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Effect of irrigation scheduling and organic source of nutrient on plant growth, yield and quality of wheat (*Triticum aestivum*)

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Abstract
A field experiment was conducted during *Rabi* 2019 at Crop Research Center of Chandigarh University, Gharuan (Mohali) to study the effect of irrigation scheduling and organic source of nutrient on the growth, yield and quality of wheat. The amount of organic sources applied to crop was 15.25 t/ha of vermicompost and 3.75 t/ha of FYM. There were total six treatments comprising of wheat with treatment details were M1: Vermicompost @ 7.5 t/ha, M2: FYM @12.5 t/ha + Vermicompost @ 3.75 t/ha, S1: control, S2: 20-21 DAS irrigation, S3: 20-21 + 50-55 DAS irrigation, S4: 20-21 + 50-55 + 75-80 DAS irrigation. The experiment was laid down in split plot design with three replications with organic source of nutrient as main plots and irrigation scheduling as sub plot treatments. Growth, yield attributes, grain and straw yields of wheat were more in case of treatment of irrigation scheduling was (20-21 + 50-55 + 75-80 DAS). And among different organic nutrient sources, FYM + Vermicompost gave the best results. Highest nitrogen (123 kg/ha), available phosphorus (15.9 kg/ha), and available potassium (249.4 kg/ha) was recorded in irrigation scheduling treatment (20-21 + 50-55 + 75-80 DAS) whereas, the application of nutrient sources, (FYM + vermicompost) recorded highest N (118 kg/ha), P (14.8 kg/ha), K (246.6 kg/ha) at all recorded observations. Highest net returns ₹ 21886 and net returns per rupee invested of ₹ 1.33 was recorded in treatment S4 followed by treatment M2.

Keywords: irrigation scheduling, FYM, vermicompost, growth, yield

Introduction
Wheat is one of the most essential cereal crops grown in the Indo-Gangetic plains and central. India. Since early 1960's, India witnessed a extraordinary increase in wheat productivity owing to adoption of semi-dwarf, non-lodging, disease-resistant, photo-insensitive and fertilizer-responsive varieties coupled with improved agronomical practices. India, today is, the 2nd largest wheat-producing country on the globe. The supply with enough food having sufficiently good quality is one of the most important problems in the world today.
Since mid-80's, yield has started stagnating or even declining and in the last few years in a row, there has been a wide gap amongst the target and reliable production (Pathak *et al.* 2003) [2]. The changes in policy with regard to inputs and globalization circumstances created a questionable situation on achieving the 109 million tonnes target requirement by 2020 (Nagarajan, 2005) [1]. The production and productivity of wheat in north India varies spatially with latitude and longitude. Since wheat in north India is grown after rainy time of year and on soils deprived in organic carbon and presented nitrogen, it is necessary to apply irrigation and fertilizers, particularly nitrogen. Sufficient and timely water application is a critical pre-requisite for proper plant growth for augmenting crop yield. Though more than 70% of the wheat-grown areas are irrigated today and as cultivars vary widely, fertilizer and irrigation also have got differential responses. To connect the gaps between the targeted and genuine yields of wheat, scientific understanding of these responses across the locations is very much necessary. Therefore, keeping the facts in the view the experiment was conducted to see the performance of wheat variety PBW-343 under various organic sources of nutrient and irrigation scheduling.

Materials and methods
This experiment was conducted during the 2019-2020 *Rabi* season at University farm, University Institute of Agricultural Sciences, Chandigarh University, Gharuan (Punjab) to study the effect of irrigation scheduling and organic source of nutrient on growth, yield and quality of wheat (*Triticum aestivum*). The experiment was laid out in a split plot design with three replications having a plot size of 5m x 2m. Row spacing of 20 cm was maintained. Wheat variety PBW-343 was sown at the rate 100 kg ha-1 on 14-12-2019. Farm yard manure and Vermicompost were incorporated in soil during seed bed preparation.
During this study two different organic nutrient sources i.e. (M1) Farm yard manure and (M2) Farm yard manure + vermicompost in main plot and four different time of irrigation i.e. (S1) Control, (S2) 20-20 DAS irrigation, (S3) 20-21 + 50-55 DAS irrigation, (S4) 20-21 + 50-55 + 75-80 DAS irrigation were evaluated. Data was analyzed for growth and yield attributing characters like plant height (cm), dry matter accumulation (m^2), leaf area index, number of effective tillers (m^2), number of spikelets/spikes, test weight and grain yield were recorded. The data recorded on different aspects in the present study was subjected to the statistical analysis using analysis of variance as per procedure recommended by Gomez and Gomez (1984).

Results and Discussion

Effect of irrigation scheduling and organic sources of nutrient on growth parameters (plant height, leaf area index, and dry matter accumulation), yield (grain) and yield attributes (number of effective tillers, test weight, number of spikelets/spike).

Plant Height

The increase in plant height (table 1) was reported maximum between 60 to 90 DAS and thereafter it was only marginal to harvest. The highest plant height was observed in irrigation treatment (20-21 + 50-55 + 75-80 DAS) with 7.91cm, 56.27cm, 69.77cm, and 70.06cm plant height at 30, 60, 90 DAS and at harvest, respectively. It was significantly superior to other treatments at all the recorded observations. Minimum plant height of wheat was recorded in treatment (control). Among the organic nutrient sources, maximum plant height was recorded in treatment (farm yard manure + vermicompost) with 6.36cm, 53.43cm, 63.48cm and 61.51cm at 30, 60, 90 DAS and at harvest respectively. It was significantly superior to other treatments at all the recorded observations. This might be due to the fact that vermicompost contain growth promoting hormones which may help in more nutrient uptake by the plant and this could bring a positive effect on crop growth. Similar findings were obtained by Agarwal *et al.* (2003) [3]. Plant height increased successively from 30 DAS up to harvest with advancement in the age of the crop irrespective of nutrient sources.

Table 1: Effect of irrigation scheduling and organic nutrient sources on plant height, dry matter accumulation, and leaf area index.

Treatments	Plant height (Harvesting)	Dry matter accumulation (Harvesting)	Leaf area index (90 DAS)
Organic sources of nutrient			
Vermicompost	56.85	613.73	2.00
Farm yard manure + Vermicompost	61.51	670.81	2.74
CD (P=0.05)	4.36	16.18	0.42
Irrigation time			
Control	43.50	546.92	1.98
20-21 DAS	58.96	624.35	2.02
20-21 + 50-55 DAS	64.20	656.43	2.42
20-21 + 50-55 + 75-80 DAS	70.06	741.38	3.06
CD (P=0.05)	4.79	13.36	0.26

Dry matter accumulation

The data (table 1) depicted that dry matter accumulation increased progressively with the advancement of crop growth up to harvest, the maximum increase being recorded between 90 DAS and harvest. The results revealed that the highest dry matter accumulation was recorded in irrigation treatment (20-21 + 50-55 + 75-80 DAS) from 30 DAS till harvest (49.82gm/m^2) to (741.38g/m^2), which was significantly superior to all the treatments. Among the organic sources of nutrient treatment (Farm yard manure + Vermicompost) recorded highest dry matter accumulation at 30, 60, 90 DAS and at harvest (45.32g/m^2, 208.58g/m^2, 382.58g/m^2, and 670.81g/m^2), which was significantly superior to all the organic treatments. Frequently irrigated treatment (i.e., 20-21 + 50-55 + 75-80 DAS) provided adequate soil moisture coinciding with crown root initiation, late tillering, jointing, flowering, milky and grain filling stages which have been identified as critical stages and have effect on dry matter accumulation for water in wheat growth. The present results are in accordance with the findings of Kaur *et al.* (2018) [6].

Leaf area index (LAI)

The data (table 1) depicted that the LAI increased with the advancement of crop stages reaching peak value at 90 DAS. At 90 DAS highest LAI was calculated in treatment (20-21 + 50-55 + 75-80 DAS) is 3.06, which was significantly superior to all the treatments, whereas the lowest was recorded under control (1.98). Among the organic nutrient sources, maximum LAI was recorded in treatment (farm yard manure + vermicompost) with 1.40, 2.12 and 2.74 at 30, 60, 90 DAS and at harvest respectively, which was statistically significant to all organic nutrient sources. And lowest was recorded under vermicompost only at all observations. The results are in congruence with that of Davari *et al.* (2012) [5], this might be due to the fact of recommended dose of organic source (Vermicompost @ 3.75t/ha + Farm yard manure @ 12.5t/ha) effect on the leaf area index LAI of wheat plants at different growth stage.

Number of effective tillers

Critical analysis of data (table 2) revealed that effective tillers markedly increased with irrigation application by various days. The maximum number of effective tillers was recorded in treatment (20-21 + 50-55 + 75-80 DAS) that is (387.00 per m^2), which was significantly superior to all the treatments, whereas the lowest was recorded under control (342.00 per m^2). Among the organic sources of nutrients, the treatment (Farm yard manure + Vermicompost) recorded maximum number of tillers (374.83 per m^2) which was statistically superior to all other organic treatment and followed by treatment (vermicompost) that is (362.92 per m^2). The number of effective tillers per meter square was significantly different for all the respective treatments. Among organic sources, vermicompost + FYM treated plots recorded the highest yield attributing parameters which might be due to more NPK content in vermicompost as compared to other organic sources which ultimately increased the growth, yield attributes of wheat crop Neelam *et al.* (2015).

Number of spikelets/spike

The data (table 2) of number spikelets/spike was significantly affected by irrigation and organic sources of nutrient of wheat crop. The maximum number spikelets/spike was recorded in the treatment of irrigation (20-21 + 50-55 + 75-80 DAS) that is (19.37) spikelets/spike, which was the superior in all the treatments, whereas the lowest was recorded in the control that is (10.32) spikelets/spike. Among the organic sources of nutrient the highest number of spikes was recorded in treatment (Farm yard manure + Vermicompost) that is (16.57)

spikelets/spike. This may be due to the fact that Farm Yard Manure and vermicompost yielded superior results as reported by Bipin *et al.* (2012).

Table 2: Effect of irrigation scheduling and organic nutrient sources on number of effective tillers, number of spikelets/spike, test weight, and grain yield.

Treatments	Number of effective tillers	Number of spikelets/spike	Test weight	Grain yield
Organic sources of nutrient				
Vermicompost	362.92	13.80	33.33	38.71
Farm yard manure + Vermicompost	374.83	16.57	35.93	40.32
CD (P=0.05)	4.82	1.58	1.71	0.61
Irrigation time				
Control	342.00	10.32	27.38	27.98
20-21 DAS	370.00	15.33	35.88	37.21
20-21 + 50-55 DAS	376.50	15.72	36.30	37.70
20-21 + 50-55 + 75-80 DAS	387.00	19.37	38.93	45.16
CD (P=0.05)	6.39	1.72	2.14	5.41

Test weight

The given data (table 2) revealed that the highest test weight (1000 grain weight) was recorded in treatment (20-21 + 50-55 + 75-80 DAS) that is 38.93 g, which was significantly superior to other treatments, whereas the lowest test weight was recorded in the control (27.38 g). Among the organic sources of nutrient the highest grain weight was recorded in treatment (Farm yard manure + Vermicompost) that is 35.93g. This may be due to the fact that Farm Yard Manure and vermicompost yielded superior results as reported by Hooda *et al.* (2019).

Grain yield

A perusal of the data (table 2) revealed that highest grain yield was recorded in treatment (20-21 + 50-55 + 75-80 DAS) with 45.16 q/ha, which was significantly higher than other sources of treatments, whereas the lowest grain yield was produced in control (27.98 q/ha). Among organic nutrient sources the treatment (Farm yard manure + Vermicompost) recorded highest grain yield (40.32 q/ha), which was significantly superior over the treatment in which only vermicompost is applied, that is (33.71 q/ha). Verma *et al.* (2018) [4] also observed that application of vermicompost significantly improves the yield and yield characters of wheat as compared to other organic sources.

Conclusion

It was concluded that the treatment (20-21 + 50-55 + 75-80 DAS) irrigation has given superior results in irrigation scheduling. Among the organic nutrient sources FYM + vermicompost has given the higher yield and superior results. And also the net returns and B: C ratio was recorded highest in treatment S4 in irrigation scheduling and M2 amongst the organic nutrient sources.

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