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BIOFILM BIOFERTILIZER APPLICATION CAN INCREASE SOIL CARBON CONTENT IN TEA CULTIVATION

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Summary

Excessive use of chemical fertilizers (CF) for a long period of time depletes soil organic carbon (SOC) in cultivated lands. However, application of Biofilm biofertilizer (BFBF) could address this issue. Thus, the current study focused on the effect of BFBF on the build-up of SOC under reduced application of inorganic fertilizers in tea cultivated soil. A field experiment was conducted for one year using two treatments viz. 100% CF (TRI recommendation) and 50% CF + BFBF (BFBF practice), each having three replicates. Soil samples were collected from 10 to 15 cm depth and SOC was measured using a standard method. Results indicated significant improvement of SOC with the BFBF practice over 100% CF ($P<0.05$), showing restoration of SOC in tea cultivation.

Keywords: Biofilm biofertilizer, Chemical fertilizer, Soil organic carbon, Tea

Introduction

Fertility of a soil can be improved by using various chemical fertilizers (CFs) and agricultural practices. However, long term excessive use of CFs on cultivated lands leads to depletion of the soil fertility and crop production (Cambardella and Elliott, 1993). Moreover, it leads to suppression of soil microbial activities and the development of microbial communities. Biofertilizers, an alternate solution for CF, consist of live formulates of beneficial microorganisms such as fungi, bacteria, algae, which can be used as a single or multiple species to increase soil health. Among biofertilizers, more efficient Biofilm biofertilizer (BFBF) which consist of microbial communities and extra polymeric substances play a major role in soil processes. BFBFs are a collection of microbial communities of rhizobacteria attached to a fungal surface including N_2 fixers, supplying N_2 through biological fixation for the root system of the plant. In return, plant root may provide root exudate carbon sources to the fungal component of the BFBF, where can be found on root surface and rhizosphere (Seneviratne at el., 2009; Seneviratne et al., 2011). These biofertilizers once applied to crop soil have shown beneficial effects such as increased nutrient availability and plant growth hormone production (Seneviratne et al., 2008). They have shown the potential of replacing CF up to 50% and also ability of reducing agrochemical uses in many crops including rice, tea and rubber, together with yield increases up to 20-40%. Present study focused to highlight the effect of BFBF on SOC availability under CF reduction by 50% in tea cultivation.

Materials and methods

A field experiment was conducted at Thalawakelle using two treatments, each having three replicates in 6 x 4 m plots arranged in RCBD for one year. The treatments were 100% CF recommended for tea by the TRI (113 kg N ha^{-1} y^{-1} as sulphate of ammonia, 33 kg P ha^{-1} y^{-1} as rock phosphate, 69 kg K ha^{-1} y^{-1} as muriate of potash and 20 kg Mg ha^{-1} y^{-1} as kieserite and 1.6 kg Zn ha^{-1} y^{-1} as zinc sulphate) and 50% CF + BFBF (BFBF practice: 2500 ml BFBF ha^{-1} y^{-1}). Soil samples were collected from 10 to 15 cm depth using a soil auger, six months after fertilizer application of the two treatments and soil organic carbon content was measured using air-dried, ground and sieved (< 2 mm) soil. One gram of the ground and sieved soil was measured into labelled 100 ml conical flasks. Ten milliliters of 5% potassium dichromate solution was added. Then 20 ml of H_2SO_4 was added to it carefully and allowed it to cool, and then 50 ml of 0.4% barium chloride was added. They were allowed to stand overnight and absorbance at 600 nm was taken using UV spectrophotometer (Anderson and Ingram, 1993). Data were analysed using Minitab statistical package.

Results and Discussion

Soil organic carbon content of BFBF practice was significantly higher than that of 100% CF treatment ($P<0.05$, Figure 1). This may be due to increase of soil microbes, specifically N_2 fixers with the application of BFBF together with the reduction dosage of CF. Those N_2 fixers in the root-associated biofilms fix and transfer N to the plant root (Seneviratne et al., 2009; Seneviratne et al., 2011). In return, plant roots provide carbon sources to the biofilms and associated microbes, which eventually help to build-up soil organic carbon.

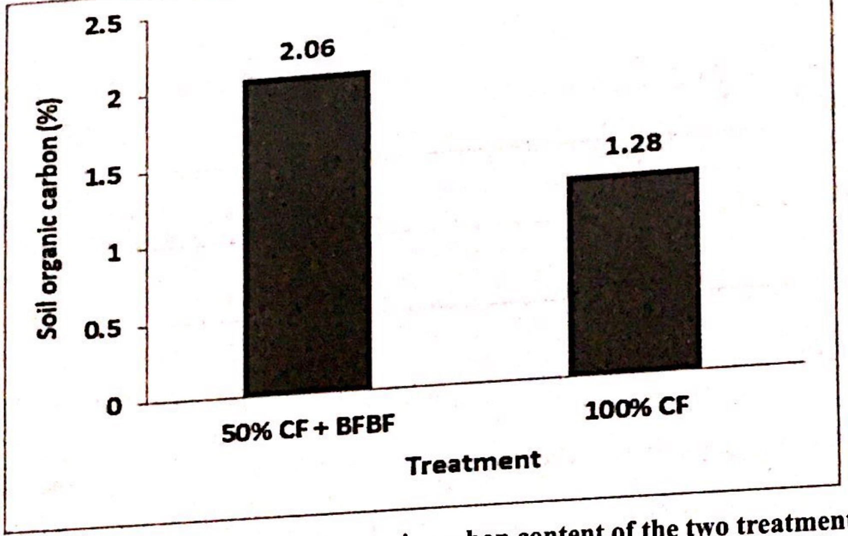

Figure 1. Comparison of soil organic carbon content of the two treatments

Conclusions

Preliminary results showed significant improvement of soil organic carbon with the BFBF practice. Thus, it could be concluded that BFBF application together with reduced dosage of CF could improve soil organic carbon concentration in tea cultivation.

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