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Original Research Article

IMPACT OF DIFFERENT ORGANIC AND INORGANIC AMENDMENTS ON GROWTH AND YIELD OF MUNG BEAN IRRIGATED WITH TEXTILE EFFLUENTS

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Abstract *Water is an important substance for all life on earth, and it is essential for human beings, financial improvement, and the existence of ecological units. The quality and quantity of the water supply is very important, especially during irrigation. Due to the extensive measurement of water and colour associated with the manufacturing process, textile printing, and dyeing production lines around the world pose a major environmental risk. Textile wastewater contains a lot of pollutants including pH, temperature, shade, COD, BOD, TSS, TDS, EC, and heavy metals. This textile runoff continues to irrigate agricultural land, causing contamination of soils and plant systems with heavy metals. Therefore, adding organic and inorganic modifiers to soil is an effective technique for fixing heavy metals. Irrigate pots with textile wastewater of selected concentrations (10%, 25%, 50%, and 100%) collected in specific industrial sectors. The parameters of vegetative growth are reduced by increasing the concentration of textile effluent. Note the substantial reduction in the growth of plants applying wastewater at 100% concentration. In the case of T5, a significant increase in growth parameters was observed, where only tap water was used to pressurize the sludge, while dilute wastewater also enhanced growth at concentrations of 10% and 25%. For the chlorophyll content of mung bean plants, when the wastewater concentration is 100%, the recorded decrease is greater, followed by 10% and 25% respectively. The presence of heavy metals in wastewater reduces plant growth. In the experiment, all four treatments contained organic amendments (pressed sludge, poultry manure, biogas slurry, and farmyard manure). The other four treatment methods are pressure treatment of textile wastewater and the amount of organic modifier is 2%. By adding a correcting agent, the utilization rate of Cr is reduced, as the correcting agent will increase the pH of the soil, thus reducing the solubility of the metal. In addition, Cr can form insoluble complexes with organic materials, thus reducing its solubility.*

Keywords: *ecological; heavy metals; mung bean; textile; wastewter*

Introduction

Due to lack of fresh water for irrigation and drinking, we have to use industrial wastewater for irrigating the crops after proper treatment to fulfill the agricultural requirements. We can categorize the textile industries as the most polluting industries because the network of these industries is distributed widely throughout the whole of Pakistan. Textile effluents pose various problems due to their improper disposal of natural water and land. Due to expensive treatments and high running costs the waste water is directly drained into the nearby crop field as an irrigation source. This nutrient-rich water not only enhances crop growth but also accumulates higher concentrations of heavy metals. These effluents affect adversely different crops because they contain various organic and inorganic harmful chemical species. We cannot deny the use of this water, but it should be used after or with proper

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treatment which is economical and easily accessible (Yasmeen et al., 2014).

When the soil becomes toxic, soil fertility and its degradation process become slow. Heavy metal toxicity mainly depends on its chemical form and concentration (Hassan et al., 2013). Heavy metal mobility is inhibited by various mechanisms like precipitation, adsorption, exchange of ions, and formation of complexes with organic and inorganic compounds (Mansoor & Baig, 2014). Most heavy metals enter in system through anthropogenic activities (Sharma and Dubey, 2005). The first plant organ that encounters various components is the root (Younas et al., 2020). Many mechanisms have been developed to inhibit the transfer and uptake of these metals e to above-ground plant parts. It has been reported that these metals cause the production of superoxide, hydrogen peroxide, and radicals (Chowdhary et al., 2018).

Mung bean (*Vigna radiata* L.) locally known as moong or golden grain is a member of the Fabaceae family. It is extensively cultivated because of its good economic value. It is a prime pulse crop that is cultivated in both autumn and spring, in a year. In Pakistan, mung bean is ranked second in terms of production after chickpea (*Cicer arietinum*). Seeds are more pleasant to taste, nutritive, and easy to digest than any other pulse crop grown in the whole of the country. It is composed of 24.7% protein, 0.6% fat, 0.9% fiber, and 3.7% ash (Kumar & Chopra, 2012). It is a rich protein source. It preserves the fertility of soil by nitrogen fixation and plays an important role in sustainable crop production. Its water requirements are less than summer crops because it is a short durationcrop It is resistant to drought and can bear harsh environmental conditions, and hence significantly grown in less rainy regions of Pakistan (Yaseen et al., 2017).

There are a lot of reasons for the low production of Mung bean, but heavy metals are major contributors e.g. molybdenum (Mo), zinc (Zn), iron (Fe), copper (Cu), and nickel (Ni) are known as essential nutrients for the plants. High concentrations of these also cause toxicity. Arsenic (As), zinc (Zn), nickel (Ni), selenium (Se), lead (Pb), Chromium (C r), and copper (Cu) are harmful to humans and plants and are pollutants of the environment (Yaseen et al., 2017). Waste disposal, increased agrochemical use, irrigation by wastewater, animal rearing and production of crops, burning of fossil fuel, road traffic, power stations mining, and many other sectors play an important role in heavy metals accumulation in soil and water (Kannan & Upreti, 2008). Wildlife and human health sectors are in danger and agriculture is facing production losses in agriculture due to heavy metal accumulation and contamination of soil and water (Kapil & Mathur, 2020).

The following objectives were kept in mind before starting the experiment:

- To detoxify the effect of heavy metals by using different organic amendments.
- For the assessment of the combine effect of textile effluent and organic amendments on the yield of mung bean.
- To observe the effectiveness of organic alterations regarding their effect on decreasing the bioavailability of heavy metals in Mung bean

MATERIALS AND METHODS

Pot experiment was conducted in the wire house of the Institute of Soil and Environmental Science, University of Agriculture Faisalabad during 2019-2020.

Experimental conditions

To conduct pot experiment the wire house of ISES. UAF. Was used. The potted experiment aims to assess the stimulation of growth and yield of mung bean by textile wastewater of various concentrations. Fill the pot with 10 kg of soil and sow mung bean seeds. Watering with textile effluents of specific concentrations (10%, 25%, 50%, and 100%) collected in specific industrial sectors was judged to be more toxic during previous characterization tests.

By maintaining the effluent/tap water ratio at 0: 100, 10:90, 25:75, 50:50, and 100: 0, respectively, the calculated amount of wastewater is dissolved in tap water to make a kit. After germination, scatter the seeds in all pots with ten plants per pot. Measure the vegetative growth parameters every week. The chlorophyll content was also determined. Determine the cool and dry weight of the plants at the end of the experiment. The experimental design is a CRD factorial with three replicas.

Immobilization for Heavy Metals by Using Organic Amendments

Experimental Conditions

For the conduction of soil pot trial, wire house of the ISES, UAF. Faisalabad was occupied. Then experiment included ten treatments containing three replications for each. Organic amendments were applied at the rate of 2%. The design used for the experiment was CRD under Factorial. The treatment plan is given below as:

T0= Control
T1= Industrial effluent
T2= FYM @ 2%
T3= Biogas slurry @ 2%
T4= Poultry Manure @ 2%
T5= Press Mud @ 2%
T6= Textile effluent + FYM
T7= Textile effluent + Biogas slurry

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T8= Textile effluent + Poultry manure
T9= Textile effluent+ press mud

Pots were filled with ten kg of soil in each pot. Organic amendments were homogeneously assorted in the soil at the time of filling of pots. Mung Bean was sown for the experiment. Selected concentrations of textile effluent were applied to each pot (10%, 25%, and 50%) gathered from the Sitara textile industry that was located at Sargodha Road, Faisalabad. The proper conc. of tap water was applied to every pot according to the specific irrigation plan which was settled for all replications and treatments. A total of twelve irrigations (500 mL) were applied to mung at three to four days of intervals.

Soil Analysis

The soil is tested before sowing and after harvest to assess soil characteristics and changes in the soil. The soil sample was ground through a 2mm sieve. Many characteristics of the prepared soil samples were analyzed, namely texture, (ECe), pH, sodium adsorption rate (SAR), and organic matter (OM) (Gee and Bauder, 1986).

Preparation of Amendments and calculations

Four amendments were used for the research. These amendments were poultry manure, farm yard manure, biogas slurry, and press mud. All these amendments were collected from the University of Agriculture Faisalabad. Amendments were applied to soil pots @ 2%. As the weight of the soil pot was 10kg, so 200g of each amendment was added to the concerned replication. Amendments were applied before sowing and thoroughly mixed in soil.

Determination of chlorophyll content

SPAD chlorophyll meter was used to determine the chlorophyll content of the leaves of mung beans.

Plant Harvest

Mung Bean Harvesting

Harvesting was done after 90 days of the sowing. Plant Length, fresh weight of plant shoots, and fresh root weight were measured at harvesting. After harvesting, both shoots and roots were dried in an oven at a temperature of 65 ^{0}C until specific weights and then dry weights were determined. Concentrations of micronutrients and Cr were determined after the digestion process by using an atomic absorption spectrophotometer (AAS).

Statistical Analysis

Results from the study were scrutinized by using the specific software called Statistic 8.1. Data collected from the study was analyzed through statistics following ANOVA as well as means from Tukey HSD test.

Results

Growth Parameters of Mung Bean Irrigated with Textile Effluent and Organic Amendments

Results presented in Figure 1 indicated that the application of industrial effluent decreased the plant height by 28% as compared to the control plant. However, the application of organic amendments increased plant height more than the control treatment. Different amendments responded differently regarding increment in the plant height where farmyard manure, poultry manure, and press mud increased plant height by 11, 6 and 14% as compared to the control. However, the application of biogas slurry decreased plant height by 3% in comparison with the control. Figure 2 also shows the comparison of textile effluent with organic amendments and treatment with only textile effluent. So, data revealed that all combinations of organic amendments FYM, BGS, PM, and Pres mud with textile effluent increased the root length of mung bean by 103, 55, 105, and 112% respectively as compared to the treatment containing 100% textile effluent. The data (figure 3) showed that textile effluent reduced the shoot fresh weight of mung bean but by the application of organic amendments (FYM, PM, BGS, and press mud) shoot fresh weight was improved. The reduction in shoot fresh weight was 24% over the normal treatment. Under normal conditions, the maximum increase in weight was observed by treatment of press mud and it increased shoot fresh weight up to 21% over the respective control treatment. It is revealed from the data (Figure 4) that the shoot dry weight of mung bean was increased by the application of organic amendments (FYM, BGD, PM, and Press mud). These amendments had reduced significantly the effect of heavy metals on mung bean growth and yield. Figure 5 describes the comparison between textile effluent with organic amendments and treatment with only textile effluent. So, data revealed that all combinations of organic amendments FYM, BGS, PM, and Pres mud with textile effluent increased the chlorophyll content of mung bean by 78, 40, 66, and 89% respectively as compared to the treatment contained 100% textile effluent. 1000 grain weight of mung bean was also elaborated by the combined effect of textile effluent having organic amendments with the same organic amendments solely (figure 6). Moreover, results revealed that press mud detoxified the heavy metals present in textile effluent significantly and increased 1000 grain weight more than other amendments. As compared to treatment that had 100% textile effluent application, a combination of press mud with effluent represented 73% more 1000 grain weight(g). The data (figure 7) showed that textile effluent reduced the grain fresh weight of mung bean but by the application of organic amendments (FYM, PM, BGS, and press mud) grain fresh weight was improved. The

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reduction in grain fresh weight was 30% over the normal treatment. Under normal conditions, the maximum increase in weight was observed by treatment of press mud and it increased grain fresh weight up to 26% over the respective control treatment. As the concentration of textile effluent was increased the reduction in grain dry weight was observed. The application of industrial effluent decreased the grain dry weight by 28% as compared to the control plant. However, the application of organic amendments increased grain fresh weight than the control treatment. Different amendments responded differently regarding increment in the grain dry weight where farmyard manure, poultry manure, and press mud increased grain dry weight by 34, 23 and 53% as compared to the control. However, application of biogas slurry decreased plant height by 22% in comparison with the control (figure 8).

Pods fresh weight of mung bean was also elaborated by the combined effect of textile effluent having organic amendments with the same organic amendments solely. Moreover, results revealed that press mud detoxified the heavy metals present in textile effluent significantly and increased pods' fresh weight more than other amendments. As compared to treatment that had 100% textile effluent application, a combination of press mud with effluent represented 73% more pod fresh weight(g) (Figure 9). The combination of textile effluent with FYM decreased pod's dry weight by 25% as compared to the treatment that contained only FYM. Similarly, textile effluent with BGS, Poultry manure, and press mud also decreased pod's dry weight 35, 19, and 38% as compared to the treatments in which BGS, Poultry manure, and press mud were applied solely (Figure 10). Data (figure 11) represented that textile effluent reduced the root fresh weight of mung bean but by the application of organic amendments (FYM, PM, BGS, and press mud) root fresh weight was improved. The reduction in root fresh weight was 48% over the normal treatment. Under normal conditions, the maximum increase in weight was observed by treatment of press mud and increased root fresh weight up to 36% over the respective control treatment. The maximum decrease in root fresh weight was observed in treatment where only textile effluent was functional @ 100%. The data (figure 12) showed that textile effluent reduced the shoot dry weight of mung bean but by the application of organic amendments (FYM, PM, BGS, and press mud) root dry weight was improved. The reduction in root dry weight was 24% over the normal treatment. Under normal conditions, the maximum increase in weight was observed by treatment of press mud and it increased shoot fresh weight up to 34% over the respective control treatment.

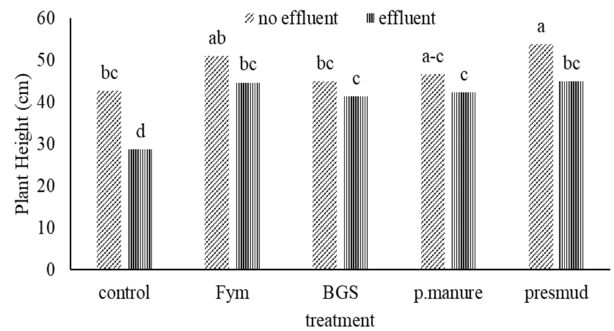

Figure 1: Interactive effect of organic amendments and textile effluent on the Shoot length (cm) of mung bean.

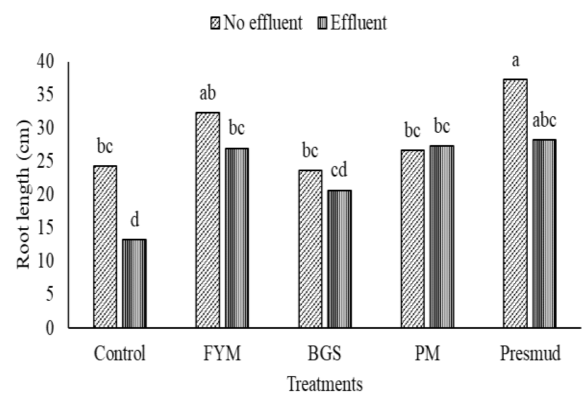

Figure 2: Interactive effect of organic amendments and textile effluent on the root length (cm) of mung bean.

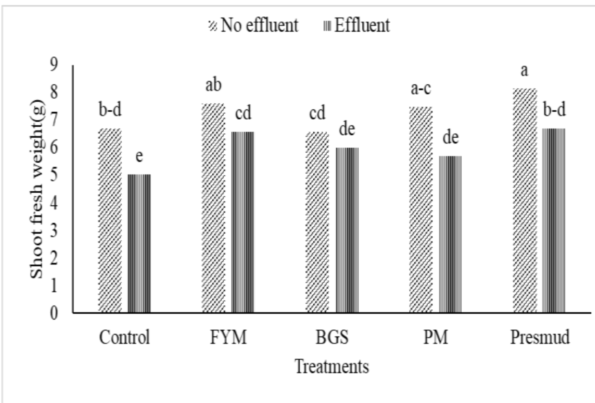

Figure 3: Interactive effect of organic amendments and textile effluent on the shoot fresh weight (g) of mung bean

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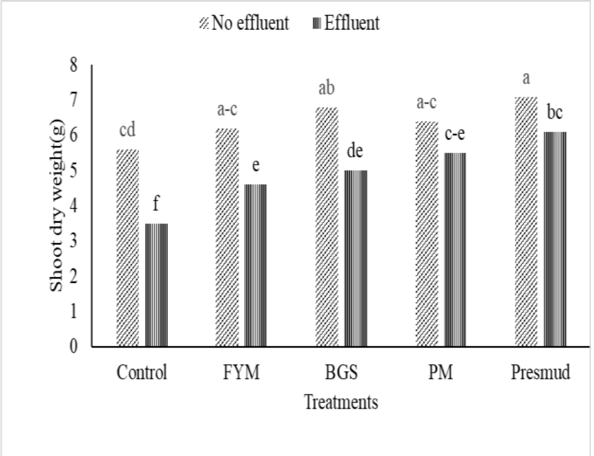

Figure 4: Interactive effect of organic amendments and textile effluent on the shoot dry weight (g) of mung bean

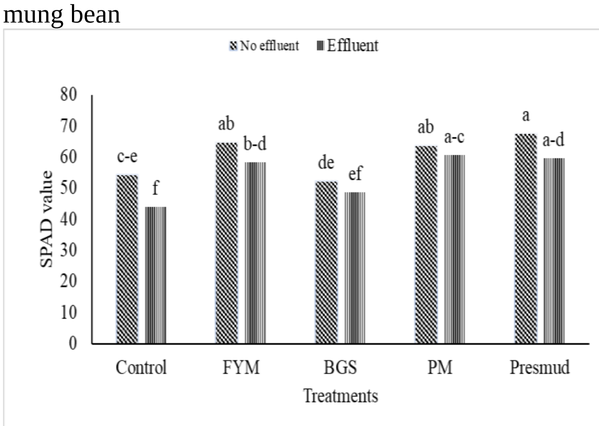

Figure 5: Interactive effect of organic amendments and textile effluent on the Chlorophyll content (SPAD) of mung bean

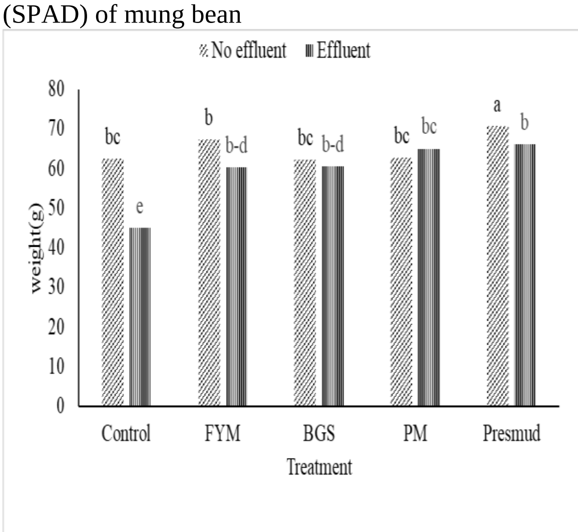

Figure 6: Interactive effect of organic amendments and textile effluent on the 1000 grain weight (g) of mung bean

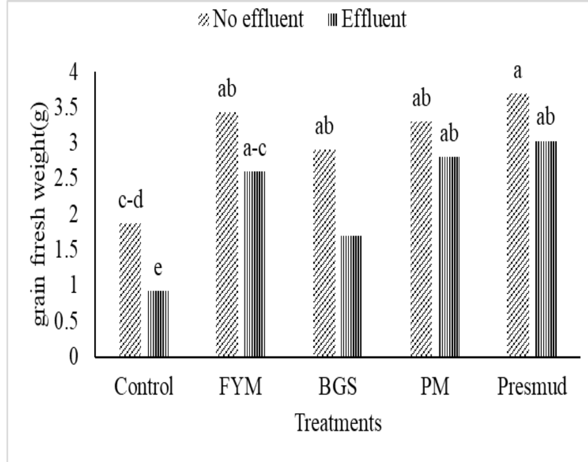

Figure 7: Interactive effect of organic amendments and textile effluent on the grain fresh weight (g) of mung bean

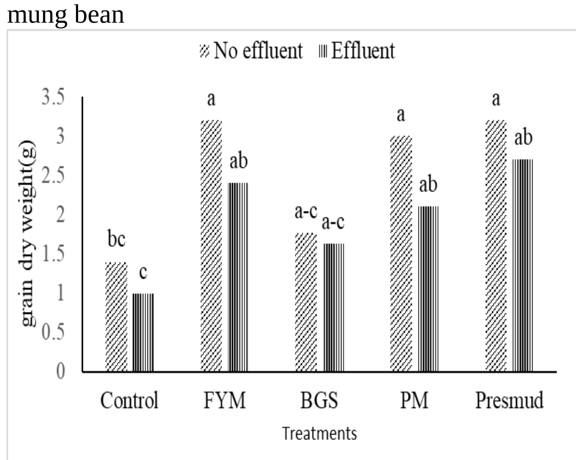

Figure 8 Interactive effect of organic amendments and textile effluent on the grain dry weight (g) of mung bean

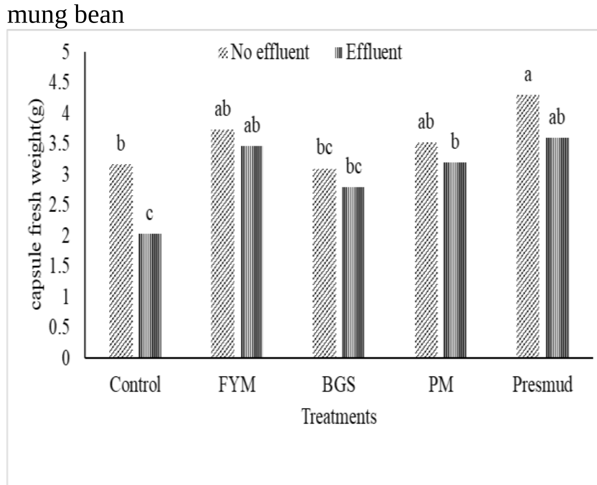

Figure 9: Interactive effect of organic amendments and textile effluent on the capsule fresh weigh (g) of mung bean

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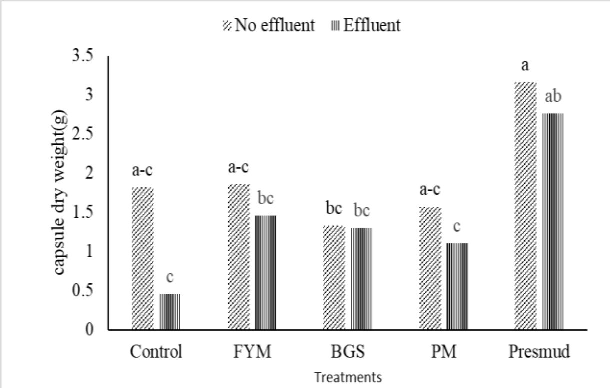

Figure 10: Interactive effect of organic amendments and textile effluent on the capsule dry weight (g) of mung bean

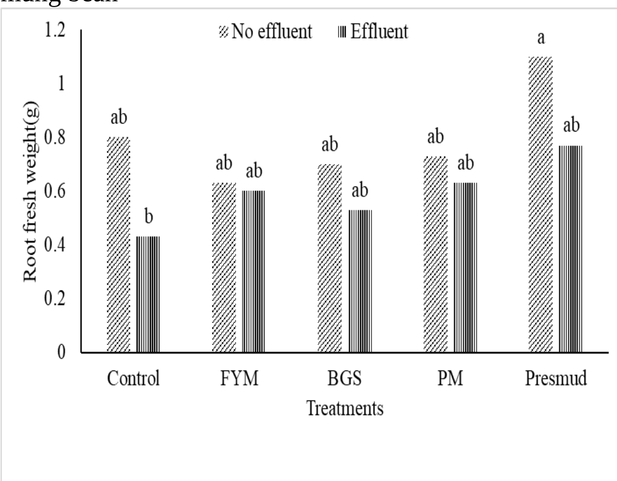

Figure 11 Interactive effect of organic amendments and textile effluent on the root fresh weight (g) of mung bean

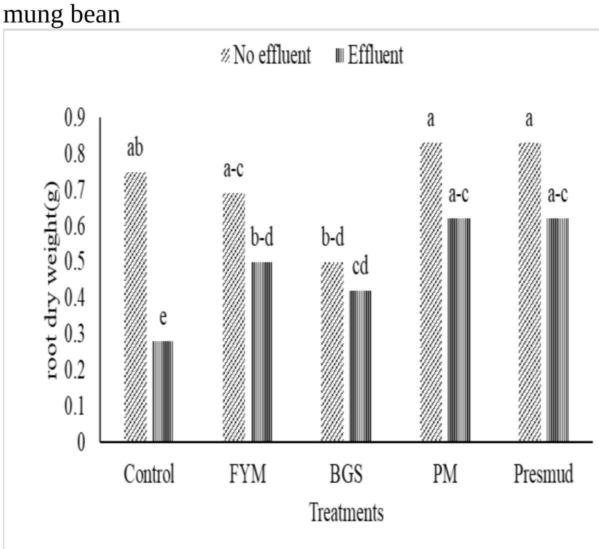

Figure 12 Interactive effect of organic amendments and textile effluent on the root dry weight (g) of mung bean

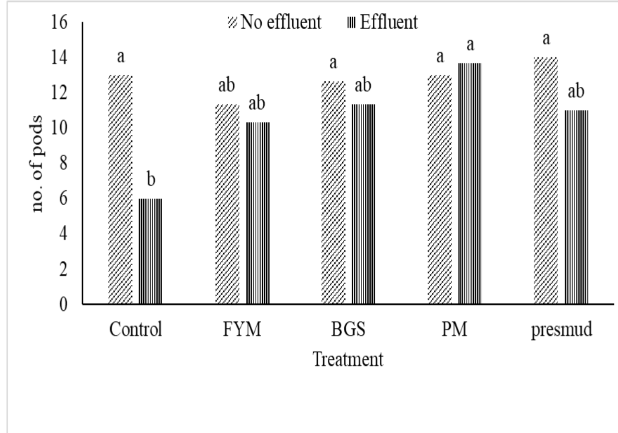

Figure 13 Interactive effect of organic amendments and textile effluent on the pods per plant of mung bean

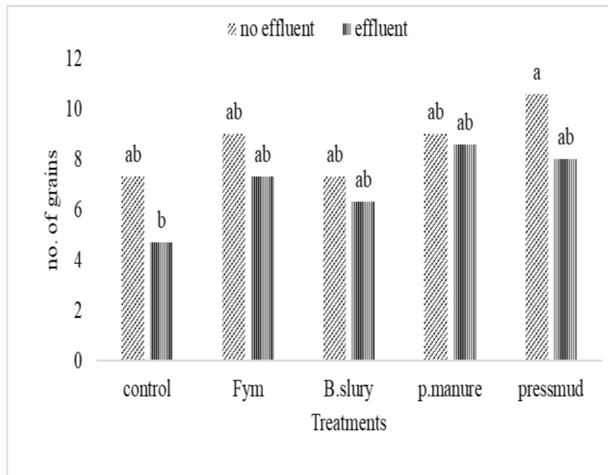

Figure 14: Interactive effect of organic amendments and textile effluent on the grains per pod of mung bean

DISCUSSION

Results revealed that the sample of textile effluent kept high conc. of dyes, that's why all samples were dark-coloured with a pungent smell. (Ok *et al*. 2010) described that due to chromophore all the textile effluents expose the high colour of textile dyes. Their degradation is difficult because of the combined results of acid temperature and pH that make them intensively coloured. The foul odor is produced by volatile compounds found in the sample (Arul *et al*., 2011). This study shows that the temperature of the textile effluent sample is very high, even more than the permissible limit. Sulfide release may be increased due to high temperature. Higher temperatures can also cause oil and natural gas volatilization, introducing organic compounds into the environment and increasing pollution in the air. The solubility of the gas decreases due to the high temperature in the water and reaching high BOD and COD (Chhikara *et al*., 2013). It was noted from the

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study that the pH value of all textile effluent samples exceeded the permissible limit. The pH value represents the activity of hydrogen in the water and essential factors related to the environment as it reveals the concentration like acidic and alkaline state of water (Kalshetty *et al*., 2011). Checking the pH of the wastewater sample is important to balance water quality as it impacts other chemical reactions. Solubility as well as toxicity of metals is also dependent on the pH of the effluent sample. Therefore, it is important to calculate the pH of wastewater samples to balance water properties (Fakayode, 2005). A higher pH value indicates that the effluent is alkaline. In general, the pH value of wastewater samples increases with the bleaching process, which is generally not conducive to aquatic environments (Effler *et al*., 1990). The pH value changes the physical and chemical properties of water and seriously damages the life of aquatic organisms, humans, and plants. By changing the pH value, the survival rate of various microorganisms and their biological reaction rate can be affected (Sankpal and Naikwade, 2012).

In industry, metallic cadmium is used as a preservative (Arup, 2003). As a result of the ingestion of cadmium in drinking water, risks to human health generally include lung damage, kidney infection, bone fragility, and bone damage (Nordberg *et al*., 2002). Chromium is commonly used in molten metals, for example as a colorant for paints, papers, adhesives, and other ingredients. It is also used as a preservative for leather, wood, and electroplating (Martin and Griswold, 2009). Long-term exposure to chromium can also cause damage to the kidneys, liver, and nervous tissue (Hanaa *et al*., 2000). Waste-water from the textile industry involves organic and inorganic chemicals, and the coordination of the two can adversely affect plant growth. The physical and chemical analysis of wastewater reflects a high conductivity value, indicating the presence of a large amount of metals and salts. It is clear from the survey results that the use of textile wastewater in turn affected the growth, physiological, and chemical parameters of mung bean. Decreased growth parameters under high emission characteristics may be due to large amounts of lethal substances, heavy metals, hazardous organic compounds, high biochemical oxygen demand, and chemical oxygen demand (Robinson *et al*., 2001). In this study, it was verified that the development and yield of mung bean with a concentration of textile wastewater and poultry manure (2%) were hampered when identified with other contents of the amendments. Indeed, there are pollutants in textile wastewater, in particular, because of the risk that Cr threatens the growth of mung bean. In addition, its harmful effects reduce plant biomass and promote the absorption of chromium in plant soil. In the ongoing inspection, it was noted that the control plants reflected reduced growth due to the toxicity of Cr. The results showed that the application of textile wastewater at different dilutions will harm all physiological parameters measured. The negative effects of textile wastewater (dilution level> 20%) can be considered salinity problems caused by the illegal use of wastewater and can harm the physiological parameters of plants (Singh et al., 2020). Like our results, Bhati and Singh (2003) and Kaushik *et al*. (2005) The characteristic of textile wastewater is that the physiological parameters of plants are adversely involved, but at lower concentrations, they show no adverse effects or have no obvious inhibitory effect on the physiological parameters of plants. Continuing to use chemical fertilizers, whether or not they are used in the proper proportions, will weaken soil fertility and therefore cannot maintain the baseline for increasing crop yields. The same goes for Zia *et al*. (2000). On the other hand, due to the use of organic amendments, soil fertility increases, resulting in reduced leaching losses. From a long-term perspective, the availability of nutrients has also been broadened and the relationship between nutrient ratio and crop demand is more evident (Hossain and Sarkar, 2015). Generally, the brewing of soil and poultry manure has a neutral pH and tends to be alkaline at pH, which is the same idea as López-Mosquera *et al*. (2008).

Conclusion

The results showed that as the concentration of the textile wastewater increased, the pressing of the sludge caused a substantial increase in the growth and development of the plants. It has also been found to be effective in increasing the absorption of trace elements and reducing the concentration of chromium. In general, the press slurry containing 2% textile wastewater showed a better response than the other treatments.

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Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

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There is no conflict of interest among the authors regarding this case study.

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All authors contributed equally.

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