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# Assessment of fly ash incorporation with vermicompost on rice yield and soil properties in Entisol

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**Abstract**

The present experiment was conducted during *Kharif* season 2020 at the Research Farm of Krishi Vigyan Kendra, Bemetara (CG). The experiment was laid out in randomized block design having three replications and eight treatments *viz.*, $T_1$- Control ($N_0:P_0:K_0$), $T_2$ - 100% RDF (120:80:60), $T_3$ - 75% RDF + 20 t $ha^{-1}$ fly ash, $T_4$ - 75% RDF + 20 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermi-compost, $T_5$ - 75% RDF + 40 t $ha^{-1}$ fly ash, $T_6$ - 75% RDF + 40 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermi-compost, $T_7$ - 75% RDF + 60 t $ha^{-1}$ fly ash and $T_8$ - 75% RDF + 60 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermi-compost. The results of the field experiment revealed that yield and yield contributing characters of rice crops were significantly increased by applied fly ash with vermicompost over control. The highest grain and straw yield (29.25 and 65.22 q $ha^{-1}$, respectively) were recorded under $T_6$ - 75% RDF + 40 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost followed by $T_8$ - 75% RDF + 60 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost, $T_7$ - 75% RDF + 60 t $ha^{-1}$ fly ash and $T_5$ - 75% RDF + 40 t $ha^{-1}$ fly ash as compared to 100% RDF (20.92 q $ha^{-1}$ and 46.64 q $ha^{-1}$, respectively) and the lowest (9.73 q $ha^{-1}$ and 21.69 q $ha^{-1}$, respectively) was found under $T_1$ - Control ($N_0:P_0:K_0$). Among applied treatments, the increase in yield of 9% was observed with $T_6$ - 75% RDF + 40 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost as compared to $T_2$ - 100% RDF shown an increase in yield as well as saving of 25% RDF. The yield attributing characters of rice (viz. plant height and effective tillers) were significantly increased by incorporation of fly ash and vermicompost over control, whereas test weight was not affected with applied treatments and was statistically at par. The higher effective tillers (9.33$hill^{-1}$) was noted under $T_6$ - 75% RDF + 40 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost and $T_8$ - 75% RDF + 60 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost treatments and the lowest (4.67 $hill^{-1}$) was recorded under ($T_1$) control. After the harvest of rice, different physico-chemical properties of soil were analysed and observed that soil pH, EC was non-significantly influenced with applied fly ash and vermicompost treatments, whereas the organic carbon, available nitrogen, phosphorus, and potassium in the soil after harvest rice crop were increased significantly over control. The highest soil organic carbon content (0.40%) was observed with $T_8$ - 75% RDF + 60 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost followed by $T_6$ - 75% RDF + 40 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost and the lowest (0.32%) was found under control. The highest soil available N (156.00 kg $ha^{-1}$) and available P (13.47 kg $ha^{-1}$) were observed under treatment 75% RDF + 60 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost ($T_8$) and the lowest N and P (136 and 10.09 kg $ha^{-1}$) was found under control, respectively. The highest soil available K (309.00 kg $ha^{-1}$) was observed with applied $T_6$ - 75% RDF+40 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost and the lowest was noted under control treatment.

The overall results showed that use of 75% RDF+40 t $ha^{-1}$ fly ash+2 t $ha^{-1}$ vermicompost ($T_6$) followed by 75% RDF + 60 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost ($T_8$) increased growth and yield attributes as well as saving and improved soil fertility of Entisol.

**Keywords:** Fly ash, vermicompost, nitrogen phosphorus, potassium

## Introduction

Rice (*Oryza sativa*) is the most important crop in the world and the main food source for more than half of the world's population, especially in Asia. The phrase "rice is life" is particularly suitable for India because this crop plays a key role in our country's food security and provides a source of income for millions of people. More than 90% of the world's rice is grown and consumed in Asia, which has 60% of the world's population. In India, rice ranks first among all the crops occupying 43.79 million ha area and production of 116.40 million tonnes with average productivity of 2659 kg/ha (GOI, 2018) [4]. Similarly, In Chhattisgarh rice grown area occupies 36.06 lakh hectares and production of 65.27 lakh tonnes with average productivity of 1810 kg/ha (GOI, 2018) [4] Chhattisgarh is also known as the "Indian rice bowl".

Some researchers have studied the impact of fly ash treatment on soil quality, hoping to use this industrial waste as an agronomic supplement. The physical and chemical quality of the modified fly ash soil depends on the initial quality of the soil and fly ash, but in most cases, it can be broadly generalized. When more than 10% fly ash is added to the soil, it can increase the yield of many crops by 20-25% and has high nutritional value. It has also been found to be beneficial to soil and crops (Yavarzadeh and Shamsadini, 2012) [16].

**Materials and Methods**

The present experiment entitled "Assessment of fly ash incorporation with vermicompost on rice yield and soil properties in Entisols" was conducted during the *Kharif* season of 2020 at Krishi Vigyan Kendra, Research Farm, Bemetara (C.G.). Krishi Vigyan Kendra, Research Farm, Bemetara has located about 70 km away from the district headquarter, Raipur. Bemetara lies at 81° 32' 8.2104" E. longitude and 21° 42' 50.4900" N latitude with 278 m high from the sea level.

Soil pH was determined in 1:2.5 water-soil suspension (by Jackson, 1967) [6] and then samples were allowed to settle down for recording electrical conductivity (Black, 1965) [2]. The organic carbon was determined by Walkley and Black rapid titration method (1934). Available nitrogen was estimated by alkaline potassium permanganate method (Subbiah and Asija. 1956) [14], available phosphorus by 0.5 M Sodium bicarbonate extractant method (Olsen *et al.*, 1954) [11] and available potassium was determined by neutral normal ammonium acetate extractant (Hanway and Heidel, 1952) [5]. The soil of the experimental field is locally known as Bhata and it comes under the order of Entisol. It is sandy loam in texture, slightly acidic (6.21), low in organic carbon (0.30%), available N (130 kg ha$^{-1}$), low in available P (9.91 kg ha$^{-1}$), and available K (250 kg ha$^{-1}$).

**Results and Discussion**

The significantly higher effective tillers were recorded with the application of $T_6$ - 75% RDF + 40 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost and $T_8$ - 75% RDF + 60 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost over $T_2$ - 100% RDF.

The data recorded on grain yield as affected by different fly ash and vermicompost treatments are presented in Table 1. Grain yield of rice was significantly increased with applied fly ash with vermicompost treatments over control ($N_0$ $P_0$ & $K_0$) and ranged from 9.73-29.25 q ha$^{-1}$. The highest grain yield (29.25 q ha$^{-1}$) was recorded under applied - 75% RDF + 40 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost i.e. in $T_6$ treatment but it was at par with treatments $T_7$ - 75% RDF + 60 t ha$^{-1}$ fly ash and $T_8$ - 75% RDF + 60 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost and the lowest grain yield (9.73 q ha$^{-1}$) was noted under $N_0$ $P_0$ & $K_0$ ($T_1$) control. The data on straw yield as affected by different fly ash and vermicompost treatments are presented in Table 1. The straw yield of rice was significantly increased with applied fly ash with vermicompost treatments over control ($N_0$ $P_0$ & $K_0$) and ranged from 21.69-65.22 q ha$^{-1}$. The highest grain yield (65.22q ha$^{-1}$) was recorded under applied treatment, $T_6$ - 75% RDF + 40 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost as compared to other treatments, but at par with $T_7$ - 75% RDF + 60 t ha$^{-1}$ fly ash and $T_8$ - 75% RDF + 60 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost. The lowest straw yield (21.69 q ha$^{-1}$) was recorded in treatment $T_1$ - control. Increasing doses of fly ash with vermicompost showed significantly higher soil organic carbon compared to $T_1$ -control and $T_2$ - 100% RDF, while a non-significant effect on soil pH and electrical conductivity was observed. The significantly higher available nitrogen was recorded with the application of $T_8$ - 75% RDF + 60 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost over $T_2$ - 100% RDF and $T_1$ - control. The significantly higher available phosphorus was recorded with the application of $T_8$ - 75% RDF + 60 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost over $T_2$ -100% RDF and $T_1$ - control. The significantly higher available potassium was recorded with the application of $T_6$ - 75% RDF + 40 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost and $T_8$ - 75% RDF + 60 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost over $T_2$ - 100% RDF and $T_1$ - control The soil available potash status was also similar to soil available phosphorus due to the application of different treatments.

Similar findings were also reported by Mulla *et al.* (2000), Selvakumari *et al*. (2000), Yeledhalli *et al*. (2008), Rautaray *et al.* (2003), Das *et al*. (2013) and Ramteke (2016) [17, 12, 3, 18, 19, 20] and observed that application of fly ash and vermicompost improved physical environment, root activity, available nutrients in the soil as well as nutrient uptake and the resulting complementary effect on rice grain yield.

**Table 1:** Effect of fly ash and vermicompost on yield and yield attributes Plant height (cm), Numbers of effective tillers hill$^{-1}$, Test weight (g) of rice

| Treatment | Plant height (cm) | Numbers of effective tillers hill$^{-1}$ | Test weight (g) | Grain (q ha$^{-1}$) | Straw (q ha$^{-1}$) |
|---|---|---|---|---|---|
| Control | 151 | 4.67 | 13.28 | 9.73 | 21.69 |
| 100% RDF | 164 | 7.33 | 13.34 | 20.92 | 46.64 |
| 75% RDF + 20 t ha$^{-1}$ fly ash | 164 | 7.00 | 13.45 | 18.02 | 40.17 |
| 75% RDF + 20 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost | 163 | 8.33 | 13.38 | 20.11 | 44.69 |
| 75% RDF + 40 t ha$^{-1}$ fly ash | 163 | 8.67 | 13.54 | 21.78 | 48.47 |
| 75% RDF + 40 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost | 164 | 9.33 | 13.65 | 29.25 | 65.22 |
| 75% RDF + 60 t ha$^{-1}$ fly ash | 163 | 9.00 | 13.55 | 27.53 | 61.39 |
| 75% RDF + 60 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost | 164 | 9.33 | 13.58 | 27.81 | 62.00 |
| SEm± | 0.73 | 0.37 | 0.03 | 1.45 | 3.23 |
| CD (p=0.05) | 2.21 | 1.11 | NS | 4.41 | 9.79 |

**Table 2:** Effect of fly ash and vermicompost on pH, EC, Organic carbon and Available N, P, K in the soil at harvest of rice

| Treatments | pH | EC (dSm$^{-1}$) | OC (%) | N (kg ha$^{-1}$) | P (kg ha$^{-1}$) | K (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|
| Control | 6.25 | 0.22 | 0.32 | 136 | 10.09 | 256 |
| 100% RDF | 6.33 | 0.23 | 0.33 | 141 | 11.58 | 287 |
| 75% RDF + 20 t ha$^{-1}$ fly ash | 6.45 | 0.23 | 0.35 | 144 | 12.56 | 286 |
| 75% RDF + 20 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost | 6.30 | 0.23 | 0.39 | 146 | 12.84 | 295 |
| 75% RDF + 40 t ha$^{-1}$ fly ash | 6.52 | 0.23 | 0.36 | 145 | 12.67 | 301 |
| 75% RDF + 40 t ha$^{-1}$ fly ash + 2 t ha$^{-1}$ vermicompost | 6.33 | 0.25 | 0.40 | 151 | 13.21 | 309 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 75% RDF + 60 t $ha^{-1}$ fly ash | 6.61 | 0.25 | 0.37 | 146 | 12.78 | 308 |
| 75% RDF + 60 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost | 6.44 | 0.25 | 0.40 | 156 | 13.47 | 309 |
| SEm± | 0.08 | 0.01 | 0.01 | 1.34 | 0.45 | 1.29 |
| CD (P=0.05) | NS | NS | 0.04 | 4.07 | 1.36 | 3.92 |

## Conclusion
From the study following important conclusion can be drawn: The results generated from the study showed that fly ash and vermicompost could be a source of plant nutrients and they could be used in agricultural soil for the production of the crop. Fly ash and vermicompost show a significant positive effect on yield and major and micronutrients availability nutrient in the soil. Application of $T_6$ - 75% RDF + 40 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost followed by $T_8$ - 75% RDF + 60 t $ha^{-1}$ fly ash + 2 t $ha^{-1}$ vermicompost proved better treatments with regard to nutrient availability as well as yield of rice.

## References

1. Bhople BS, Bhoyan SM, Nimje AM. Impact of fly ash on physical and chemical properties of black cotton soil and yield of sunflower crop. Journal of Soils and Crops. 2011;21(2):234-238.
2. Black CA. Methods of Soil Analysis. Amer. Soc. of Agro. Inc. Publ. Madison, Wisconsin, USA. College Soil Testing Laboratory, Iowa, Agriculture. 1965;57:1-31.
3. Das BK, Choudhury BH, Das KN. Effect of Integration of Fly Ash with Fertilizers and FYM on Nutrient Availability, Yield and Nutrient Uptake of Rice in Inceptisols of Assam, India. Int. Jour. Advanc. Res. Tec. 2013;2(11):2278-7763.
4. GOI. State/Season-wise Area, Production and Productivity of Rice in India. Ministry of Agriculture & Farmers Welfare, Govt. of India; c2018.
5. Hanway JJ, Heidel H. Soil analysis methods as used in Iowa state college soil testing laboratory. Iowa agriculture. 1952;57:1-31.
6. Jackson ML. Soil Chemical Analysis–Prentice Hall Inc. Englewood Cliffs, NJ, USA; c1967.
7. Jala S. Fly ash as an amendment agent for soil fertility. Ph.D. Thesis, Thapar Institute of Engineering and Technology, Patiala (Punjab); c2005.
8. Jaybeen S, Sinha MP. Bacterial population dynamics in fly ash amended soil with and without amelioration by earthworms. Nature Environment and Pollution Technology. 2012;11(1):99-104.
9. Khan MJ, Qasim M. Integrated use of boiler ash as organic fertilizer and soil conditioner with N, P, K in calcareous soil. Songklanakarin Journal of Science Technology. 2008;30(3):281-289.
10. Lee Yong Bok, Ha Ho Sung, Lee Chang Hoon, Kim Pilloo. Coal fly ash and phospho-gypsum mixture as an amendment to Improve soil fertility. Communications in Soil Science and Plant Analysis. 2008;39(78):10411055.
11. Olsen SR, Cole CV, Watnable FS, Dean LA. Estimation of available phosphorous in soils by extraction with sodium carbonate. U.S.D.A. Cir. 1954;933:1-10.
12. Rautaray SK, Ghosh BC, Mittra BN. Effect of fly ash, organic wastes and chemical fertilizers on yield, nutrient uptake, heavy metal content and residual fertility in a rice–mustard cropping sequence under acid lateritic soils. Bioresource Technology. 2003;90:275-283
13. Sikka, Kansal BD, Effect of fly ash application on yield and nutrient composition of rice, wheat and pH and available nutrient status of soils. Bioresource Technology. 1995;51:199-203.
14. Subbaiah BV, Asija G L, A rapid method for estimation of available N in the soil. Current Science. 1956;25:259-260.
15. Walkley A, Black IA. An examination of the Digestion method for determining soil organic matter, and a proposed modification of the chromic acid titration method. Soil science. 1934;37(1):29-38.
16. Yavarzadeh MR, Shamsadini H. Safe environment by using fly ash and vermicompost on wheat., In International Conference on transport, environment and civil engineering, held during 25-26 August 2012 at Kuala Lumpur (Malaysia), 2012, 146-148.
17. Yeledhalli NA, Prakash SS, Ravi MV, Narayanarao K. Long-term effect of fly ash on crop yield and soil properties. Karnataka i. of Agricultural Science 2008;21(4):507-512.
18. Mulla AL, Nariman, Lene Simonsen, and Jens Bülow. Post-exercise adipose tissue and skeletal muscle lipid metabolism in humans: the effects of exercise intensity. The Journal of physiology. 2000;524(3):919-928.
19. Selvakumari G, *et al*. Effect of integration of Flyash with fertilizers and organic manures on nutrient availability, yield and nutrient uptake of rice in alfisols. Journal of the Indian Society of Soil Science. 2000;48(2):268-278.
20. Ramteke J, Shah S, Godhia D, Shaikh A. Election result prediction using Twitter sentiment analysis. In2016 international conference on inventive computation technologies (ICICT). IEEE. 2016 Aug 26;1:1-5.