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Assessment of Impact of Bat Guano on the Growth of *Zea mays*

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ABSTRACT

There is an increasing demand for organic fertilizers due to the harmful effects of chemical fertilizers on the soil as well as human health. The overuse of chemical fertilizers has hardened the soil, decreased fertility, strengthened pesticides, polluted air and water and thereby bringing hazards to human health and environment. Therefore, in modern agricultural practices, the chemical fertilizers are now replacing by organic fertilizers. Bat guano is not known to the farmers due to very few works is done on its plant promoting properties. Therefore, present study was undertaken to study its effect on the growth of *Zea mays*. The pot experiment was conducted in the laboratory. This study is mainly concern with the bat guano of Indian flying fox, *Pteropus medius*, which is collected from the roosting colonies and used in different quantities (soil: guano ratio- 20:1, 20:2, 20:3) and two types of soil (Autoclaved and Non-autoclaved). The plant growth study indicated that, there is increase in shoot and root length at soil: guano ratio of 20:2 for both autoclaved and non-autoclaved soil. The biomass was also better at the same ratio.

***Key words*:** Assessment, Impact, Bat guano, Growth, *Zea mays*

In traditional agricultural practices, the farmers were used organic fertilizers which include dung and urine of cattle, sheep manure, chicken manure, night soil, composted agricultural wastes, etc. But due to the ever-increasing demand of food, the organic manure replaced by chemical fertilizers. Excessive uses of chemicals have several adverse effects on agriculture as well as human health. Though chemical fertilizers increase crop production; their overuse has hardened the soil, decreased fertility, strengthened pesticides, polluted air and water, and released greenhouse gases, thereby bringing hazards to human health and environment as well. Excessive use of the chemical fertilizers depletes essential soil nutrients and minerals that are naturally found in fertile soil. In order to defeat the hazard of chemical fertilizers, modern farmers once again practicing to the organic farming techniques and application of organic manure has been suggested [2], [11-12], [14]. Application of vermicompost to improve soil fertility is becoming more popular but very little is known about the application of bat guano as organic manure [7].

Bat guano is the fecal matter of bats rich in nitrogen, carbon, vital minerals and of course beneficial microorganisms. Chemical properties and the microbes in the guano enrich the soil fertility and the texture and the microbes help to clear any toxins in the soil, control the fungi and nematodes in the soil [12]. Bat guano had also reported to contain useful fungi and bacteria, which act as a natural fungicide to protect plants from diseases. Bacteria and fungi play key role to maintain soil health. Bacteria are necessary for plant growth on new fresh sediments. Bacteria are useful in fixation of atmospheric nitrogen and carbon, produce organic matter and other nutrients to begin nitrogen cycling process in the soil [10]. These properties of the guano again depend upon the bat species, location and age of the guano. The bat guano has so many important properties, but it not so popular among the farmers. Since bat guano has more scope in agriculture, the present investigation was undertaken to assess the impact of bat guano on the growth of maize (*Zea mays*).

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MATERIALS AND METHODS

The bat guano was collected from the colonies of bat dwelling on the tress in the Masur village of Karad Taluka of Satara District, Maharashtra (India). These colonies were of Indian flying fox, *Pteropus medius*, which is nocturnal and feeds mainly on ripe fruits, such as banyan, mangoes, chikkus, bananas, and nectar. Colony comprises of 100-140 individual and it is surrounded by different tress, agricultural land and water bodies. The bat guano deposited beneath the roosting colony was collected for the plant growth study.

To study the effect of guano on plant growth black soil was collected from 40 cm depth. One half of the soil collected was autoclaved. 200g of each soil type (autoclaved and non-autoclaved) was mixed with guano in different ratios in plastic pots. The treatments included:

T_1- autoclaved soil (control); T_2, T_3, T_4-autoclaved soil + bat guano (20:1, 20:2, 20:3) respectively; T_5-non- autoclaved soil (control); T_6, T_7, T_8- non-autoclaved soil + bat guano (20:1, 20:2, 20:3) respectively. All the treatments were taken in three sets. Maize (*Zea mays*) seeds were used as test seeds to study the impact of guano on its growth. Seeds were soaked in tap water up to eight hours. Water was drained and the seeds were permitted to germinate overnight on wet cloth. Two germinated maize seeds were sown separately per treatment and allowed to grow in laboratory conditions. The pots were watered with distilled water per day until harvest (15 days). On uprooting the seedlings shoot and root lengths were noted. Plants were oven dried at 80^0C until constant weight was obtained to find out the dry weight (biomass).

RESULTS AND DISCUSSION

The guano collected from roosting colonies of flying fox consists of blackish brown and grey elongated pellets measuring 1–1.5 × 0.4– 0.7 cm. Fecal pellets containing the seeds of banyan, guava and some unidentified seeds.

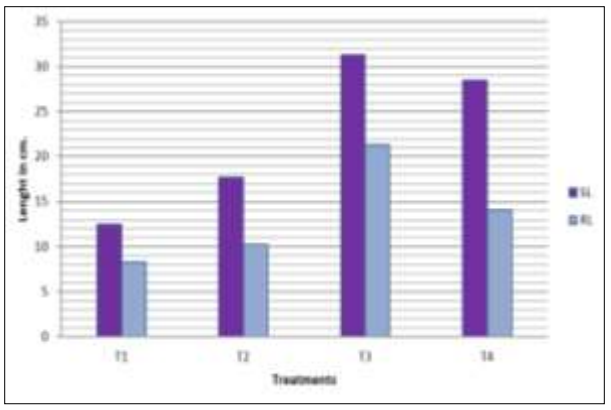

Fig 1 Shoot length (SL) and root length (RL) of maize seedlings in autoclaved soil + Bat guano. T_1- autoclaved soil (control); T_2, T_3, T_4- autoclaved soil + Bat guano (20:1, 20:2, 20:3)

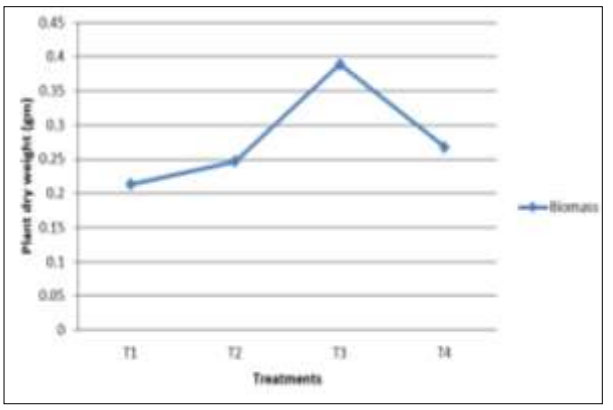

Fig 2 Dry weight (biomass) of maize seedlings in autoclaved soil + Bat guano. T_1- autoclaved soil (control); T_2, T_3, T_4- autoclaved soil + Bat guano (20:1, 20:2, 20:3)

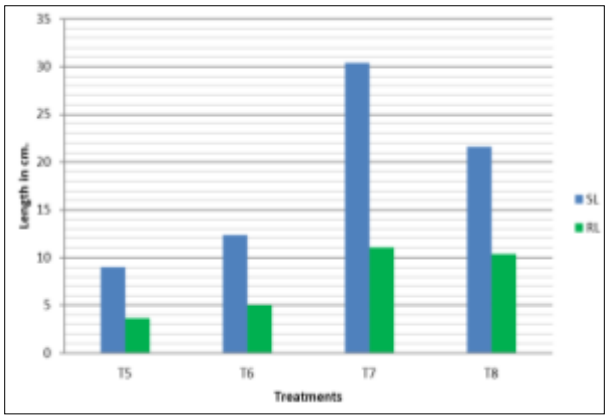

Fig 3 Shoot length (SL) and root length (RL) of maize seedlings in non-autoclaved soil + Bat guano. T_5-autoclaved soil (control); T_6, T_7, T_8 non-autoclaved soil + Bat guano (20:1, 20:2, 20:3)

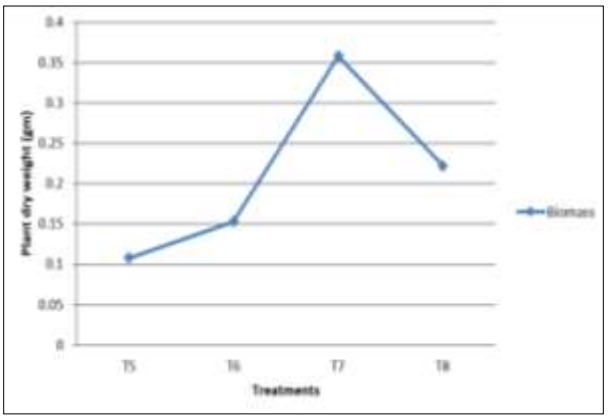

Fig 2 Dry weight (biomass) of maize seedlings in non-autoclaved soil + Bat guano. T_5- non-autoclaved soil (control); T_6, T_7, T_8- non-autoclaved soil + Bat guano (20:1, 20:2, 20:3)

Plant growth study of *Zea mays* in terms of its shoot and root length and biomass using bat guano in different ratios is given in the (Fig 1-4). Soil amendment with bat guano from (T_2, T_3, T_4 and T_6, T_7, T_8) gave better results than controls, T_1 (autoclaved soil) and T_5 (non-autoclaved soil). Also, T_3 (autoclaved soil+ bat guano, 20:2) and T_7 (non-autoclaved soil + bat guano, 20:2) gave the best growth in shoot length and biomass. The production of biomass in T_2, T_3, T_4, T_6, T_7, T_8 was better than the controls T_1 and T_5 respectively. Autoclaved soil amended with bat guano showed better growth of *Zea mays* when compared to non-autoclaved soil.

The fertilizer used in this study is the bat guano collected from the roosting colonies in the Masur village of Satara district, Maharashtra. The study was carried out in the laboratory. The aim of the investigation was to study the bat guano applications in the growth of crops and at which proportion they enhance the growth. Two broad categories of bat guano based on NPK ratios as high phosphorus guano (3:13:4 - 4:30:4) from frugivorous bats and high nitrogen guano (8:4:1- 13:3:3) from insectivorous bats [7]. In agriculture and horticulture, bat guano is reported to be useful in a number of ways, such as fertilizer material due to high contents of nitrogen (N) and phosphorous (P) [5-6], soil building material, fungicide, control of nematocide as well as compost inoculants [1], [4], [8]. It has been also reported that bat guano have pH (water) values of 4-5.6 a range which could allow it to work as a soil conditioner for calcareous soils and thus improving both nutrient supply and rhizosphere environment [7], [13]. The contents of bat guano is depend upon various factors including the geographical location where the bats and guano is found, bat species, guano age, type and form of caves where bats live and type of diet taken by bats [3], [9].

The effect of bat guano on the growth of *Vigna radiata* seedlings using *Megaderma lyra* guano from two different geographical locations (Yennehole and Varanga) in different quantities (soil: guano; 20:1, 20:0.5, 20:0.1) and in two types of soil (Autoclaved and Non-autoclaved) and reported that guano from Yennehole was found to be better as manure compared to that from Varanga and likewise bat guano was required in a very small quantity to increase the efficiency of plant growth [12].

The present study was carried out at quantities of soil: guano ratio (20:1, 20:2, 20:3) indicating that guano is useful for better crop production. Soil amendment with bat guano from (T_2, T_3, T_4 and T_6, T_7, T_8) showed better results than controls, T_1 (autoclaved soil) and T_5 (non-autoclaved soil). Also, T_3 (autoclaved soil+ bat guano, 20:2) and T_7 (non-autoclaved soil+ bat guano, 20:2) shown the best growth in shoot length and biomass. The production of biomass in T_2, T_3, T_4, T_6, T_7, T_8 was better than the controls T_1 and T_5 respectively. Autoclaved soil mixed with bat guano showed better growth of *Zea mays* when compared to non-autoclaved soil. It is also found that the bat guano increased the biomass significantly. Likewise amending the guano with farm yard manure in appropriate ratios may help overcome the nutrient deficiencies to improve crop production [7].

In the present investigation the autoclaved soil was used to remove the soil microorganisms and study the plant growth effect. It was recorded that even the autoclaved soil mixed with the bat guano showed best growth at soil: guano (20:2) ratio indicating that the bat guano contained plant growth promoting microorganisms along with necessary nutrients. Thus, bat guano can be used as a biofertilizer due to their rich composition of nutrients and microbial flora.

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CONCLUSION

The present study was carried out to assess the effect of bat guano of Indian Flying fox, *Pteropus medius* on the growth of *Zea mays* seedlings in different quantities and in two types of soil i.e., autoclaved and non-autoclaved. The results indicated that soil amendment with bat guano showed better results than controls in both soil types i.e., autoclaved and non-autoclaved. Also, there was best growth in shoot length and biomass at soil: guano ratio 20:2. The production of biomass in experimental seedlings was better than the controls. Autoclaved soil mixed with bat guano showed better growth of *Zea mays* when compared to non-autoclaved soil.

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