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Original Article

Press Mud as a Substitute to Soil

Arnav Aggarwal

Modern School Barakhamba Road, New Delhi, India.

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Abstract *- The research mainly focuses on proving the existence of a substitute for the soil on which plants can be grown. The aim was to sustain plants in press mud and compare their growth with plants grown in different soil and press mud ratios. The null hypothesis- plants can only be grown on soil, was proven completely wrong by this study as a plant (fenugreek) grew in a pot with 100% press mud. The main objective of this study is to encourage people to use press mud instead of soil and conserve soil for more rational and important uses. The methods used in this research include experimental methods in which fenugreek plants were grown in different pots having different ratios of soil and press mud. Each pot was recorded regularly, measuring the amount of water added, pH of the soil and temperature of the soil. The study's results were positive as plants sustained in press mud indicate that press mud can be used as an alternative to soil. Farmers and plant nurseries can widely use press mud to prevent soil depletion.*

Keywords *- Press mud, Kitchen garden, Soil, Fenugreek plant, Plant nurseries, Sugar cane industry.*

1. Introduction

Press mud is a waste material generated by sugar industries. Press mud is unavoidable and is produced when making sugar canes. It is rich in many plant nutrients and has the properties to ameliorate degraded soils (*Solaimalai A.,2001*). Sugar mills in India produce around 12 million tons of press-mud (Neha Gupta,2011) as a waste from double sulfation processes- a process of purification of sugar cane juice using lime and sulfur dioxide gas.

The chemical composition of press mud is moisture (67.95–76.53%), nitrogen (1.63–2.29%), ash (19.28–30.76%), sugar (12.10–13.29%), and crude wax (6.70–11.01%). (*Md. Moshfeukus Saleh-E-In, 2012*).

Press mud is rich in many plant nutrients like cellulose, hemicellulose, fiber, and organic carbon, as well as nitrogen, phosphorus, potassium, magnesium, and calcium. For this reason, press mud is used in agriculture. Many research works indicate that the application of press mud improves soil fertility, nutrient uptake, and yield of crops (*Muhammad Umer Chattha,2019*)

It is the residue of the filtration of sugarcane juice. The clarification process separates the juice into a clear juice that rises to the top, and mud formed at the bottom is press mud. This mud is then filtered to separate the suspended matter, which includes insoluble salts and fine bagasse.
(Tran G. 2015)

Ideally, soil particles should be removed from the mixed juice before clarification. To avoid decay by fungi and bacteria, the press mud should be dried immediately.
Press mud is similar to the soil's texture and functions. Like soil, press mud also includes plant growth regulators, auxins, enzymes, vitamins, and hormones resulting in maintaining the tilth, fertility, and productivity of agricultural soils (*Solaimalai et al., 2001*).

Soil is the most important source, depleting at a high rate. Statistically, almost 36 billion tons of soil are lost yearly due to water, deforestation and other changes in the land.
(*European Commission joint research centre, 2017*)

Soil supports flora and fauna, which are vital for humans. Soil is a path between the air, water, rocks and organisms and is responsible for many functions in the natural world. These functions include air quality and composition, recycling nutrient elements, water cycling and purification, natural waste treatment, and recycling and habitat for most living things and their food. The role of soil in the ecosystem is diverse. Soil has a role to play in every sphere of human life. (*Tapas Bhattacharyya,2015*).

Harvesting crops from soil makes the soil lose its nutrients and fertility. We should conserve soil and use it extensively in large fields to grow important staple crops. Soil has different uses, so it should be used only when necessary. Apart from growing plants, it is also used to make utensils and for construction and art. Soil is also applied to the face and body to improve the skin. Some organic soils are also a source of fuel. One of the most important uses of

soil is medicinal purposes by transfer of nutrients from plants to human beings either indirectly or directly by ingestion. (Rolf Nider, 2018)

The trend of planting pots in houses and kitchen gardens has leapt recently. The number of nurseries has also increased tremendously. (Lachmi Deb Roy, 2018)
The global greenhouse, nursery, and flowers market are expected to grow from $369. 26 billion in 2020 to $396. 62 billion in 2021 at a compound annual growth rate (CAGR) of 7. 4%. *The "Greenhouse, Nursery, and Flowers Global Market Report, 2021*)

The kitchen garden is becoming affordable, and it is no longer difficult to grow fruits and vegetables independently. A most important part of nature- the soil is getting used up to satisfy these trends of kitchen gardens, and it may not look as much of a problem now, but in the long run, it could cause difficulties.

In this research paper, the main focus is to use press mud as a substitute for the soil to grow fenugreek using different ratios of soil and press mud.

2. Materials and Methods

12 pots of different ratios were used in this research. These twelve pots were divided into 2 batches of six pots, each one having slightly bigger pots and size while the other had smaller ones. The pots of each batch contain different proportions of soil and press mud. The pots are labeled A, B, C, D, E, and F. The ratios in each batch are given as follows:

Table 1. Different ratios of soil and press mud in different pots

A	100% SOIL
B	80% SOIL, 20% PRESS MUD
C	60% SOIL 40% PRESS MUD
D	40% SOIL, 60% PRESS MUD
E	20% SOIL 80% PRESS MUD
F	100% PRESS MUD

Water was added after measuring and was recorded correctly. The water was measured by a labelled beaker and was recorded without any margin of error.

Fig. 1 The pH and temperature of the soil were measured by a soil survey instrument. The instrument measured soil pH with a range of 3.5-9.0. (Source: *Amazon. in)*

The data was recorded on the excel sheet regularly.

2.1. Data Collection Procedure

The procedure of the experiment was:

1. Fill all the pots in correct ratios of soil and press mud.
2. Plant seeds in them.
3. Water all the pots and place them in an organised order.
4. After every 4-5 days, water them and record the variables like water added, pH of the soil and temperature of the soil.
5. After all the pots have grown, pluck the yield out and measure the weight of the yield by a weighing machine in grams.

The data formed would be used to check whether plants could be grown on press mud and what would be the weight of the plant as compared to the plants grown in 100% soil.

2.2. Aim of the study

Study the effects of using press mud instead of soil to grow plants in different ratios of press mud and soil.

2.3. Hypothesis

Null Hypothesis - There is no alternative to the soil in which plants can be grown.
Alternate Hypothesis - The use of organic soil or different proportions of soil and press mud can be used to grow plants.

3. Results and Discussion

3.1. Results

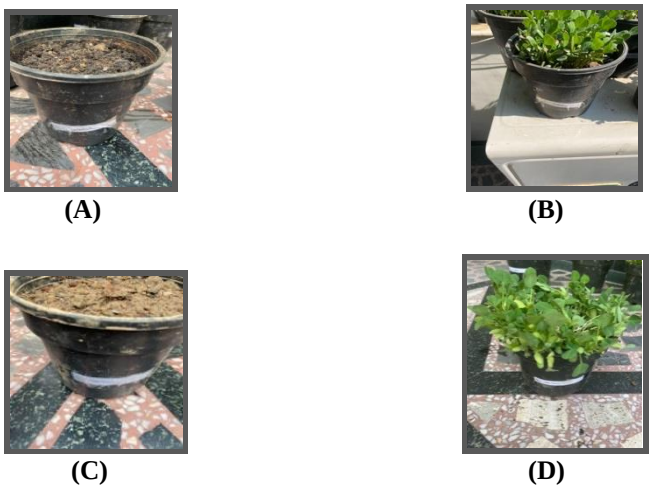

Fig. 2 (A) and (B) are the pots with 100% press mud on the first and last day, respectively, while (C) and (D) are the pots with 100% soil on the first and last day, respectively.

The above pictures show that both pots could grow fenugreek plants, whether 100% soil or 100% press-mud. It took 25 days to grow these plants.

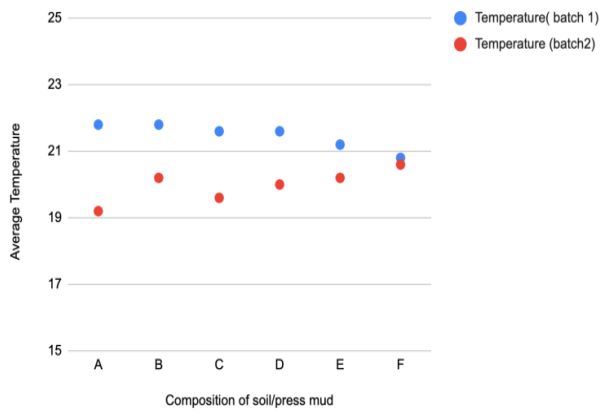

Fig. 3 Average temperature of all plants of batch 1 and batch 2 over the period

This scatter plot in Figure 3 shows the average temperature in degrees celsius of the soil in different pots containing different ratios of soil/press mud. It is the average temperature throughout growing fenugreek.

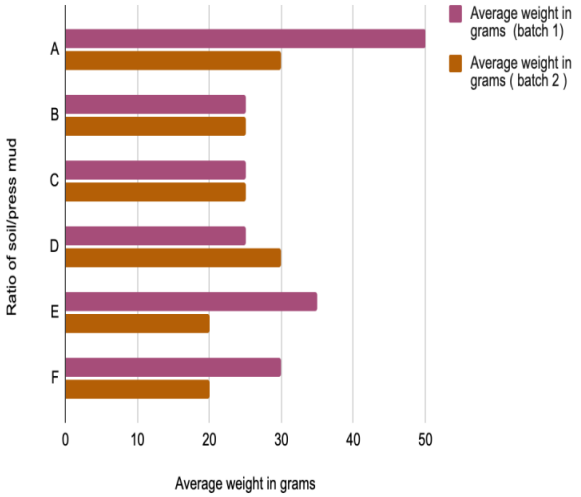

Fig. 4 Average weight of individual pots in both batches

Figure 4 shows the average yield weight of particular batches of different soil/press mud ratios.

Table 3. Weight of the harvest from all pots and their averages

	A	B	C	D	E	F
Weight Batch 1	50g	25g	25g	25g	35g	30 g
Weight Batch 2	30g	25g	25g	30g	20g	20g
Average	40g	25g	25g	27.5g	27.5g	25g

The above table shows the average weight of all the plants according to their respective ratios of soil and press mud in which they were grown.

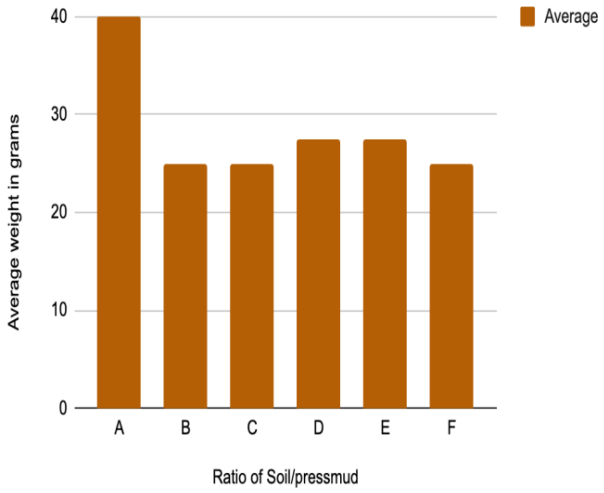

Fig. 5 Average weight in grams of both the batches of pots.

This graph shows the average yield weight of both batches of different soil/press mud ratios. The graph shows that the average fenugreek weight is much higher in Pot A, which is 100% soil. It also shows that the weights in the rest of the pots are almost equal.

3.2. Discussion

The main finding of the result shows that plants can be grown completely without soil. It can be shown by the growth of fenugreek plants in a pot with 100% press mud.

Fig. 6 Pot with 100% press mud of batch 2 on the last day

100% press mud was used to grow fenugreek in Pot F. Hence null hypothesis is rejected. The alternate hypothesis is accepted that different ratios or even 100% press mud can be used to grow plants.

The results show that plants also grew on 100% press mud, suggesting that press mud can be used as an alternative to growing plants for domestic purposes.

The average temperature of batch 1 with slightly smaller pots is comparatively greater than batch 2 in all cases. Moreover, the temperature in batch 1 decreased constantly from 100% soil to 100% press mud.

The average weight of different pots, as shown in the results, clearly shows that the weight of 100% soil yield is more than the others by a margin. But, it can also be seen that a significant yield was present in other pots. In literature, we can see that applying press mud increased soil fertility and agronomical performances. Nutrients present in press mud like nitrogen and ash add to the fertility of the soil. (*Kumar,2016).* It could be why the absence of soil didn't affect soil yield significantly.

Biswal et al.; reported that ash could significantly improve the physiochemical properties of the soil due to an increase in porosity and water holding capacity. (Trtinath Biswal, 2018), it could also be a reason for the growth of plants without soil.

Nitrogen plays a very important role in meiosis, an important step in the plant reproduction system; the presence of abundant amounts of nitrogen in press mud helps in the plant's growth without the need for any fertilisers (Han Yang 2022). Due to the presence of nitrogen, press mud thus can be used as a bio-friendly fertiliser as well..(*Shang Dong Yang, 2013*) Intuitively, all the plants were green and the same in texture, irrespective of the ratio of soil and pressmud.

4. Conclusion

People can use press mud to grow plants at home, limiting excess use of soil. Farmers can also mix proportions of press mud to the natural soil as the yield is not that different, and they can grow plants on less available soil by doing so.

The main conclusion is that plants can be grown without soil using press mud- and unavoidable waste from sugar industries.

The plants in all the pots and batches grew to their maximum, showing that plants can sustain in both soil and press mud.

This study also shows that it takes approximately 25 days to grow a fenugreek plant in the late winter.

Although the yield in 100% soil was the largest, the yield in 100% press mud was not 0.

From this, we can conclude that plants can be grown without using soil on press mud.

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