World Journal of Pharmaceutical research

Volume 2, Issue 6, 2507-2516. Research Article ISSN 2277 – 7105

GROWTH OF CHILLI PLANTS (CAPSICUM ANNUUM) IN FLY ASH BLENDED SOIL

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Article Received on
21 August 2013,

Revised on 27 Sept. 2013,
Accepted on 29 October 2013

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ABSTRACT

The physico-chemical characterization of fly ash, three different soils and irrigation water was carried out. The growth of chilli plants was studied in 0%, 2%, 5%, 10%, 15%, 20%, 25% fly ash blended soils. Growth of plants was monitored regularly after every month up to three months from the date of sowing for all the three blended soils in rainy, winter and summer seasons of the year 2009-10. Based on the data obtained it is found that 5% to 10% flyash- soil blending concentrations improved the physical properties of soil and also contributed to better growth and yield of chilli plants in all the three rainy, winter and summer seasons. The present work shows the possibility of use of fly ash by blending with soil for better plant growth. Thus utilization of flyash in agriculture may provide a feasible alternative for its safe disposal without serious deleterious effects and may save the cost of fertilizers and elevates the economy of farmers if used in proper ratio by blending.

KEY WORDS: Blended soil; Fly ash; Plant growth; Chilli; Waste and Characterization.

INTRODUCTION

Rapid industrialization, population explosion and more urbanization in India have created enormous problems of environmental pollution in terms of generating the variable quality and quantity of solid and liquid waste. In developing countries like India, the disposal of domestic

and industrial waste is becoming a problem of great concern, which may cause land, water and air pollution. Soil contamination by industrial effluents has affected both soil health and crop productivity.

Many untreated and contaminated sewage and effluents may have high concentration of several heavy metals such as Cd, Ni, Pb and Cr [1,2] which get accumulated in the living cells causes the decrease in cell activities, inhibition of growth and various deficiency/ diseases in plants [3]. However, these effluents [4] are purposely used for irrigation due to scarcity of water especially for vegetable and fruits. Effluents for irrigation have been practiced for centuries throughout the world [5,6]. It provides farmers with a nutrient enriched water supply and society with a reliable and inexpensive system for wastewater treatment and disposal [7]. But this is being done without knowing the effects of contaminants present in the effluents on the quality and growth of different plants.

The nutritional status is a major determinant of the productivity of a soil. Many waste materials containing essential plant nutrients are available in huge quantities which when applied at appropriate rates can enhance the nutrient status as well as other soil properties. Out of these solid wastes, fly ash is the major waste produced in thermal power stations. Every year thermal power plants in India produce more than 100 million tons of fly ash, which is expected to reach 175 millions in the near future [8]. Due to the absence of well planned strategy in India for the disposal of this fly ash, it is posing serious health and ecological hazards [9]. It has been reported [10,11] that the fly ash has a potential to improve the contents of nutrient elements of soil required for health plant growth. It contains [12] useful components such as Ca, Mg, Fe, Cu, Zn, Mn, B, S and P along with appreciable amounts of toxic heavy metals such as Cr, Pb, Hg, Ni, V, As, and Ba. The toxic heavy metals hinder the nutrients utilization by plants and adversely affect the microbial population and hence soil fertility. Many workers [13, 14, 15] also found increase in yields in several crops by addition of fly ash which was attributed to the correction of nutrient deficiencies in plants although the response varied from soil to soil.

Thus, the use of fly ash in agriculture provides a feasible alternative for its safe disposal to improve the soil environment and enhance the crop productivity. However, a proper management strategy has to be developed to abate the land pollution from the heavy metals present in the fly ash. Present investigation is a part of systematic work undertaken to study the effect of fly ash on the growth of plants (Chilli) and thereby to control the pollution load.

MATERIALS AND METHODS

The fly ash was obtained from RPL Urja limited, at Wani in Yavatmal District of Maharashtra (India). Seeds of chilli (of make Jwala) were collected from the market. Three different soil samples were taken at 25cm depth from the surface and sampling was carried out by quartering method. These soils were air dried and powdered. These soils were blended with fly ash in % by weight as 0%, 2%, 5%, 10%, 15%, 20% etc. and 1kg of each blend were kept in cleaned polythene bags.. Two seeds of chilli were sown in each bag.

The physico-chemical characteristics of fly ash and soils were analyzed by standard methods, [16,17]. The physical and chemical properties of irrigation water were analysed by following the procedure of [18]. All chemicals used were of AR/GR grade.

All plants were watered equally with same period and with the same irrigation water. The height, number of leaves, number of flowers and the number of fruits were recorded on each plant after every month from the date of sowing up to the three months. The observations were taken in rainy (June- Sept.), winter (Dec. - March) and summer (April- July) seasons of the year 2009-10.

RESULTS AND DISCUSSION

Physico-chemical characteristics and elemental analysis of fly ash and three different soils are presented in table-1. Similarly, the analysis of irrigation water is shown in table-2. The results of fly ash analysis showed pH of 7.63, electrical conductivity (EC) of 0.55mS/cm which may be due to the presence of high concentration of oxides of Ca and Mg [19]. Also, it contains high concentration of P, K, Ca, Mg, Fe and Mn. Various studies [20,21,22,23] conducted in India and abroad have indicated that application of fly ash to soil reduce bulk density and dry density and increase the water holding capacity and porosity.

The experiment was started in rainy' 09 season; it was observed that among all % blending concentrations of S_1, the optimum height (14.5 inch), number of leaves (75), number of flowers (37) and the number of fruits (18) were found at 10% blending concentration. In case of S_2, the optimum level fly ash-soil blending concentration was found at 5% where the maximum height, number of leaves, number of flowers and number of fruits were 19.5 inch, 98, 46 and 23 respectively. For S_3, the maximum value of plant height (15 inch) and the number of leaves (85) number of flowers (38) and fruits (20) were maximum at 10% blending.

These results may be attributed to the fact that, due to the higher values of W.H.C., pH, K, Mg, Cu and Mn in S_2 than S_1 and S_3, it showed optimum level concentration at 5% i.e. lesser blending concentration than for S_1 and S_3. However, 10%, 5%, 15% and10% blending concentrations for S_1, S_2 and S_3 respectively are found to be the optimum concentrations. The increase in lady's finger plant growth and yield was also reported [24] by blending diluted molasses with soil at 0.2-0.5% concentration.

The maximum values of plant height (13.5 inch), number of leaves (60), number of flowers (33) and number of fruits (23) for S_1 in ***winter 2009-10*** were found at 10% blending concentration. For S_2, the optimum level blending concentration is 5% where the values of plant height (12.5 inch), number of leaves (86), number of flowers (43) and number of fruits (24) were found maximum. Similarly for S_3, the maximum plant height (14 inch), number of leaves (99), number of flowers (44) and number of fruits (31) were found at 10% blending concentration. Increase in growth and yield was also reported [25] under fly ash application in the soil up to 10 tons/ha and was interpreted as due to improved soil structure and enhanced nutrient availability. Crops like rice, wheat, gram etc. were grown on varying level of fly ash encouraging the crop growth and subsequently its yield. Tomato cultivators grown on fly ash amended soils had higher tolerance to wilt fungus *Fusarium Oxysporum* [26].

In ***summer'2010***, the optimum level blending concentration for S_1 was found at 5% where the plant height (13), number of leaves (75), number of flowers (40) and number of fruits (20) were found maximum. 5% optimum concentration for S_1, might be due to it has higher % of W.H.C. and porosity and lower bulk density. For S_2, the plant height (11 inch), number of flowers (32) and number of fruits (22) were maximum at 5% blending concentration. The number of leaves (92) was found maximum at 10% concentration which might be due increased biochemical parameters at this concentration. Similarly, in case of S3, the maximum plant height (12), number of leaves (81), number of flowers (40) and number of fruits (21) were found at 10% blending concentration. The similar results were reported by [27], where they found an increase in yield of wheat up to 20t/ha fly ash dosing to soil and decline thereafter but still higher than the yield under no ash addition. They reported moisture retention of soils on fly ash treatment. Thakare et al [28], reported similar results in soya bean (Glycine Max) by using soyawaste blended soil and found maximum growth and yield at 10% blending concentration. The possible reason for this is may be the role of growth regulators and the balance between promoters and inhibiters, which shift due to the trace

element composition of fly ash. Some negative effects were also reported but these may be due to excessive concentrations of industrial waste which may lead to nutrient toxicity and other soil disorder (Siddharth Singh 2011).

From the commercial viewpoint, in rainy, winter and summer season the overall maximum number of fruits were found at 5% to 10% blending concentration. Figures 1, 2 and 3 show the number of fruits (for S_1, S_2 and S_3) in rainy, winter and summer seasons respectively. This shows that the nutrients like available nitrogen, phosphorous and potassium in fly ash are sufficient which can correct the deficiencies of these in soils. Thus at 5% to 10% blending concentrations of fly ash with soil, the chilli plant are able to absorb maximum amount of nutrients from blends resulting in good yield. This indicates that, the ingredients present in the blends of fly ash and soil at particular concentration are supportive to the growth of plants.

Table 1: physico-chemical characteristics of three soils and

Sr. No.	Parameters	S1	S2	S3	Fly ash
1	Bulk density (g/cc)	1.49	1.61	1.78	1.43
2	W.H.C. (%)	75.83	75.83	58.42	62.50
3	pH	7.63	7.70	7.65	7.63
4	Conductivity (mS/cm)	0.51	0.53	0.50	0.55
5	Available P (kg/ha)	16	18	20	24.33
6	Available K (kg/ha)	552	625	298	456
7	Na (%)	0.52	1.78	0.63	0.67
8	Organic C (%)	0.39	0.34	0.49	0.48
9	Ca (%)	36	27	29.25	23.56
10	Mg (%)	3.68	9.23	3.68	19.23
11	Porosity (%)	60.05	54.52	35.63	46.59
12	Moisture (%)	8.99	7.16	10.02	7.02
13	Zn (ppm)	0.25	0.48	0.47	1.37
14	Cu (ppm)	1.16	2.84	1.41	0.98
15	Fe (ppm)	0.29	0.56	0.64	2.91
16	Mn (ppm)	2.04	5.21	1.62	2.77

Table 2: Physico-chemical characteristics of irrigation water

Sr. No.	Parameters	Irrigation Water
1	pH	7.18
2	Conductivity	3.41 mS/cm
3	Calcium	4.8 meq/L
4	Magnessium	1.6 meq/L
5	Sodium	0.71 meq/L
6	Potassium	0.41 meq/L
7	Bicarbonates	2.0 meq/L
8	Chlorides	2.0 meq/L
9	Sulphates	1.52 meq/L

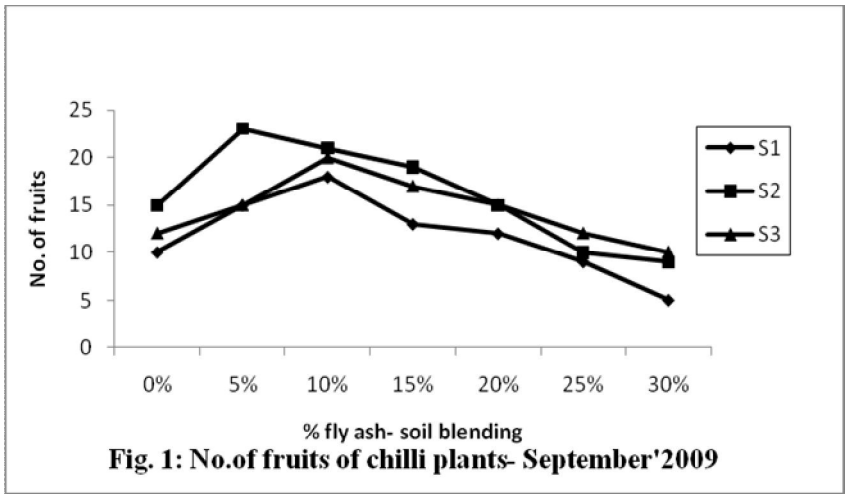

Fig. 1: No.of fruits of chilli plants- September'2009

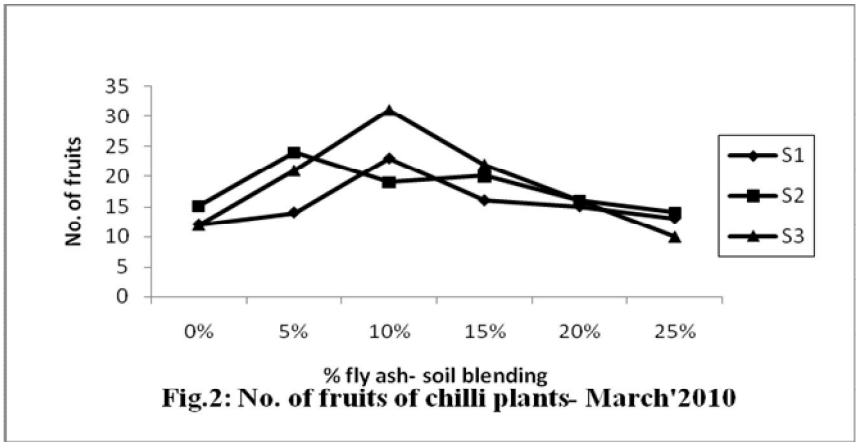

Fig.2: No. of fruits of chilli plants- March'2010

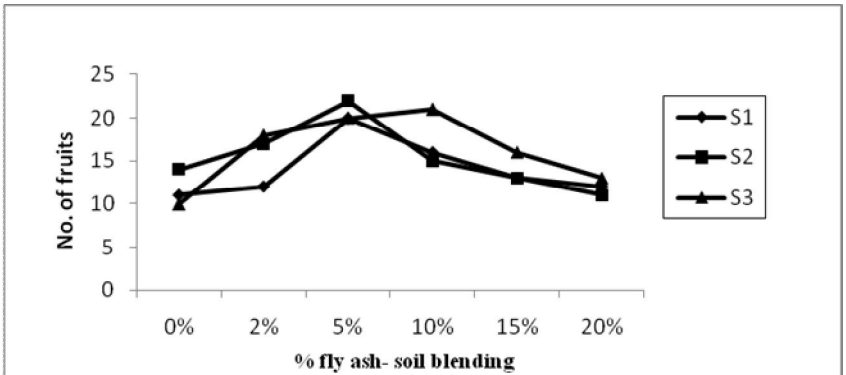

Fig.3: No. of fruits of chilli plants-July'2010

CONCLUSION

In general, 5 to 10% flyash-soil blending concentrations were found beneficial for the growth and yield of chilli plant. That means fly ash acts as an excellent soil modifier, conditioner and a source of essential nutrients for appreciably improving the texture and fertility with significant increase in crop yield over the control at a particular concentration only and is supportive to plant growth. However, other blending concentrations may lead to reduction in growth and yield parameters of crops. This study show that the available ingredients in flyash were useful for certain levels for utilization of a particular plant species. Thus utilization of flyash in agriculture may provide a feasible alternative for its safe disposal without serious deleterious effects and may save the cost of fertilizers and elevates the economy of farmers if used in proper ratio by blending. Hence, there is an opportunity with fly ash to be used as an eco-friendly and non-conventional fertilizer at particular concentration. However there is a need of detail and time series study to declare flyash totally safe and eco-friendly to be used as fertilizer.

ACKNOWLEDGEMENT

One of the authors, P.B.Thakare is grateful to, The Principal and the management of Arts, Commerce and Science College, Arvi, Tq. Arvi, Dist. Wardha. M.S., India. Thanks are also due to The Principal and Head of Chemistry department, Bapurao Deshmukh College of Engineering, Sevagram, Dist. Wardha, M.S.(India),for providing all the laboratory facilities.

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