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Performance assessment of bio-decomposer and nitrogen management on emergence and NDVI values under super seeder sown wheat (*Triticum aestivum* L.) following combine harvested rice

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Abstract
Conservative tillage practises have recently grown in popularity in India, particularly in the upper Indo-Gangetic plain under the rice-wheat cropping system (RWCS). The management of combine harvested rice is the most challenging task for Indian farmers in the RWCS. Among all the on-farm management of rice residue *viz.*, surface retention, incorporation (*in-situ)* and composting (*ex-situ*) and the recent practice *i.e.*, use of bio-decomposer, are the promising options to address the issue of burning as well as maintaining soil health for long-term sustainability of RWCS. For which there were several issues that needed to be addressed with the incorporation of crop residues. Management on emergence performance is one such issue that must be addressed for increased grain yield. Furthermore, the incorporation of organic crop residues into the soil would result in a higher C:N ratio, which could contribute in nutrient immobilisation during seedling growth. As a result, to address the aforementioned issues a field experiment was carried out for two years on performance assessment of bio-decomposer and nitrogen management on emergence and NDVI values under super seeder sown wheat (*Triticum aestivum* L.) following combine harvested rice at G. B Pant University of Agriculture and Technology, Pantnagar 2020-21 and 2021-22. The experiment conducted was laid in split plot design consists of 12 treatments with two factors as main: with and without bio-decomposer and nitrogen levels (Nitrogen @180 kg/ha and nitrogen @150 kg/ha) and one factor as sub-plot: three nitrogen splits as 50% + 25% + 25%; 40%+30%+30%; and 30%+35%+35%. Significantly higher emergence and NDVI value was observed under Nitrogen @180 kg/ha and similarly higher emergence and NDVI value was recorded significantly when nitrogen was schedule as 50% + 25% + 25% during both the years of experimentation. Although the inclusion of a bio-decomposer had no significant effect on either parameter, a numerical increase was observed in addition to benefiting the sustainable environment.

Keywords: Bio-decomposer, C:N ratio, conservative tillage, emergence, incorporation, indo-gangetic, immobilisation, nitrogen, NDVI and super seeder

Introduction
Conservative tillage practises have recently grown in popularity in India, particularly in the upper Indo-Gangetic plain under the rice-wheat cropping system (RWCS). The management of combine harvested rice is the most challenging task for Indian farmers in the RWCS. Farmers resort to burning to manage such a massive amount of rice residue. Rice residue contain around 0.7% N, 0.23% P, and 1.75% K and it is also an important source of micronutrients such as Zinc and is also rich in Silicon (Goswami *et al.*, 2020) [4]. Therefore, the need for providing a cost-effective and farmer friendly option for the management of rice residue is both a major challenge as well as an opportunity for the sustainability of the intensive RWCS in North-West India. As a result, on farm management of rice residue like surface retention, incorporation (*in-situ*) and composting *(ex-situ*) and the recent application i.e., use of bio-decomposer, are the promising options to address the issue of burning as well as maintaining soil health for long-term sustainability of RWCS. The soil–atmosphere interface formed by the seedbed layer is of a particular concern to agronomists and soil scientists as it is the focus of the physical processes controlling crop establishment, biological activity, water infiltration and runoff. Initial plant population has direct bearing on crop yield and seedling emergence influences the initial plant population. Gan *et al.* (1992) [2] reported that the wheat plants that emerged early contribute more towards crop yield than those that emerged later.

Thus, desirable crop yields are achieved by providing seeds with an environment that encourages early germination and emergence. Green seeker was used to assess the normalized difference vegetation index (NDVI) which measures the reflected green radiation from vegetation. Strong correlation between leaf chlorophyll content and nitrogen has been previously reported by Verhulst and Govaerts (2010) [9]. The reflectance is influenced by chlorophyll concentration, leaf area index crop growth stage and nitrogen content in the leaves **(**Naito *et al.,* 2017) [6]. Nitrogen deficiency hampers carbon dioxide assimilation capacity which reduces Rubisco content during execution of Calvin cycle (Lu and Zhang, 2000) [11]. Management on emergence performance is one such issue that must be addressed for increased grain yield during *in situ* management. Furthermore, the incorporation of organic crop residues into the soil would resul In a higher C: N ratio, which

Could contribute in nutrient immobilisation during seedling growth. As a result, to address the aforementioned issues a field experiment was carried out for two years on performance assessment of bio-decomposer and nitrogen management on emergence and NDVI values under super seeder sown wheat following combine harvested rice.

Materials and Methods

Emergence count

The emergence count was taken at 10 and 15 DAS by counting number of emerged seedlings from the marked areas i.e., between one metre space of two sticks in two locations in the experimental unit, and expressed as the number of emerged seedlings/m^2.

Green seeker

Green seeker is used for measuring greenness of crop biomass and display the average value as the normalized difference vegetation index (NDVI). The NDVI value appeared on the LCD display immediately when trigger is pulled over the green vegetation. Green vegetation absorbs most of the red light and reflect the infrared light which is measured by green seeker. Hence, the green seeker value is direct indicator of green vegetation sensor indicator observation, which is indirectly reflecting chlorophyll content.

The handheld green seeker crop sensor was kept over 60 to 100 cm of the crop canopy and readings was recorded after continues pulling of the trigger with normal walking speed at 21 and 50 DAS.

Treatments execution

Kharif rice was harvested by combine harvester at a certain height. Loose straw was retained and spread uniformly on the field and average straw weight was recorded by taking 5 samples randomly from 1 m^2 each. And the experiment was laid out in Split-plot design accordingly. Subsequently, inoculant was prepared and sprayed. After 4-5 days of application of the inoculant without any primary tillage operation, the seed was sown through super seeder. Sowing was done at good moisture content. In the same way the process was repeated during the second year as well.

Statistical analysis

The experimental data was analyzed by using analysis of variance technique; the critical difference at 5% of significance was calculated for testing the significance of difference between any two means wherever F-test was significant (Rangaswamy, 1995) [7].

Result and Discussion

Emergence count

The data pertaining to emergence count/m^2 of wheat at 10 and 15 DAS under various treatment are provided in table 1 and fig. 1.

Application of bio-decomposer and nitrogen levels and three splits did not influence emergence count/m^2 significantly during both the years of experimentation. Application of bio-decomposer recorded higher emergence over without decomposer. While nitrogen @180 kg/ha recorded numerically more emergence count/m2 than nitrogen @150 kg/ha during both the years. Similarly, scheduling of nitrogen when split as 50%+25%+25% on wheat recorded numerically more emergence count/m2 during both the years. Due to application of bio-decomposer and urea in higher dose might have facilitated wheat emergence.

Incorporation of residues might have led to relatively poor contact between seed and soil which led to lower emergence count/m2. Non-significant interaction effect on various treatments was recorded on emergence count/m2 of wheat during both the years. Similar findings have been recorded by Ishaq *et al.* (2000) [1] and Ramzan *et al.* (2014) [8].

Table 1: Effect of bio-decomposer, nitrogen levels and its splitting on emergence count of wheat at different days after sowing

Treatment	Emergence count (m^2)			
	10 DAS		15 DAS	
	2020-21	2021-22	2020-21	2021-22
A) Application of decomposer				
D0	182	184	247	247
D1	181	186	249	249
S.Em±	3.0	2.8	2.1	2.1
CD at 5%	NS	NS	NS	NS
B) Nitrogen levels				
N1	179	181	247	247
N2	184	189	249	249
S.Em±	3.0	2.8	2.1	2.1
CD at 5%	NS	NS	NS	NS
C) Split doses of Nitrogen				
S1	183	185	249	249
S2	182	187	248	248
S3	180	183	248	248
S.Em±	3.1	3.1	3.9	3.9
CD at 5%	NS	NS	NS	NS

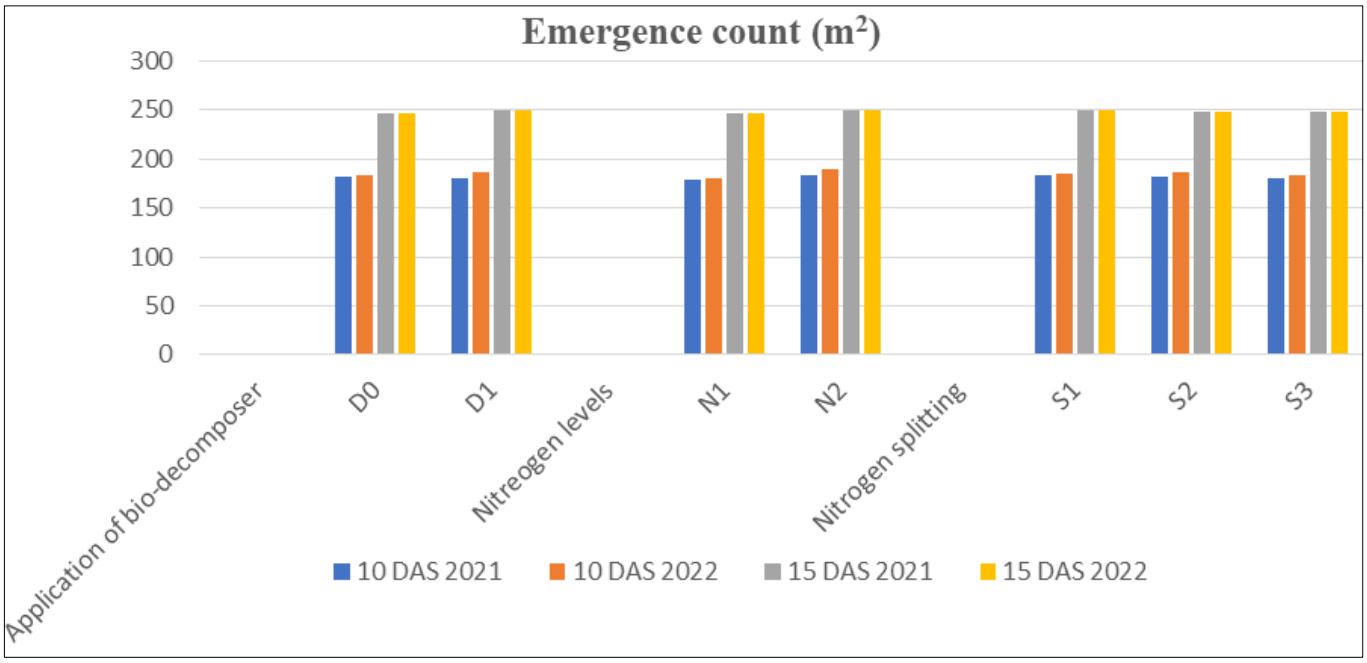

Fig 1: Effect of different treatments on emergence count of wheat at different days after sowing

Green seeker

Data on NDVI values were recorded by green seeker at 21 and 50 DAS and presented in Table 2 and fig. 2.

Green seeker was used to assess the normalized difference vegetation index (NDVI) which measures the reflected green radiation from vegetation. The intensity of reflectance in wheat leaf canopy is the indirect measure of chlorophyll content (Gitelson *et al*., 2003) [3]. Green seeker data given in Table 2 reveals that green seeker readings increased from 21 to 50 DAS of wheat.

Application of bio-decomposer did not significantly affect green seeker reading. Bio-decomposer application recorded numerically higher green seeker reading than without decomposer application during both the years.

Application of nitrogen @180 kg/ha recorded significantly higher green seeker reading than the nitrogen @150 kg/ha in both the years. NDVI is directly related to chlorophyll content and photosynthetic activity of healthy leaves reflect NIR whereas pigments like chlorophyll and carotenoid absorb red in large quantity (Wang *et al.*, 2004) [10] and thus reflect it less. Increasing the nutrient concentrations with mineralization of organic residue that increased cellular activities and make the plant comparatively green and healthy. Thus, the higher NIR reflection in nitrogen @180 kg/ha gave higher NDVI value than nitrogen @150 kg/ha.

Scheduling of nitrogen also show significant influenced with the green seeker reading. The highest NDVI value was recorded in 50%+25%+25% nitrogen scheduling followed by 40%+30%+30% and lowest was recorded when nitrogen was Split as 30%+35%+35% during both the years. The reflectance is influenced by nitrogen content in the leaves (Naito *et al.*, 2017) [6]. Nitrogen deficiency hampers carbon dioxide assimilation capacity which reduces Rubisco content during execution of Calvin cycle (Liu *et al.* 2007) [5]. Thus, the higher NIR reflection in nitrogen split as 50%+25%+25% gave higher NDVI value than nitrogen in the other splits.

Interaction effect was found non-significant with different treatments of green seeker reading in wheat during both the years.

Table 2: Effect of bio-decomposer and nitrogen levels with three splits on green seeker reading in wheat

Treatment	Green seeker reading (m²)			
	21 DAS		50 DAS	
	2020-21	2021-22	2020-21	2021-22
Application of decomposer				
D0	0.61	0.63	0.78	0.80
D1	0.65	0.66	0.83	0.84
S.Em±	0.01	0.01	0.02	0.02
CD at 5%	NS	NS	NS	NS
Nitrogen levels				
N1	0.60	0.62	0.77	0.78
N2	0.66	0.67	0.84	0.85
S.Em±	0.01	0.01	0.02	0.02
CD at 5%	0.05	0.05	0.05	0.05
Split doses of Nitrogen				
S1	0.68	0.69	0.85	0.85
S2	0.62	0.63	0.80	0.81
S3	0.60	0.61	0.77	0.78
S.Em±	0.02	0.01	0.02	0.02
CD at 5%	0.05	0.04	0.05	0.05

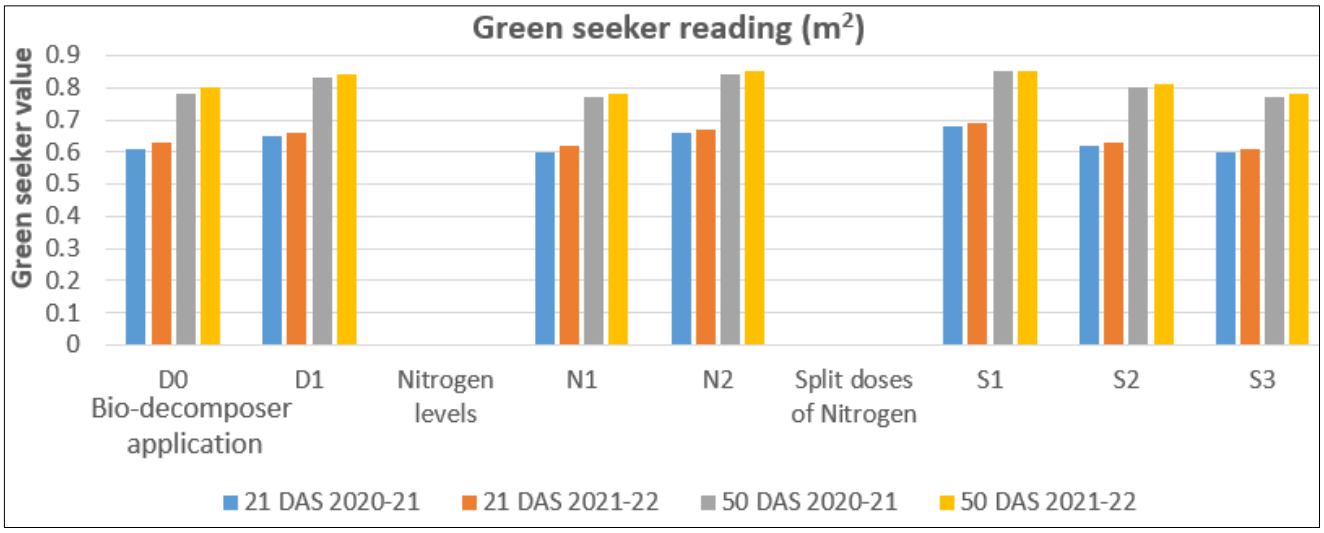

Fig 2: Effect of different treatments on green seeker reading of wheat at different days after sowing

Conclusion

Nitrogen application @ 180 kg/ha, split as 50%+25%+25% with bio-decomposer resulted in significantly higher NDVI values and numerically higher emergence under super seeder sown wheat after combine harvest rice.

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