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Effect of biopesticides on soil parameters

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Abstract
Cultivable soil is rich in minerals and microorganisms that support the growth and yield of crops. Recent trends of agriculture rely on usage of synthetic pesticides for restricting the growth of pests and other pathogenic microbes. Due to this practice, the fertility of the soil decreases and the microbial biomass is under threat. Using synthetic pesticides converts the pests as resistant varieties which lead to the formulation of more potent pesticides. These synthetic polymers interfere with the quality of the crops which leads to many toxic effects to human and animals. To overcome this problem, biofertilizer and biopesticides are being widely used. This study highlights the usage of biopesticides which does not alter the soil physical, chemical and microbial parameters, still protecting the crop form harmful pests and insects. The components used in the study are commonly available at low cost. Hence, this study will form a foundation as an alternative for synthetic pesticides.

Keywords: biopesticide, Soil parameters, minerals, soil microbes, IMViC

1. Introduction
Soil is a natural body consisting of layers (soil horizons) of mineral constituents of variable thicknesses, which differ from the parent materials in their morphological, physical, chemical, and mineralogical characteristics. Soil also contains minerals like potassium, phosphorous, magnesium, calcium and other organic matter which helps in the growth and development of plants. Naturally occurring microorganisms help in nitrogen fixation and other important process of the plants [1].

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. A pesticide may be a chemical substance, biological agent such as a virus or bacterium, antimicrobial, disinfectant or device used against any pest. Effect of the synthetic pesticides, may it be in the form of solid, liquid or gaseous form gets integrated into the plants resulting in accumulation of toxic substances inside the crops. When consumed by animals and human, it causes severe side effects which have the severity of even changing the genetic content of the individual. Also, usage of such synthetic pesticides reduces the soil fertility resulting in reduction of minerals and microbial content. Hence, as an alternative, biopesticides are used for crop protection and increasing the immunity of the plants [2, 3].

Bio-pesticides are receiving much practical attention as a means to reduce the load of synthetic chemical product being using to control plant diseases [4, 5]. This study is intended to determine the effect of various bio-pesticide on the microbial content as well as the mineral content soils.

2. Materials and methods
2.1 Collection and analysis of soil samples
Two different soil samples were collected for the study, one from the home garden, where there was no use of pesticides or synthetic fertilizers and the other from a paddy field of Coimbatore in which synthetic pesticides were used for more than five years. The two samples were tested for soil parameters like color, texture, graininess, oist cast, stickiness and pH as per standard protocols [6]. Chemical properties of the soil like phosphorous, potassium, nitrogen, calcium and magnesium content were determined as per standard protocol [7, 8]. Microbial content of the samples were analyzed by Gram's staining and IMViC test [9].

2.2 Preparation of bio pesticides
Commonly available products like cow urine, cow urine + neem leaf extract + cow dung (1:1:1), fermented curd were taken as biopesticide samples [10-12]. The samples were mixed with test soils in equal ratio and incubated at room temperature. The physical, chemical and microbial parameters of the incubated soils were analyzed at 4, 7, 10, 15 and 21 days of incubation.

3. Results and discussion
From the analysis of soil parameters, the following results were obtained.

Table 1: Physical Parameters of the collected soil samples

Parameters	Soil 1	Soil 2
Colour	Brown	Black
Soil texture	Medium	Clay
Graininess	Less than 50%	Less than 5%
Oist cast	Clay absent	Clay present
Stickiness	Less	More
pH	Alkaline	Highly acidic

Table 2: Chemical Parameters of the collected soil samples

Parameters	Soil 1 (nm)	Soil 2 (nm)
Phosphorus	0.20	0.20
Potassium	0.25	0.24
Nitrogen	0.30	0.28
Calcium-magnesium	0.34	0.21

From the microbial analysis and IMVic tests, five different microbial strains were identified in the soil samples. The bacterial strains identified were *Bacillus substilis, Pseudomonas fluorescens, Staphylococcus aureus, Klebsiella pneumonia* and *Camphylobacter jejuni*.

Biopesticides like cow urine extract, neem extract + cowurine+ cow dung, fermented curd were prepared as per standard procedure. The collected soil samples were mixed with these formulations and incubated. The above mentioned parameters were analyzed for the incubated soil on 4, 7, 10, 15 and 21 days of incubation. The results obtained were as follows. There was no change in the physical parameters of the soil but there was an increase in all the mineral content which can be seen from the graph.

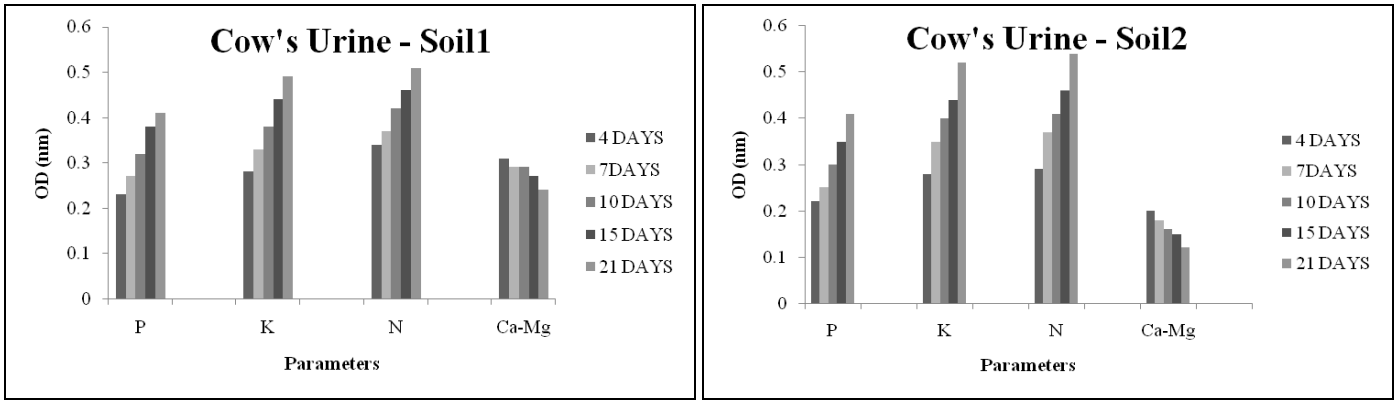

Fig 1: Mineral Content of Soil1 and Soil2 with Cow Urine

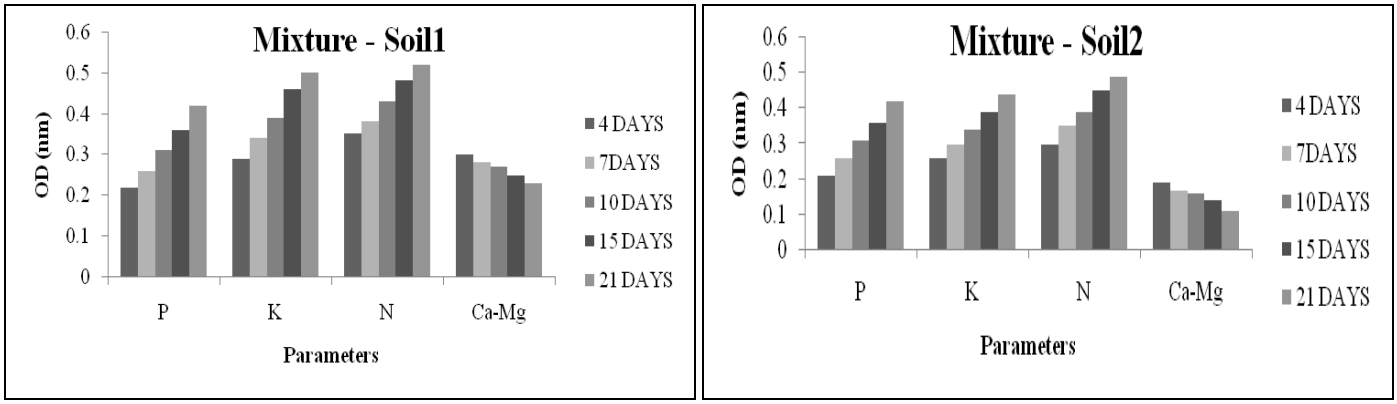

Fig 2: Mineral Content of Soil1 and Soil2 with mixture

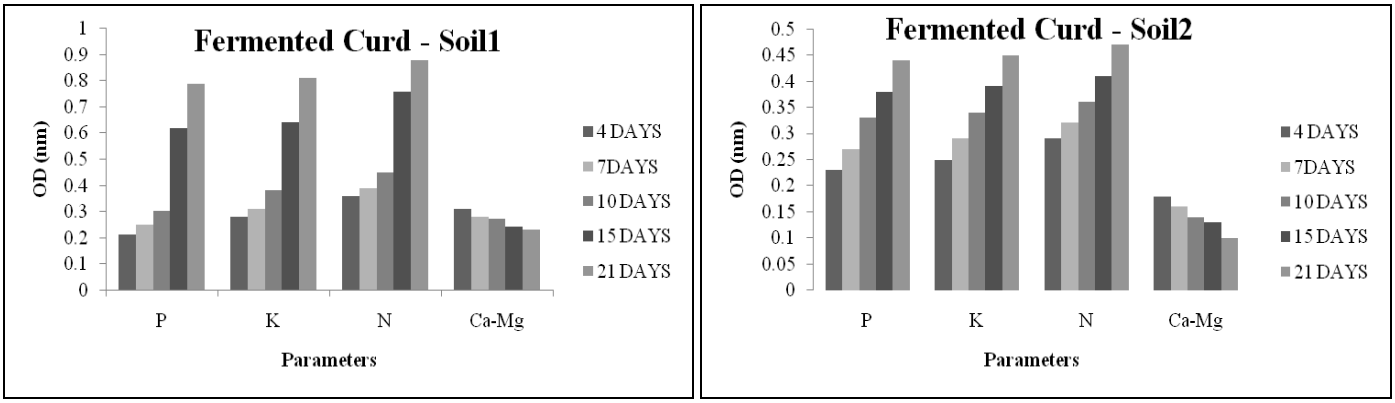

Fig 3: Mineral Content of Soil1 and Soil2 with Fermented Curd

From the above graphs, it is clear that there is an increase in the concentration of the essential minerals in the soil samples as the incubation days increased. When comparing the three biopesticides used, the mixture i. e., cow's urine + neem

extract + cow dung found to be effective in maintaining and increasing the mineral content of the soil followed by cow's urine. The fermented curd did not show any drastic increase in the mineral content, but still there was a marginal difference in the chemical composition of the soil samples. This result is in accordance with previous studies [13-15].

Analysis of microbial content of the soil showed the following results. The level of the microbial content was maintained throughout the incubation period of 21 days. In soil2 which was treated with synthetic pesticides for a longer period, the microbial content was very low, like 5 colonies/CFU; but it showed a good increase of upto 20 colonies/CFU after treating with biopesticide. Of the three formulations used, the mixture showed a reasonable effect on the microbial content of the soil samples followed by cow's urine [16, 17].

The chemical properties such as phosphorus content, potassium content, nitrogen content, calcium and magnesium content showed a great variation in which calcium and magnesium content decreased during the course of incubation. This can be verified by decrease in the growth of *Staphylococcus*, which is useful in supplying these nutrients to the plants, the microbial content of the soils were analyzed by planting the sample in selective media and the number of colonies formed were analyzed, which showed an increase as the incubation times progressed. This behavior was observed in all the four microorganism *Bacillus subtilis, Pseudomonas fluorescence, Klebisella pneumonia* and *Camphylobacter jejuni*, except for *Staphylococcus aureus* which decreased progressively [18]. The physical and chemical properties of the soil did not change to a toxic or fatal level from which it can be concluded that compared to commercial fertilizer, bio-pesticides does not produce any harm to the soil and can be utilized by the microorganism easily for their nutritional purpose [19]. Also Bio-pesticides help in enhancing the growth of microorganism which is an added advantage.

4. Conclusion

The laboratory level experiments performed in the above study found that the biopesticide formulations used for analysis were found effective in a way that they did not interfere with the physical properties of the soil, yet enhancing the microbial and chemical parameters. The study must be further extended to the field level in order to elucidate the complete effect on the crops and environment. Yet the results found in this study can be taken as a base for the formulation, usage and analysis of biopesticides without affecting the yield of the crops and soil properties [20].

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