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Original Research Article

Determining the Effects of Ash from Hospital Waste Incineration on the Growth of *Fava Bean*

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Abstract: The present study aimed to determine whether there are effects of medical waste incineration ash from hospitals in promoting the growth of fava bean plants. Samples were taken in soil (mixture) and ash in different proportions and placed in boxes according to sample numbers: 1 consisted of 1 kg of soil, sample number 2 also included 1 kg of ash, and sample number 3contained half a kilo of soil plus half a kilo of ash. Sample number 4: a quarter of soil + 3 quarters of ash; sample number 5: a quarter of ash plus three quarters of soil. Before the research was done in the Directorate of Agriculture, Kirkuk, Department of Modern Irrigation Technologies, and Water and Soil Management Division Laboratories, a quantitative analysis of medical waste ash was done to find out the amounts of different materials and compounds in the ash. The analysis revealed a percentage of 0.189% for total nitrogen, 0.087% for total phosphorus, 0.47% for total potassium, and 25.476% for organic matter. We observed normal plant growth when we planted the seeds in soil, but no growth at all when we planted them in ash. When planted in an anvil containing half a kilo of soil and half a kilo of ash, the plant grew successfully, and no seeds were formed. In the fourth treatment, which included a quarter kilo of soil and three quarters of a kilo of ash, the plant did not grow, and on the contrary, it led to the appearance of white spots on the mixture. In the fifth treatment, which included a quarter kilo of ash and three quarters of a kilo of soil, the plant did not grow, and on the contrary, it led to the appearance of blackened soil. It is concluded from the current study that contaminated and hazardous waste should be buried in relation to medical waste, and restrictions should be placed on access to the waste disposal site.

Keywords: Hospital Waste, Ash, Bean, Nitrogen.

INTRODUCTION

Medicinal waste encompasses all waste generated during diagnostic or medicinal procedures [1-3]. Medical waste, for instance, is defined as solid, liquid, and gaseous waste produced in hospitals, vet clinics, dentistry offices, medical research facilities, pharmaceutical companies, and blood banks [4, 5]. There are different types of medical waste, such as pathological waste, which includes human organs, body parts, and tissue; sharps, which includes needles, syringes, and blades; chemicals, which includes heavy metals from medical devices and solvents used in lab work; and infectious waste, which includes bodily fluids. Between 70 and 90 percent of medical waste is innocuous and similar to home waste. Hazardous categories classify the remaining 10–25%, raising concerns for human health and the environment [6, 7]. There are two primary categories of medical waste incinerator products. The waste that is discharged into the environment, including fly ash (MWFA), carbon dioxide, sulfur oxides, and chlorides, makes up the first section. The second component is bottom ash (MWBA), which is the ash that remains in the incinerator. The ash still in the incineration chamber makes up 75–90% of the total ash [8, 9]. We conducted several chemical investigations to study and assess the nature of the fly and bottom ash. The main studies found out about the ash's mineralogy, metal leaching, particle size distribution, and metal content [9]. Worldwide, there is no unified legislative framework governing the use of incineration ash. The laws governing the use of ash for fertilization vary from one nation to another. Lithuania only specifies the use of wood biomass ash.

Certain chemical elements have minimum and maximum amounts in some nations. Finland, for instance, establishes minimum levels of calcium, phosphorus, and potassium in fertilizer made from biomass ash. Fly ash used in agriculture must have a minimum of 10% calcium content and a minimum of 2% total phosphorus and potassium content [10, 11]. Ash can be used in many different ways, depending on the type of biomass that is used. This is because biomass feedstocks are very different, and so are the ash that is made by burning them. The suitability of multi-crop biomass for solid biofuel production has already been supported by a number of research studies conducted by the authors [12-15]. Therefore, in the present study, the aim was to determine whether there are effects of ash from hospital waste incineration on the growth of fava bean plants.

MATERIALS AND METHODS

When waste is burned in hospitals by the incinerator, it becomes ash after being isolated according to the nature of the material or compound used. The incinerator device must be handled with extreme caution, especially after burning the waste, and it requires a specialized cadre with a full scoop for burning waste. Medical waste refers to materials that have no value or use, yet their continued presence in the environment poses serious risks to human, animal, and plant sources and elements [16]. We took samples in different proportions of soil and ash, then placed them in a boxes.

Sample No. 1 / 1 kg of soil
Sample No. 2 / 1 kg of ash
Sample No. (3) / half a kilo of soil + half a kilo of ash
Sample No. (4) A quarter of soil + 3 quarters of ash
Sample No. (5) A quarter of ash + 3 quarters of soil

Then, the seeds of fava beans were used because they are considered important crops because their seeds are soft and dry. Most researchers were interested in this crop because it is considered an important food source for humans and sometimes animal feed. It also improves soil properties through nitrogen fixation and contributes to regulating the agricultural cycle, especially in areas that depend on rain (rain-fed areas).

RESULTS AND DISCUSSION

Before the research was done in the Directorate of Agriculture, Kirkuk, Department of Modern Irrigation Technologies, and Water and Soil Management Division Laboratories, a quantitative analysis of medical waste ash was done to find out the amounts of different materials and compounds in the ash. Table 1 revealed that the percentage of total nitrogen was 0.189%, total phosphorus was 0.087%, total potassium was 0.47%, and organic matter was 25.476%.

We mixed the detected ash components with soil to see if any seed growth occurred after planting. It was found that when the seeds were planted in soil only (Figure 1), there was normal plant growth, while when planted with ash only (Figure 2), there was no growth. When planted in an anvil containing half a kilo of soil and half a kilo of ash (Figure 3), the plant grew successfully and no seeds were formed. In the fourth treatment, which included a quarter kilo of soil and three quarters of a kilo of ash (Figure 4), the plant did not grow, and on the contrary, it led to the appearance of white spots on the mixture. In the fifth treatment (Figure 5), which included a quarter kilo of ash and three quarters of a kilo of soil, the plant did not grow, and on the contrary, it led to the appearance of blackened soil.

Figure 1: Plant growth normally when using only soil

Figure 2: Non-plant growth when using only ash

Figure 3: Plant growth when using half a kilo of soil and half a kilo of ash

Figure 4: non-plant growth when using quarter kilo of soil and three quarters of a kilo of ash

Figure 5: Non-plant growth when using quarter kilo of ash and three quarters of a kilo of soil

Table 1: Percentages of some elements in hospital waste ash

Elements	Percentage
total nitrogen	0.189%
Total phosphorus	0.087%
total potassium	0.47%
organic matter	25.476%

In this study, the ash from burning hospital waste had a catastrophic effect on the fava bean plant. It stopped growing completely, and even when only small amounts were used, it still caused the plant to grow in a way that wasn't straight. This may be due to the fact that the ash from incinerating hospital waste contains very high levels of heavy metals that have a very toxic effect on plants and soil, as indicated by Honest *et al*., [17], and Selman *et al*., [18]. The ash from incinerating hospital waste contained high levels of heavy metals, including nickel, cobalt, and lead [19, 20]. Therefore, the results of the current study were clear that the ash from incinerating hospital waste is a toxic and lethal substance for plants, especially fava beans.

CONCLUSIONS

It is concluded from the current study that contaminated and hazardous waste should be buried in relation to medical waste, and restrictions should be placed on access to the waste disposal site (building a fence around the place to prevent access by animals and children) and allocating closed places for all medical waste containers after sorting them instead of parking them in hospital facilities and corridors.

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