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Effect of application timing of organic n sources on yield and economics of rice (Pusa Basmati 1509)

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Abstract
Two successive field experiments were conducted during *kharif* 2019 and 2020 at the Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture and technology Meerut, Uttar Pradesh. The experiment consisted of fourteen different treatments in randomized block design replicated thrice. Soil of the experimental field was sandy clay loam in texture and neutral in reaction with low in nitrogen and medium in available phosphorus and potassium. Result revealed that higher grain yield (41.45q/ha) and (40.10 q/ha) was recorded with the treatment consisting application of application of 25% N of recommended dose through dhaincha on planting date rest of nitrogen through chemical fertilizer (T_5) during 2019 and application of 25% recommended N through vermicompost 10 DBP + rest N through chemical fertilizer during 2020.During both the years higher straw yield 69.23 qh^{-1} and 67.00 qh^{-1} was recorded in T_5. This treatment also resulted in comparatively higher B:C ratio during both the years.

Keywords: economics, basmati-1509, B: C ratio

Introduction
Rice (*Oryza sativa* L.) is the staple food to feed over half of the world's population. Use of inorganic fertilizers has several negative impacts on soil fertility. Presently; use of organic sources is slowly mushrooming up over the globe due to its scientifically proven beneficial effects. In India, rice is grown in about 43.86 million hectares with a production level of 104.80 million tones and the productivity is about 2390 kg/ha [1]. There is an ample scope to increase the productivity of rice. To increase the productivity of rice, it is important to maintain the fertility and organic matter status of soil. Green manuring and application of vermicompost are the ways to improve organic matter status of soil. In vermicompost, the secretions from worms and associated microbes act as growth promoters. Since, it is a natural eco-friendly approach; it does not have any adverse impact on the soil or the environment. Certain metabolites produced by the earthworms may also be responsible to stimulate the plant growth. Vermicompost also helps in preventing plant diseases [2]. The nutrients present in vermicompost are readily available [3]. A positive effect of vermicompost application on yield attributes and yield of various crops [4-6]. Dhaincha (Sesbania species) is a valuable crop of the summer season (March to July) with multi-various uses. It finds use in green manuring, soil reclamation, as an animal feed and in agro-forestry. Some species are even known to control weeds and the seeds of still others have valuable properties for gum production. Dhaincha being a leguminous crop utilizes atmospheric nitrogen through symbiotic nitrogen fixation to meet a Major part of its nitrogen requirement. Nutrient availability from organic sources depends on their decomposition as well as mineralization. It is very pertinent that the timing of organic sources application should be in such way that nutrients release from them are fully utilized by crop without losses. So for generally organic sources with variable C:N ratio are applied at planting, however it is urgently required to optimize the timing of their application. Considering this fact present experiment was planned.

Materials and Methods
The field experiments were carried out during the *kharif* 2019 and 2020 at Crop Reaserch Center, Sardar Vallabhbhai Patel University of Agriculture and technology, Modipuram, Meerut Uttar Pradesh (India). Soil of the experimental field falls under sandy loam in texture, neutral in reaction with low in organic carbon and available nitrogen, medium in available phosphorus, potassium, zinc. The experiment consisted fourteenth (14) treatments of INM

based like that's Control (T_1) , recommended dose of N P K (T_2), 25% recommended N through dhaincha 10 DBP + rest N through chemical fertilizer (T_3), 25% recommended N through dhaincha 5 DBP + rest N through chemical fertilizer (T_4), 25% recommended N through dhaincha on planting date +Rest N through chemical fertilizer (T_5), 25% recommended N through vermicompost 10 DBP + Rest N through chemical fertilizer (T_6), 25% recommended N through vermicompost 5 DBP + Rest N through chemical fertilizer (T_7), 25% recommended N hrough vermicompost on planting date + rest N through chemical fertilizer (T_8), 37.5% recommended N through dhaincha 10 DBP + rest N through chemical fertilizer (T_9), 37.5% recommended N through dhaincha 5 DBP + rest N through chemical fertilizer (T_{10}), 37.5% recommended N through dhaincha on planting date + rest N through chemical fertilizer (T_{11}), 37.5% recommended N through vermicompost 10 DBP + Rest N through chemical fertilizer (T_{12}), 37.5% recommended N through vermicompost 5 DBP + Rest N through chemical fertilizer (T_{13}), 37.5% recommended N through vermicompost on planting date + rest N through chemical fertilizer (T_{14}) were tested in randomized block design with three replications. Recommended dose of P and K was applied in all the treatments with exception control. Rice variety (Pusa Basmati-1509) was transplanted in plant geometry on 16 July during 2019 and 2020. Recommended dose of fertilizer i,e. 60 kg P_2O_5 and 40 kg K_20/ha was applied through DAP, SSP and MOP and nitrogen through DAP, urea and organic sources (Dhaicha, vermicompost). Whole of phosphorus and potassium was applied at planting while 25 and 37.5% N through organic source and planting date 12.5 and 25 percent of nitrogen as per treatment. The remaining half–dose of nitrogen was applied in two equal split was also applied at planting date through chemical fertilizer. at tillering and panicle initiation stages. After threshing each plot separately the grains were cleaned and weight was recorded in kg/plot and this yield converted into per hectare basis. The observation recorded during the course of investigation were tabulated and analyzed statistically to draw a valid conclusion.

Result and Discussion

Grain yield

Data regarding the effect of different treatments on grain yield of basmati rice are presented in Table no 1. It is clear from the table that the grain yield varied significantly under different treatments and ranged from 19.69 to 41.45 and 19.67 to 40.10 qha^{-1} during 2019 and 2020 respectively. Substitution of 25% N through dhaincha applied at the time of planting or vermicompost applied 10 days before transplanting yielded non significantly higher than T_2 where 100% N was applied through chemical fertilizers during both the years. Increment in yield in Comparision to T_2 was 7.7 per cent with the application of dhaincha (T_5) and 6.9 per cent with vermicompost during (T_6) 2019 while this increment was 1.4 and 4.8 percent during 2020. All the treatments of dhaincha with exception of T_9 during 2020 yielded statistical at par with T_2. Similarly treatments consisting substitution of 25% N through vermicompost incorporated at different timings also yielded at par with T_2 but this effect was not noticed with substitution of 37.5% N through vermicompost where yield was significantly lower than T_2. Yield reduced drastically without fertilization during both the years and almost 52% yield decline from best treatment was recorded.

Straw yield

Data presented on Table no 1, reveal that there was significant effect of different treatments on the straw yield of basmati rice crop**.** It is clear from the table that the straw yields differ significantly under different treatments from 34.23 to 69.23 and 34.88 to 67.00 q ha^{-1} during 2019 and 2020 respectively. Substitution of 25% N through dhaincha applied at the time of planting yielded significantly higher than the treatments with exception of T_2, T_3, T_4, T_6, T_8, T_{11} while during 2020 with exception T_1, T_{12}, T_{13} this treatment was statistically *at par* to rest of the treatments. Increment in straw yield in T_5 as compared to T_2 was 3.4 percent during 2019 while during 2020 it was almost similar

Economics

The economic analysis of any experimental research is an important expect for getting the most beneficial treatment combination from soil health and farmer s point of view. It is very obviously that a treatment with more chemical fertilizers may obtain a highest net return with minimum cost of cultivation in comparison to a treatment which includes organic sources but from soil health point of view its recommendation cannot be made. The maximum cost of cultivation incurred under T_{12},T_{13},T_{14} Rs.(47558.00/-) and Rs.(49192.00/-) during 2019 and 2020, Highest gross return in curred with the application of 25% N through dhaincha at planting date during 2019 and vermicompost at 10 day before planting during 2020. Net return was maximum under T_5 in 2019 and T_2 in 2020. Although T_2 gave Rs 3168.06 more return than T_5 during 2020 but T_5 is more beneficial from soil health point of view because it include organic source dhaicha which improve the physical, chemical and biological properties. B:C ratio was found maximum under T_2 (2.2) and (2.3) because of comporatively lower cost of cultivation and minimum is T_1 (1.4) and (1.5) during 2019-2020.

Table 1: Effect of application timing of organic N sources on grain and straw yield of Basmati rice (Pusa Basmati-1509).

Treatments	Grain yield (q ha^{-1})		straw yield (q ha^{-1})	
	2019	2020	2019	2020
T_1	19.69	19.67	34.23	34.88
T_2	38.50	38.28	66.96	66.92
T_3	35.34	34.55	61.42	64.15
T_4	41.19	36.45	61.47	64.05
T_5	41.45	38.80	69.23	67.00
T_6	41.16	40.10	64.27	65.90
T_7	38.52	39.10	58.96	66.80
T_8	38.38	36.19	59.50	61.41
T_9	34.70	33.80	58.05	64.90
T_{10}	37.49	34.76	56.67	60.94
T_{11}	36.40	36.90	61.39	67.00
T_{12}	34.00	31.30	57.59	55.90
T_{13}	31.20	30.72	58.71	63.38
T_{14}	29.90	30.46	53.02	56.84
S.E.(m)±	2.36	1.31	3.31	2.36
C.D. at 5%	6.87	3.80	9.63	6.87

Table 2: Effect of application timing of organic N sources on economics (Cost of cultivation, gross of return, net return and B:C ratio) of basmati rice (Pusa Basmati -1509)

Treatments	Cost of cultivation Rs/ha		Gross of Return Rs/ha		Net Return Rs /ha		B:C Ratio	
	2019	2020	2019	2020	2019	2020	2019	2020
T_1	31507.00	31507.00	42577.97	45851.50	11070.97	14344.50	1.4	1.5
T_2	37788.00	38052.00	83260.39	89000.89	45472.39	50948.89	2.2	2.3
T_3	41960.00	42224.00	76432.82	81267.90	34472.82	39043.90	1.8	1.9
T_4	41960.00	42224.00	87053.43	84836.39	45093.43	42612.39	2.1	2.0
T_5	41960.00	42224.00	89075.86	90004.83	47115.86	47780.83	2.1	2.1
T_6	44960.00	46224.00	87551.08	92174.99	42591.08	45950.99	1.9	2.0
T_7	44960.00	46224.00	81700.22	90520.80	36740.22	44296.80	1.8	2.0
T_8	44960.00	46224.00	81553.69	83680.05	36593.69	37456.05	1.8	1.8
T_9	43058.00	43192.00	74597.22	80040.23	31539.22	36848.23	1.7	1.9
T_{10}	43058.00	43192.00	79383.73	80862.71	36325.73	37670.71	1.8	1.9
T_{11}	43058.00	43192.00	78337.28	86417.03	35279.28	43225.03	1.8	2.0
T_{12}	47558.00	49192.00	73228.67	73072.12	25670.67	23880.12	1.5	1.5
T_{13}	47558.00	49192.00	68363.87	73845.27	20805.87	24653.27	1.4	1.5
T_{14}	47558.00	49192.00	64865.77	71716.01	17307.77	22524.01	1.4	1.5

Conclusion

To achieve maximum yield of rice grain and straw yield during *Kharif* season, an integrated nutrient management system of application of 25% N through dhaincha at planting date or vermicompost at 10 days before planting and rest dose N through chemical fertilizer seems better one since grain and straw yield in these treatment was maximum.

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