

Influence of Ash Applied to Oat Crop (*Avena sativa* L.) Grown under Organic Fertilization with Manure

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Abstract

The power plant ash is an inorganic residue with a variable chemical buildup according to the type of charcoal used and quality. Depositing, stabilizing and eventually reintegrating the ash in the natural circuit raises a series of problems due to its disastrous effect on biodiversity. Even with these problems, at a moderate micro and macro mineral content, power plant ash could present interesting agro technical and ecological alternatives. For this reason, the controlled integration of ash could put a stop to pollution with ash by reintegrating the material in the agricultural ecosystems.

For this purpose, in the field of research of Ecological and Forage Crops from Faculty of Animal Science and Biotechnologies Timișoara, research was conducted over the influence of the reintegration of 40 t of ash per ha, produced by C.E.T. Timișoara, on the biomass production of oatmeal (*Avena sativa* L), fertilized by levels of 25 and 50 t per ha of manure. After harvesting, the analysis of the total biomass quantity, both above and underground, revealed similar results in all trials. In conditions that include heavy metal concentrations beneath normal geological values, conclude that the application of 40t per ha may be an agro technical solution for the integration of power plant ash in the agricultural ecosystem.

Keywords: manure, oat biomass, power plant ash

1. Introduction

Due to characteristics regarding storage and processing of matter, soils constitute barriers in the way of pollution due to the fact that they ensure the degradation of organic matter and the redistribution of inorganic matter. Therefore this results, gradually, in the diminution of the polluting impact caused by recycling through bio-geo-chemical circuits, specific to natural and agricultural ecosystems. That is why soils are considered live systems, veritable bio-regulators of the matter circuit in nature [1].

Power plant ash represents a complex pollutant with varied effects on both the natural and anthropic environments, even after it's storage at a dump site. Planting vegetation on ash dump sites is a slow process that takes place over a long period of time [2,3]. It is known that power plant ash concentrates high levels of metals, from which over 70% are represented by SiO₂, Al₂O₃ and Fe₂O₃, and around 30% are CaO, Na₂O, K₂O and MgO [4]. Even considering all this, with careful agro technical supervision, the ash may be reincorporated in the soil together with some organic fertilizers, which could actually prove beneficial, providing the soil with Ca, Na, K, Mg, also ensuring a neutral pH. In order not to exceed the tolerance threshold for metals of the plants the correct proportions of ash, soil and fertilizer must

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be ensured. For this reason, in our experiment we studied the effects of 40 t of power plant to organically enriched soil.

2. Materials and methods

In the research fields of Ecology and Animal feed cultures of the B.U.A.S.V.M. Timisoara, were tested the inclusion of 40 t of ash from the Timisoara Power plant on barley production (*Avena sativa* L.). The soil was fertilized with 25t and 50 t/ha of manure. The experimental plot had a surface of 2 m², the barley being drills on eight rows. Each of the variants: M (control group), V1

(25 t/ha manure) and V2 (50 t/ha manure) was organized with 3 repetitions, so that the experimental bloc was made of 9 plots. Harvesting the biomass was made at the point of complete ripeness. The amount of grain, roots and above-ground biomass was determined.

3. Results and discussion

Table 1 presents a comparison on the chemical composition of ashes from different power plants (CTE) in Romania.

Table1. Chemical analysis of ashes from some CTE from Romania

Location of ash C.T.E.	Chemical composition,(average values) %							
	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	SO ₃	Na ₂ O	K ₂ O	MgO
Timisoara	43.51	28.10	9.28	12.85	-	-	-	2.26
Arad	51.30	19.20	-	4.25	-	0.45	1.57	1.91
Deva	47.33	24.34	-	5.85	2.75	0.58	1.97	2.73
Craiova	49.20	22.80	7.82	8.80	1.44	0.51	1.70	2.41

The predominant components are SiO₂, Al₂O₃ and Fe₂O₃. This presents the possibility of forming compounds such as silicates, calcium aluminates, etc., with favorable implications on the hydrolysis. Using the information presented, we may infer that the reintegration of power plant ash would not pose significant pollution issues if it is done according to correct agro technical and ecological

regulations. That is why, in our experiment we integrated 40 t/ha of ash from CET Timisoara on two levels of organic fertilization:

- V1 25 t/ha
- V2 50 t/ha

Biomass production values after harvesting are presented in tables 2, 3.

Table 2. Biomass production

Plot Nr.	Variants	Grain +				T + F + R (kg/ha)	Total biomass (kg/ha)
		blade root (kg/ha)	Grain (kg/ha)	Shaft + leaves (kg/ha)	Roots (kg/ha)		
1	M	3555	2666	9000	3000	12000	15555
2	V1	3713	2785	13750	3750	17500	21213
3	V2	4928	3696	11750	3250	15000	19928
4	M	5294	3971	10750	4250	15000	20294
5	M	3462	2596	6000	2250	8250	11712
6	V1	4068	3051	8750	2500	11250	15318
7	V2	3417	2563	12000	4250	16250	19667
8	V1	2890	2167	11500	5250	16750	19640
9	V2	4273	3205	11420	4500	15920	20193

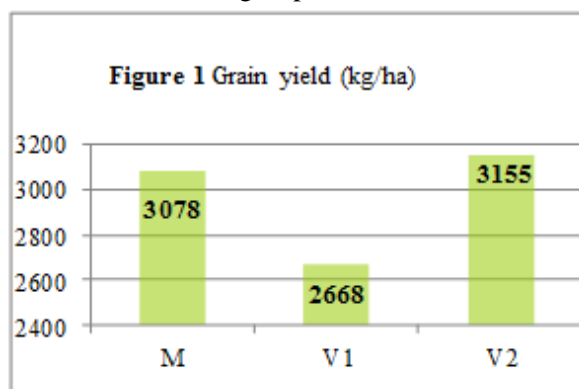
Table 3. Processing and statistical interpretations

Plots	Variants	\bar{x}	$\bar{x} \pm S \bar{x}$	\bar{x}	\bar{x}	\bar{x}	$\bar{x} \pm S \bar{x}$
1, 4, 5	M	4104	3078 ± 220	8583	3167	11750	15854 ± 165
2, 6, 8	V1	3557	2668 ± 288	11333	3833	15167	18724 ± 186
3, 7, 9	V2	4206	3155 ± 190	11723	4000	15723	19929 ± 152*

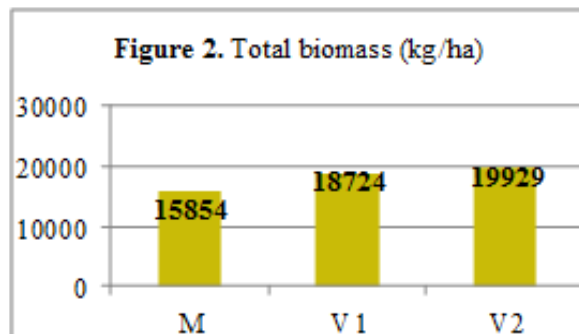
* p ≤ 0.05

Integrating 40 t/ha of ash in the soil has a negative effect on the grain production (Figure 1). However this negative effect can be corrected by introducing a corresponding amount of fermented manure.

When using 25 t/ha manure, the polluting effect of the ash on the soil causes the production of seeds 13.4% (V1) smaller than the control lot. When using 50 t/ha (V2), the production of grain is similar to the control group, but 18.2% larger than the low fertilization group.



In our experiment there was recorded total biomass, both the above ground plant and root mass of oatmeal (Figure 2).



When compared to the soil without ash or fertilizer, the total biomass production indicates an increase in production in the case of either fertilized plots, the numbers being positively correlated to the amount of manure used. When using 50 t/ha manure, there was a 25.7 % increase in production, compared to the control lot.

Power plant ash appears to be a pollutant that generates a lot of environmental health issues in depositing and its usage (if possible). The results indicate that through a correctly dosed fertilization, the integration of the ash at around 30-40 t/ha does not influence barley production negatively. Of course, grain production is not stimulated directly. It is possible, in soils with a

denser texture to increase biomass production by fertilizing with 50 t/ha manure and integrating the ash.

4. Conclusions

Integrating power plant ash in the soil 30-40t/ha does not negatively influence the production of barley seeds in conditions where fermented manure was used at 50 t/ha.

Using a correct amount of organic fertilizer, the presence of ash in the soil could increase biomass production by 25.7 %.

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