NCNE-2020 Special Issue

J. Indian Chem. Soc.,
Vol. 97, July 2020, pp. 989-992

Physico-chemical analysis of municipal solid waste on germination and plantlet enhancement of groundnut (*Arachis hypogaea)* seeds

Nisha Gupta[a], Manisha Agrawal*[a] and Dharm Pal[b]

[a]Department of Applied Chemistry, Rungta College of Engineering & Technology, Bhilai-490 020, Chhattisgarh, India

[b]Department of Chemical Engineering, National Institute of Technology Raipur, Raipur-492 010, Chhattisgarh, India

E-mail: dr.manisha.agrawal@rungta.ac.in

Manuscript received online 07 April 2020, accepted 01 June 2020

The current circumstances of urban solid waste administration in Indian urban communities are profoundly insufficient due to increase in the air, water and soil pollutions day by day. Present investigation proposes an idea about use of the Municipal Solid Waste (MSW) in agriculture land as soil booster, and also to minimize the problem of pollution. The trials were completed by taking concentrates of the various percentage of MSW (5, 10, 15, 20, 25, and 30%) with distilled water taken as reference. The extract of MSW was prepared by mixing of MSW and distilled water in (w/v) proportion. Groundnut seeds *(Arachis hypogaea)* were planted in pots as the Randomized Completely Block Design (RCBD) with 5–30% concentrates of MSW independently. The germination parameters were measured at 24, 48, and 72 and 96 h, simultaneously with the electrical conductance, pH, and salinity, percentage of moisture, temperature, micronutrients and macronutrients of MSW by the standard methods. The results showed that the macro-nutrients, germination percentage, RSG%, GI%, and RRG% found good agreement with high extract (30%) of MSW and the increased seedling growth of groundnut seeds. Hence, the MSW extracts can be used as improver of nutrients in soil as well as seedling growth booster of groundnut seeds.

Keywords: Germination, MSW, plant nutrient, micro-nutrients, seedling growth, germination index.

Introduction

At present, the world generates approximately 1.3 billion tones of solid waste yearly. Expected increase in the volume of solid waste may reache about 2.2 billion tones by the year 2025. The price of administration of solid waste will increase from today's annual $205.4 billion to about 375.5 billion by the year 2025. The increase of expenditure will be an acute issue for developing and low-income countries[1]. Latest observations regarding effect of MSW on the physico-chemical properties of soil indicates that the blending of MSW to the normal soil in calculated ratio improves the organic matter and soil nutrients to enrich the properties of the normal soil[2–4]. The MSW contains N, P, K and many micronutrients. MSW is biodegradable due to presence of the microorganism and it is converted into stable organic compound humus. For that composting is a resourceful technique and can be applied to the soil[5–7]. MSW may be used as a substrate for vegetable and seedlings growth, which was proved by experiments and investigation in tomato plants[8]. The assessing supplement of MSW extract on germination and early development of groundnut seeds were acted in the ongoing test. The impact of productiveness of soil due to blending of MSW is also determined in this study. MSW extracts increases the effect on seed germination and plantlet augmentation as well as the existence of plants is also improved.

Experimental

After the collection of MSW soil sample from the dump sites in series of steps needed to perform before the examination. The substances which cannot be broken down by natural organisms have been isolated by hands. The MSW sample has been dehydrated in an oven at 110°C after that sample was sieved. The size of the particle reduces up to ≤ 2 millimeters to ≤ 0.5 millimeters and then stored in airtight glass bottle.

The physical properties of MSW such as pH, temperature, moisture%, electrical conductivity (EC) and salinity have been measure by standard method and the chemical char-

acteristics; macronutrients nitrogen, phosphorous, potassium, calcium and magnesium as well micronutrients zinc, iron, copper, manganese have been determined by the Flame photometer (Model: 3L411) and Atomic Absorption Spectrophotometer (Model: VV2203). In this experiment, twenty-five of groundnut seeds *(Arachis hypogaea)* were placed into each Petri dish. The width of the Petri dish was 100 millimeters. Every Petri dish was enclosed by filter paper, and filter paper were soaked with 5, 10, 15, 20, 25 and 30% extract of MSW. Filter paper was soaked with distilled water taken as the reference. In every dish 10 milliliters extract of MSW was sprayed, and for the reference only distilled water was spilled to the dish. During the treatments, set of dishes were kept at the room temperature[8]. Germination of seeds was counted at 24, 48, 72 and 96 h. Every action was repeated five times. Results analyses were done in a totally randomized structure. Seed germination rate, level of relative seed germination, level of relative root development, germination index characteristics were estimated by following formula[8].

$$\text{Seed germination rate} = \frac{\text{Number of germinating seed}}{\text{Total number of seed}} \times 100 \quad (1)$$

$$\text{Level of relative seed germination (RSG)} = \frac{\text{No. of seed germinatted in MSW extract}}{\text{No. of seed germinated in control}} \times 100 \quad (2)$$

$$\text{Level of relative root growth} = \frac{\text{Mean root length in MSW extract}}{\text{Mean root length in control}} \times 100 \quad (3)$$

$$\text{Germination index} = \frac{\text{RSG} \times \text{RRG}}{100} \quad (4)$$

Results and discussion

Physicochemical properties:

Physical characteristics of MSW were shown in Table 1. The temperature of MSW is 30°C and the percentage of moisture of MSW is 20.5%. Both are very important for biodegradation in MSW. The pH value of MSW is 7.9. So MSW was moderately alkaline, it influences the availability and solubility of soil nutrients in the soil. Conductivity refers to the electrical conductivity of the solution. The highest conductivity of MSW is 0.32 (dS/m) and salinity refers to the extracts of soluble inorganic salts in the soil. The highest salinity of MSW is 0.42 g/kg[3]. Chemical parameters calculated were macronutrient phosphorous, potassium, nitrogen, calcium and magnesium. Micronutrients like manganese, zinc, iron and copper give a beneficial impact in plant growth. The highest value of nitrogen is 150.2 kg hec^{-1}. The highest value of phosphorus is 280.7 kg hec^{-1}. The highest value of potassium is 624.7 kg hec^{-1}. Mg element is a necessary element for the augmentation of the plant. The proportion of calcium to magnesium present in the soil is a key factor in determining the presence of nutrients[4]. If the quantity of magnesium is more than the amount of calcium in the soil, plant growth can be severely affected. The quantity of replaceable Ca is an important factor while classifying the soil. Presence of Ca triggers the root elongation and influences the uptake of another nutrient. The relative amount of Ca and Mg is important in determining nutrient accessibility. But results had been favoring the growth as Ca and Mg present in MSW is 150.2 and 100.3 ppm. 5.3 ppm Zn helps to create ethanoic acid within the root to stop putrefaction. The component Fe was found 25.2 ppm that acts as a cofactor in haemoprotein and as a catalyst in the photosynthesis process. In this approach, the extract of MSW was helpful for dicotyledon seeds germination and seedling growth. Cu is significant micronutrient and its insufficiency can cause stunting of growth in plant. Therefore it is essential for plant growth[6]. The presence of Cu in MSW was 11.5 ppm. Mn may be a vital constituent for various metabolic proteins like malic dehydrogenize and oxalosuccinic decarboxylase enzyme[3]. Its quantity in MSW is 16.7 ppm.

Table 1. Physico-chemical characteristics of MSW

Physical parameters					
Temperature (°C)	Moisture (%)	pH	EC (dS/m)	Salinity (g/kg)	–
30.0	20.5	7.9	0.32	0.42	–
Chemical parameters					
Macronutrients	N (kg hec^{-1})	P (kg hec^{-1})	K (kg hec^{-1})	Ca (ppm)	Mg (ppm)
	150.2	280.7	624.7	150.2	100.3
Micronutrients (ppm)	Zn	Fe	Cu	Mn	–
	5.3	25.2	11.5	16.7	–

Germination rate:

The after-effect of the level of germination appeared in Fig. 1. The germination rate contrasts among various concentrates of MSW created bigger plantlet in correlation with the reference. Investigated result indicates that the groundnut seed has been germinated within 72 and 96 hrs in 25% and 30% MSW concentrate. Concentrates of MSW were powerful for seed germination[9,10].

Level of relative seed germination:

The consequence of the percentage of RSG is expressed in the Fig. 2. The percentage of RSG is very high in groundnut sample at extract of 30% MSW at the time duration of 96 h. The higher value of RSG% indicates that these species of seeds showing better relative growth rate due to supply of nutrients from the extracts. The high potential relative development rate is seen when developing in ideal development conditions and the level of decrease of relative growth rate in an imperfect situation[2].

Level of relative root development:

The outcome of the RRG% is appeared in the Fig. 3. The maximum value of RRG was achieved in the percentage of 25 and 30% extract of MSW at 96 h. Extract of MSW dominates for groundnut seed root growth[8,9].

Germination index:

Germination index (GI%) is revealed in Fig. 4. Germination index is the responsive feature which indicates the toxicity and level of full growth of compost[8,9]. Investigations were done at different time intervals like 24, 48, 72 and 96 h. Best result of GI% was seen in 25% and 30% extracts of MSW at 72 and 96 h. So these extracts of MSW are very suitable for groundnut seed. The highest GI value show best seed quality.

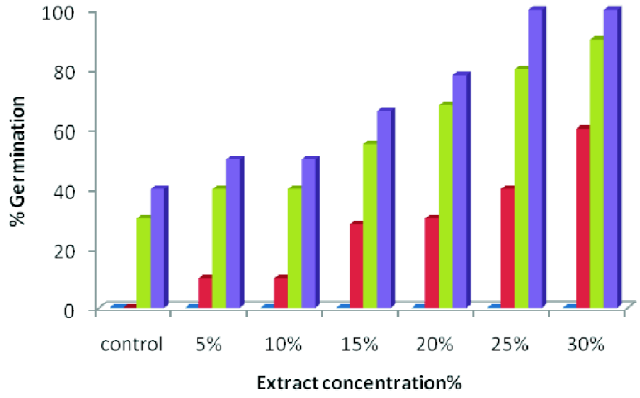

Fig. 1. Germination rate of groundnut seed in MSW extract.

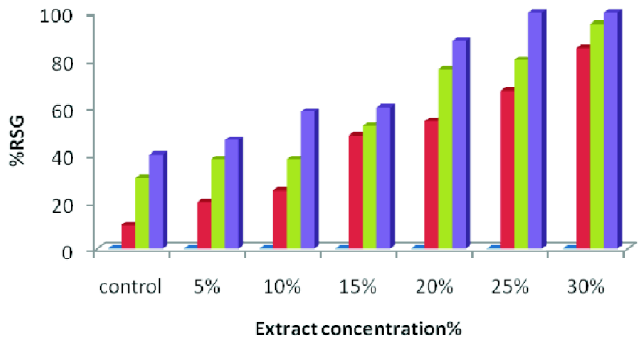

Fig. 2. Relative seed germination% of groundnut seed in MSW extract.

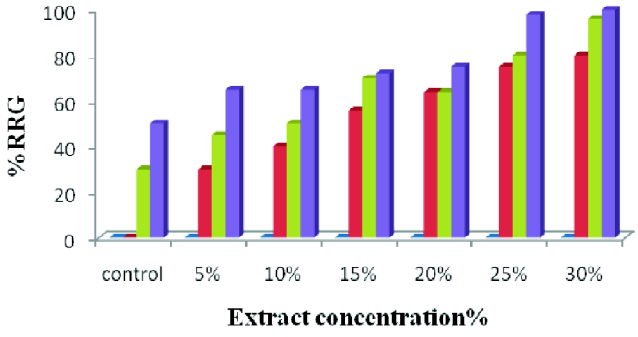

Fig. 3. Relative root growth% of groundnut seed in MSW extract.

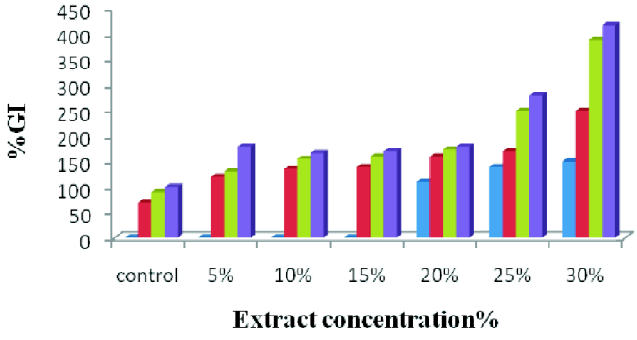

Fig. 4. Germination index% of groundnut seed in MSW extract.

Color code of bar for Figs. 1, 2, 3 and 4 are common and listed below: Blue colour bar - 24 h, Red colour bar - 48 h, Green colour bar - 72 h and Violet colour bar - 96 h.

Conclusions

This experimental study shows that due to the impact of extract of MSW, the groundnut seeds have different growth rates. The percentage of germination, RSG%, RRG%, and GI% values have increased by using 25% and 30% extract of MSW for groundnut seeds. This shows that the extracts of MSW can be valuable medium for the seed augmentation.

References

1. Daniel Hoornweq and Perinaz Bhada-Tata, "Urban Development & Local Government Unit, World Bank", 2012, 1-271.
2. Marta Dominguez and Remigio Paradelo Nunez, *Int. J. Rec. Org. Waste Agri.,* 2019, **8(2)**, 171.
3. Anchal Sharma, Rajiv Gangly and Ashok Kumar Gupta, *Int. J. Rec. Org. Waste Agri.*, 2019, **8**, 197.
4. R. Rana, R. Gangly and A. K. Gupta, *J. Mater Cycl. Waste Manage*., 2018, **20**, 678.
5. Alessandra Cesaro and Anna Conte, *J. Env. Mang.*, 2019, **232**, 264.
6. Hiarhi Monda and Vincenza Cozzolino, *Sci. Total Environ.*, 2017, 590.
7. Muhammad Khalid Iqbal, *Soil Productivity Enhancement, Intech Open*, 2018, **3**, 35.
8. Nisha Gupta and Manisha Agrawal, *Int. J. Res. Form. Appl. & Nat. Sci.*, 2014, **8**, 51.
9. Nisha Gupta and Manisha Agrawal, *Int. J. Sci. Eng.,* 2014, **3**, 1418.