Theme 1
Status and trends of global soil nutrient budget

Innovating Organic Fenugreek (*Trigonella foenum-graecum*) Cultivation Using a Unique Locally Produced Liquid Biofertilizer

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INTRODUCTION

Soils play a critical foundational role in agriculture production. Yet, the soils of Kuwait are sandy and infertile. Kuwait is hyper-arid and arable land and water scarce country. Open field agriculture is focused on forage production and vegetables (conventional & organic) are grown in greenhouses. In organic farming (OF) organic fertilizers add organic matter, nutrients, heavy metals and salts. The use of liquid biofertilizer (LBF) in OF is limited due to high cost and unavailability. The LBF contains living cells of efficient strains of microorganisms (bacteria, fungi, actinomycetes etc), that help crop plants' uptake of nutrients by their interactions in the root zone. The objectives of this paper are; i) to develop a LBF locally and; ii) innovate organic fenugreek cultivation in greenhouse (GH).

METHODOLOGY

A pilot scale LBF (10 L batch) was prepared aerobically using compost to extract nutrients, acids and grow microbial population in water by using molasses/oat meal as energy source for the growth of microbes and fungi, and Kelp (containing cytokinins and Auxins growth stimulant) over an optimized brewing time of 16 hours.

To test the efficacy of LBF a pot (surface area 227 cm²) experiment was conducted to grow fenugreek in the GH (29 Sept - 15 Nov 2021) using native desert sandy soil (*Typic torripsamments*). The lower half of six pots was filled with 2.5 kg native sandy soil/pot, the upper half was filled with the mixture of 1.5 kg soil and 68 grams compost/pot (@ 3kg/m² a standard farmer practice.

No chemical fertilizer was used. Twenty-five seeds were placed in each pot at 0.5 cm depth. All seeds were germinated within 2 days. The reference evapotranspiration (ETo) was measured in the greenhouse using an evaporation pan. The pots were irrigated every 2nd day based on the cumulated ETo for 2 days. Three pots were irrigated with fresh water (T1-control) and 3 pots were irrigated with 1:9 (LBF : water) (T2) based on ETo measured in the greenhouse.

RESULTS

At the start of LBF production the initial electrical conductivity (EC) of the fresh water was 200 µS/cm, which increased to 1,321 µS/cm after 30 minutes, 2,930 after 4 hours and to a maximum of 3,580 µS/cm after 16 hrs. The pH of the fresh water (8.14) was decreased (3.56) after 16 hrs. Similar phenomenon of pH decrease has also been reported earlier (Islam et al., 2016) where he reported decrease of pH from 8.8 to 8.1 during the incubation and storage time.

The fresh biomass per pot (average of 3 pots) was 16.3 g (T_1) and 26.1 g (T_2), a significant increase of 59.3% with LBF (figs. 1 & 2). Average fresh weight of roots/pot was 5.37 g and 10.93 g for T_1 and T_2 respectively (100% increase). Similarly, an average 29% increase/plant length was recorded in T_2 (26.9 cm) over T_1 (20.9 cm). The root/shoot was increased significantly in T_2 over T_1. No disease was observed.

Fig. 1: Comparison of fenugreek growth without (left) and with the use of LBF (right)

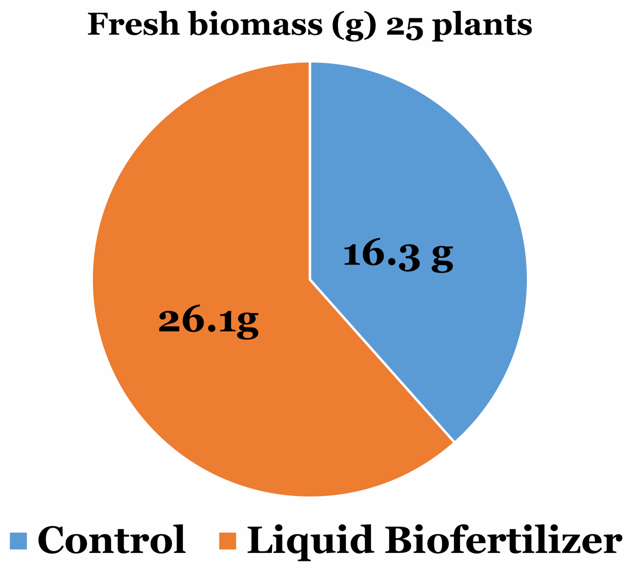

Fig. 2: Effect of liquid biofertilizer on the fresh biomass of Fenugreek (*Trigonella foenum-graecum*) in greenhouse trial

DISCUSSION

The increase of EC during the production of LBF is due to the release of electrolytes, nutrients and organic acids. The pH is decreased due to the release of humic, fulvic acids and microbial growth. This process can be further explained by the fact that the CO_2 produced by microbial activities dissolved in LBF forming carbonic acid, which is a weak acid, thus resulting decrease of pH over time (Zumdahl, 1993), as well as due to the release of other organic acids.

The positive effects of LBF has been found in the form of increased above and belowground biomass.

The increase in plant growth parameters is due to the presence of organic acids, growth stimulants, nutrients and lower pH of LBF relative to fresh water. The lower pH can increase the release of fixed soil nutrients (P, Fe, Cu, Mn, Zn) in soil. The enhanced mineralization of compost in the pots due to LBF may be another factor. All these factors have contributed to intensify organically grown FN-greens production.

The LBF can be used in various ways, i) seed inoculation, ii) soil drenching (direct application to soil bed), iii) foliar application (Noble and Coventry, 2005), and iv) to inoculate the carrier for either use in soil directly or used for the production of engineered biofertilizerrs (EBFs) using various materials.

CONCLUSIONS

Significant increase in fresh biomass, root growth and plant length with LBF has shown great promise to further this preliminary research on other strategic vegetable crops strategically grown organically in Kuwait.

The production of LBF can be up-scaled for use in open-field and greenhouse vegetables production. However, it is recommended to investigate LBF further on other organically grown vegetables before upscaling in open-field and greenhouse conditions.

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