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Effects of integrated nutrient management on dry matter accumulation in the rice-wheat cropping system

Gourisankar Pradhan and Ram Swaroop Meena

Abstract
An experiment was conducted during *Rabi* and *Kharif* season (2018-2020) to study the "Effects of integrated nutrient management on dry matter accumulation on rice-wheat cropping system" in the agriculture research farm department of Agronomy, Banaras Hindu University, Uttar Pradesh. The experiment was laid out in split-plot design having four nutrient levels of NL0=control, NL1= 75% recommended nutrients dose (RND) of nitrogen (N), P_2O_5 and K_2O, NL2= 100% RND of N, P_2O_5 and K_2O, NL3= 100% RND of N, P_2O_5 and K_2O + 5kg iron +5kg zinc in main plot and nine combination of compost (C1=carpet waste, C2=pressmud, C3=bagasse) and biofertilizers (BF1= *Pleurotus sajor-caju*, BF2= *Azotobacter chroococcum*, BF3= *Trichoderma viride*) i.e. C1+BF3, C1+BF2, C1+BF1, C2+BF3, C2+BF2, C2+BF1, C3+BF3, C3+BF2, C3+BF1 assigned in sub plot. The treatment combinations were replicated three times and allocated at random in each replication. The result shows that the application of different nutrient levels with a combination of compost and biofertilizers increased the biomass accumulation of wheat and wheat. In the case of wheat, at 60 DAS the treatment combination NL3 and C1BF1 was superior in biomass accumulation over other treatment combinations. However, at 90 DAS the treatment combination NL3 and C1BF3 was found better accumulation of biomass than that of other treatment combinations. Similarly, in residual crop rice, the treatment combination NL3 and C1BF3 found higher biomass accumulation as compared to other treatment combinations at 60 and 90 DAS.

Keywords: Biomass accumulation, compost, rice, wheat

Introduction
The rice (*Oryza sativa* L.) -wheat (*Triticum aes*tivum L.) cropping system (*Oryza sativa* L.) is one of the world's largest agroecosystems, occupying 24 million hectares (mha) of farmland, primarily in Southeast Asia (Yadav *et al*., 2000; Brar *et al*., 2013) [1, 2]. Out of which 13.5 mha are spread in four South Asian countries, *viz.*, across India, Pakistan, Bangladesh, and Nepal (Ram *et al*., 2016; Devkota *et al*., 2019) [3, 4]. The cultivation of high-yielding crop varieties and multiple cropping is rapidly depleting soil fertility. Soils that were once abundant in available nutrients are gradually becoming depleted (Sarwar *et al*., 2008) [5]. Composting can help to improve organic matter status. Compost is an excellent source of nutrients due to its high organic matter content. Compost can improve the physical and chemical properties of soil, potentially increasing crop yields. Every year, agricultural-based industries generated a massive amount of residues (Sadh *et al*., 2018) [6]. If these residues are released into the environment without proper disposal, they may cause pollution and harm human and animal health. The sugar industries in India produced more than 8 mt of pressmud, 7.5 mt of molasses, and 44 mt of bagasse (Dotaniya *et al*., 2016) [7]. These wastes are important sources of macro-, secondary, and micro-nutrients. The application of these waste agriculture field improve soil physicochemical and biological properties and increased the fertility status of the soil. It leads to an increase in crop growth and yields. If all of the press mud is recycled through agriculture, approximately 32,464, 28,077, 14,038, 3434, 393, 1030, and 240 tonnes (t) of N, P, K, Fe, Zn, Mn, and Cu, may be available aid in the sustainability of expensive chemical fertilizers (Dotaniya *et al*., 2016) [7]. The integrated nutrient management approach of compost along with biofertilizers improves the growth, yield, and productivity in the rice-wheat cropping system.

Materials and Method
Experimental site
The field experiment was carried out at an agriculture research farm, institute of Agricultural sciences, Varanasi, Banaras Hindu University, Uttar Pradesh in the year 2018-2020. The soil of the experimental location was sandy clay loam.

The design applied for the field experiment was a split-plot design. In the main plot four nutrient levels (NL), viz., NL0=control, NL1= 75% recommended nutrients dose (RND) of nitrogen (N), P_2O_5, and K_2O, NL2= 100% RND of N, P_2O_5, and K_2O, NL3= 100% RND of N, P_2O_5 and K_2O + 5kg iron +5kg zinc. In sub plot nine combination of compost (C1=carpet waste, C2=pressmud, C3=bagasse) and biofertilizers (BF1= *Pleurotus sajor-caju*, BF2= *Azotobacter chroococcum*, BF3= *Trichoderma viride*) i.e. C1+BF3, C1+BF2, C1+BF1, C2+BF3, C2+BF2, C2+BF1, C3+BF3, C3+BF2, C3+BF1. All the treatments were applied to the wheat crop in both the years 2018-19 and 2019-20. Rice was grown after wheat in both years to see the residual effects of the applied treatment. The sources of N, phosphorus (P), and potassium (K) were applied through urea, diammonium phosphate (DAP), and muriate of potash (MOP), respectively. A full dose of P, K, and half dose of N was applied at the time of sowing in wheat. However, the remaining 50% N was applied in two equal splits i.e. one at the crown root initiation stage and another at the booting stage. The biofertilizer treated compost was applied at the rate (@) 4 tonne ha^{-1} before sowing of wheat. In residual crop rice, only 75 kg N ha^{-1} was applied.

Results and Discussion

Effects on biomass accumulation in wheat at 60 days after sowing (DAS)

The effects of treatment combination of different nutrient levels and combination of compost with biofertilizers on biomass accumulation in wheat at 60 DAS were presented in table 1. The interaction of NL3 and C2BF2 recorded the highest biomass production based on the two years of pooled data. The second most biomass production was observed in NL3 and C1BF1 treatment combinations. This might be due to the slow release of nutrients from carpet waste compost during the initial period of application. Similar is the type of result documented by (Sharma *et al*., 2019) [8]. The lowest biomass accumulation was found in the treatment combination NL0 and C1BF2. This was due to no external sources of nutrients added to the soil. Banerjee and Pal, (2009) [9] reported that the control treatment recorded the lowest dry matter in rice. The treatment combination of NL3 +C1BF2 was found at par with the treatment combinations NL3 +C1BF1. Likewise, the treatment combination of NL1 +C2BF3 was found at par with the treatment combinations NL1 +C2BF2.

Table 1: Interaction effect of INM practices on biomass accumulation (g $meter^{-1}$ row length) of wheat at 60DAS.

	NL0	NL1	NL2	NL3
C1BF3	93.37	90.59	90.18	79.97
C1BF2	65.11	85.80	95.14	103.91
C1BF1	65.67	80.67	86.85	115.99
C2BF3	83.10	82.80	103.10	95.12
C2BF2	69.68	81.69	93.29	116.20
C2BF1	72.82	85.88	96.63	104.84
C3BF3	91.77	85.95	92.04	89.05
C3BF2	73.15	78.62	97.89	108.87
C3BF1	91.43	84.78	92.28	89.06
SEm±	2.13			
CD (*p*=0.05%)	5.96			

Effects on biomass accumulation in wheat at 90 days after sowing

The effects of treatment combination of different nutrient levels and combination of compost with biofertilizers on biomass accumulation in wheat at 90 DAS were presented in table 2. The interaction of NL3 and C1BF3 recorded the highest biomass production based on the two years of pooled data. The second most biomass production was observed in NL3 and C1BF2 treatment combinations. This might be due to the slow release of nutrients from carpet waste compost during the initial period of application. The lowest biomass accumulation was found in the treatment combination NL0 and C3BF1. This was due control plot and bagasse having lower compost and a lower concentration of nutrients, Dotaniya *et al*., (2016) [7] reported the nutrient content in bagasse was lower than pressmud compost. The treatment combination of NL0 +C3BF3 was found at par with the treatment combinations NL0 +C3BF2. Likewise, the treatment combination of NL3 +C2BF3 was found at par with the treatment combinations NL3 +C1BF1.

Table 2: Interaction effect of INM practices on biomass accumulation (g $meter^{-1}$ row length) of wheat at 90DAS.

	NL0	NL1	NL2	NL3
C1BF3	344.33	418.65	448.82	481.29
C1BF2	329.06	397.68	432.96	469.52
C1BF1	309.52	392.57	414.30	451.37
C2BF3	332.73	378.25	416.09	441.66
C2BF2	313.49	363.42	394.87	439.61
C2BF1	306.78	345.52	385.66	415.32
C3BF3	292.43	321.23	376.20	407.65
C3BF2	282.35	311.01	366.74	380.30
C3BF1	275.94	309.99	363.42	333.76
SEm±	6.56			
CD (*p*=0.05%)	18.36			

Residual effects on biomass accumulation in rice at 60 days after sowing

The residual effects of treatment combination of different nutrient levels and combination of compost with biofertilizers on biomass accumulation in rice at 60 DAS were presented in figure 1. The interaction of NL3 and C1BF3 recorded the highest biomass production based on the two years of pooled data. The second most biomass production was observed in NL3 and C1BF2 treatment combinations. This might be due to the slow release of nutrients from carpet waste compost during the initial period of application. The lowest biomass accumulation was found in the treatment combination NL0 and C3BF1. This was due to no external sources of nutrients added to the soil. A similar type of result was documented by Sharma and Banik, (2012) [10]. The treatment combination of NL3 +C1BF2 was found at par with the treatment combinations NL3 +C1BF3. Likewise, the treatment combination of NL0 +C3BF2 was found at par with the treatment combination NL0 +C3BF1.

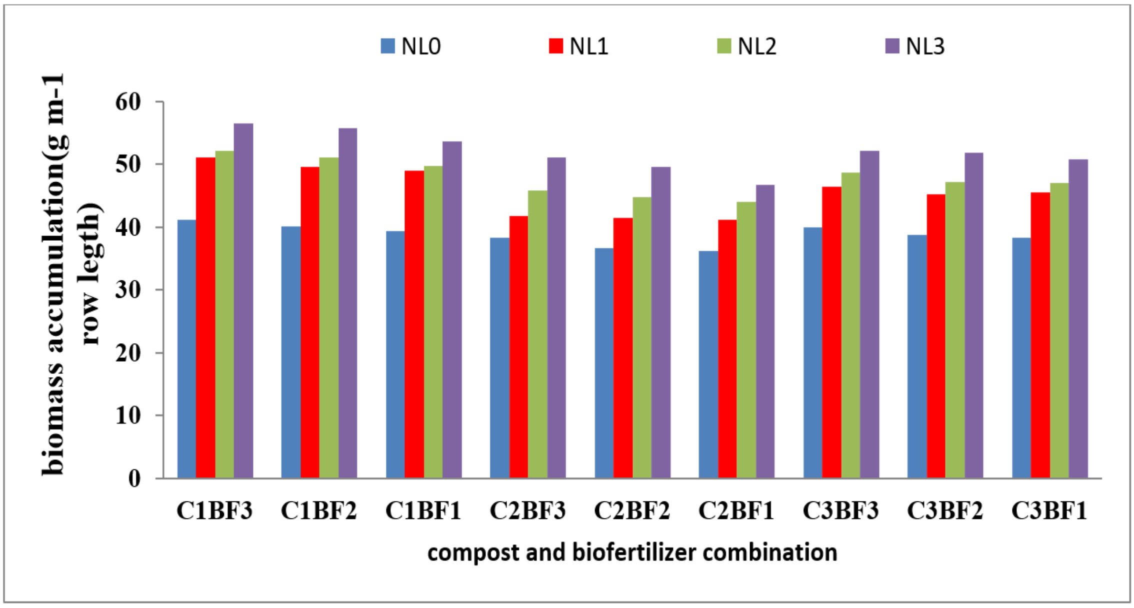

Fig 1: Interaction effect of residual INM practices on biomass accumulation (g meter^{-1} row length) of rice at 60DAS.

Residual effects on biomass accumulation in rice at 90 days after sowing

The residual effects of treatment combination of different nutrient levels and combination of compost with biofertilizers on biomass accumulation in rice at 90 DAS were presented in figure 2. The interaction of NL3 and C1BF3 recorded the highest biomass production based on the two years of pooled data. Singh *et al*., (2011) [11] reported that the integrated nutrient management schedule performed higher dry matter accumulation in the rice- pea system than the sole application of nutrients. The second most biomass production was observed in NL3 and C1BF2 treatment combinations. This might be due to the slow release of nutrients from carpet waste compost during the initial period of application. The lowest biomass accumulation was found in the treatment combination NL0 and C2BF1. This was due control plot and pressmud having a lesser residual effect. The treatment combination of NL0 +C3BF3 was found at par with the treatment combinations NL0 +C3BF2. Likewise, the treatment combination of NL3 +C2BF3 was found at par with the treatment combinations NL3 +C1BF1.

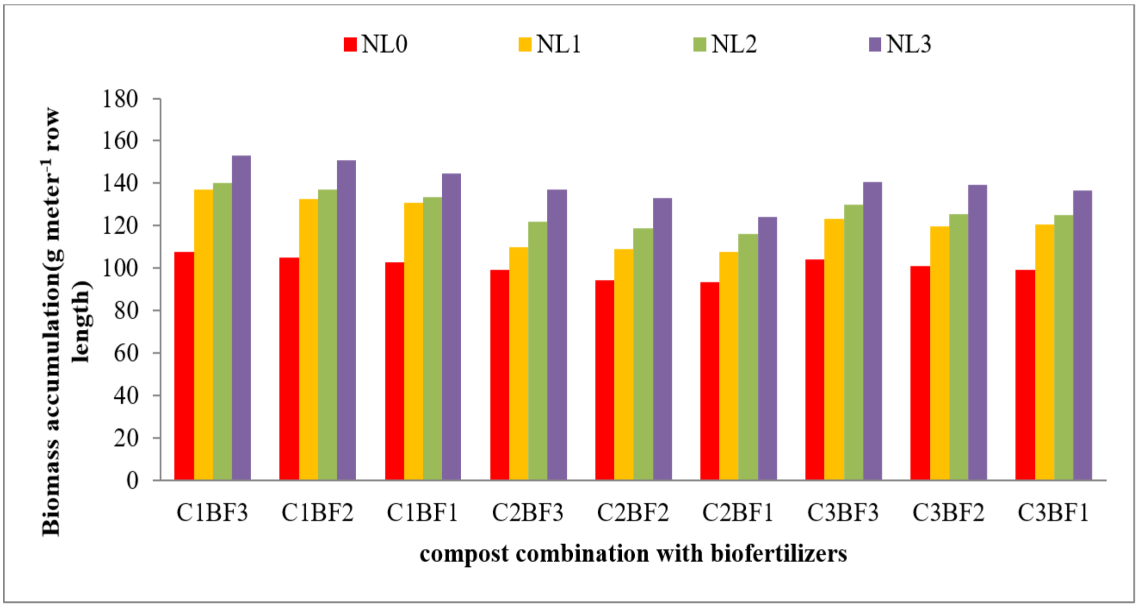

Fig 2: Interaction effect of residual INM practices on biomass accumulation (g meter^{-1} row length) of rice at 90DAS.

Conclusion

In the case of wheat, at 60 DAS the treatment combination NL3 and C1BF1 was superior in biomass accumulation over other treatment combinations. However, at 90 DAS the treatment combination NL3 and C1BF3 was found better accumulation of biomass than that of other treatment combinations. Similarly, in residual crop rice, the treatment combination NL3 and C1BF3 found higher biomass accumulation as compared to other treatment combinations at 60 and 90 DAS. The carpet waste compost was observed to have higher dry matter accumulation than that of bagasse and pressmud compost in two years of pooled data.

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