

Original Research Article

Study on the effect of Vermicompost and Municipal Compost integrated with Inorganic Fertilizer on plant growth of Wet Season Rice.

Abstract

The field experiment was conducted during the wet season (kharif) of 2020 at the Regional Research Sub-Station (RRSS), BCKV, Chakdaha, West Bengal, India. Design of the experiment was Randomized Block Design (RBD) with six treatment combinations replicated four. The treatments were T_1 = 100% Recommended Dose of Fertilizer (RDF) (N: P_2O_5 : K_2O @ 60:30:30 kg ha⁻¹), T_2 = 100% N from Vermicompost @ 3.75 t ha⁻¹, T_3 = 100%N from Municipal Compost @ 3.75 t ha⁻¹, T_4 = 50% N (from inorganic source) + 50% N (from Vermicompost), T_5 = 50% N (from inorganic source) + 50% N (from Municipal Compost), T_6 = Control (no fertilizer and no compost). Almost in all cases the growth parameters varied significantly. The plant height increases with the advancement of date and attains significantly high plant height in T_1 treatment (56.60 cm at 30 DAT and 89.25cm at 60 DAT respectively) but at 90 DAT highest plant height attained in T_4 treatment (108.60 cm). Maximum significant number of tillers was found at T_1 treatment (15.20 and 16.20 at 60 and 90 DAT respectively). Regarding Dry Matter Production significantly highest dry matter was observed at 60 DAT (335.50g m⁻²) in both T_1 and T_4 treatment. At 30 DAT and 90 DAT it was observed highest in T_4 treatment (151.20 and 440.60g m⁻² respectively). Similar trend was also observed in case of Crop Growth Rate (CGR). LAI was highest in T_1 treatment followed by T_4 treatment in all the 3 dates. Therefore it may be concluded that 50% organic manure with vermicompost or municipal compost were economical, which may improve the soil characteristics.

Keywords: Plant height, Number of tillers m⁻², Dry matter production, Leaf Area Index, Crop Growth Rate

Introduction

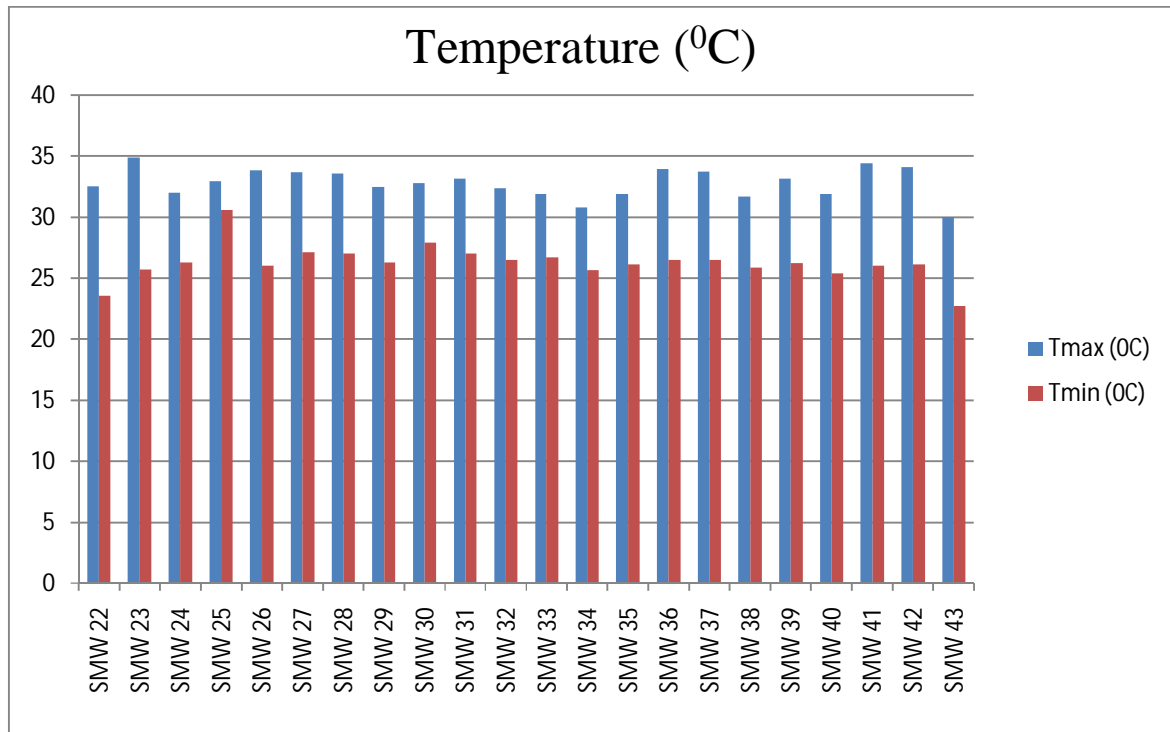
Organic composts, in general, are beneficial to soil fertility and micro fauna when applied continuously. They improve the physico – chemical, enzymatic and microbiological status and in due course result in the well – defined improvement of crop growth and yield. The production and use of vermicompost in agriculture is economical with regard to food production and more eco-friendly with regard to environment and soil protection (Ajaykumar and Sivakumar, 2020). Through the process of vermicomposting, many different kinds of organic wastes can be made into valuable vermicompost. The nutrient level, especially the macro and micronutrients were found to be always higher in vermicomposts than the compost derived from other methods (Bejbaruah et al., 2013). The present study determine the effect of Vermicompost and Municipal Compost integrated with Inorganic Fertilizer on plant growth of Wet Season Rice.

Materials and Methods

The field experiment was conducted at Regional Research Sub-Station (RRSS), Chakdaha, Nadia under Bidhan Chandra KrishiViswavidyalaya, Mohanpur, West Bengal, where the experiment was conducted is situated at 23^o 5.3'N latitude and 83^o 5.3'E longitude and at an elevation of 9.75 meters above the mean sea level (MSL) in the new alluvial zone (NAZ) of West Bengal.

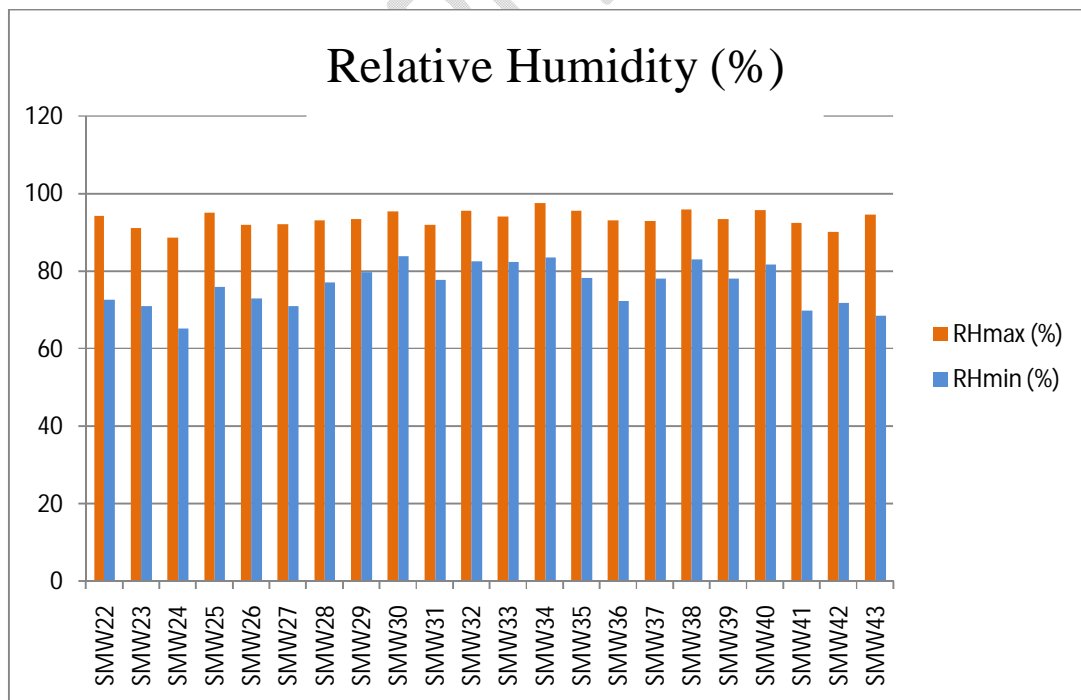
Meteorological parameters during the period of experimentation

The experiment site is under humid subtropical climatic condition. The details regarding meteorological parameters during the period of experimentation is given below:



(SMW= Standard Meteorological Week, T_{max} = Maximum Temperature, T_{min} = Minimum Temperature, °C= Degree Celsius)

Fig. 1: Maximum and minimum temperature(°C) during the period of experimentation (June to October 2020)



(SMW= Standard Meteorological Week, RH_{max} = Maximum Relative Humidity (%), RH_{min} = Minimum Relative Humidity (%))

Fig. 2: Maximum and minimum Relative Humidity (%) during the period of experimentation (June to October 2020)

Table 1: The initial Physico-chemical properties of the experimental soil (0-15 cm soil depth)

Sl. No.	Particulars	Result	Analytical method employed
1.	Mechanical composition		Bouyoucos hydrometer method (Piper, 1950)
	Sand (%)	46.50	
	Silt (%)	25.00	
	Clay (%)	28.50	
2.	Soil texture	Sandy clay loam	USDA system (Brady, 1950)
3.	Electrical conductivity or EC (dSm ⁻¹)	0.61	Conductivity bridge method
4.	Soil pH (in 1:2.5 soil water suspension)	7.05	Beckman's pH meter method (Jackson, 1973)
5.	Organic carbon (%)	0.68	Walkey and Black's rapid titration method (Jackson, 1973)
6.	Total N (%)	0.052	Macro-kjeldahl method (Jackson, 1973)
7.	Available P (kg ha ⁻¹)	16.00	Olsen's method (Black, 1965)
8.	Available K (kg ha ⁻¹)	129.00	Ammonium acetate method (Jackson, 1973)

Table 2 : History of previous cropping

Year	Pre-kharif season	Kharif season	Rabi season
2015-2016	Sesamum	Rice	Rice
2016-2017	Mustard	Rice	Rice
2017-2018	Lathyrus	Rice	Rice
2018-2019	Mustard	Rice	Rice
2019-2020	Lentil	Rice	Rice

Table 3 : Details of the experiment

Crop growing season	Kharif 2020
Design of the experiment	Randomized Block Design (RBD)
Number of replications	Four
Number of treatments	Six

Number of varieties	One, i.e., Satabdi (IET 4786)
Total number of plots	Twenty four
Plot size	5 m x 4 m
Spacing	20 cm x 15 cm
Recommended dose of fertilizers (RDF)	60:30:30 Kg N:P ₂ O ₅ :K ₂ O ha ⁻¹
Dose of Vermicompost	3.75 t ha ⁻¹
Dose of municipal compost	3.75 t ha ⁻¹

Table 4 : Treatment details of the experiment

Treatments	Details
T₁	100% NPK, i.e, 60: 30: 30 Kg N:P ₂ O ₅ :K ₂ O ha ⁻¹
T₂	100% N from Vermicompost
T₃	100%N from Municipal Compost
T₄	50% N (inorganic source) + 50% N (from Vermicompost)
T₅	50% N (inorganic source) + 50% N (from Municipal Compost)
T₆	Control (no fertilizer and no compost)

Agronomic management followed in the experiment

Table 5: Application of organic and inorganic fertilizer in the seed bed

Organic/ Inorganic fertilizer	Amount (kg 100 m⁻²)		
	Before seed sowing	15 days after sowing	7 days before seedling uprooting
FYM	200.0	-	-
Urea	1.5	1.5	0.5
SSP	4.0	-	-
MOP	1.0	-	-

Pre-harvest observations

Plant height, Number of tillers m⁻², Dry matter production, Leaf Area Index, Crop Growth Rate at 30, 60 And 90 DAT.

Table 6 : Pre-harvest observations for different parameters

Sl. No.	Parameters	Time of observation
1.	Plant height	30, 60 And 90 DAT
2.	Number of tillers m ⁻²	30, 60 And 90 DAT
3.	Dry matter production (g m ⁻²)	30, 60 And 90 DAT

4.	Leaf Area Index (LAI)	30, 60 And 90 DAT
5.	Crop Growth Rate($\text{g m}^{-1} \text{ day}^{-1}$)	30, 60 And 90 DAT

Methods of calculating growth attribute

Plant height

For calculating height, ten randomly selected plants were taken in each individual plot. Then average height was calculated. A total of three observations were taken at 30, 60 and 90 DAT.

Number of tillers hill⁻¹

Four hills were selected randomly from each plot and tillers were counted at 30, 60 and 90 DAT. From the observations, average number of tillers hill⁻¹ was calculated.

Dry matter production

To determine the dry matter accumulation, plant samples were collected from each plot at 30, 60 and 90 DAT. Samples were cut at the ground level by using sickle. After that, leaves and stems were separated and put in paper packets with proper labeling to identify the individual plots. Then they were over dried at 70°C for 12 hours and their dry weights were measured. After that, the dry matter accumulation m^{-2} was calculated.

Leaf Area Index (LAI)

Ten samples of green leaf lamina from four hills of each plot were separated, a rectangular bit of 10 cm length were cut from ten leaves. Leaf weights were taken from middle portion of leaf having more or less similar, breadth, width of each cut leaf was measured. After that, the whole amount of the area-weight relationship was calculated. By using the relationship, leaf area of the leaf samples were measured.

Leaf Area Index (LAI) is the area of leaf surface per unit area on land surface. It can be calculated for each treatment and each plot at different growth stages. Leaf Area Index (LAI) was calculated from area-weight relationship using the formula given by Watson (1958).

$$\text{LAI} = \frac{\text{Leaf area of plants in unit area (cm}^2\text{)}}{\text{Ground surface in unit area (cm}^2\text{)}}$$

Crop Growth Rate (CGR)

Each and every time, one hill was collected randomly from each plot. Then the crop growth rate was recorded on dry weight basis. It is calculated using the following formula:

$$\text{CGR} = \frac{W_2 - W_1}{P (t_2 - t_1)}$$

Where,

W_1 and W_2 - Whole plant dry weight at time t_1 and t_2 respectively

P- Ground area occupied by the plant (m^2)

t_1 and t_2 - Time interval in days

Results and Discussion

The observations which were recorded and analyzing all the data of the field experiment of the thesis entitled “Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganic fertilizer on growth and yield of wet season rice” are presented and discussed in this chapter.

Growth attributes

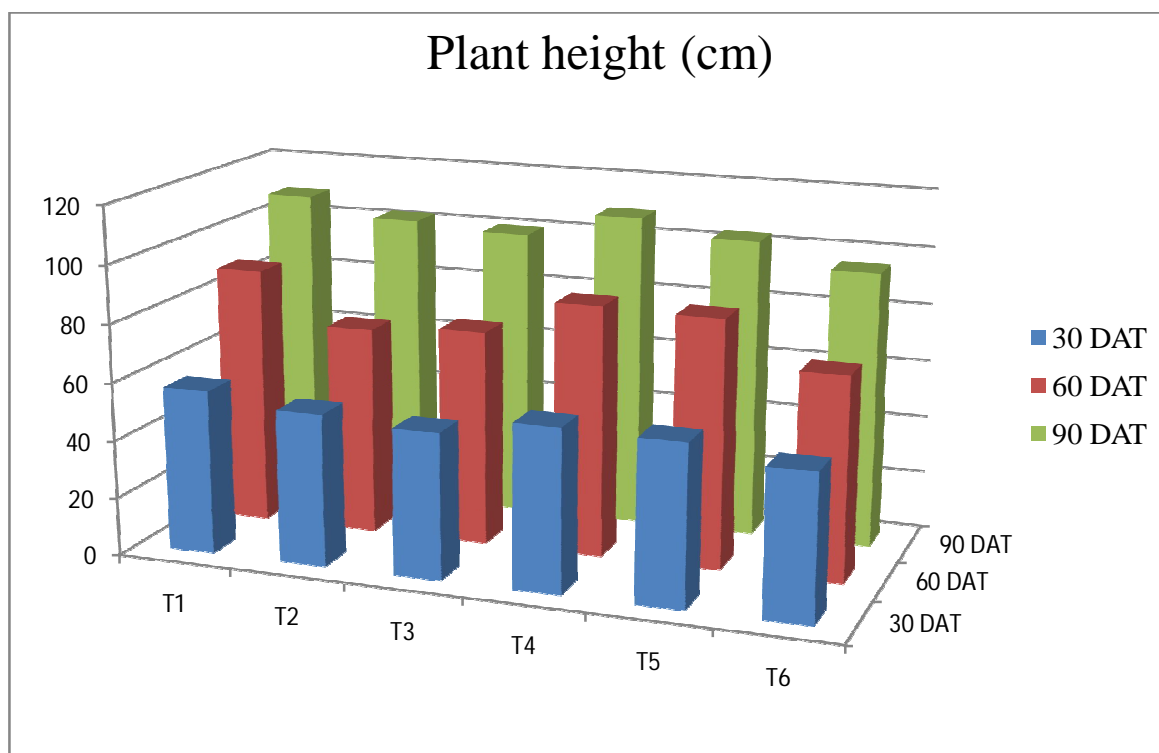
Plant height (cm)

The plant heights of the different dates of transplanting were significantly differed among the different treatment combinations and also with the different dates of transplanting except at early growth stages of plant growth. The plant height ranges from 50.00 cm to 56.60 cm, 70.25 cm to 89.25 cm and 95.20 cm to 108.60 cm at 30 DAT, 60 DAT and 90 DAT respectively (Table 7). At 60 DAT plant height attains maximum (89.25) in the treatment T₁ i.e., 100% recommended doses of fertilizer which was at par with T₄ (50% RDN + 50 % N from vermicompost) and T₅ (50% RDN + 50 % N from Municipal compost) respectively. The plant height at 30 and 60 DAT in T₁, T₄ and T₅ treatment were 56.60, 56.03, 55.19 and 89.25, 86.50, 85.62 respectively. Mahmud *et al.* (2016) opined that the chemical fertilizer had a significant effect on plant height. The trend of increase of plant height is more in the peak crop growth stage i.e., 60-90 DAT than 30-60 DAT. The maximum plant height 108.60 cm was attained with the application of 50% chemical fertilizer along with the application of 50% organic nitrogen from vermicompost source i.e. the T₄ treatment at 90 DAT. Similar observation also reported by Sultana *et al.* (2021). In all the three dates, lowest plant height was observed in the control plot (treatment T₆) where no chemical fertilizer or organic compost was used.

Table 7: Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganic fertilizer on plant height (cm) of wet season rice

Treatment	Plant height (cm)		
	30 DAT	60 DAT	90 DAT
T ₁	56.60	89.25	108.55
T ₂	52.45	71.76	102.34
T ₃	50.20	74.20	100.05
T ₄	56.03	86.50	108.60
T ₅	55.19	85.62	103.20
T ₆	50.00	70.25	95.20
S.Em (±)	3.213	4.197	2.250
CD (P=0.05)	NS	12.651	6.782

(T₁= 100% RDF, T₂= 100% N from Vermicompost, T₃= 100%N from Municipal Compost, T₄= 50% N (inorganic source) + 50% N (from Vermicompost), T₅= 50% N (inorganic source) + 50% N (from Municipal Compost), T₆= Control (no fertilizer and no compost))



(T_1 = 100% RDF, T_2 = 100% N from Vermicompost, T_3 = 100%N from Municipal Compost, T_4 = 50% N (inorganic source) + 50% N (from Vermicompost), T_5 = 50% N (inorganic source) + 50% N (from Municipal Compost), T_6 = Control (no fertilizer and no compost))

Fig. 3 : Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganicfertilizer on plant height of wet season rice

Number of tillers hill⁻¹

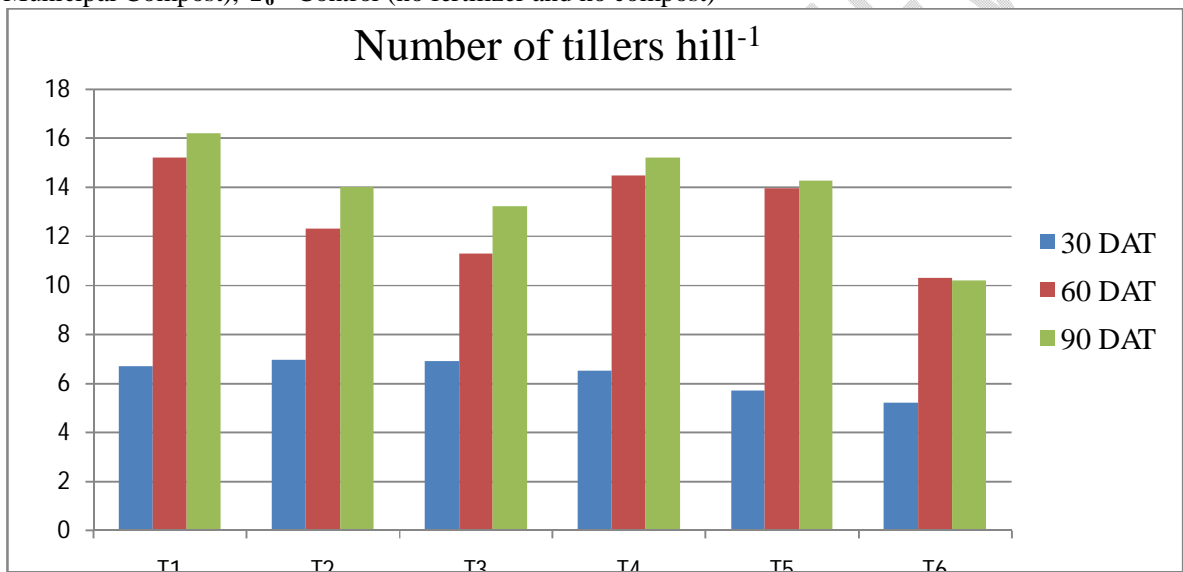
The number of tillers hill⁻¹ differs significantly among the different dates of transplanting. Though the initial crop growth stage i.e. 30 DAT, did not differ significantly. The number of tillers hill⁻¹ ranges from 5.20 to 6.95 in control treatment and the treatment receiving 100% nitrogen from vermicompost i.e. treatment T_2 in 30 DAT. But the maximum numbers of tillers hill⁻¹ were 15.20 and 16.20 respectively in the treatment T_1 (Table 7) in 60 and 90 DAT respectively. The trend of increment in number of tillers hill⁻¹ is with the advancement of the crop growthstage. Singh and Bharadwaj (2007) opined the similar observation as is found in their field study. During 60 DAT the range of number of tillers hill⁻¹ significantly varied among the different treatment combinations and it ranges from 10.30 in control treatment (T_6) to 15.20 in 100% RDF application i.e. treatment T_1 . Similar observation was also recorded in 90 DAT though the rate of increment is bit slower than 30 DAT to 60 DAT (Table 8). Mahmud *et al.* (2016) also reported that application of chemical fertilizer has a significant effect on tiller number.

Table 8: Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganicfertilizer on number of tillers hill⁻¹ of wet season rice

Treatment	Number of tillers hill ⁻¹		
	30 DAT	60 DAT	90 DAT

T₁	6.70	15.20	16.20
T₂	6.95	12.30	14.00
T₃	6.90	11.30	13.20
T₄	6.50	14.50	15.20
T₅	5.70	13.95	14.26
T₆	5.20	10.30	10.20
S.Em (±)	0.451	1.059	1.026
CD (P=0.05)	NS	3.192	3.093

(**T₁**= 100% RDF, **T₂**= 100% N from Vermicompost, **T₃**= 100%N from Municipal Compost, **T₄**= 50% N (inorganic source) + 50% N (from Vermicompost), **T₅**= 50% N (inorganic source) + 50% N (from Municipal Compost), **T₆**= Control (no fertilizer and no compost)



(**T₁**= 100% RDF, **T₂**= 100% N from Vermicompost, **T₃**= 100%N from Municipal Compost, **T₄**= 50% N (inorganic source) + 50% N (from Vermicompost), **T₅**= 50% N (inorganic source) + 50% N (from Municipal Compost), **T₆**= Control (no fertilizer and no compost)

Fig 4: Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganic fertilizer on number of tillers hill⁻¹ of wet season rice

Dry matter production (g m⁻²)

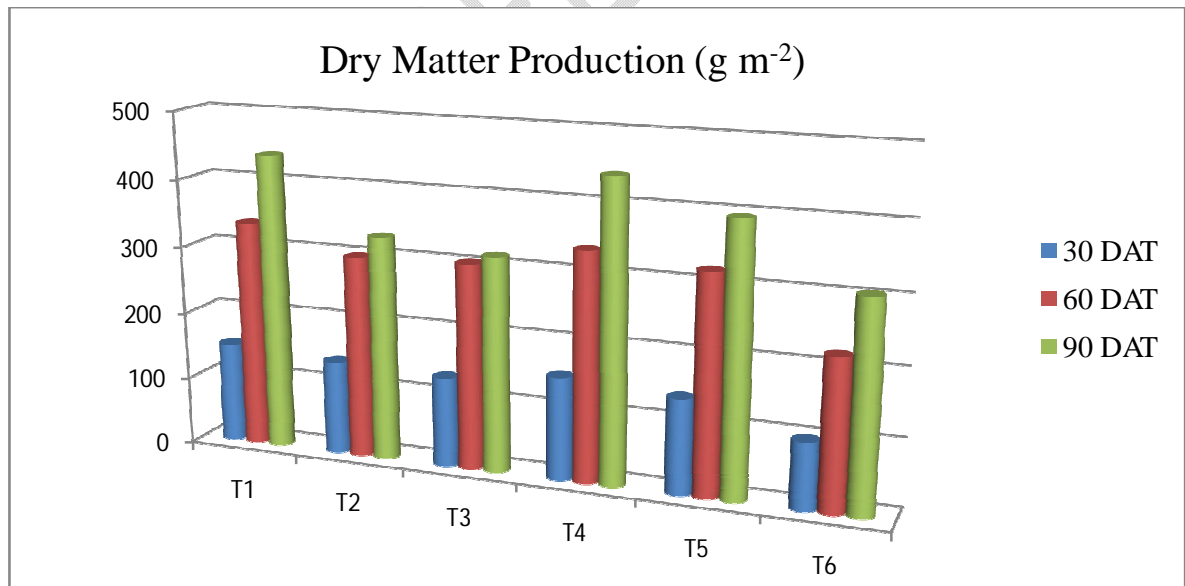
Dry matter production varied significantly among the different dates of transplanting. However, maximum dry matter production was with the application of the treatment receiving 50% N from inorganic source along with 50% N from vermicompost (T₄) in all the three dates of observation. Dry matter production ranges from control treatment to T₄ was 98.50 to 151.20, 220.30 to 335.50 and 305.20 to 440.60 g m⁻² at 30, 60 and 90 DAT respectively (Table 9). Percentage increase in the treatment T₄ i.e. 50% N (inorganic source) + 50% N (from Vermicompost) over control at 30 DAT, 60 DAT and 90 DAT were 53.30, 52.29 and 44.36 respectively. The increment of dry matter production was more during the early crop growth stages than the later stages. Dry matter production increased with the application of 50% inorganic along with the 50% organic either vermicompost or municipal compost. Similar observation was also reported by (Ghoshet *al.*, 1994). In all the three dates of observations (30, 60 and 90 DAT) T₄ and T₅ i.e. 50% of RDN along with 50% either vermicompost or

municipal compost were at par. But in all cases T_4 i.e. 50% nitrogen from vermicompost along with 50% RDN showed maximum response in dry matter production.

Table 9: Effect of Vermicompost vis-à-vis Municipal compost integrated with inorganic fertilizer on Dry Matter Production (g m^{-2}) of wet season rice

Treatment	Dry Matter Production (g m^{-2})		
	30 DAT	60 DAT	90 DAT
T_1	148.60	335.50	438.20
T_2	138.25	298.20	330.40
T_3	132.02	302.50	315.50
T_4	151.20	335.50	440.60
T_5	139.40	320.50	395.05
T_6	98.50	220.30	305.20
S.Em (\pm)	9.718	20.400	30.854
CD (P=0.05)	29.293	61.492	93.004

(T_1 = 100% RDF, T_2 = 100% N from Vermicompost, T_3 = 100%N from Municipal Compost, T_4 = 50% N (inorganic source) + 50% N (from Vermicompost), T_5 = 50% N (inorganic source) + 50% N (from Municipal Compost), T_6 = Control (no fertilizer and no compost))



(T_1 = 100% RDF, T_2 = 100% N from Vermicompost, T_3 = 100%N from Municipal Compost, T_4 = 50% N (inorganic source) + 50% N (from Vermicompost), T_5 = 50% N (inorganic source) + 50% N (from Municipal Compost), T_6 = Control (no fertilizer and no compost))

Fig 5: Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganic fertilizer on Dry Matter Production (g m^{-2}) of wet season rice

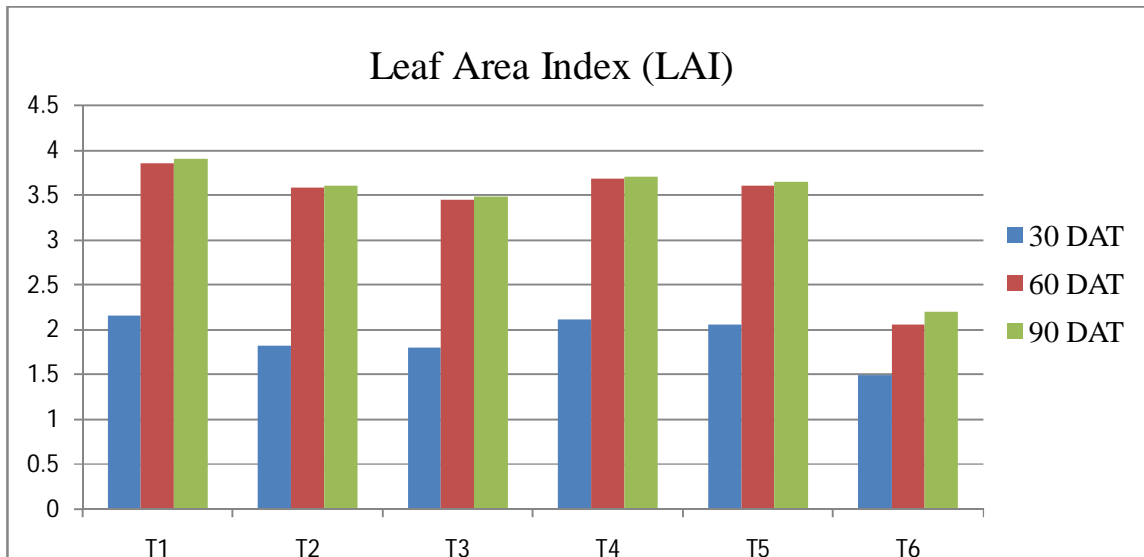
Leaf Area Index (LAI)

Leaf area index (LAI) varied significantly among the different treatments in all the dates of transplanting (Table 10). Though in early growth stages i.e. 30 DAT it was not significant, during peak growth period i.e. 60 DAT, leaf area index (3.85) was significantly recorded maximum in T₁ treatment where 100% recommended dose of chemical fertilizer was applied followed by T₄ (3.68) where 50% chemical fertilizer along with 50% nitrogen from vermicompost was applied. At both 30 and 60 DAT also maximum leaf area index were in T₁ treatment (2.15 and 3.85 respectively) followed by T₄ treatment (2.11 and 3.68 respectively). Minimum leaf area index was attained in control treatment where there was no application of any nutrients. Murthy *et al.* reported during his study on (1991) that leaf area index was attained its peak at early growth stages. As the growth increases the leaf area index gradually decreases as it enters into the sensitive stages. The increment of leaf area index on 60 DAT and 90 DAT was not wider. However highest leaf area index was attained 3.90 at 90 DAT in T₁ treatment followed by 3.70 in T₄ treatment where 50% chemical fertilizer along with 50% nitrogen from vermicompost was applied. Roulet *et al.* (2007) in his field study also reported that leaf area index was maximum during the application of recommended doses of chemical fertilizer.

Table 10: Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganic fertilizer on Leaf Area Index (LAI) of wet season rice

Treatment	Leaf Area Index (LAI)		
	30 DAT	60 DAT	90 DAT
T ₁	2.15	3.85	3.90
T ₂	1.82	3.58	3.60
T ₃	1.80	3.45	3.48
T ₄	2.11	3.68	3.70
T ₅	2.05	3.60	3.65
T ₆	1.49	2.05	2.20
S.Em (±)	0.258	0.357	0.331
CD (P=0.05)	NS	1.076	0.998

(T₁= 100% RDF, T₂= 100% N from Vermicompost, T₃= 100%N from Municipal Compost, T₄= 50% N (inorganic source) + 50% N (from Vermicompost), T₅= 50% N (inorganic source) + 50% N (from Municipal Compost), T₆= Control (no fertilizer and no compost))



(**T**₁= 100% RDF, **T**₂= 100% N from Vermicompost, **T**₃= 100%N from Municipal Compost, **T**₄= 50% N (inorganic source) + 50% N (from Vermicompost), **T**₅= 50% N (inorganic source) + 50% N (from Municipal Compost), **T**₆= Control (no fertilizer and no compost))

Fig 6: Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganicfertilizer on Leaf Area Index (LAI) of wet season rice

Crop growth rate ($\text{g m}^{-1} \text{day}^{-1}$)

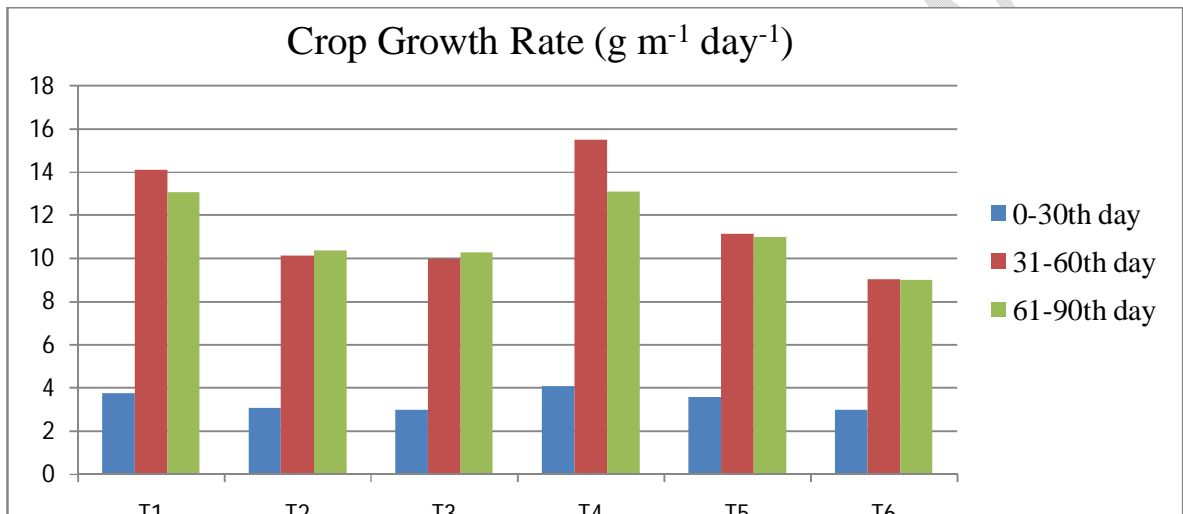
Crop growth rate was also significantly differs among the three dates of transplanting like dry matter accumulation. However, the ranges among the treatments were 3.00 to 4.10 at 0-30 DAT, 9.05 to 15.53 at 31-60 DAT and 9.04 to 13.11 at 61-90 DAT respectively. The percent increase over control to the maximum crop growth rate in three respective dates of transplanting was 36.67, 71.60 and 45.02 respectively. As dates advances from transplanting to harvesting the CGR increases upto 31-60 DAT and then showed declining trend as found in dry matter production. Maximum crop growth rate was recorded during the peak crop growth. From the table 11, it has been found that **T**₄ i.e. 50% N from inorganic source + 50% RDN from vermicompost applied plot showed better result. In all the three dates **T**₄ treatment gave highest crop growth rate (4.10,15.53 and 13.11 at 0-30, 31-60 and 61-90 DAT respectively).Borah *et al.* (2016) also reported that combined effect of inorganic along with organic either in the form of vermicompost or FYM lead to more all the growth parameters as height of the plant, leaf area index, higher dry matter production, crop growth rate and also yield parameters which ultimately reflected the higher grain production.

Table 11: Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganicfertilizer on Crop Growth Rate ($\text{g m}^{-1} \text{day}^{-1}$) of wet season rice

Treatment	Crop Growth Rate ($\text{g m}^{-1} \text{day}^{-1}$)		
	0-30 DAT	31-60DAT	61-90DAT
T ₁	3.80	14.13	13.10
T ₂	3.10	10.15	10.40
T ₃	3.00	10.00	10.30

T₄	4.10	15.53	13.11
T₅	3.60	11.15	11.00
T₆	3.00	9.05	9.04
S.Em (±)	0.009	0.01	0.141
CD (P=0.05)	0.026	0.300	0.402

(T₁= 100% RDF, T₂= 100% N from Vermicompost, T₃= 100%N from Municipal Compost, T₄= 50% N (inorganic source) + 50% N (from Vermicompost), T₅= 50% N (inorganic source) + 50% N (from Municipal Compost), T₆= Control (no fertilizer and no compost)



(T₁= 100% RDF, T₂= 100% N from Vermicompost, T₃= 100%N from Municipal Compost, T₄= 50% N (inorganic source) + 50% N (from Vermicompost), T₅= 50% N (inorganic source) + 50% N (from Municipal Compost), T₆= Control (no fertilizer and no compost)

Fig 7: Effect of Vermicompost vis-à-vis Municipal Compost integrated with inorganic fertilizer on Crop Growth Rate (g m⁻¹ day⁻¹) of wet season rice

Conclusion

The experiment was carried out using different level of chemical fertilizer and organic manures (vermicompost and municipal compost) to figure out if the using of organic manures (vermicompost and municipal compost) is economical or not as compared to the chemical fertilizers.

From reviewing the result of plant height, it can be observed that in case of both 30 and 60 DAT plant height attains maximum in the treatment T₁ i.e., 100% recommended doses of fertilizer which was at par with T₄ (50% RDF + 50 % N from vermicompost) and T₅(50% RDF + 50 % N from Municipal compost) respectively. At 90 DAT, the maximum plant height 108.60 cm was attained with the application of 50% chemical fertilizer along with the application of 50% organic nitrogen from vermicompost source i.e. T₄ treatment.

Maximum number of tiller hill⁻¹ was observed in the treatment receiving 100% nitrogen from vermicompost i.e. treatment T₂ at 30 DAT. But the maximum numbers of tillers hill⁻¹ were 15.20 and 16.20 respectively in the treatment T₁ (100% RDF) at 60 and 90 DAT respectively.

In case of dry matter production, percentage increase in the treatment T₄ i.e. 50% N (inorganic source) + 50% N (from Vermicompost) over control at 30 DAT, 60DAT and 90DAT were 53.30, 52.29 and 44.36 respectively. In all the three dates of observations (30, 60 and 90 DAT) T₄ and T₅ were at par i.e.

50% of RDN along with 50% either vermicompost or municipal compost. But in all cases T₄ i.e. 50% nitrogen from vermicompost along with 50% RDF showed maximum response in dry matter production.

In the early growth stages i.e. 30 DAT, leaf area index (LAI) was not significant. During peak growth period i.e. 60 DAT, leaf area index (3.85) was significantly recorded maximum in T₁ treatment where 100% recommended dose of chemical fertilizer was applied followed by T₄ (3.68) where 50% chemical fertilizer along with 50% nitrogen from vermicompost was applied. Highest leaf area index was attained 3.90 at 90 DAT in T₁ treatment followed by 3.70 in T₄ treatment.

Crop growth rate was also significantly differs among the three dates of transplanting like dry matter accumulation. The percent increase over control to the maximum crop growth rate in three respective dates of transplanting was 96.67, 71.60 and 45.67 respectively. Basically, it was observed that though T₁ i.e. 100% RDF through inorganic fertilizer applied plot showed significantly better but T₁ and T₅ were at par in 31-60 DAT and 61-90 DAT respectively.

All the growth parameters such as plant height, number of tillers, leaf area index, dry matter production were observed maximum with the application of 100% recommended doses (60:30:30 Kg N: P₂O₅:K₂O ha⁻¹) of chemical fertilizers followed by the 50% application of nitrogen from vermicompost along with 50% nitrogen from chemical fertilizers. Among both the two organics – Vermicompost and Municipal compost applied in addition to chemical fertilizers were recorded much improved and positive effect over the control treatment. Application of organic manures in addition to chemical fertilizers improves all the soil quality parameters resulting the uptake of others nutrients preferably micronutrients to the plants.

References:

- Ajaykumar, R. and Sivakumar, S.D. (2020). Effect of Integrated Nutrient Management on Growth, Physiological, Nutrient Uptake, Root and Yield Parameters of Transplanted Lowland Rice. *Current Journal of Applied Science and Technology*, **39**(40): 35-43.
- Apon, M., Gohain, T., Apon, R., Banik, M. and Mandal, A.K. (2018). Effect of integrated nutrient management on growth and yield of local rice (*Oryza sativa* L.) under rainfed upland condition of Nagaland. *The Pharma Innovation Journal*, **7**(7): 426-429.
- Ali, R.I., Awan, T.H., Ahmad, M., Saleem, M.U. and Akhtar, M. (2012). Diversification of rice-based cropping systems to improve soil fertility, sustainable productivity and economics. *Journal of Animal and Plant Sciences*, **22**(1): 108-112.
- Bejbaruah, R., Sharma, R.C. and Banik, P. (2013). Split application of vermicompost to rice (*Oryza sativa* L.): its effect on productivity, yield components, and N dynamics. *Organic Agriculture*, **3**(2): 123-128.
- Celik, I., Gunal, H., Budak, M. and Akpinar, C. (2010). Effect of longterm organic and mineral fertilizers on bulk density and penetration resistance in semi arid Mediterranean soil conditions. *Geoderma*, **160**(2): 236-243.
- Chakrabarti, K., Sarkar, B., Chakrabarty, A., Banik, P. and Bagchi, D.K. (2000). Organic recycling for soil quality conservation in subtropical plateau region. *J. Agron. Crop Sci.*, **184**: 137-142.
- Chatterjee, R., Gajjela, S. and Thirumdasu, R.K. (2017). Recycling of organic wastes for sustainable soil health and crop growth. *Int. J. Waste Resour.*, **7**: 296-303.
- Chattopadhyay, N., Gupta, M.D. and Gupta, S.K. (1992). Effect of city waste compost and fertilizers on the growth, nutrient uptake and yield of rice. *J. Indian Soc. Soil. Sci.*, **40**: 464-468.

- Das, A., Patel, D.P., Kumar, M., Ramkrushna, G.I., Ngachan, S.V., Layek, J. and Lyngdoh, M. (2014). Influence of cropping systems and organic amendments on productivity and soil health at mid altitude of North East India. *Indian J AgricSci*, **84**(12): 1525-1530.
- Das, B., Chakraborty, D., Singh, V., Ahmed, M., Singh, A. and Barman, A. (2016). Evaluating fertilization effects on soil physical properties using a soil quality index in an intensive rice-wheat cropping system. *Pedosphere*, **26**: 887-894.
- Deepa Devi, A.K. 1992. Studies on bioconversion of organic wastes into nutrient enriched composts and their effect on soil fertility, crop growth and yield of sorghum. *M.Sc., (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, India.*
- Devkota, S., Panthi, S. and Shrestha, J. (2019). Response of rice to different organic and inorganic nutrient sources at Parwanipur, Bara district of Nepal. *Journal of Agriculture and Natural Resources*, **2**(1): 53-59.
- Gogoi, B. (2011). Soil properties and nutrients availability as affected by integrated nutrient management after rainfed cropping sequence. *Indian Journal of Agricultural Research*, **45**(4): 36-39.
- Haynes, R.J. and Naidu, R. (1998). Influence of lime, fertilizer and manure applications on soil organic matter content and soil physical conditions: a review. *Nutrient Cycling in Agroecosystems*, **51**(2): 123-137.
- Hussain, A., Sheraz, S., Bhat, R.A., Rasool, F.A. and Raihana, H.K. (2012). Integrated nutrient management of Rice (*Oryza sativa* L.) under temperate conditions of Kashmir. *Agricultural Science Digest*, **32**(1): 18-22.
- Hussainy, S. (2019). Integration of different organic manures and nitrogenous fertilizer and its effect on the growth and yield of rice. *Journal of Pharmacognosy and Phytochemistry*, **8**: 415-418.
- Hossen, S., Islam, N., Alam R. and Baten, A. (2015). Effects of different rates of compost application on methane emission and crop yield in aman rice. *The Journal of Agriculture and Natural Resources Sciences*, **2**(3): 530-536.
- Kaisar, N., Moslehuddin, A.Z.Md., Tarafder, M.A. and Rahman, Md.S. (2020). Effects of integrated nutrient management on performance of t. aus rice (BRRI dhan48) in old brahmaputra floodplain soil, *International Journal of Advanced Geosciences*, **8**(1): 47-56.
- Kale, R.D. and Bano, K. (1986). Field trials with vermicompost: An organic fertilizer. In: *Proceedings of National Seminar on 'Organic Waste Utilization by Vermicomposting'*, GKVK Agricultural University, Bangalore, India, pp 151-160.
- Mishra, M.S., Rajani, K., Sahu-Sanjat, K. and PadhyRabindra, N. (2005). Effect of vermicomposted municipal solid wastes on growth, yield and heavy metal contents of rice (*Oryza sativa*). *Fresenius Environ. Bull.*, **14**: 584-590.
- Ramachandra, T.V. (2006). Management of Municipal Solid Waste, Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore Environmental Pollution. *Printed by TERI Press, New Delhi.*
- Ramadass, K. and Palaniyandi, S. (2007). Effect of enriched municipal solid waste compost application on soil available macronutrients in the rice field. *Archives of Agronomy and Soil Science*, **53**(5): 497-506.