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SOIL SCIENCE

Impact of Fly Ash on Soil Properties and Productivity

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ABSTRACT

Fly ash is considered as a good soil & source of secondary plant nutrients as well as micronutrients and can significantly improve the physio-chemical properties of the soil due to increase in porosity and water holding capacity. It can efficiently be used as a source of pesticide carrier, plant growth promoter etc. It has also been reported to be safe for agricultural application in context of toxicology & radioactivity. The poor infiltration and fine texture of clay soil causes water logging problem and reduces biological activities in soil. In contrast to this, loose particle and higher in filterability in sandy soil results in low water holding capacity and poor nutrient retention. Fly ash, a waste product of thermal power plants, causes environmental pollution and is hazardous to human health. Fly ash may be used as amendment to improve soil properties and plant growth in soils. The addition of 20% fly ash in decade soil and up to 30% in sandy soils improved the germination, plant height, biological and grain yield of wheat. The addition of fly-ash has also shown improvement in the soil properties viz. texture, structure and bulk density. Permeability of clay loam soil increased from 0.54cm/hr to 2.14cm/hr by the addition of 50% fly ash whereas it decreased from 23.80 cm/hr to 9.67 cm/hr in sandy soil by addition of 50% fly-ash. Water holding capacity of sandy soil also increased from 0.38 cm/cm to 0.53 cm/cm at 50% level. The agricultural productivity increased by addition up to 30% fly ash and 10% compost in different type of soil as experimented in the present study.

Highlights

- Increased yield of crops is maximum for 70% soil, 20% fly ash & 10% compost.
- Soil having Soil 70% + Fly ash 15% + Compost 15% produces better yield of flower.
- Soil having Soil 70% + Fly ash 20% + Compost 10% better yield of vegetables.
- 50% tap water and 50% waste water containing fly ash gives better yield for rice cultivation.

Keywords: Fly ash, coal ash, agriculture, soil

Fly ash is produced as a result of coal combustion in thermal power plant. Now a day's fly ash disposal into the environment is one of the major concerns throughout the world mainly in developing countries. Fly ash production depends on the quality of the coal, which contains a relatively high proportion of ash that leads to 10-30% fly ash formation (Singh G. *et al.* 2011). Fly ash sometimes used in buildings, production of bricks, construction of roads, embankment & cement industries. Its alkaline character and a high concentration of mineral substances have resulted in attempts in using it as fertilizer or amendment to enhance the physico-chemical properties of soil. The fly ash contains a high concentration of toxic heavy metals such as Cu, Zn, Cd, Pb and Ni, Cr etc. (Rautray *et al.* 2003; Lee *et al.* 2006; Tiwary *et al.* 2008) along with low nitrogen and phosphorous contents and pH ranges from 4.5 to 12. The mineralogical, physical & chemical property of fly ash (Adriano *et al.* 1990) depends on the nature of parent coal. In general fly ash particles are spherical and have a size distribution with medium around 4 μm (Srivastav *et al.* 20007). Fly ash has usually high surface area and light texture due to presence of large, porous and carbonaceous particles. Chemically, 90-99% of fly ash is comprised of Si, Al, Fe, Ca, Mg and Na & K with Si & Al forming the major matrix identified in fly ash and oxidation of C & N during combustion drastically reduces their quantity in ash (Herman et., 1977). Soil properties as influenced by fly ash application have been studied by several workers (Jian et. Al., 2011) for utilisation this industrial waste as agronomic amendments. Fly ash application to sandy soil could permanently alter soil texture, increase micro porosity and improve the water holding capacity (Gagnon *et al.* 2004).

IMPACT OF FLYASH ON SOIL FERTILITY

Soil properties as influenced by fly-ash application have been studied by several workers (Honeycutt et.al. 1988) for utilizing this industrial waste as an agronomic amendment.

Effect of Fly-ash on Physical Properties of Soil

Fly-ash application to sandy soil could permanently alter soil texture, increase micro porosity and improve the water-holding capacity (Gagnon *et al.* 2001). Fly ash addition at 70 t ha^{-1} has been reported to alter the texture of sandy and clayey soil to Loamy (Carlson *et al.* 1993). Addition of fly-ash at 200 to $acre^{-1}$ improved the physical properties of soil and shifted the textual class of a refuge from sandy loam to silt loam (Calace *et al.* 2002). The particle size range of fly-ash is similar to silt and changes the bulk density of soil. It was observed that among five soil types, Reyes silty clay showed an increase in bulk density from 0.89 to 1.01 g cc^{-1} and a marked decrease in soil having bulk density varying between 1.25 and 1.60 g cc^{-1} when the corresponding rate of fly ash amendment increased from 0 to 100%. Application of fly ash at 0,5,10 and 15% by weight in clay soil significantly reduced the bulk density and improved the soil structure, which in turn improves porosity, workability, root penetration and moisture-retention capacity of the soil (King *et al.* 1984; Panda *et al.* (2012) concluded that addition of fly ash up to 46% reduced the dry density of the soil in the order of 15-20% due to the low specific gravity and unit weight of soil. A gradual increase in fly-ash concentration in the normal field soil (0, 10, 20 up to 100% v/v) was reported to increase the porosity and water-holding capacity (Kumar, A *et al.* 2003). This improvement in water-holding capacity is beneficial for the growth of plants especially under rain-fed agriculture. Amendment with fly ash up to 40% also increased soil porosity from 43 to 53% and water-holding capacity from 39 to 55% (Sippola *et al.* 2003). Fly ash had been shown to increase the amount of plant available water in sandy soils (Tabone *et al.* 2010). The Ca in fly ash readily replaces Na at clay exchange sites and thereby enhances flocculation of soil clay particles. Keeps the soils friable, enhances water penetration and allows roots to penetrate compact soil layers (Jackson *et al.* 1997). Water-holding capacities of fly ashes from different thermal power plants in Eastern India were compared and the effect of size fractionation on the water-holding capacity was determined in an investigation by usual procedure.

Effect of Fly-ash on Chemical Characteristics of Soil

Lime in Fly-ash (FA) readily reacts with acidic components in soil and releases nutrients such as S, B and Mo in the form and amount beneficial to crop plants. FA improves the nutrient status of soil (Rautray *et al.* 2003). The FA has been used for correction of sulphur and boron deficiency in acid soils (Raina *et al.* 2003). Application of fly ash in agriculture increases the pH of acidic soils because it is a residue of power plant and is producsed due to coal burning and that residue contains huge amount of basic impurities (i,e metal hydroxides). (Rajanan *et al.* 1979). Most of the fly ash produced in India is alkaline in nature, hence, its application to agricultural soils could increase the soil pH and thereby neutralize acidic soils (Simard *et al.* 1988). The hydroxide and carbonate salts give fly ash one of its principal beneficial chemical characteristics, the ability to neutralize acidity in soils (Cernec *et al.* 2005). Fly ash had been shown to act as a liming material to neutralize soil acidity and provide plant available nutrients (Mishra *et al.* 1991). Researchers have been shown that the use of fly ash as liming agent in acid soils may improve soil properties and increase crop yield (Mishra and Behera 1991). The electrical conductivity of soil increase with fly ash application and so does the metal content. Decolourization of effluents by fly ash has been reported earlier by a number of workers (Monte *et al.* 2009) and a mixture of fly ash and coal in the ratio of 1:1 can be substituted for activated carbon owing

Table 1: Effect of fly-ash on soil properties

Parameters	Tons ha^{-1} fly ash in field soil						
	Days after amendment	**0**	**10**	**12.5**	**15.0**	**17.5**	**20.0**
pH	35	7.40	7.50	7.50	7.50	7.70	7.80
	110	7.50	7.50	7.60	7.60	7.60	7.60
EC (mho cm^{-1})	35	0.11	0.12	0.13	0.13	0.13	0.15
	110	0.18	0.18	0.19	0.23	0.24	0.34
Available P (mg 100 g^{-1})	35	2.20	2.40	2.50	2.60	2.80	2.90
	110	1.90	1.90	2.0	2.50	2.80	2.80
OC (%)	35	0.37	0.38	0.38	0.43	0.44	0.46
	110	0.30	0.34	0.34	0.34	0.37	0.39
OM(%)	35	0.63	0.66	0.66	0.74	0.76	0.79
	110	0.51	0.58	0.58	0.58	0.64	0.67
N(%)	35	0.09	0.08	0.08	0.06	0.06	0.06
	110	0.06	0.06	0.05	0.04	0.05	0.05

to increase in surface area available for absorption (Geng *et al.* 2006). Metals like Fe, Zn, Cu, Mn, Ni and Cd have been shown to be available at higher concentrations in DTPA extracts of FA (Geng *et al.* 2007). The increased accumulation of essential ions such as Zn, Mn and Cu by the paddy shoot/grain might be due to increased activity of ionic transporters (Mabee & Roy 2003), in turn due to higher essential ion availability in the FA observed that gradual increases in soil pH, conductivity, available phosphorus, organic carbon and organic matter with increased application of fly-ash (Table 1). Fly ash is considered to be a rich source of Si and application of FA in Si-deficient soils has been demonstrated to improve the Si content of rice plants as well as their growth (Lee *et al.* 2006).

Effect of Fly-ash on Biological Properties of Soil

There is a dearth of studies regarding the effects of FA amendment on soil biological properties. Numerous short term laboratory incubation studies found that the addition of unweathered FA to sandy soils severely inhibited microbial respiration, numbers, size, enzyme activity and soil nitrogen cycling processes such as nitrification and N mineralization (Dutta *et al.* 1999). Information regarding the effect of fly-ash amendment on soil biological properties is very scanty (Furlani *et al.* 2011). These adverse effects were partly due to the presence of excessive levels of soluble salts and trace elements in un-weathered fly-ash. However, the concentration of soluble salts and other trace elements was found to decrease due to weathering of fly-ash during natural leaching, thereby reducing the detrimental effects over time. Moreover, the use of extremely alkaline (pH 11-12) fly-ash could also be the reason for those adverse effects. The application of lignite fly-ash reduced the growth of several soil borne pathogenic microorganisms, whereas the population of Rhizobium and P-solubilizing bacteria were increased under the soil amended with either farmyard manure or fly-ash individually or in combination. Amendment of Class F, bituminous fly-ash to soil at a rate of 505 Mg ha^{-1} did not Couse any negative effect on soil microbial communities and improved the populations of fungi, including arbuscular mycorrhizal fungi and gram-negative bacteria as revealed from analysis of community fatty acids (Scoot *et al.* 1995). Suggested that the microbial communities that developed in 17-20-year-old lignite ash deposits in Germany contained specific ash tolerant populations that different significantly from those in surrounding soils. The isolated metal tolerant plant growth promoting bacteria (NBRI K28 Enterobacter) from FA contaminated soils and found that the strain NBRI K 28 and its siderophore overproducing mutant NBRI K28 SDI are capable of stimulating plant biomass and enhance phytoextraction of mental (Ni, Zn and Cr) from FA by mental accumulating plant i.e. Brassica juice (Indian mustard). Concurrent production of siderophores, indole Acetic Acid (IAA) and phosphate solubilisation revealed its plant growth promotion potential.

Finally, in most of the cases mutant of NBRI K28, exerted more pronounced effect on mental accumulation and growth performance of B. juncea plants that wild type. Actionomycetes and fungi declined with 5% FA and all populations declined by 57, 80 and 86% respectively (Gea *et al.* (2005) revealed on the basis of pot-culture experiment that using sterile, phosphorus-deficient soil to study the effect of FA at three different concentrations, viz. 10, 20 and 30 g FA kg^{-1} soil on the infectivity and effectiveness of vesicular arbuscular mycorrhiza (VAM) Glomus aggregattum in. All the concentrations of FA amendent in soil were found to significantly affect the intensity of VAM colonization inside the plant roots and at higher concentration (30g FA kg^{-1} soil); the formation of VAM fungal structure was suppressed completely. The dry weight of the pigeonpea plants under the incluence of FA amendment in VAM fungus infested soils was found to be considerably less (though not significant increase in growth over the plants without *G. aggregatum* inoculation.

However, Fa amendment without VAM inoculation was also found to enhance the growth of plants as compared to control plants (without FA and VAM inoculums). Hyrnkiewiez *et al.* (2009) evaluated the use of inoculation with a mycorrhiza associated bacterial strain (*Sphingomonas* sp. 23L) to promote *mycorrhiza* formation and plant growth of three willow clones (*Salix* sp.) on fly ash from an overburdened dump in a pot experiment. They conclude that inoculation with *mycorrihza* promoting bacterial strains might be a suitable approach to support *mycorrhiza* formation with autochthonous siteadpoted ectomycorrhizal fungi in FA and thereby to improve re-vegetation of FA landfills with willows presented a correlation between organic acid exudation and metal uptake by ectomycorrhizal fungi grown on pond ash in vitro and this finding supports the widespread role of low molecular weight organic acid as a function of tolerance when exposed to metals in vitro. The enzymatic activity of soil is also an important factor for measuring soil biological properties after FA amendment in soil. The high pH and electrical conductivity of FA have been suggested to be important elements limitingmicrobial activity (Shimek *et al.* 1988) reported that invertase, amylase, dehydrogenase and protease activity increased with increasing application taken 7 concentrations of FA amended soil (0,2,5,5,10,15,25 and 50% w/w) for the toxicity test of earthworms (*Drawida willsi*) and studied the CO_2 evolution and enzyme activities (dehydrogenase, protease and amylase) in the presence and absence of *Drawida willsi*. They found little or no inhibition of soil respiration and enzyme activities up to 2.5% FA amendment. With further addition of FA, all the above activities were significantly decreased. On the other hand, significant stimulation of soil respiration and microbial activities we are observed up to 5% FA amendment when the soils contained earthworms. This may be due to increased microbial activity induced by substrates that are produced by the earthworms. Lal *et al* (1996) reported that FA added to soil at 16% 9w/w) increase enzyme activities (urease and cellulose).

However, acid phosphatase activity was depressed

Table 2: Effect of Fly-ash on Soil Enzymes Activity

Parameters	**Tons ha^{-1} fly ash in field soil**						
	Day after amendment	**0**	**10**	**12.5**	**15.0**	**17.5**	**20.0**
Protease activity	35	30.900	34.50	37.20	49.90	42.60	43.70
(g tyrosine g/soil/h	110	26.200	36.40	39.3	39.10	38.90	36.00
Amylase activity	35	53.900	58.20	62.60	78.30	35.30	40.30
(μ g tyrosine g/soil/h	110	44.200	48.30	50.60	63.00	20.80	23.50
Invertase activity	35	553.400	363.60	382.00	495.80	511.80	635.80
(μ g tryrosine g/soil/h	110	65.000	75.00	89.10	128.70	80.60	62.90
Soil respiration	35	0.006	0.05	0.11	0.14	0.14	0.12
(g Co/m/h)	110						

and with FA application. So, mix application of FYM and FA proved to be beneficial in augmenting proliferation and activity of microorganisms in acid soils. Fly ash composted with wheat straw and 2% rock phosphate (w/w) for 90 days enhanced chemical and microbiological properties of the compost and fly ash up to 40-60% and did not exert any detrimental effect on either C.N ratio or microbial population The available phosphorus estimation of soil receiving fly ash at varying rates of 0-80 t ha^{-1} showed higher availability of this element compared to control (no fly ash). Both 40 and 60 t ha^{-1} of fly ash resulted in the same status of soil available P. The improved availability may partly have been contributed by fly ash which itself contained some available P and partly to some native phosphate solubilizes.

However, the treatments receiving P, striata inoculation showed further enhancement in P availability due to their ability to solubilize insoluble phosphorus. The inoculation effect was most pronounced in F40 treatment with available P being 34.7 ppm. Both F40 and F60 treatments were statistically at par with each other but superior to the control.

EFFECT OF FLY ASH ON SOIL CARBON SEQUESTRATION POTENTIAL

A significant enhancement of Carbon sequestration by terrestrial ecosystems is needed to help offset the growth in atmospheric CO_2 inputs during the transition from fossil fuels to renewable and alternative energy sources over the next 50-100 years. While trees and the ocean are important sinks for C, soils can make a large one time contribution to this effort if ways can be found to return them to pre-agricultural levels of C. Our part of the challenge is to explore ways of enhancing net sequestration of C by soils while minimizing release of other GHGs. Agricultural lime contributes a prime role in the global fluxdes of the greenhouse gases such as carbon dioxide, nitrous oxide and methane. According to the inter-governmental Panel on Climate Change (IPCC), agricultural lime application contributes to global warming through emission of CO_2 to the atmosphere, the US EPA estimated that estimated that 9 Tg (teragram = 10^{12} g = 106 metric ton) CO_2 was emitted from an approximate 20 Tg of applied agricultural lime in 2001 (Mc Bride and *et al.* 2005). Some researchers have been worked on utilisation of fly ash in place of agricultural lime to increase the pH of the soil and soil becomes more suitable for agricultural purpose. An experimental study revealed that 1 tone of FA could sequester up to 26 kg of CO_2, i.e. 38.18 ton of FA per tones of CO_2 sequestered. This study confirmed the possibility to use this alkaline residue for CO_2 mitigation (Montes-Hernadez *et al.* 2009). So use of FA instead of lime as soil ameliorant can reduce net CO_2 emission and thereby, lessen global warming. In other sector, using FA to replace cement can decrease cement in concrete mixture and results in decreasing CO_2 from the production of cement. This CO_2 is thought to be major contributor to the greenhouse effect and the global warming of the planet. According to one estimate, use of 1 tonne of FA in concrete will avoid 2 tons of CO_2 emitted from cement production and reduces green-house effect and global warming.

So, there are some advantages of using FA in concrete and cement production as well as in agricultural sector (1) use of a zero-cost raw material, (2) conservation of natural resources mainly land (topsoil), water, coal and lime as well as one other resource as chemical fertilizer, (3) elimination of waste and (4) minimization of global warming.

REDUCES THE COST OF CULTIVATION

Saving of chemical fertilizers use of fly ash along with chemical and organic materials in an integrated way can save chemical fertilizer as well as increased the fertilizer use efficiency (FUE). The, integrated use of fly ash organic and inorganic fertilizers saved N, P and K fertilizers to the range of 45.8, 33.5 and 69.6% respectively and gave higher FUE than chemical fertilizers alone or combined use of organic and chemical fertilizers in a rice groundnut cropping system(Kumela *et al.* 2017).

METHODOLOGY FOR HEAVY METAL ANALYSIS IN COLLECTION OF FRESH VEGETABLES

Fresh vegetables were collected from the experimental field. The vegetables collected were categorised into three groups like rooted vegetables, fruit vegetables and leafy vegetables.

Sample preparation: The sample after collection were dried at 100 °C in oven and made fine powdered for heavy metal analysis.

Sample analysis: the dry powdered sample were acid digested and made homogenized solution and the heavy metal were analysed by using spectrophotometer, Atomic Absorption Spectrophotometer by following standard analytical procedure (APHA 2005).

PROCEDURE OF FIELD EXPERIMENT

Two experimental fields have been selected for carry out of experiment, one in back side of Professor colony -1, VSS, University of technology and other one in the back side of Professor colony -2, VSS, University of technology. Both the field has been well developed for conducting experiment. Different seeds such as beet, maize, cucumber, potato, sunflower, rice and plants like acacia, gambaro, jammun, chakunda, neem have been collected for conducting experiment in the experimental field. For each set of experiment, one control experiment has been performed without adding any foreign materials or chemical fertilizers. The experimental field has been prepared with combinations of fly ash, sludge, soil and compost in different proportion as mentioned below. One field has also been prepared for experimenting waste water for the purpose of irrigation. Design of field experiment with the use of fly ash and sludge (Garg *et al.* 2017).

Table 3: Experimental field no 1

Plot No.	Condition	Types of seed cultivated
1	Control (100% Soil)	Beet, Maize, Patato, Cucumber
2	Soil 75% + Fly ash 25%	Beet, Maize, Patato, Cucumber
3	Soil 70% + Fly ash 30%	Beet, Maize, Patato, Cucumber
4	Soil 50% + Fly ash 50%	Beet, Maize, Patato, Cucumber
5	Soil 70% + Fly ash 20% +Compost 10%	Beet, Maize, Patato, Cucumber

EXPERIMENTAL FIELD FOR CULTIVATION OF RICE

In the left corner of university, a vacant place has been selected for doing experiment for rice cultivation. The fields measured 620cm × 700cm × 580cm and 425cm x 580cm sizes have been prepared. One field is taken as control experiment with 100% soil. The 2nd field was taken as experimental field with 85% soil and 15% fly ash and the 3rd field taken with 70% soil and 30% fly ash. In the field a major amount of (15% and 30%) fly ash have been applied and in both control field and fly ash mixture field rice have been cultivated. During growth period observation have been recorded about healthiness and after harvesting, quantity have been measured about yield of rice and analysis have been much about accumulation of heavy metal if any also. Soil having Soil 70% + Fly ash 15% + Compost 15% produces better yield of flower. Soil having Soil 70% + Fly ash 20% + Compost 10% better yield of vegetables

Table 4: Experimental field no.2

Plot no	Condition	Seed Type	Area
01	Control 100% Soil	Puja	620cm × 700cm
02	Soil 85% + Fly ash 15%	Puja	480cm × 580cm
03	Soil 70% + Fly ash 30%	Puja	425cm × 580cm

Table 5: Experimental field no.3

Plot no	Condition	Type of Flower plant
01	Control 100% Soil	Marigold and Dahlia
02	Soil 70% + Fly ash 30%	Marigold and Dahlia
03	Soil 70% + Fly ash 15% + Compost 15%	Marigold and Dahlia

Table 6: Experimental field no.4 (Experiment only with different concentration of Fly ash)

Plot no	Condition	Type of seed cultivated
01	Control (100% Soil)	Bean, Brussels sprout, Maize, Radish, Cauliflower, Coriander, Onion, Beet
02	Soil 75% + Fly ash 25%	Bean, Brussels sprout, Maize, Radish, Cauliflower, Coriander, Onion, Beet
03	Soil 70% + Fly ash 30%	Bean, Brussels sprout, Maize, Radish, Cauliflower, Coriander, Onion, Beet
04	Soil 50% + Fly ash 50%	Bean, Brussels sprout, Maize, Radish, Cauliflower, Coriander, Onion, Beet
05	Soil 70% + Fly ash 20% + Compost 10%	Bean, Brussels sprout, Maize, Radish, Cauliflower, Coriander, Onion, Beet

METHODOLOGY FOR RECLAMATION WASTE LAND THROUGH FLY ASH

A low laying area and morum pit have been identified inside VSS. University of technology campus. The area was filled with fly ash and level the site with dozor. Then pit were dug out of size 45cm × 45cm × 45cm size. Then the pits were filled up with a mixture of river bank soil, fly ash and cow dung in the ratio 70:20:10. Then different sampling like jamrol, gambhari, jammun, acacia etc. plant species were collected and planted in the field. The watering in regular interval was made for survival of the plants. The growth rate with respect to height, leaves no. and branches have been counted. In the similar way control experiment were also set up for each species to study the effect of fly ash in biological activities.

Table 7: Experimental field no. 5

Plot no	Condition	Type of plants Cultivated
01	Control 100% Soil	Jamrol, anar, lichi, amla, karmanga, guava, mango, ata, eucalyptus, gambhari, radhachuda, krushna chuda, chandan, teak, acacia, jamun
02	Soil 70% + Fly ash 30%	Jamrol, anar, lichi, amla, karmanga, guava, mango, ata, eucalyptus, gambhari, radhachuda, krushna chuda, chandan, teak, acacia, jamun
03	Soil 70% + Fly ash 20% + cow dung 10%	Jamrol, anar, lichi, amla, karmanga, guava, mango, ata, eucalyptus, gambhari, radhachuda, krushna chuda, chandan, teak, acacia, jamun

METHODOLOGY FOR FIELD EXPERIMENT USING WASTE WATER

An experimental field has been selected in the back side of Professor's colony. The field is divided into three plots. In the plot no. 1 the plant was irrigated by normal water which was named as control plot. The second plot the irrigation was made by using 75% normal water and only 25% of waste water. In the plot number -3 the irrigation was made by 50% normal water and 50% waste water. In the entire plot, four types of vegetable plants were selected for cultivation which are brinjal, chilli, tomato and ladies finger.

Table 8: Experimental field no.6

Plot no	Condition	Type of seed Cultivated
01	Control (100% normal water)	Brinjal, Chilli, tamato, ladies finger
02	75% tap water and 25% waste water	Brinjal, Chilli, tamato, ladies finger
03	50% tap water and 50% waste water	Brinjal, Chilli, tamato, ladies finger

EXPERIMENTS ON RICE CULTIVATION WITH IRRIGATION OF TREATED WASTE WATER

The experimental field has been selected in the corner of the University; a vacant place has been selected for doing experiment for rice cultivation. The field is divided into four plots and the sizes of each plot measured 620cm × 700cm have been prepared. One field is taken as control experiment with 100% normal water. The 2nd field is taken as experimental field with 75% normal water and 25% waste water, the 3rd field taken with 50% normal water and 50% waste water and the 4th plot is taken as experiment with 100% waste water. During growth period observations have been recorded about healthiness and after harvesting, quantities have been measured about yield of rice. 50% tap water and 50% waste water gives better yield.

Table 9: Experimental Field no.7

Plot no	Condition	Variety of rice cultivated	Area
01	Control (100% normal water)	Puja	620cm × 700cm
02	75% tap water and 25% waste water	Puja	620cm × 700cm
03	50% tap water and 50% waste water	Puja	620cm × 700cm
04	With 100% waste water	Puja	620cm × 700cm

CONCLUSION

Fly ash can be used in combination with chemical fertilizer and organic carbon to get additional benefits in terms of improvement of soils physical characters for increased yield of crops. From this study it can be concluded that mixing of fly ash 20% with soil 70% and up to 10% of the cow dung or compost is useful to improve soil physical properties as well as to increase the yield of agricultural products. Again it was observed that by using 50% waste water and 50% normal water the rice production increases significantly. The flower production increases by using Soil 70% + Fly ash 15% + Compost 15%. By using fly ash to a calculated percentage in soil, the water holding capacity and soil fertility increases.

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