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Evaluation of fungal mediated vegetable waste compost on growth and yield of paddy (*Oryza sativa* L.) var. Gujarat-4

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Abstract
To evaluate the effect of fungal mediated vegetable waste compost (FMVWC) on growth and yield components of Paddy, a field experiment was carried out in randomized block design with 3 replications. Various locally available organic manures like Celrich (Commercial product of Excel Crop Care Pvt. Ltd, Mumbai), FYM (Form Yard Manure), Vermi-Compost and Green manure (*Glyricidia* leaves) @10 t/ha were used in this study to compare with FMVWC. The treatments of organic fertilizers were given alone as well as supplemented with 25 percent of recommended dose (RD) of inorganic fertilizer for paddy-NPK (N=100, P=50, K=50 kg/ha). A simple control without any treatment and Chemical control (RD) was used as check. Growth and yield attributes were significantly increased in all the treatments over control. The maximum grain yield among only organic manure treatment was noted in block [C] applied with FMVWC @10 ton/ha. Plant treated with combination of organic manure and 20% chemical fertilizers (RD) were at par in compare to chemical control (RD) treatment. The treatment FMVWC+25% RD showed excellent result in all growth and yields attributes. An increase in the yield by FMVWC treatments was may be due to rich in nutrients, the compost (FMVWC) was prepared using vegetable refuse as the raw material. It contained good amount of nutrients supplied during the cultivation. When the refuse was subjected to composting by strong cellulose degrading fungi maximum amount of nutrients released and the same become available to the crop.

Keywords: organic manures, fungal mediated vegetable waste compost (FMVWC), recommended dose (RD) of chemical fertilizers, yields

Introduction
Paddy is a main crop in majority of states in India, it requires heavy amount of nutrients from the soil, which lead poor soil health. The nutrient mining of high yielding varieties from soil is more than that applied through fertilizers. This negative balance over the years has lead to impoverishment of soil and decline crop productivity (Nambiar, 1984; FFTC, 1998; Mahajan *et al*., 2008; Agbede, 2010) [21, 10, 15, 2]. In the past few decades, chemical fertilizers have widely used to produce more yields throughout the world. Continuous use of chemical fertilizers deteriorates the soil fertility (FFTC, 1998; Kumar *et al*., 2019) [10, 14]. The overuse of inorganic fertilizers has also lead soil, air, and water pollutions (Agbede, 2010; Savci, 2012; Kakar *et.at*.,2019) [2, 26, 13]. Extensive soil survey in Maharashtra state over the past twenty years also revealed that soil fertility has declined and the organic matter as well as nutrient reserves of soil are decreasing at alarming rate (Patil, 1994; Zende, 2002; Mahajan *et al*.,2008) [23, 32, 15].
The balance between nutrient removals by crops has to be fulfilling with only addition of organic resources because of slow release of nutrients (Gaur *et al.*, 1995; Tahat *et al*., 2020) [11, 30]. Recycling of organic wastes becomes vital for replacing at least a part of the plant nutrients drawn from the soil. Organic manures and compost are therefore necessary for countering the damage and maintaining the humus, soil fertility and productivity (Arif *et al.*, 2014) [4]. Various conventional sources of organic manures like FYM, Night soil, Compost, Vermi-compost, Poultry manure and Green manures are the ideal sources to incorporate in the soil. Organic manures play a vital role in maintaining soil fertility and help to improve physical condition of soil, which also provide adequate amount of necessary nutrients resulting good crop production (Yadav *et al*.,2014; Adekiya *et al*.,2019) [31, 1]. To maintain the soil fertility for long term sustainable agriculture application of organic manures are only solution.
Several study on organic forming has been done throughout the glove, the report of tropical Asian country showed that organic farming alone does not supply enough nutrients resulting low crop production, therefore organic fertilizers need to be supplemented by a basal dressing of chemical fertilizer for good yields. The long term use of organic materials such as livestock manure and crop residues have been found to bring about a gradual improvement in soil productivity and crop performance (Tahat *et al*.,2020) [30]. Thus, there is a need of an integrated nutrient management system to maintain soil quality and subsequently to obtain high yield and excellent grain quality. The present research aims to select and process the agricultural wastes to get excellent organic manures for crop productivity and clarify the influence of combined organic and inorganic fertilizers on the growth and yields attributes of paddy.

Materials and Methods
Experimental designs
The experiment was carried out to evaluate fungal mediated vegetable waste compost-FMVWC (vegetable wastes was

composted using cellulolytic fungal consortium) with other organic manures with as well as without fertilizer supplements on growth and yield on paddy crop (*Oryza sativa*) var. Gujrat-4, in field condition.

Twelve treatments were constructed using randomised block design with three replicates. The details of treatments are given in table 1.

Table 1: Treatments their symbols and description

Treatments	Symbol	Description
Control	A	Soil
Celrich (CR)	B	@10t/ha (an organic fertilizer commercially available in market)
Fungal Mediated Compost (FMVWC)	C	@1ot/ha(vegetable wastes Compost)
Green Manure (GM) *Glyrecidia* leaves	D	@10t/ha (Leaves of *Glyerecidia*)
Form yard manure (FYM)	E	@10t/ha (Cow dung)
Vermi Compost (VC)	F	@10t/ha (Commercial available Vermi-compost)
Chemical Control (RD)	A1	The recommended dose for traditional farming (120 kg/ha urea and 100 kg/ha DAP)
CR+25% RD	B1	@10t/ha + 25% RD
FMVWC+25%RD	C1	@10t/ha + 25% RD
GM+25% RD	D1	@10t/ha + 25% RD
FYM+25%RD	E1	@10t/ha + 25% RD
VC+25% RD	F1	@10t/ha + 25% RD

All selected organic manures were incorporated in soil during pudling before plantation of paddy seedlings. Chemical fertilizers Suphala and Urea were applied at the time of plantation (Suphala equivalent to N (40%), P (50%), K (50%) The second and third dose of Urea applied after one month and three months of plantation.

Field establishment and site description

The experiment was conducted at K.V. Pendharkar College Dombivili (E) Agricultural field, Thane Maharashtra India. The soil in the field station is classified as a Red sandi Soil. The physical and chemical properties of soil given in table 2. Twenty five days old paddy seelings var.Gujrat-4 with mean height 30cm was obtained from Karjat Rice Research centre Karjat Raigad Maharashtra. The Seedlings were transplanted in the main field in the month of July. The unit plot size was 1 m x 1m single –single seedling transplanted with 15 cm x 20 cm. plant spacing. Gap filling was done after 15 days of plantation to maintain uniform plant population. The Irrigation, weeding and other intercultural operations were done as and when necessary.

Table 2: Physical and chemical properties of soil of the experimental plot

Soil Properties	Description and Quantity
Type of Soil	Sandy red soil
Texture group	Sandy clay loam with pebbles
Silt particles	37.14%
Clay particles	22.82%
Sand particles	40.04%
pH	8.4
Electrical conductivity	0.03dS/m
Total Nitrogen	1.01%
Phosphorus	4.1 mg/kg
Potassium	45 mg/kg
Calcium carbonates	26.7%

Measurements

Growth attributing characters.

Ten plants were selected randomly from each block for record the observation. Data were recorded for some vegetative characters like height of the plant, number of tillers per plant, number of functional leaves per plant after 30 days and 60 days of plantation.

Yield attributing characters

Yield contributing characters like length of panicle, number of grains per panicle, total yield per block and total straw yield per block were recorded. For yield attributing characters like length of panicle, number of grains per panicle, fifty observations were under taken from each block and average value is calculated for analysis.

Data analysis

The recorded data for different characters were analyzed statistically using method describe by Panse and Sukhatme (1967) [22] to find out the variation among the different lines by F-test. A Two-Way Analysis of Variance was performed to test the variance among the treatments.

Results

Growth attributing characters

Growth contributing parameters of Paddy influenced by various treatments were given in Table 3. The support of observation given in photo plate 1.

Plant Height

The heights of plants subjected to different treatments were recorded at the end of 30 days and 60 days. A wide range of variation was observed among the treatments. Results clearly indicated that the treatment FMWC and Green manure gave maximum response at the end of 30 days (49.76 and 49.65 cm respectively) followed by vermi compost treatment (45.33 cm). These treatments were well ahead to control (37.8 cm), Celrich treatment (40.2 cm) and FYM treatment (40.91cm) plants height. Among the treatment supplemented with 25% of recommended dose (RD) of chemicals, maximum plant height at the end of 30 days was noted in plants treated with FMWC+25% RD (56.59 cm). The treatment FYM+25% RD also showed good result (54.36 cm) in compare to other supplemented treatments, whereas Treatment RD (Chemical control) plants showed 50.68 cm as an average plant height. In the second set of observation after 60 days FMWC and FMWC +25% RD showed maximum response 67.36 and 93.96 cm plant height respectively, which was considerably higher than control and RD (57.8 cm & 67.3 cm). The other treatments were also at par to control and RD.

Number of tillers per plant.

The periodic data pertaining to number of tillers as influenced by various treatments are given in table 3.

Highest total numbers of tillers were observed in plots treated with FMWC (5.5 and 8.0) after 30 and 60 days of plantation.

It was followed by Celrich (3.3 and 5.7 respectively) the control plot had average 1.9 & 3.5 tillers per plant. The *Glyricidia* leaves and FYM treatment showed similar response in 30 days (3.3 tillers per plant) but at 60 days *Glyrecidia* leaves treatment showed maximum number of tillers (5.2) in compare to FYM (3.7). The vermi- compost treatment showed least response (2.5 and 3.5 respectively). While among the supplemented treatments FMWC+25% RD produced highest numbers of tillers 7.7 and 10.6 respectively after 30 and 60 days of plantation followed by celrich (5.5 & 9.2) and *Glyrecidia* leaves (5.7 & 8.6 tillers per plat respectively).The average number of tillers in RD(chemical control) treatment was 4.6 &7.6 respectively after 30 and 60 days. The FYM+25% RD and Vermicompost+25% RD were almost at par with each others. Maximum numbers of fertile tillers were also observed in plots treated with FMWC+25% RD, it was followed by Celrich+25% RD and Green manure +25% RD.

Number of functional leaves per plant.

The periodic data pertaining to number of tillers as influenced by various treatments are given in table 3

At the time of plantation the average number of leaves in seedling was three. After 30 and 60 days of plantation, the field treated with FMWC and Green Manures showed promising results and the number of functional levers per plants were more (23.86, 38.6 and 12.4, 25.6 respectively) in compare to control(7.3, 17.8) and other treatments. Among the chemical fertilizer supplemented treatment the maximum number of function leaves ware also found in FMWC+25% RD & Green Manure +25% RD (31.8, 48.13 &17.26, 34.8 respectively). The chemical control (RD) treated plants produced 17.86 and 30.53 after 30 days and 60 days of plantation.

Table 3: Effect of nutrient sources on plant height, number of functional leaves and total numbers of tillers per hill after 30 and 60 days of plantation

Treatments with symbol	Avg. Height of plant in (cm)		Avg. No. Of functional leaves		Avg. No. Of tillers per plant	
	30 day's	60 day's	30 day's	60 day's	30 day's	60 day's
Control-A	37.8	57.8	7.33	17.8	1.9	3.5
CR-B	40.2	58.9	10.06	23.13	3.3	5.7
FMVWC-C	49.76	67.36	23.86	38.6	5.5	8.0
G.M-D	49.65	61.96	12.4	25.6	3.0	5.2
FYM-E	40.91	61.49	9.66	20.13	3.0	3.7
VC-F	45.33	66.56	10.06	16.0	2.5	3.4
RD-A1	50.68	67.3	17.86	30.53	4.6	7.6
CR+ RD- B1	52.66	82.96	18.6	39.0	5.5	9.2
FMWVC+RD-C1	56.59	93.96	31.8	48.13	7.7	10.6
GM+RD- D1	49.96	73.9	17.26	34.8	5.7	8.6
FYM+RD- E1	54.36	80.8	15.46	31.23	3.6	6.5
VC+RD- F1	46.0	69.8	12.93	30.93	3.06	7.0
F-Test	Sign.	Sign.	Sign,	Sign.	Sign.	Sign.
SE	1.3	1.13	1.0	1.10	0.25	0.23
CD@5%	2.23	1.90	1.71	1.9	0.429	0.394

Yield attributing characters.

Data pertaining to yield attributes *viz*. length of panicle, number of grains per panicle, weight of 1000 grains per treatments, total yield per block and total dry mater production per block given in table number-4. The support of observation given in photo plate 2.

Length of panicle per plant.

Panicle average length in control plant was (16.45 cm), while maximum panicle length was noted in plants treated with FMVWC (19.8 cm) followed by Celrich (19.7cm). The treatment Green manure, FYM and Vermi-compost exhibited almost similar length of panicles. The plants treated with chemical fertilizer (RD) in combination with organic fertilizer, FMVWC(C1) exhibited 21.25 cm panicle length and was followed by Celrich(B1) (19.53cm).The chemical control(A1) treated plant exhibited 19.0 cm an average length of panicle. Minimum panicle length was shown by Treatment Green manure (D1) (18.55 cm) and vermi-compost (F1) (18.49 cm).

Table 4 & Photo plate 2

Number of grains per panicle.

Among organic manures, Maximum number of grains per panicle was observed in plants treated with FMVWC (213.73), it was followed by FYM (140.8) and Celrich (138.46) organic and minimum of that was for Green manure (133.4), whereas control plants showed 108.46 as an average number of grains per panicle. The chemical fertilizer supplemented treatments were significantly increased in number of grains per panicles.

However the Number of grains per panicle in chemical control (A1) was less (165.4) than the FMVWC (C) alone (213.73).

In Chemical supplemented treated FMVWC (C1) produced an average of 278.4 grains per panicle followed by Celrich (B1) 215.2 and Vermi-compost (F1) 210.53. The minimum number was seen in plot treated with Green manure (D) (175.13), whereas in chemical control (A1) the number of grains per panicle was 165.4.

Table 4: Effect of nutrient sources on yield attributing characters.

Treatments with symbol	Length of panicle	No. of grains/panicle	Total Yield (g)	Total Straw Yield/ Block (g)
Control-A	19.7	108.46	92.25	91.73
Celrich-B	19.8	138.46	163.76	173
FMVWC-C	17.7	213.73	485.8	343
G.M-D	17.4	133.4	161.62	186.33
FYM-E	17.85	140.8	141.8	117.33
VC-F	19	135.13	136.36	130.3
RD-A1	19.53	165.4	297.76	320
CR+ RD- B1	19.53	215.2	522.6	396.33
FMWVC +RD-C1	21.25	278.4	901.86	564.33
G.M+RD-D1	18.55	175.13	373.9	352.3
FYM+RD-E1	19.05	209.46	362.2	330.3
VC+RD-F1	19.49	210.53	402.89	277.66
F-Test	Sign.	Sign.	Sign.	Non-Sign.
SE	0.26	3.8	48	--
CD@5%	0.446	6.52	82.41	--

Weight of 1000 grains per Treatments.

Maximum 1000-seed weight was noted in plants treated with FMVWC (C1) (15.2 g). The other treatments showed almost similar result, the 1000 grains weight was not influenced significantly by treatments.

Plate 1: Photographs of experimental blocks.

Plate 2: Photographs of Yield attribiting Characters.

Total grain yield per block in gram.

Maximum grain yield was observed in plots treated with FMVWC+25% RD (C1) (901.86g), it was followed by Celrich (B1) (522.6 g) and Vermi-compost (F1) (402.89g) Whereas, minimum grain yield (362.2 g) was noted in the plot treated with FYM(E1) as against Chemical control (A1) 297.76 g. The treatment FMVWC(C) alone showed higher yield in compared to Chemical control (A1) and other chemical supplemented treatments Green manure, FYM and Vermic-compost. The amount of grain yield in control block was 92.25g.

Total dry matter production per block in gram

The total biological yield in control plant was 91.3g, while among un supplemented treatment maximum biological yield was noted in plants treated with FMVWC (343 g) it was higher than the treatment Vermi-compost(F1) (277.66 g) and Chemical control(A1) 320g. The plants treated with chemical fertilizer with FMVWC (C1) showed 564.33 g biological yield and was followed by Celrih (B1) (396.33 g).

Discussion

During the course of investigation it was observed that various growth and yields attributes, height of plants, number of tillers, number of functional leaves, length of panicle, number of grains per panicle, total yields and total dry matter production were significantly increased by application of different nutrient sources. It is probably due to enhanced availability of nutrients. The nutrient availability to plants from organic sources is prolonged due to slow relies and microbial action on organic matter, which improved physical condition of soil (Sarker *et al*., 2004, Mieke *et al*., 2020) [24, 16]. However, The effect of chemical fertilizer on plants are very quick because they are readily soluble in soil solution and thereby instantly available to plants. The variation in plant height due to different nutrient sources was considered to be due to variation in the availability of major nutrients. This observation is well supported by Muhammad *et al*. (2008) [20] he observed similar results with application of organic manure and compost in rice. The available nutrients might have helped in enhancing number of tillers, number of functional leaves and leaf area, which thereby resulted in higher photo-assimilates and more dry matter accumulation. Swarup and Yaduvanshi, (2000); Sharada *et al*., 2018 [29, 28] reported the similar findings. The increase in fresh weight by application of organic manures has also been reported by Sarwar *et al*. (2008) [25]. The general height, tillers, more number of leaves are the growth attributes, which contributes to increased higher yields productivity (Ebaid *et al*., 2007; Badshah *et al*.,2014; Moe *et al*.,2019) [8, 6, 19]. The FMVWC showed excellent results in all growth attributing characters. The similar results reported by Mirza *et al*., (2010) [18] after application of different organic manures. Organic manures offer sufficient micro nutrients along with other major balanced nutrition to the plants, which positively affect on all vegetative parts like leaf and tiller in plants (Miller, 2007) [17]. In present investigation it was found that organic fertilizer FMVWC (C) alone and in combination with chemical fertilizers (C1) significantly increased the plant height, tillers, number of leaves and yield attributes like length of panicle, number of grains per panicle, total yields and biomass over untreated control and chemical control. This excellent result of FMVWC was due to high nutrient supply to the plants. The said compost (FMVWC) was prepared using vegetable refuse as the raw material. It contained good amount of nutrients because it received high amount of nutrients during the cultivation. Once the refuse was subjected to composting by strong cellulose degrading fungi maximum amount of nutrients released and the same became available to the crop. Organic manure makes soil porous and which promote better root development and hence absorption and translocation of more nutrients from the soil (Singh and Agarwal, 2001) [27].

The yield components of paddy crop *viz*., number of panicle, number of grains/panicle and total yield and high biomass showed significant differences due to treatments.

A significant difference in length of panicle, number of grains/panicle, total yield and biomass was observed by treatment FMVWC alone as well as along with recommended dose of chemical fertilizers, which was excellent among other treatments. It may due to available more water enhanced nutrient availability which improved nitrogen and other macro- and micro-elements absorption as well as enhancing the production and translocation of the dry matter content from source to sink. The application of FYM with nitrogen fertilizer significantly increased panicle length, panicle weight, number of filled grains/panicle and grain yield in Paddy (Moe *et al*., 2019) [19].

Ebaid *et al*. (2007 & Mirza *et al*. (2010) [8, 18] reported that the yield attributing characters of rice are influenced by variation in fertilizer packages. The higher grain production due to supplemented dose of chemical fertilizers along with organic manures in Paddy was reported by Channabasavanna and Biradar (2001) [7] and Iqbal *et al*., (2020) [12]. Similar results were reported by El- Weheishy *et al*., (1997) [9], Awad (2001) [5]. There was no significant influence by any of the treatment in terms of weight of 1000 grains. The grain weight is stable varietal character because the grain size is rigidly controlled by hull.

From the above discussion it is clear that FMVWC has a significant influence on growth and productivity in Paddy. Other organic sources of nutrients also showed significant results. So blend of organic fertilizer with little dose of inorganic fertilizer will be better sustainable strategy to maintain soil fertility and to produce better growth and yield. All the treatments showed significant influence on growth and productivity of grains when applied in supplemented form. In the present study it was observed that FMVWC @10 ton/ha could give more yield over recommended dose of inorganic fertilizes for paddy cultivation. However, the supplemented treatment showed promising result in terms of yields, among organic fertilizer treatments with 25% of recommended dose, FMVWC produced the higher grain yield.

Conclusion

India is an agricultural country, agricultural residues are predominant in rural area but in urban, suburban and semi-urban, vegetable wastes and other solid wastes are generated in large quantities. At present the collection, transportation and disposal of these wastes are a big problem. Heaps of the uncollected wastes, rotting at the market places represent ugly sights to the people apart from causing health and pollutions problems. Owing to its high biodegradability, it can be looked upon as a very useful and promising feedstock for formation of organic manures. Vegetable wastes can be utilising to make good quality compost by

application of strong cellulolytic fungi which degrade efficiently within 25-30 days. Organic manure can be a better supplement of inorganic fertilizer to produce better growth and yield for the sustainable agriculture. All the used organic manures showed significant influence on growth and productivity of paddy. Form the present study it was observed that 10 ton/ha organic fertilizer along with 25 % recommended chemical fertilizer could give better result than 100% inorganic fertilizes. However, among organic fertilizer vegetable waste compost @ 10ton/ha itself produced the better results in all aspects and mainly grain yield compared to others organic fertilizer treatments. The uses of vegetable waste compost reduce the production cost and boost the yield of Paddy as well as to maintain and improve soil health.

References

1. Adekiya A, Agbede T, Aboyeji C, Dunsin O, Simeon VJSh. Effects of biochar and poultry manure on soil characteristics and the yield of radish. Scientia horticulturae,2019:243:457-63.
2. Agbede TM. Tillage and fertilizer effects on some soil properties, leaf nutrient concentrations, growth and sweet potato yield on an Alfisol in south-western Nigeria. Soil Tillage Res,2010:(110):25-32.
3. Anisuzzaman M, Rafii MY, Jaafar NM, Izan Ramlee S, Ikbal MF, Haque MA. Effect of Organic and Inorganic Fertilizer on the Growth and Yield Components of Traditional and Improved Rice (Oryza sativa L.) Genotypes in Malaysia. Agronomy,2021:11:1830.
4. Arif M, Tasneem M, Bashir F, Yaseen G, Iqbal RMJJAR. Effect of integrated use of organic manures and inorganic fertilizers on yield and yield components of rice. J. Agric. Res,2014:52(2):197-206.
5. Awad HA. Rice production at the North of Delta Region in Egypt as affected by irrigation intervals and nitrogen fertilizer levels. *J. Agric. Sci. Mansoura Univ*,2001:26:1151-1159.
6. Badshah MA, Naimei T, Zou Y, Ibrahim M, Wang K. Yield and tillering response of super hybrid rice Liangyoupeijiu to tillage and establishment methods. Crop J,2014:(2):79-86. [CrossRef]
7. Channabasavanna AS, Biradar PD. Yield and yield attributes of transplanted summer rice as influenced by organic manures and zinc levels. *J. Maharashtra Agril. Univ*,2001:(26):170-172.
8. Ebaid RA, EL-REFAEE IS. Utilization of rice husk as an organic fertilizer to improve productivity and water use efficiency in rice fields. *African Crop Science Conference Proceedings*,2007:(8):1923-1928.
9. El-Weheishy MM, Abd El-Hafez AG. Response of flooded rice to water deficit. *J. Agric. Res. Tanta Univ*,1997:23:273-288.
10. FFTC. Publication database. Food and Fertilizer technology centre Taiwan Microbial and Organic Fertilizers in Asia, 1998.
11. Gaur AC, Neelkantan S, Dargan KS. Organic manure. ICAR, New Delhi, 1995, 154.
12. Iqbal A, He L Ali I, Ullah S, Khan A, Khan A, Akhtar K ***et al***. Manure combined with chemical fertilizer increases rice productivity by improving soil health, post-anthesis biomass yield, and nitrogen metabolism. PLoS One,2020:7:15-25.
13. Kakar K, Xuan TD, Haqani MI, Rayee R, Wafa IK, Abdiani S, *et al*. Current situation and sustainable development for rice cultivation and production in Afghanistan. Agriculture,2019:9:49-58.
14. Kumar R, Kumar R, Prakash O. The impact of chemical fertilizers on our environment and ecosystem. Res. Trends Environ. Sci,2019:54:69-86.
15. Mahajan A, Bhagat R, Gupta RJSJOA. Integrated nutrient management in sustainable rice-wheat cropping system for food security in India. AARC Journal of Agriculture,2008:6(2):29-32.
16. Mieke RS, Muhamad KP, Silke S, Kustiwa A, Tualar S. Performance of rice paddy varieties under various organic soil fertility strategies. Open Agriculture,2020:5:509-515.
17. Miller HB. Poultry litter induces tillering in rice. *J. Sustain. Agric*,2007:31:1-12.
18. Mirza Hasanuzzaman KU, Ahamed NM, Rahmatullah N, Akhter KN. Rahman ML. Plant growth characters and productivity of wetland rice (Oryza sativa L.) as affected by application of different manures. *Emir. J. Food Agric*,2010:22(1):46-58.
19. Moe K, Moh SM, Htwe AZ, Kajihara Y, Yamakawa T. Effects of integrated organic and inorganic fertilizers on yield and growth parameters of rice varieties. Rice Sci. 2019;(26): 309–318.
20. Muhammad I. Response of wheat growth and yield to various levels of compost and organic manure. *Pak. J. Bot.*2008; 40(5): 2135-2141.
21. Nambiar, KVK. Ghosh AG. Highlights of research of long term fertilizer experiment in India (1971-82). IARI, New Delhi. 1984 Pp.100. cited from Tondon, HLS. (Ed.) 1992. Pp.15.
22. Panse VG, Sukhatme. Statistical Methods for Agricultural Workers. ICAR. New Delhi. 1967.
23. Patil ND. 'Mati Parikshan va Khatancha Vapar' Baliraja,1994:25:36-47.
24. Sarker MAR, Pramanik MYA, Faruk GM, Ali MY. Effect of green manures and levels of nitrogen on some growth attributes of transplant aman rice. *Pakistan J. Biol. Sci*,2004:7:739-742.
25. Sarwar G, Schmeisky H, Hussain N, Muhammad S, Ibrahim M, Safdar E. Improvement of soil physical and chemical properties with compost application in rice-wheat cropping system Pak. *J. Bot*,2008:40(1):275-282.
26. Savci S. Investigation of effect of chemical fertilizers on environment. Apcbee Procedia,2012:1:287–292.
27. Singh R, Agarwal SK. Analysis of growth and productivity of wheat in relation to levels of FYM and nitrogen. *Indian Journal of Plant Physiology*.2001:6:279-83.
28. Sharada P, Sujathamma P. Effect of Organic and Inorganic Fertilizers on the Quantitative and Qualitative Parameters of Rice (Oriza sativa L.). Curr. Agric. Res. J,2018:6:166-174.
29. Swarup A, Yaduvanshi NPS. Effect of Integrated nutrient management on soil properties and yield of rice in Alkali soils. *J. Indian Soc. Soil Sci*,2000:48:279-282.
30. Tahat MM, Alananbeh KM, Othman YA, Leskovar DI. Soil health and sustainable agriculture. Sustainability,2020:12:4859. [CrossRef]
31. Yadav S, Babu S, Yadav M, Singh K, Yadav G, Pal S. A review of organic farming for sustainable agriculture

in Northern India. International Journal of Agronomy, 2013, 13-22.
32. Zende GK. 'Jamin and Jaminichi niga' ISBN 8187002-74-3. Sun Publication, Pune, 2002, 168.