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Suitability of tobacco dust for agricultural purposes

Sana Akhtar*[1], Sarah Shakeel[1], Almas Hamid[1], Sajid Rashid Ahmad[2]

[1]*Department of Environmental Sciences, Kinnaird College for Women, Lahore, Pakistan*

[2]*College of Earth and Environmental Sciences, Quaid-e-Azam Campus, University of the Punjab, Lahore, Pakistan*

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Abstract

The waste from tobacco industry in Pakistan is either disposed off in landfills or sent for incineration. Being majorly organic, the tobacco dust can serve as potential soil amendment. This study aims on the possibility of recycling of tobacco dust through its application to soil. This will lead to sustainable agricultural waste management. Tobacco dust and organic compost were applied to treatment A and B with selected dose. Effects on growth rate and leaf number of plant (*Alstonia scholaris*) were observed. Samples were analyzed for NPK, Organic Matter, Moisture Content, pH, Cadmium (Cd), Chromium (Cr), Nickel (Ni) were analyzed for 13 weeks. Results showed highest average growth rate i.e. 20.3 cm and 22.7 cm in sample A4 (TD400g) and B4 (OF200g) respectively. Tobacco dust improved soil NPK and Organic Matter i.e. 3.46% in sample A1 (TD1000g), 2.68% in sample A5 (TD200g), 2.21% in sample A1 (TD1000g), 5.32% in sample A1 (TD1000g) respectively but remained low when compared to soil supplemented by organic compost. In conclusion tobacco dust in combination with organic compost, can serve as soil amendment by improving the nutrients to optimum level. The concentration of heavy metals in both treatment ($p>0.05$) were below the permissible limit. The adequate dose of tobacco dust increased the growth and leaf number thus making it suitable for plants and reducing the need of its incineration.

***Corresponding Author:** Sana Akhtar ✉ sanakhtar23@gmail.com

Introduction

Tobacco forms an important cash crop of Pakistan. Tobacco industry is significant because of its immense role in the Pakistan's economy in the form of its contribution to government exchequer. Moreover it is a source of employment for a large population; an estimated 11 million people are associated with farming, manufacturing, production and trading of tobacco products. Tobacco is the only crop of Pakistan whose yield is above the world average and matches with per hectare yield of America and other developed countries around the globe (Raza *et al.,* 2015).

Many tobacco product manufacturing industries utilize tobacco plant for different products, mainly cigarette. These industries dispose off their waste to landfills that may be very poisonous due to the presence of alkaloids, and tannins (Briski *et al.,* 2003). It also contains high nicotine level that makes it not suitable for being directly disposed off to the soil (Chaturvedi, 2008).

To handle this problem, multinational companies incinerate their tobacco dust which is costly and an intensive energy consuming process especially in the developing and energy deficit country like Pakistan. Hence the capability of tobacco dust as prganic soil amendment was studied as it contains nitrogen (2.35%), potassium (1.95%), and phosphorus (0.97) to improve the soil health and increase the fertility (Kayikcioglu, 2011).

This utilization of tobacco dust reduces the agricultural solid waste, emission of gases, energy consumption in incineration process and also cost of its disposal (Saltali *et al.*, 2000). The efficiency of different agricultural waste like manure (M), hazelnut husks (HH), tea production wastes (TPW), and tobacco dust (TD) on clay and loamy sand fields has been studied. The results clearly depicted that tobacco dust has positive effects on aggregate stability, electrical conductivity, nitrate and nitrogen content (Adediran, 2004).

Tobacco dust application to land improves the soil physical and chemical properties. It also effects soil's bulk density, available water content and structure stability. Not only organic matter of the soil is increased but pH, nitrogen, phosphorous and potassium of the soil also improves through application of tobacco dust (Cercioglu *et al.*, 2012; Ganiger *et al.,* 2012).

Various organic waste such as farm yard manure, tobacco dust, grape marc, mushroom compost and animal manures have been studied as a source of organic matter. It was observed that tobacco dust increases the organic matter with increasing the nitrogen, phosphorous and potassium of the soil (Karaca, 2004).

The present study was undertaken to assess the potential of utilizing the tobacco dust in agriculture in order to reduce the usage of inorganic fertilizers. Further, the evaluation of the effects of tobacco dust on soil and most appropriate nitrogen (N), phosphorous (P), potassium (K) content was also carried out.

Materials and methods

Selection of Alstonia scholaris as *Plant Materials*

Alstonia scholaris was selected for study owing of its beings very sensitive to environmental changes and shows the effects due to any environmental change more clearly. It provides valuable components for medicines, seasonings, beverages, cosmetics and dyes. Its pharmacological activities range from anti malarial to anticancer activities. Its bark is used for treatment of abdominal pains and fevers and the latex for neuralgia and toothache (Pratap, 2013).

Sampling of Tobacco Dust (TD), Organic Compost (OC) and Soil

Samples of Tobacco Dust (TD), Organic Compost (OC) and Soil were collected. For sampling, composite methodology was adopted (U S EPA 2012).

The tobacco dust of a leading Tobacco Company was taken from the incinerator facility where it is regularly sent for incineration. The sample taken was from the waste sent 2 days prior to sampling to the facility. The time period plays a great role in decomposing the organic waste. After decomposing the waste could be toxic due to nicotine presence and will not be able to use it as organic fertilizer. For soil sampling, an organic farm in a nursery located near Lahore was selected. Some seasonal vegetables such as spinach, coriander, lemon and other floral plants were being grown there. The OC sampling for research was also done from the same organic farm.

Analysis

Soil Sample

Soil samples collected from an organic farm were analyzed in the laboratory for their inherent nutrient values. Two treatments of the soil were also prepared to assess the impacts of tobacco dust conditioner on soil and plant growth. 1000g, 1200g, 1400g, 1600g, and 1800g soil samples were filled in five pots coded as A1, A2, A3, A4, A5 (treatment A). While the same soil samples weighing 1500g, 1600g, 1700g, 1800g and 1900g filled in other five pots coded as B1, B2, B3, B4, B5 (treatment B).

Tobacco dust (TD)

The nutrient values of tobacco dust *(Nicotiana tabacum)* sample were analyzed in the laboratory with the main focus to apply it for soil conditioning. TD was mixed in pots of treatment A as 1000g, 800g, 600g, 400g and 200g TD in pots A1, A2, A3, A4, and A5 respectively. This application rate maintained an amount of 2 kg of sample in each pot including soil and tobacco dust as mentioned in table 1.

Organic compost (OC)

500g, 400g, 300g, 200g and 100g organic compost samples were mixed in pots B1, B2, B3, B4, and B5 respectively. This application rate maintained an amount of 2 kg of sample in each pot including soil and OC as mentioned in the Table 1. The 11^{th} pot was filled with soil sample (without TD, OC) used as control pot and referred as control experiment C1. The research was carried out for 13 weeks and later the results of TD and OC application, its impact on soil and plant sapling were studied.

Physico-Chemical Parameters

Parameters such as organic matter (OM %) (United Nations Economic Commission for Europe), Kjeldahl Nitrogen (N) (EPA Gov.), Kjeldahl Phosphorous (P) (EPA Gov.) and Potassium (K) in samples were determined by flame photometer (ppm, %) method (Dikinya 2010). Moisture content (MC) (United Nations Economic Commission for Europe), pH (United Nations Economic Commission for Europe), Electrical Conductivity (EC) (United Nations Economic Commission for Europe) and heavy metal (Cd, Cr, Ni) (Aqua Regia Digestion 2000) were also analyzed. Physical Parameters such as counting of leaf numbers and height (cm) of plant sapling were observed during pot experiment.

Statistical Analysis

The impact of different doses of TD and OC on soil was studied statistically with independent sample T-test. For that purpose a software SPSS (Statistical Package for the Social Science) version 24.0 was used.

Results and discussion

During 13 weeks, physical parameters of plant saplings were monitored. Highest growth rate was 20.2cm and 22.75cm in pot 4 where 400g TD and 200g OC was applied to the soil in Treatment A and Treatment B respectively (Table 3). In Treatment B (pot 4), the growth rate of sapling was high as compared to treatment A (pot 4). In pots 1 and 2 there was slightly high growth rate 6.79cm, 8.74cm in treatment A as compare to treatment B i.e. 5.91cm, 5.51cm. Growth rate pattern showed that tobacco dust increases sapling growth where high dose of TD was applied and vice versa. OC is a fertilizer to readily provide the nutrients so it provide high growth rate in pots where low OC was applied and vice versa. Excess quantities of OC lower the growth rate. Control treatment showed slightly high growth rate 7.54cm as compared to pot 1 where high TD and OC applied (Table 3).

Table 1. Soil, TD and OC Sample ratio in treatment A and B.

Pots	Soil Sample (g)	Tobacco Dust (g)	Organic compost (g)	Total Weight (kg)
A1	1000	1000	-	2
A2	1200	800	-	2
A3	1400	600	-	2
A4	1600	400	-	2
A5	1800	200	-	2
B1	1500	-	500	2
B2	1600	-	400	2
B3	1700	-	300	2
B4	1800	-	200	2
B5	1900	-	100	2

Table 2. Physicochemical properties of TD, soil sample and OC.

Sr. No.	Parameters	Units	Values		
			TD	SS	OC
1.	Total Nitrogen	(ppm)	34500	13500	54300
	(N)	(%)	3.45	1.35	5.43
2.	Available Phosphorous	(ppm)	15003	2034	28300
	(P)	(%)	1.50	0.203	2.83
3.	Potassium	(ppm)	40342	10200	63200
	(K)	(%)	4.03	1.02	6.32
4.	Organic Matter (OM)	(%)	6.1	1.85	7.5
5.	Moisture Content (MC)	(%)	7.3	18	21
6.	Ph	-	6.2	7.1	7.5
7.	Electrical Conductivity (EC)	(mS/cm)	7.17	2.62	6.5
8.	Cadmium (Cd)	(mg/kg)	0.033	0.005	0.002
9.	Chromium (Cr)	(mg/kg)	0.016	0.008	0.081
10.	Nickel (Ni)	(mg/kg)	0.045	0.003	0.052

Table 3. Average height and leaf number of *A. Scholaris* in treatment “A”, “B” and “C”.

Sr. No.	Observation	Treatment “A” tobacco dust application					Treatment “B” organic compost application					Treatment “C” control treatment
		A1 TD-1000g	A2 TD-800g	A3 TD-600g	A4 TD-400g	A5 TD-200g	B1 OC-500g	B2 OC-400g	B3 OC-300g	B4 OC-200g	B5 OC-100g	C1 (0 g Amendment)
1.	Height (cm)	39.1	48.2	38.1	36.5	41.9	63.2	68.1	64.7	62.4	63.8	33.02
	Leaf No.	8	9	7	8	8	8	10	8	9	10	8
2.	Height (cm)	40.6	51.3	40.6	38.6	45.7	64.1	68.4	69.9	67.9	69.2	35.8
	Leaf No.	8	8	12	12	12	8	10	8	9	10	8
3.	Height (cm)	42.9	53.6	46.2	48.3	47.9	66.2	70.6	71.7	71.8	75.2	38.0
	Leaf No.	8	12	11	12	12	8	15	13	14	15	8
4	Height (cm)	44.2	55.3	49.9	53.7	50.6	68.0	72.5	75.1	77.4	80.4	38.76
	Leaf No.	13	12	11	16	16	12	15	13	14	15	12
5	Height (cm)	45.9	57.0	51.3	56.8	52.7	69.1	73.6	78.5	85.2	83.0	40.56
	Leaf No.	13	12	11	20	16	12	15	18	19	15	12
Growth Rate (cm)		6.79	8.74	13.2	20.3	10.8	5.91	5.51	13.7	22.7	19.2	7.54

Leaf number of plant sapling was identified in each treatment (Table 3). The leaf number was high in treatment A pot 4 (TD400) i.e. 20. In treatment B high leaf number was achieved in pot 4 (OC200) i.e. 19. The lowest number of leaf was 11 in treatment A pot 3 (TD600). The leaf number varies from 11-20 including control treatment having 12 leaf number. Leaf number pattern showed high number of leaf was present where low dose of amendment was applied and low number of leaf was assessed in high application of TD and OC. Berova (2010) stated that leaf number, size and mass of plants treated with an organic fertilizer considerably increased as compared to those of the control sample.

Table 4. Physicochemical properties of treatment "A", "B" and "C".

Sr. No.	Treatment "A" Tobacco Dust Application							Treatment "B" Organic Compost Application					Treatment "C" Control Treatment
	Parameters	Units	A1 TD-1000g	A2 TD-800g	A3 TD-600g	A4 TD-400g	A5 TD-200g	B1 OC-500g	B2 OC-400g	B3 OC-300g	B4 OC-200g	B5 OC-100g	C1 (0g Amendment)
1.	Total Nitrogen (N)	(ppm)	34600	25600	18000	12400	12000	39800	39300	26700	24800	12000	830
		(%)	3.46	2.56	1.80	1.54	1.4	3.98	3.93	2.67	2.48	1.20	0.08
2.	Available Phosphorous (P)	(ppm)	23200	13800	16800	19300	26800	48600	31000	21780	23800	19000	65
		(%)	2.30	1.38	1.68	1.93	2.68	4.86	3.10	2.17	2.38	1.90	0.06
3.	Potassium (K)	(ppm)	22100	20600	15000	14600	12500	35000	29500	24800	15600	17800	323
		(%)	2.21	2.06	1.50	1.46	1.25	3.50	2.95	2.48	1.56	1.78	0.03
4.	Organic Matter (OM)	(%)	5.32	5.02	4.78	4.56	4.34	7.56	7.01	6.68	5.35	5.17	0.78
5.	Moisture Content	(%)	12	15	14	19	17	28	30	26	15	17	12
6.	pH	-	5.8	6.1	7.1	7.3	7.6	8.34	8.23	7.26	7.69	7.13	6.5
7.	Electrical Conductivity	(mS/cm)	5.6	5.7	5.2	4.3	3.5	3.46	3.28	3.29	3.20	3.23	3.21

Table 5. Heavy metals content of treatment "A", "B" and "C".

Sr. No.	Treatment "A" Tobacco Dust Application					Treatment "B" Organic Compost Application						Treatment "C" Control Treatment	Indian Soil Standard	European Soil Standard
	Parameters /Units	A1 TD-1000g	A2 TD-800g	A3 TD-600g	A4 TD-400g	A5 TD-200g	B1 OC-500g	B2 OC-400g	B3 OC-300g	B4 OC-200g	B5 OC-100g	C1 (0g Amendment)		
1.	Cd (mg/kg)	0.016	0.015	0.016	0.014	0.011	0.017	0.016	0.015	0.016	0.011	0.002	3-6	3
	(%)	0.0016	0.0015	0.0016	0.0014	0.0011	0.0017	0.0016	0.0015	0.0016	0.0011	-	0.3-0.6	0.3
2.	Cr (mg/kg)	0.15	0.17	0.14	0.10	0.09	0.032	0.030	0.023	0.021	0.02	0.001	N/A	100
	(%)	0.015	0.017	0.014	0.10	0.009	0.0032	0.0030	0.0023	0.0021	0.002	-	-	10
3.	Ni (mg/kg)	0.038	0.037	0.032	0.027	0.022	0.029	0.027	0.023	0.022	0.013	0.0007	75-150	50
	(%)	0.0038	0.0037	0.0032	0.0027	0.0022	0.0029	0.0027	0.0023	0.0022	0.0013	-	7.5-15	5.0

On comparison between treatments, percentage of total nitrogen (Table 4) ranges from 1.4% to 3.98%. Highest total nitrogen resulted in pots where high dosage of amendment was applied in both A and B treatment. But in treatment C, total nitrogen percentage greatly reduced (0.08%) as compared to soil sample (1.35%). Organic compost sample showed (Table 4) highest percentage of total nitrogen percent i.e. 5.43 %. According to Wang *et al.,* 2008, tobacco dust can affect the amount of nitrogen (N) availability to plants from soil which may influence the growth of plant. Increased nitrogen (N) availability results in increased photosynthesis and growth in plants. According to Candemir and Gulser (2010) applications of tobacco dust affects total nitrogen (N) content in soil positively.

Percentage of available phosphorous varied from 0.06% to 4.86% (Table 4). Highest amount of percentage of phosphorous (P) observed in sample B1 pot 1 (OC500) i.e. 4.86 % treated with the organic compost. Soil sample has 0.2 % and control sample has 0.06% available phosphorous (P). Organic compost (OC) are meant to increase the pH of soil that makes the phosphorous (P) soluble in the soil (Doran 2000). Cercioglu *et al.,* (2010) reaffirmed that available phosphorus (P) in the soil has increased from level 8.88 mg/kg to 12.38 mg/kg by application of the tobacco dust that improve physicochemical properties of the soil.

Table 6.1. Independent Sample T-Test, For Height (cm)

Group Statistics

	samples	N	Mean	Std. Deviation	Std. Error Mean
values of Height	Tobacco Dust	5	11.9600	5.18943	2.32078
	Organic Compost	5	13.4320	7.73889	3.46094

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
values of Height	Equal variances assumed	1.346	.279	-.353	8	.733	-1.47200	4.16703	-11.08118	8.13718
	Equal variances not assumed			-.353	6.992	.734	-1.47200	4.16703	-11.32767	8.38367

Table 6.2. Independent Sample T-Test, For Leave Number.

Group Statistics

	sample	N	Mean	Std. Deviation	Std. Error Mean
Leaves Number	Tobacco Dust	5	14.4000	3.64692	1.63095
	Organic Compost	5	15.8000	2.77489	1.24097

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Leaves Number	Equal variances assumed	.540	.483	-.683	8	.514	-1.40000	2.04939	-6.12590	3.32590
	Equal variances not assumed			-.683	7.469	.515	-1.40000	2.04939	-6.18504	3.38504

The highest percentage of potassium (K) was observed in organic compost sample (Table 2) that is 6.32% whereas tobacco dust sample (TD) contains 4.03% potassium (K). High percentages of potassium (K) were observed in treatment B (Table 4) pot 1, 2, 3 (OC 500,400,300) resulting 3.5%, 2.95%, 2.48% of potassium (K) and in treatment A pot 1, 2 (TD 1000, 800, 600) resulting 2.21%, 2.06% respectively.

The lowest percentage was observed in control treatment C (0.03%). Application of the tobacco dust (TD) increased the potassium (K) percentage of the soil as compared to that of soil sample (SS).

Saltali *et al.*, (2000) found that increasing rate of tobacco dust increased total nitrogen (N) and available phosphorous (P) and potassium (K) contents in soil. The OM percentage in treatment B ranged from 5.17% to 7.5% whereas in treatment A ranged from 4.34% to 5.32% (Table 4).

The pattern of organic matter percentages increased with increased application rate of tobacco dust. Cercioglu *et al.,* (2010) confirmed the given results that TD improves organic matter content in soil as an alternative to inorganic fertilizer. It is possible to use tobacco dust as a soil amendment due to its high organic matter and NPK values.

Table 6. 3. Independent Sample T-Test, For Nitrogen.

Group Statistics

	samples	N	Mean	Std. Deviation	Std. Error Mean
values of nitrogen	Tobacco Dust	5	2.1520	.85751	.38349
	Organic Fertilizer	5	3.0240	.87825	.39277

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
values of nitrogen	Equal variances assumed	.076	.790	-1.589	8	.151	-.87200	.54894	-2.13785	.39385
	Equal variances not assumed			-1.589	7.995	.151	-.87200	.54894	-2.13797	.39397

Table 6. 4. Independent Sample T-Test, For Phosphorous.

Group Statistics

	samples	N	Mean	Std. Deviation	Std. Error Mean
values of phosphorous	Tobacco Dust	5	1.9940	.51086	.22846
	Organic Fertilizer	5	2.8820	1.19198	.53307

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
values of phosphorous	Equal variances assumed	2.228	.174	-1.531	8	.164	-.88800	.57997	-2.22540	.44940
	Equal variances not assumed			-1.531	5.422	.182	-.88800	.57997	-2.34465	.56865

High percentage of moisture content (30%) was found in treatment B pot 2 (OC400) whereas pot 1 and 3 (OC 500,300) has 28%, 26% of moisture content (Table 4).

Treatment A pot 4 (TD400) has 21% whereas organic compost has 19% moisture content. The lowest percentage was observed in TD sample. The pattern of moisture content percentage showed that tobacco dust requires moisture to get into mineralized form. Increased amount of TD decreases the percentage of moisture content and vice versa. Addition of tobacco waste increased organic matter content and retention of the moisture content (MC) in soil. The buildup of organic carbon helps in retention of soil moisture and acts as buffer to soil and also increases the infiltration rate (Ganiger, 2012).

Table 6. 5. Independent Sample T-Test, For Potassium.

Group Statistics					
	samples	N	Mean	Std. Deviation	Std. Error Mean
values of potassium	Tobacco Dust	5	1.6960	.41525	.18570
	Organic Compost	5	2.4540	.80534	.36016

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
values of potassium	Equal variances assumed	2.175	.178	-1.871	8	.098	-.75800	.40522	-1.69244	.17644
	Equal variances not assumed			-1.871	5.986	.111	-.75800	.40522	-1.75008	.23408

Table 6. 6. Independent Sample T-Test, For Organic Matter.

Group Statistics					
	sample	N	Mean	Std. Deviation	Std. Error Mean
values of organic matter	Tobacco Dust	5	4.8040	.38351	.17151
	Organic Compost	5	6.3540	1.04892	.46909

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
values of organic matter	Equal variances assumed	9.284	.016	-3.103	8	.015	-1.55000	.49946	-2.70176	-.39824
	Equal variances not assumed			-3.103	5.051	.026	-1.55000	.49946	-2.83004	-.26996

Treatment A pot 1 (TD 1000) showed low pH 5.8 slightly acidic whereas high pH was found by pot 5 (TD200) that is 7.6 in treatment A that is slightly alkaline (Table 4).

The trend of the pH values visibly make ascertain that as the dose of tobacco dust gradually become low, the pH of soil gradually becomes basic. Xua *et al.*, (2006) assessed that pH of soil decreases with the application of plant residue and agro-industrial waste. In treatment B, the soil pH varies from 8.34 to 7.13. The pH range showed that more addition of the organic compost moved the pH towards basic.

Amendment of tobacco dust results high electrical conductivity in samples (Table 4). Treatment A pot 1 (TD 1000) showed high EC i.e. 5.6mS/cm. Candemir *et al.,* (2010) clearly affirmed that highest electrical conductivity (EC) was achieved in soil with application of tobacco dust. As tobacco dust has high organic content that improves soil chemical structure by improving ions structure, electrical conductivity and nutrients level furthermore it also physically improve soil with refining the water intake capacity, water holding capacity (Bulluck, 2002). The organic compost application results lower EC (Table 4).

Table 6. 7. Independent Sample T-Test, For Moisture Content.

Group Statistics

	samples	N	Mean	Std. Deviation	Std. Error Mean
values of moisture content	Tobacco dust	5	15.4000	2.70185	1.20830
	Organic Compost	5	23.2000	6.76018	3.02324

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
values of moisture content	Equal variances assumed	11.064	.010	-2.396	8	.043	-7.80000	3.25576	-15.30781	-.29219
	Equal variances not assumed			-2.396	5.246	.060	-7.80000	3.25576	-16.05249	.45249

Table 6. 8. Independent Sample T-Test, For pH.

Group Statistics

	samples	N	Mean	Std. Deviation	Std. Error Mean
values of pH	Tobacco Dust	5	6.7800	.78549	.35128
	Organic Compost	5	7.7300	.54877	.24542

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
values of pH	Equal variances assumed	2.006	.194	-2.217	8	.057	-.95000	.42852	-1.93817	.03817
	Equal variances not assumed			-2.217	7.153	.061	-.95000	.42852	-1.95890	.05890

The addition of organic amendments can also affect other soil chemical properties, such as pH and electrical conductivity (EC).

The tobacco dusts contain some metals in it due to the application of inorganic fertilizers. Tobacco (*Nicotiana tabacum* L.) leaf may accumulate relatively high levels of cadmium (Cd) and other heavy metals during their growth from soil.

The presence of heavy metals in soils originates from both natural and anthropogenic sources (Moulin, 2006).

It was comprehended (Table 5) that all the heavy metal concentration were below the permissible limits and were not harmful for the soil as well as for the plant saplings. Indian soil standards (Mushtak, 2010) and European soil standard (Commission Regulation, 2006) were used to compare the results of heavy metals in soil.

Table 6. 9. Independent Sample T-Test, For Electrical Conductivity.

Group Statistics

	sample	N	Mean	Std. Deviation	Std. Error Mean
values of EC	Tobacco Dust	5	4.8600	.93968	.42024
	Organic Compost	5	3.2920	.10085	.04510

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
values of EC	Equal variances assumed	16.344	.004	3.710	8	.006	1.56800	.42265	.59336	2.54264
	Equal variances not assumed			3.710	4.092	.020	1.56800	.42265	.40488	2.73112

Independent sample T-test results showed (Table 6) that growth rate, leaf number, nitrogen (N), phosphorous (P), potassium (K), moisture content and pH showed no significant difference ($p>0.05$) between two independent groups (Tobacco dust and Organic compost). This result evaluated that both treatments have same effect on soil for nutrient availability. On the other hand organic matter and electrical conductivity showed significant difference ($p<0.05$) between the two amendments in the treatment A and B.

Conclusion

The present study illustrated that tobacco dust has the potential to enhance the soil macro nutrients such as nitrogen (N), phosphorous (P), potassium (K) and other parameters; pH, moisture content (MC), organic matter (OM), electrical conductivity (EC) that are necessary for the plant growth. The treatment A pot 4 (400g TD) exhibited the best results having high plant growth and more leaf numbers. The concentration of heavy metals in both treatment ($p>0.05$) were below the permissible limit. Tobacco dust increased the organic matter in the soil that makes it more fertile for sustainable growth of plant.

By substituting commercial fertilizers by tobacco dust, many agricultural problems can be solved. In this way agro-industrial solid waste can be re-utilized and its disposal issue can be solved.

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