Eco. Env. & Cons. 29 (2) : 2023; pp. (726-729)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i02.029

Response of wheat cultivar (PBW-343) to fly ash amended soil

Nishant Vashistha and Ashish Tejasvi

Department of Botany, Agra College, Agra (U.P.), India

(Received 11 October, 2022; Accepted 17 December, 2022)

ABSTRACT

The large amount of fly ash produced in the process of power generation through coal based thermal power stations is a matter of great environmental concern. Proper handling of this huge amount of fly ash is badly needed. As we know that fly ash is a coal residue, so it is entirely organic in nature. It has different micro and macro nutrients like soil. The present study was performed to find out the effect of fly ash on different growth and yield parameters of wheat through field experiments. Fly ash (FA), organic manure like farmyard manure (FYM) and chemical fertilizer (CF) were used alone and also in different combinations. In relation to different parameters it was seen that combined application of fly ash and chemical fertilizer with farmyard manure helped in improving the estimated various growth characters as compared to fly ash alone and control.

Key words: *Coal, Fertilizer, Fly ash, Growth, Nutrients*

Introduction

Burning of coal in thermal power plant produces many residues which are collectively called coal combustion residues (CCRs). Among these different residues fly ash is produced in huge amount. Coal is the only natural resource available in abundance in India so it is widely used as a thermal energy source and as a fuel for thermal power plants producing electricity (Ahmad, 2017). Thermal power plants in India consume more than 430 million tons of coal and produce around 145.42 million tons of fly ash annually and which may exceed up to 1000 million tons by the year 2031-32 (Kumar and Jha, 2014). Presently, management of this problematic residue is really a great environmental and economic concern all over the world. Because such a large amount of fly ash is generated each year, a great deal of research needs to be conducted to determine the feasibility of its utilization in agriculture (Raj and Mohan, 2014). According to Sharma *et al*., 2016 fly ash is rich in different trace elements like As, B, Ca, Mo, S, Se, Sr etc.

Productivity of soil increases by fly ash amendment. Fly ash has very fine particles, low to medium bulk density, high surface area and it is very light in form (Kumar *et al*., 2000). Fly ash can be used as a source material for some nutrients like Ca, S, B, Mo and some other essential metals (Sajwan *et al*., 1995). Aggarwal *et al.,* (2009) concluded that application of fly ash modify the physical and chemical properties of soil along with the growth and yield of wheat. Pandey and Singh (2010) found that fly ash can be used in the effective manner in the barren or sterile soil for enhancing quality and improving the state of being fertile. Among many, some Industrial heavy wastes like fly ash and paper factory sludge are sufficiently potent of enhancing soil pH besides being very rich sources of various plant nutrients (Mesa, 1991; Sims *et al.,* 1993; Guerini *et al.,* 1994).

Fly ash also contains heavy metals in its composition so it can be used in agriculture as a source of fertilizer for soil which can increase the plant growth performance (Abdel *et al.,* 1995). The use of fly ash reduced the growth of several soil borne pathogenic microbes whereas the population of *Rhizobium* sp. was increased under the soil amended with fly ash (Chandrakar *et al.,* 2015).

Materials and Methods

For the present study fly ash was collected in sufficient quantity from National Capital thermal Power Station, Dadri (U.P.). For field experiments, fly ash (FA), organic manure like farmyard manure (FYM) and chemical fertilizer (CF) were used alone and also in different combinations. Fly ash @ 10 t/ha, FYM @ 1500 kg/ha was applied. In total, eight treatment combinations were used in this study: (1) control (without any application) (ii) CF (recommended dose), (iii) FYM, (iv) FA, (v) FA + CF, (vi) FA +FYM, (vii) CF+ FYM and (viii) CF+ FYM + FA. A uniform nutrient level of 150 kg N, 60 kg P and 40 kg K ha-1 through these materials and chemical fertilizers (CF) was maintained for all the treatments except fly ash (FA) and control plots and then their effect was studied on growth parameters of PBW-343 cultivar of wheat.

Methodology

Experimental plots (2m x 2m) were prepared using different treatment combinations for two days before sowing of wheat variety. A distance of 20 cm was maintained row to row and of 10 cm plant to plant. The sowing was done with the help of a dibbler manually. Thinning was done 21 days after sowing in order to maintain spacing between the plants within the rows. Recommended cultural practices were used for raising the crop. The treatments were replicated thrice in randomized block design (RBD). Thus, plots were prepared for PBW-343 cultivar of wheat. Periodic observations on plant growth parameters were recorded.

Results and Discussion

The current field experiment was organized to study the direct impact of various fertilization sources utilized with fly ash amendment in combined form on different growth parameters of test crop. In this experiment, fly ash was utilized source of soil amendment and plant nutrients like farmyard manure and chemical fertilizers were used under an integrated nutrient supply system. The germination %, number of ears, number of tillers, plant height, days to 50% flowering, days to maturity and total chlorophyll (mg/g) were the growth parameters recorded during the present investigation. Combined application of fly ash and chemical fertilizer with farmyard manure helped in improving the estimated various growth characters as compared to fly ash alone and control. In the experiment there was a clear stimulation in germination percentage of wheat plants in all treatments in comparison to control. Among all the treatments the increase in germination percentage was minimum when fly ash was used alone with soil. Results were almost the same when farmyard manure was used alone with soil in place of fly ash. Germination percentage was found maximum by 9.7 % over control when the fly ash, farmyard manure and chemical fertilizers were used in combination. When chemical fertilizer was used alone with

Table 1. Effect of fly ash on growth parameters of PBW-343 cultivar of *Triticum aestivum* L.

Treatments	Growth Parameters						
	Germination percentage	No. of tillers	No. of ears	Plant Height (cm) (120-DAS)	Days to 50% Flowering	Days to Maturity	Total Chlorophyll (mg/g)
Control	88.46	4.50	4.26	98.34	77.000	111.00	1.27
CF	92.36	4.83	4.66	101.42	71.000	106.00	1.53
FYM	90.46	4.66	4.53	100.21	73.000	108.00	1.39
FA	90.43	4.63	4.46	99.58	73.000	108.00	1.35
FA+CF	94.36	4.96	4.83	102.22	68.000	104.00	1.63
FA+FYM	91.46	4.76	4.63	101.11	72.000	107.00	1.57
CF+FYM	93.56	4.96	4.83	102.22	68.000	105.00	1.62
CF+FYM+FA	97.10	5.26	5.06	104.54	65.000	100.00	1.96
CD at 5 %	0.40	0.10	0.11	0.51	NS	NS	0.70

soil the germination percentage was enhanced by 4.4 % over control. Data recorded for plant height followed the same pattern as in germination percentage. In fly ash amended soil the increase was 3.4 % over control. Combined application of fly ash and chemical fertilizer with farmyard manure promoted the height of plants maximally. Number of tillers, number of ears and total chlorophyll recorded an increase over control in all the treatments. Days to 50% flowering and days to maturity also gets reduced significantly under integrated nutrient supply system (Table 1). Wheat cultivar showed a positive response to fly ash treatments (Vashistha and Tejasvi, 2021, 2022).

Utilization of organic material in conjunction with chemical fertilizer helped in increasing nutrient supplying capacity of the soil (Prasad and Singh, 1980; Rethman *et al*., 1999, Mittra *et al*., 2003; Rautaray *et al*., 2003; Sarkar, 2006; Kruger and Surridge, 2009; Tejasvi and Kumar, 2012; Tejasvi, 2020, 2021). With intensification of farming and utilization of chemical fertilizers, the significance of supplementary and complementary functions of organic materials is being sensed for retaining or regaining productivity of soil (Modgal and Singh, 1990; Karmakar *et al*., 2009).The study concludes that we can save and avoid a substantial amount of costly and harmful chemical fertilizers through the utilization of industrial waste under integrated plant nutrients system along with a reduction in environmental pollution is an added advantage. Long term investigations are to be needed to access the suitable amount of fly ash for soil amendments along with careful monitoring of heavy metals and toxic elements associated with fly ash.

References

Abdel-Basser, R., Issa, A.A. and Adam, M.S. 1995. Chlorophyllase activity : Effect of heavy metals and calcium. *Photosynthetica*. 31: 421-425.

Aggarwal, S., Singh, G.R. and Yadav, B.R. 2009. Utilization of fly ash for crop production: Effect on the growth of wheat and sorghum crops and soil properties. *Journal of Agricultural Physics.* 9: 20-23.

Ahmad, I. 2017. Utilisation of thermal power plant wastewater and coal fly ash to improve growth and yield of chickpea (*Cicer arietinum* L.). *International Journal of Applied Environmental Sciences*. 12 (1): 155-178.

Chandrakar, T., Jena, D., Dash, A.K., Jena, S.N., Panda, N. and Monica, M. 2015. Soil microbial activity as influenced by application of fly ash and soil amendments to maize crop in acidic alfisols, *International Research Journal of Agricultural Science and Soil Science.* 5 (4): 120- 128.

Guerini, I.A., Villas Boas, R.L., Bull, L.T., Eira, A.F., Penatti, A., Toledo, C.M., Matsumoto, K., Machado, R.W., Mello, S.L. and De, M. 1994. Effect of cellulose residue and ash from a cellulose and paper mill on some physical, chemical and biological properties of soil in pot experiment. *Cientifica.* 22 : 43-51.

Karmakar, S., Mittra, B.N. and Ghosh, B.C. 2009. Influence of Indian soil waste on soil-plant interaction in rice under acid lateritic soil. *World of Coal Ash (WOCA) Conference May 4-7 in Lexington*, KY, USA (http://www.flyash.info).

Kruger, R.A. and Surridge, A.K.J. 2009. Predicting the efficacy of fly ash as a soil ameliorant. *World of coal ash (WOCA) conference May 4-7 in Lexington,* KY,USA (http://www.flyash.info).

Kumar, V. and Jha, G.K. 2014. Use of fly ash in agriculture: Indian Scenario, WACAU-2014, *Israel International Workshop on Agricultural Coal Ash Uses*. pp 1- 10.

Kumar, V., Zacharia, K.A. and Goswami, G. 2000. Fly ash use in agriculture: A perspective. *Proceeding of 2nd International conference on fly ash disposal and utilization*. Vol. I (FAM and CBIP, New Delhi, 2- 4 Feb, 2000. pp (ix) 1-13.

Mesa, L.J. 1991. Effects of the application of rice husk ash on the chemical and mineral composition of two Oxisols in Colombia. 8 : 322-335.

Mittra, B.N., Karmakar, S., Swain, D.K. and Ghosh, B.C. 2003. Fly ash- A potential source of soil amendment and a component of integrated plant nutrient supply system. *International ash utilization symposium, Centre of applied energy research, University of Kentucky* (http://www.flyash.info).

Modgal, S.C. and Singh, C.M. 1990. Crop residue management in agronomic research towards sustainable agriculture (Eds. K.N. Singh and R.P. Singh). *Indian Soc. Agron.,* IARI, New Delhi, pp. 7-23.

Pandey, V.C. and Singh, N. 2010. Impact of fly ash incorporation in soil systems. *Agricluture, Ecosystems and Environemnt.* 136 : 16-27.

Prasad, B. and Singh, A.P. 1980. Changes in soil properties with long-term use of fertilizer, lime and farmyard manure. *J. Indian Soc. Soil Sci.* 28: 465-468.

Raj, S. and Mohan, S. 2014. Approach for improved plant growth using fly ash amended soil. *International Journal of Emerging Technology and Advanced Engineering.* 4 (6) : 709-715.

Rautaray, S.K., Ghosh, B.C. and Mittra, B.N. 2003. Effect of fly ash organic waste and chemical fertilizer on yield, nutrient uptake, heavy metal content and residual fertility in a rice-mustard cropping sequence under acid lateritic soils. *Bioresour. Technol.* 90: 275-283.

Rethman, N.F.G., Reynolds, K.A. and Kruger, R.A. 1999.

Crop responses to SLASH (Mixture of sewage sludge, lime and fly ash) as influenced by soil texture, acidity and fertility. *International Ash Utilization Symposium, Center for Applied Research, University of Kentucky (http*://www. flyash.info).

Sarkar, S. 2006. Effect of industrial, municipal and agricultural wastes on peanut production. *The 18th world congress of soil science (July, 9-15), Philadelphia, Pennsylvania,USA(http*://crops.confex.com/crops/wc).

Sajwan, K. S., Harold Ornes, W. and Youngblood, T. 1995. The effect of fly ash/sewage sludge mixtures and application rates on biomass production. *J. Environ. Sci. Hlth.* 30 (6) : 1327-1337.

Sharma, S., Kumar, V. and Yadav, K.K. 2016. Effect of fly ash deposition on biochemical parameters of different crop plants around parichcha thermal power plant, Jhansi, India. *Int. J. Curr. Microbiol. App. Sci*. 5 (8): 873-877.

Sims, J.T., Vasilas, B.L. and Ghodrati, M. 1993. Effect of coal fly ash and co-composted sewage waste on emergence and early growth of clover crop. *Soil Sci. Plant Analysis.* 24 : 503-512.

Tejasvi, A. and Kumar, S. 2012. Impact of fly ash on soil properties. *National Academy Science Letters*. 35(1): 13-16. DOI 10.1007/s40009-011-0002-x

Tejasvi, A. 2020. Response of AZAD P_1 cultivar of pea in fly ash amended soil. *Plant Archives*. 20(1): 1959-1962. (www.plantarchives.org)

Tejasvi, A. 2021. Response of Arkel cultivar of garden pea in fly ash amended soil. Plant Archives. 21(1): 841-844. DOI: https://doi.org/10.51470/plant Archives. 21(1) : 116.

Vashistha, N. and Tejasvi, A. 2021. Effect of fly ash extract on early growth of wheat. *International Journal of Botany Studies*. 6(4) : 204- 206. (www.botanyjournals.com)

Vashistha, N. and Tejasvi, A. 2022. Impact of fly ash on growth parameters of wheat through pot culture studies. *Journal of Science and Technological Researches*. 4(3) : 17-19. (DOI:https://doi.org/10.51514/JSTR.4.3.2022.17-19)