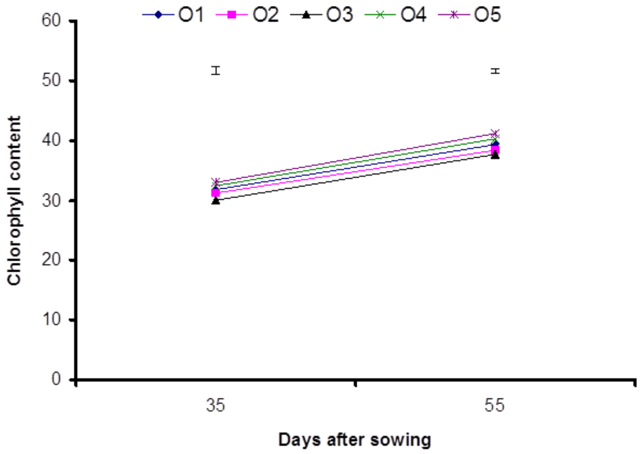

Figure 2. *Effect of organic manure on chlorophyll content of wheat. O_1 = recommended chemical fertilizer (NPKS @ 100-23-20-16 kg ha^{-1}); O_2 = poultry manure @ 6 t ha^{-1} (100% PM); O_3 = vermicompost @ 8 t ha^{-1} (100% VC); O_4 = 50% chemical fertilizer + 50% VC; O_5 = 50% chemical fertilizer + 50% PM.*

Conclusions

Considering the findings it may be concluded that significant variation existed due to the effects of mulching practices and different organic manure management levels in respect to chlorophyll content, effective tillers hill^{-1}, number of grains spike^{-1}, 1000-grain weight, grain yield, straw yield and harvest index; those were higher in mulching treatment (M_5), whereas those parameters gradually declined with the decrease in moisture level. Poultry manure with chemical fertilizers (O_5) in combination of mulching (M_5) produced the highest grain and straw yield of wheat and it took superior position in all other parameters studied including yield components. Therefore, it may be concluded that poultry manure with chemical fertilizers in combination with mulching be used successfully in an integrated way for the successful cultivation of wheat.

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