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RESPONSE OF AZAD P_1 CULTIVAR OF PEA IN FLY ASH AMENDED SOIL

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Abstract

The potential of fly ash as a soil amendment for growth and yield of garden pea (*Pisum sativum* L.) was assessed. Field experiment was carried out to study the effect of fly ash, organic manure like farmyard manure (FYM), biocompost (SOM) and chemical fertilizer (CF) in different combinations on various growth and yield parameters of pea which were observed and recorded up to 90 DAS. Azad P_1 a cultivar of pea was raised as per appropriate agronomical practices. Combined application of FA and CF with either FYM or SOM helped in improving the measured growth parameters as compared to FA alone and control. Application of organic material in conjunction with CF helped in improving nutrient supplying capacity of the soil which was further increased when FA was added as a soil amendment. Under adequate supply of nutrients, the observed growth parameters were enhanced. The results favor the use of fly ash in agriculture which in turn attains significance for eco- friendly disposal of fly ash and decreasing environmental pollution.

Key words : Fly ash, growth, nutrients, pollution, yield.

Introduction

Despite the emergence of alternate sources of energy during the last four decades, the use of coal as a prime source of energy cannot be undermined, especially in countries like India which have sufficient coal reserves. About 120 coal- based thermal power stations in India are producing about 112 million tones of fly ash per year. With more thermal power stations expected to be commissioned and possible augmentation in the capacities of existing stations, fly ash generation is expected to increase to 225 million tonnes by 2020 (Kumar *et al.*, 2005). Increased fly ash reserves necessitate planning for (i) more and more area for disposal at the cost of finite land resources and (ii) techno- economically feasible and eco- friendly ways of utilization (Singh *et al.*, 2011). Fly ash is rich in several micro and macro plant nutrients (Sahu *et al.*, 2017). Now a days, Fly Ash Utilization Programme (FAUP) in varying agro- climatic conditions and different soil- crop combinations supported with laboratory investigations have shown significant increase in yields of edible parts as well as biomass without any adverse impact on soil health (Kumar *et al.*, 2005; Kumar *et al.*, 2017; Rajpoot *et al.*, 2018). However, the physical and chemical properties of a particular fly ash are dependent on the composition of the parent coal, conditions during coal combustion, efficiency of emission control devices and practices used during storage and handling (Adriano *et al.*, 1980). The present investigation was therefore, conducted to study the effect of fly ash alone and in conjunction with different sources of fertilizers on Azad P_1 cultivar of pea.

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Materials and Methods

Fly ash was collected from National Capital Power Station, Dadri located in Gautam Budh Nagar District of Western Uttar Pradesh (India). Field experiment was carried out at a farmer's field (near Meerut) with sandy loam soil. Azad P_1 cultivar of pea (*Pisum sativum* L.) was used as test crop. Fly ash, organic manure like farmyard manure (FYM), biocompost (Simbhaoli Organic Manure, SOM) and chemical fertilizers (CF) were used in different combinations. Fly ash @ 10 t/ ha, FYM @ 603 Kg/ ha and SOM @ 350 Kg/ ha was applied. Total eight treatment combinations used in this study were: (i) Control (without any application), (ii) CF (recommended dose), (iii) FA (fly ash alone), (iv) CF+FA, (v) CF+BC, (vi) CF+FYM, (vii) CF+FA+BC and (viii) CF+FA+FYM.

Experimental plots (2m× 2m) were prepared using above treatment combinations and replicated thrice in randomized block design (RBD). A uniform nutrient level of 20 Kg N, 40 Kg P and 60 Kg K ha^{-1} through these materials and chemical fertilizers was maintained for all the treatments except fly ash and control plots. Different growth and yield parameters *viz*. plant height, root length, no. of leaves/ plant, no. of branches/ plant, no. of pods/ plant, no. of seeds/ pod, pod length, biological yield, days to 50% flowering, days to maturity, seed yield/ plant, 100 seed weight, harvest index %, NPP (Net Primary Productivity), response coefficient and chlorophyll content following Arnon (1949) were recorded on different intervals. The treated soils in which these plants are planted were analyzed for different physico-chemical parameters using appropriate methods (Misra 1968; Jackson 1973; Karmakar *et al.,* 2009).

Results and Discussion

It was observed that integrated use of organic materials favorably improved the soil physico-chemical parameters which in turn advantageous for the growth and yield parameters of pea cultivar. The number of branches, number of leaves, root length, plant height, dry matter production and net primary productivity were influenced by the treatments and an increase was recorded up to 90 DAS (Table 1). Similar positive response was observed when FA in combination with organic materials was used for cultivation of pea by some earlier workers (Deepa and Poonkodi 2004; Garg *et al.,* 2005; Ram *et al.,* 2006; Gupta *et al.,* 2007; Aggrawal *et al.,* 2009; Yunusa *et al.,* 2009; Jala and Goyal 2010; Tejasvi and Kumar 2011). Fly ash amendment showed most beneficial effects on the accumulation of chl. a, b and total chlorophyll at 60 DAS (Fig. 1). Similar observations also have been made by Gupta *et al.,* 2004; Patil and Chaudhari 2004; Sinha and Gupta 2005; Yunusa *et al.,* 2008; Nalawade *et al.,* 2009. In the present study, days to 50% flowering and days to maturity gets reduced in fly ash amended soil as compared to control. Similar observations were made by Kumar *et al.,* (1998). It is evident from data that there was sufficient increase in the number of pods per plant, seeds per pod, size of pods and 100 seed weight in all supplements as compared to FA alone or control (Table 1). The increase was more significant when either FYM or SOM was applied with CF and FA. These results are in conformity with those of Sajwan *et al.,* 1995; Kruger and Surridge 2009; Karmakar *et al.,* 2009. There was significant increase in NPP in all soil amendments as compared to control. In fly ash amended soil, an increase of 49.34 % in NPP was recorded over control. The maximum increase in

Table 1: Effect of different fertilization sources on growth, yield attributes, yield and harvest index of Azad P_1 cultivar of *Pisum sativum* L. at 90 DAS.

Characters	Root length (cm)	Plant height (cm)	No. of branches	No. of leaves	Days to 50% flowering	Days to maturity	No. of pods/ plant	Pod length (cm)	No. of seeds/ pod	100 seed weight (gm)	Seed yield (gm)	Biological yield (gm)	Harvest Index	NPP (gm)
Fertilization Sources														
C	15.70	60.50	4.80	8.20	54.00	96.00	8.20	6.40	5.80	16.033	7.09	14.64	48.40	0.152
CF	16.20	98.20	5.70	15.90	52.00	96.00	14.50	7.00	6.50	18.727	17.52	32.64	53.60	0.340
FA	16.00	92.70	5.00	14.20	48.00	91.00	10.40	6.60	6.00	17.146	10.70	20.68	51.70	0.227
CF+FA	16.30	104.30	6.10	19.30	47.00	90.00	15.80	7.20	6.80	20.327	20.46	36.12	59.40	0.401
CF+BC	16.20	99.80	5.90	18.30	51.00	96.00	15.30	7.30	6.80	19.233	19.46	35.38	55.00	0.368
CF+FYM	16.20	100.20	6.10	18.80	51.00	96.00	15.50	7.50	7.00	19.528	27.20	36.94	57.30	0.384
CF+FA+BC	16.80	109.40	6.30	21.00	46.00	90.00	16.60	7.80	7.20	21.054	25.29	41.42	60.80	0.460
CF+FA+FYM	17.10	108.80	6.40	24.20	47.00	91.00	16.80	7.90	7.40	21.635	26.78	42.87	62.30	0.471
CD at 5 %	0.521	2.666	0.433	1.375	2.113	2.673	0.876	0.658	0.665	0.833	0.400	2.774	1.243	0.019

Table 2: Effect of different modes of fertilization sources on physico-chemical properties of soil.

Characters	BD	pH	Organic carbon(%)	Nitrogen (Kg/ha)	Phosphorus (Kg/ha)	Potassium (Kg/ha)
Fertilization Sources						
C	1.34	6.7	0.29	146.10	30.90	128.10
CF	1.32	6.8	0.27	174.40	41.20	168.30
FA	0.98	7.0	0.35	162.20	33.40	147.40
CF+FA	1.28	6.9	0.32	180.00	44.50	170.60
CF+BC	1.27	6.8	0.39	183.40	46.10	172.40
CF+FYM	1.25	6.7	0.38	185.20	45.80	173.50
CF+FA+BC	1.21	7.0	0.43	194.70	61.80	178.20
CF+FA+FYM	1.20	7.0	0.42	196.50	60.20	178.80

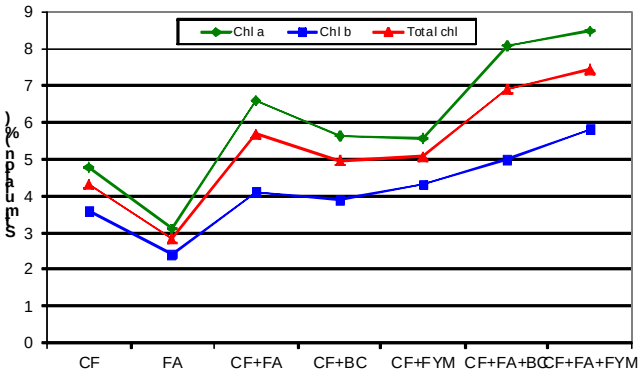

Figure 1. Effect of different fertilization sources on chlorophyll (mg/gm f.w.) of Azad P_1 cultivar at 60 DAS

NPP was observed in combined application of organic materials, CF and FA (Table 1). A significant increase in dry matter accumulation was recorded in all soil amendments as compared to control (Table 1). In fly ash amended soil, an increase of 41.25 % was recorded over control. The maximum phytomass was registered in combined application of organic materials, CF and FA where the increase in biological yield was 29.07 % over the chemical fertilizers used alone. In fly ash amended soil, only a marginal increase in harvest index over control was recorded. But the increase was significant when organic materials were applied with CF and FA (Table 1). The increase recorded in harvest index was 25.6-28.7 %. The data on harvest index indicate that fly ash cannot replace chemical fertilizers but when supplemented with CF, it proved beneficial. The maximum harvest index was obtained in integrated nutrition supply system.

The physico-chemical properties of soil were improved when chemical fertilizer was supplemented with FA and FYM or SOM. Such integrated application decreased bulk density and increased organic carbon and pH of soil. Available nutrient content also gets increased under integrated nutrient supply system (Table 2). Similar findings were also made by Mittra *et al.*, 2003; Yeledhalli *et al.*, 2008; Tejasvi and Kumar 2012; Skousen *et al.*, 2013. Truter *et al.*, (2001) also observed beneficial effect of SLASH (Fly ash + sewage sludge + lime) on plant growth and reported an increment of 200 % in maize, 240 % in triticale and 215 % in sorghum @ 10 % SLASH content in the soil. Sewage sludge application in the soil at the same rate increased dry matter production by 239 %, 370 % and 170 % in maize, triticale and sorghum, respectively. Better growth performance of FA in combination with organic materials has also been reported (Deepa and Poonkodi 2004; Garg *et al.*, 2005; Ram *et al.*, 2006; Gupta *et al.*, 2007).

The results obtained from present investigation have shown that fly ash in combination with organic manures works as an excellent soil conditioner and helps to a great extent to improve the productivity of the soil through fly ash soil amendment technology (FASAT) on sustainable basis. Nonetheless, new knowledge needs to be generated to further minimize soil and groundwater contamination and identify ways to efficiently exploit the fly ash as a soil ameliorating agent for waste land reclamation and biomass production. Also, Long term investigations should be carried out in different agro- climatic zones to assess the temporal effect of fly ash incorporation on physical, chemical and biological properties of the different soils along with careful monitoring of heavy metals and toxic levels of nutrients.

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