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Comparative Study on Soil Microbes from Muthalamada Mango Farms

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Abstract: ***Use of chemical pesticide to increase crop yield, especially in high income generating crops are common all over the world. Adverse effects of chemical pesticides on humans are a well-known. Application of chemical pesticides change the bio diversity starting from agricultural field and eventually making its way to natural ecosystem. The harmful effects of pesticide are often forgot because how the agroindustry and pesticides markets generate huge incomes since it is a multibillion-dollar market. The chemical pesticide changes the bio diversity of soil, affecting earthworms, nematodes, protozoa to various microbial communities which are essential for proper functioning of ecosystems. Microbial community is essential part of soil ecosystem, they directly influence various nutrient cycles and nutritional values of soil. The use of chemical pesticides affects the natural enzymes and functioning of bacteria and inhibits the production of useful enzymes and secondary metabolites, which helps in crop yield. In this study, soil samples from three mango farms were collected and the microbial load were analyzed. The study revealed that the mango farm which adopted organic farming technique combined with need based and approved amounts of pesticides having more soil bacteria compared to very less amount of microbial load in mango farm using chemical pesticides in Muthalamada, Mango City of Kerala. Use of organic farming along with the integration of approved pesticides in a controlled manner on agriculture fields improves crop yield without any harmful effects to the environment.***
Keywords: Mango, Organic farming, Pesticides, Muthalamada.

I. INTRODUCTION

Agriculture and its importance in human life is well known especially at present where population is increasing rapidly across the world. Providing food source for such vast population is challenging because various factors greatly affect the overall production of food source such as climate change, natural calamities, global warming and its after effects, growth of invasive species, pest attack, loss of nutritional content due to heavy usage of synthetic pesticides and chemical fertilizers (Hawkes and Ruel et al: 2006). Horticulture is one of the highest revenue generating fields through exporting. Horticulture also has high employment potential (Angrist, J D, and A B Krueger: (2001). It is a well-known fact that India is the largest producer of mango in the world (40%), followed by China and Thailand. In 2012–13, the area under mango cultivation accounted for 36% of the total area under fruit production, and the quantity produced was about 22.1% of the total fruit production of India, due to the high demand in export of mangoes and the pulp of mangoes, although mango fields face lots of challenges fruit flies and mango seed weevil and two primary diseases (powdery mildew and anthracnose) (Griesbach et. al:2003). The major loss faced by mango farmers in India is fruit fly infestation cause major loss to mango production (Ekesi *et al*. 2014). To overcome these challenges and to boost production farmers use pesticides, chemical fertilizers, inject hormones, although they show immediate results such as effective pest control, increased yield, resistance to high temperatures or other environmental factors, but the environmental impact these pesticides were high since they pollute soil as well as water sources, affects both soil and water bio diversity significantly by killing bees, birds, amphibians, fish, and small mammals. (Köhler and Triebskorn 2013: Paoli et al. 2015; WHO 2017). They affect humans from the workers of the farms to their family to local residents who are unintentionally intoxicated by chemical pesticides such as synthetic pesticides which is estimated to kill 3,55,000 people globally each year due to non-scientific usage and continuous exposure to such harmful pesticides (WHO 1990, 2012, Alavanja 2009; Alavanja and Bonner 2012).

Microflora of soil is one of the most important factors which regulates various cycles that determines the soil quality. Amount of microflora is directly linked with degradation capacity of chemicals in the soil and they regulate and store various nutrients, produce enzymes and metabolites required to degrade heavy metals and chemical compounds (Voos G and Groffman PM et.al:1997). Use of pesticides affect the normal microflora of soil samples affecting its normal biological functioning. Chemicals present in different types of pesticides would affect them adversely, in fact microbial bio mass in soil could be used as a good indicator to check the nutritional health of soil (Schloter M et.al:2003). Usage of pesticide eliminates essential bacterial or fungal bio-mass leading to elimination of competitive microbes and eventually changing the balance of soil ecosystem (Sarfraz Hussain et.al:2009). Over usage of pesticides without scientific knowledge leads to the deterioration of non-target organisms.

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Understanding the importance of soil micro flora will enable us to learn deeply about soil eco system which could be effectively utilized in agricultural practices. Combined use of organic farming and use of safe amounts of government approved pesticides will help to maintain the microbial diversity of soil. The organic farming technique will enhance the microbial load and helps in preventing loss of bio-diversity and keeping the natural cycles running, reducing negative effects such nutrient leakage and soil degradation from chemical pesticides or fertilizers (Affaires PD et.al: 2014). In this study we compare the differences in microbial load of soil samples collected from three mango farms which practiced different agricultural practices regarding pesticide usage from Muthalamada, Palakkad, Kerala known as "Mango city of Kerala". The soil from mango field adopted organic farming, mango farm using chemical pesticides and mango field where there is no usage of pesticide or organic farming techniques collected and enumerated of bacteria to evaluate the how different agricultural practices affect microbial communities of soil.

II. MATERIALS AND METHODS

A. *Sample Collection*

1) *Sampling Site:* All the soil sample needed for study were collected from Mango farms of Muthalamada panchayath, Kollengode Taluk, Palakkad District, Kerala, Latitude 10.6358° N, Longitude 76.7987° E. Mango orchards spread in 10,000 hectares of land in this grama panchayat sharing borders with Tamilnadu. Muthalamada is the one of the biggest centres of mango production in the country and first to reach global markets much before the mangoes mature in the gardens of the competitors (Arun S & A L Kamalavalli 2016).

2) *Collection of Soil Sample:* Three soil samples were collected from three different orchards. Top soil from the location were collected in sterile Ziplock bags with proper labels and sealed immediately and transferred to laboratory for study of enumeration of bacteria. Soil sample one was collected from Mango farm at Mechira, mango trees were being cultivated here for more than 35 years. The important mango varieties cultivated and exported from Mechira mango farm include Imampasanth, Alphonsa and Sindhooram. Use of pesticides over the year have been confirmed by the farmer and mango production was found to decreased over the years. Soil Sample two was collected from mango farm at Adavumaram, mango trees are cultivating for 16 years. The important mango varieties include Alphonsa, Sindhooram and Benganapalli. A Wide varieties of grafted mango trees are used for production, this mango farm adopts organic cultivation with controlled use of pesticides on need to basis and government approved as safe to eat mangoes, having good yield over years confirmed the farmer. Sample three was taken as from a field of Kuttipadam. In this farm no pesticides were used and no specific farming practices were adopted. The trees were allowed to grow naturally without any additional maintenance. The mango varieties cultivated are Alphonsa, Sindhooram , Benganapalli and Aapoos.

B. *Enumeration of Bacteria from Soil Samples*

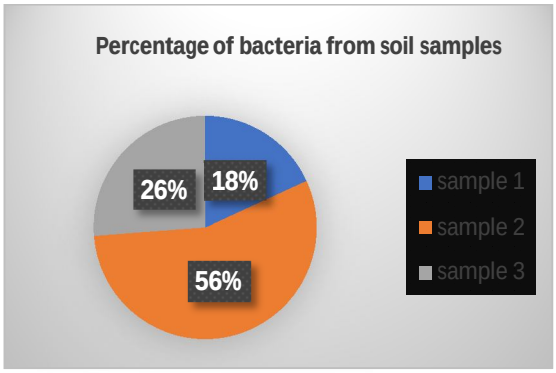
Enumeration of bacteria was carried out by spread plate method; by inoculating 0.1 ml of serially diluted samples to nutrient agar plate and evenly spreading using a sterile L rod. The dilutions taken were (10^{-3},10^{-4},10^{-5}). The inoculated nutrient agar plates were incubated at 37°C for 24 hours. The number of colonies were calculated and expressed as colony forming units per gram of soil (CFUg- 1).

Table 1. Bacterial Population in soil samples from various mango farms

Soil Sample	Location of the Mango Farm in Muthalamada Panchayath	No.Of CFU/g (dilution 10^{-5})	Number of colonies with colony morphology
1	Mechira	90 X 10^5	3
2	Adavumaram	276 X 10^5	12
3	Kuttipadam	130 X 10^5	7

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Graph 1. Percentage of soil bacterial populations from Mango farms of Muthalamada.



III. RESULTS

Wide difference in number and types of bacteria were observed from the 3 different soils tested. Sample 1 had a smaller percentage (18%) of bacterial colonies when comparing to sample 2 (56%) and sample 3(26%). Use of pesticides is more in this field and hence the decrease in the number of bacterial colonies after enumeration indicates that the use of pesticides affects the microbial population of soil directly. Sample 2 (56%) had a greater number of bacterial isolates after 24 hours incubation indicating the benefits of organic farming in keeping soil biodiversity and microorganisms intact which will be beneficial in keeping the nutrient cycles running which directly affects the crop yields, the types of organism seen in sample two was also more indicating the organic farming is favourable for different types of organisms to grow together. Sample 3 (26%) had more bacterial isolates than sample 1 (18%) and less than the sample 2 (56%) which is expected because the fields have also not used any sorts of pesticides and have only had leaves and debris fall and decay on them.



Fig 1. Nutrient Agar plate with bacterial colonies from different soil samples

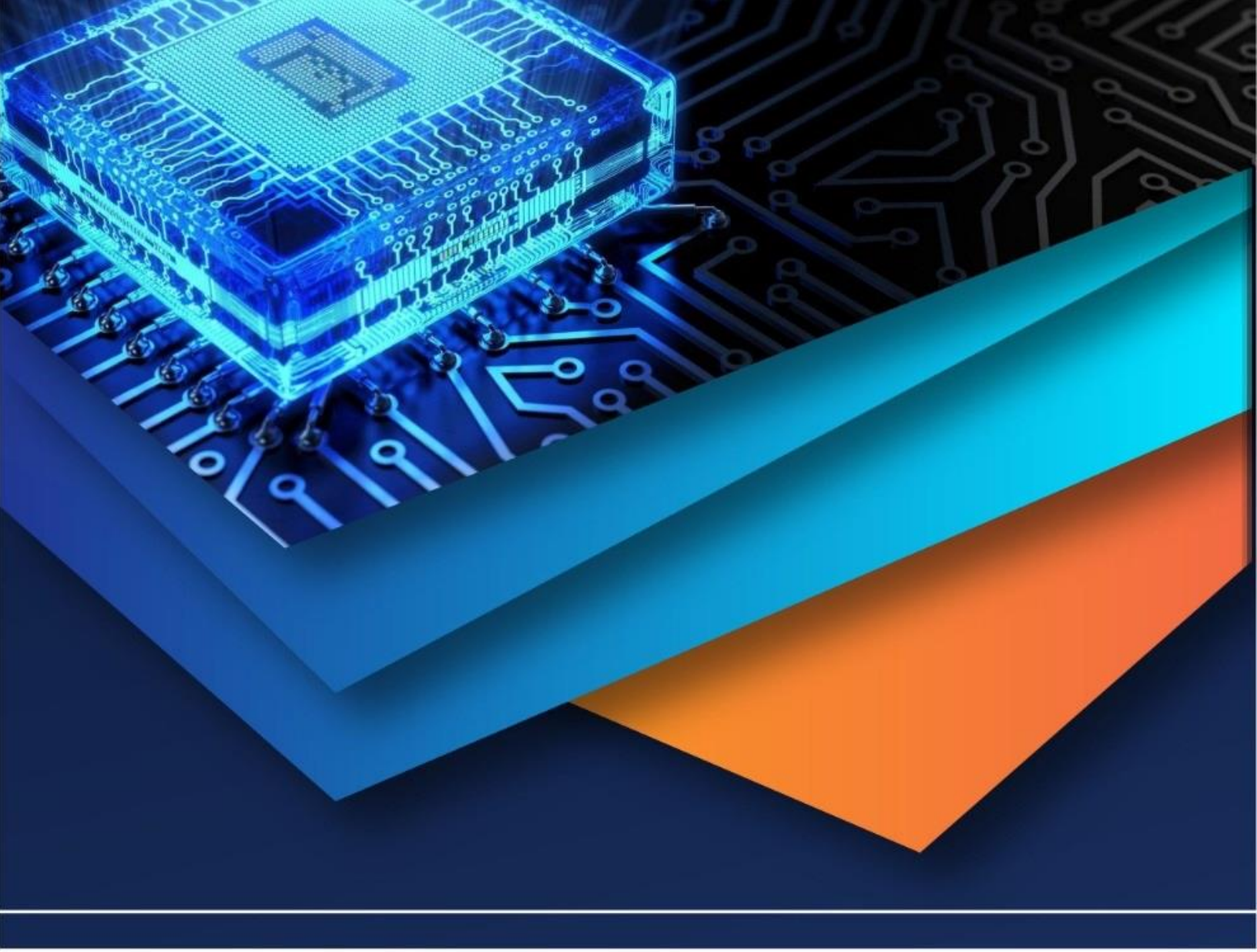
IV. DISCUSSION

Organic farming utilizes soil microbes itself to increase plant health, increase production. Different types of soil microbes and soil fauna helps in maintaining the nutrient cycles running and keeps the soil healthy. In this study we can see that the mango farm with organic farming practices have a greater number of bacteria as well as different types of bacteria. Microbes change soil properties drastically improving constantly and maintain the available nutrients for plant uptake. Monoculture agriculture, in combination with intensification and heavy chemical use, reduces the quality and biodiversity of the soil ecosystem, and this in turn will reduce productivity, runs down the resources and sustainability. (Postma-Blaauw et al., 2012). soil microbes direct influence in the productivity of plants is difficult to understand at the moment the advance in the field and expansion of studies will reveal the effect of farming practices on soil microbiota (Bünemann et al., 2006; Nelson and Spaner, 2010). Studies have shown organic farming and crop rotation could improve soil quality and thus in turn have positive effects on all aspects of soil (Pulleman et al. 2003). Organic farming improves soils, C and N values, soil respiration, mineralizable N in organically managed farms than in conventional farms and also the important factor it improves the microbial biomass (Liebig and Doran et .al (1999). Further studies and in-depth analysis of the relationship between soil microbes and crop growth are required (Kennedy et. al, 1999). This study provides the basis of comparison of microbial load between the conventional farming and use of organic farming technique in mango fields of Muthalamada.

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