

Coconut Leaf Vermiwash for Soil Health Improvement and Quality Yield of Vegetable Crops —Validation in Farmers' Fields

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INTRODUCTION

Vermiwash is a by-product obtained from vermi-compost production technology that can be used as a liquid organic fertilizer for improving crop growth and yield. Vermiwash production can be done basically by two methods. One method involves soaking soil + cow dung + earthworms substrate in excess water in plastic tub and siphoning the wash periodically from the bottom of the tub (Ismail, 1997) while another one involves releasing the earthworms in lukewarm water and agitating them gently so as to shock them to secrete higher amount of body fluids and mucus (Kale, 1988). This liquid organic fertilizer is rich in nutrients and plant growth hormones (Ismail, 1997) and its application has been reported to stimulate anthurium (Karuna *et al.*, 1999), increase soil nutrient status and yield of paddy (Thangavelu *et al.*, 2003), biological productivity of marigold (Sivasubramanian and Ganeshkumar, 2004), *Aloe vera* (Saha *et al.*, 2005), fruit quality of tomatoes (Zaller, 2006), yield of spinach, onion and potato (Ansari, 2008) and cowpea (Zambare *et al.*, 2008).

The Central Plantation Crops Research Institute had developed a simple farmer friendly technology for production of vermi-compost from the high lignin containing coconut leaves using an indigenous isolate of earthworm *Eudrilus* sp. (Prabhu *et al.*, 1998). The technology became popular and rapidly spread to many of the coconut producing states viz. Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra, Bihar, Orissa and West Bengal in a span of 10 years. Experiments were initiated to standardize vermiwash production as a value addition

to coconut leaf vermi-compost production technology. Vermiwash produced from actively vermi-composting substrates of coconut leaf + cow dung by *Eudrilus* sp. is clear brown liquid (Fig.25.1) possessing alkaline pH, containing major and minor nutrients, growth hormones, humic acid and plant beneficial bacteria particularly the fluorescent pseudomonads. Application of appropriately diluted coconut leaf vermiwash (CLV) increased germination and seedling vigour index of cowpea and paddy seeds in laboratory bioassays. Field trials conducted on cowpea, maize and okara in Institute farm during 2004-05 showed its capacity to enhance the biomass and yield of the crops accompanied by increase in soil microbial populations, enzyme activities and organic carbon content of soil (Gopal *et al*, 2005).

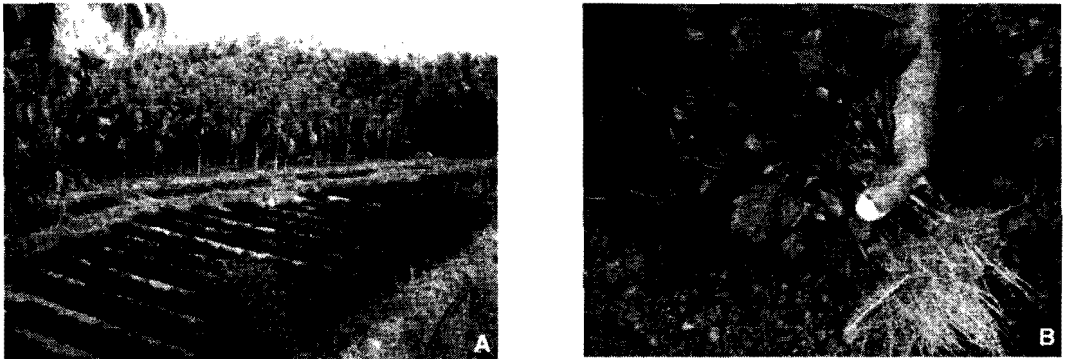


Fig. 25.1. Lush growth of amaranthus (A) with profuse production of fine root hairs (B) in the vermiwash treated plot at Edneer

To validate the results obtained in the in-house studies, field trials were initiated in collaboration with the Krishi Vigyan Kendra, Kasaragod at farmers' plots at Majal and Edneer area in Kasaragod District during 2006-2007. Two leading farmers, one from Majal and another from Edneer panchayath of Kasaragod District were selected for the field trials. Required quantities of coconut leaf vermiwash produced at CPCRI was supplied to them for application in the test crops by diluting with water at 1:5 ratio once in a week followed by regular irrigation with water. Poultry manure and neem cake was applied as basal organic inputs during field preparation followed by inorganic fertilizer (17-17-17 complex) during the middle stage of crop growth, which is the regular practice followed by farmers. This was compared with CLV treatment. Irrigation to the crops was done depending on the situation. Five rows of amaranthus, cow pea and chillies and ten pits for bitter gourd were set apart for evaluating the effect of CLV while the rest of the plots received the inorganic fertilizer application.

Soil samples were collected before the application of treatments and at the end of the experiment from all the crops at both the fields and analysed for general microbial

communities of heterotrophic bacteria, filamentous actinomycetes and fungi, and plant beneficial microbial communities of free-living nitrogen fixers, phosphate solubilizers and fluorescent pseudomonads.

The results of the yield obtained from respective vegetable crops in both the experimental locations, as recorded by the farmers, are given in Table 25.1. CLV application yielded 75kg and 200kg cow pea and bitter gourd, respectively, at farm in Majal and 55kg, 155kg and 10kg of amaranthus, cowpea and dried chillies, respectively, at Edneer farm.

Table 25.1. Yield response of vegetable crops to application of CLV (Total yield from 5 rows/10 pits)

Place	Crop	Yield(kg)	Farmer's remarks on effect of vermiwash on growth and yield quality of vegetables
Majal	Cowpea	75(81)*	Good quality of produce, better plant growth, good storage quality of the produce, softer beans
Majal	Bitter gourd	200 (218)*	Very good quality of produce, healthier look of the plants, early bearing, delayed ripening of fruits
Edneer	Amaranthus	55(59)*	Bigger leaf size, deep leaf colour, no pest and disease attack, more hairy roots, harvested plants showed wilting after longer duration
Edneer	Cowpea	155 (156)*	Better plant growth, produce was of good quality and more tastier
Edneer	Chilli(dried)	10(12)*	Rich green colour of the leaves, better plant growth, good pungency

*Yield from plots receiving Farmer's inputs of poultry manure + neem cake as basal application followed by inorganic fertilizer mix

It is clearly seen that the application of CLV produced yields on par or slightly less compared to plot receiving farmer's regular inputs of organic and inorganic fertilizers. Similarly, Mäder *et al.* (2002) reported results from a 21 year study of agronomic and ecological performance of biodynamic, bioorganic, and conventional farming systems in Central Europe. They found crop yields to be 20% lower in the organic systems, although input of fertilizer and energy was reduced by 34 to 53% and pesticide input by 97 %. Though the yield of the vegetables obtained was lower or on par compared with the farmer's inputs, yet, both the farmers had opined that application of CLV helped in production of better quality vegetables (Table 25.1). They reported that application of vermiwash produced amaranthus possessing dense root hairs, broad and tender leaves with deep colour and minimum pest and disease incidence (Fig. 25.1a and b). The crop stand of bitter gourd (Fig. 25.2a), chilli (Fig. 25.2b) and cowpea (Fig. 25.2c) was also very lush. Saha *et al.* (2005) also reported that organic source of fertilizer in the form of vermi-compost and liquid vermiwash was found to be effective and comparable with inorganic source of fertilizer in increasing content of gel moisture, gel ash and aloin in *Aloe vera*. The organic *Aloe vera* thus produced was expected to be a better marketable product. Zaller (2006) reported that foliar spraying of aqueous extracts of vermi-compost on three tomato varieties had a positive effect on the fruit qualities. It increased or decreased the peel firmness of the tomato fruit,



Fig. 25.2. Luxuriant growth and good bearing of bitter gourd at farmer's field in Majal (A) chillies (B) and cowpea (C) at Edneer

increased the fruit firmness in all the three varieties. He also reported that vermi-compost extract application had markedly reduced the incidence of *Phytophthora infestans* disease. He suggested that vermi-compost extract could be used as foliar spray for fertilization and biological disease prevention of vegetable crops. Application of vermi-compost + vermiwash diluted at different ratio with water had improved the yield and quality of spinach, onion and potato (Ansari, 2008). Production of high quality yields can also be attributed to reduced nematode damage as it had been described that CLV was able to have a deleterious effect on the juveniles of burrowing nematode, *Radopholus similis*, root-knot nematode, *Meloidogyne incognita*, root lesion nematode, *Pratylenchus coffeae* and spiral nematode, *Helicotylenchus multicinctus* which are some of the major nematode pests of crops in coconut based high-density multi species cropping system (Banu and Iyer, 2006).

Studies on soil microflora and use of enzyme activity measurements as indicators of soil functionality and thus indicators of soil quality have been extensively discussed (Nannipieri *et al.*, 2002). Application of CLV had stimulated the population of all the soil

microbial communities, particularly the plant beneficial groups of free living nitrogen fixers, phosphate solubilizers and fluorescent pseudomonads, which form an important fraction of the plant growth promoting rhizobacteria (Fig. 25.3).

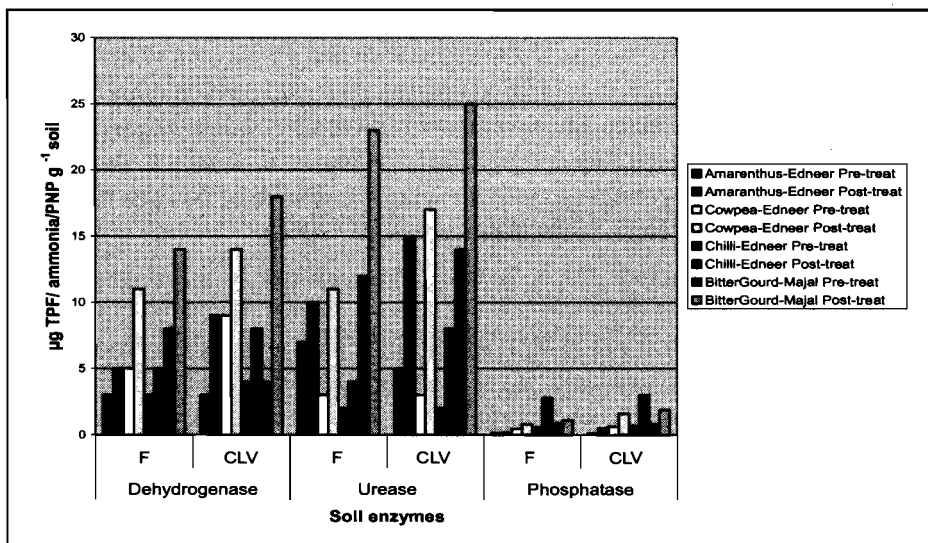


Fig. 25.3. Effect of coconut leaf vermiwash on rhizospheric microbial communities in different vegetable crops

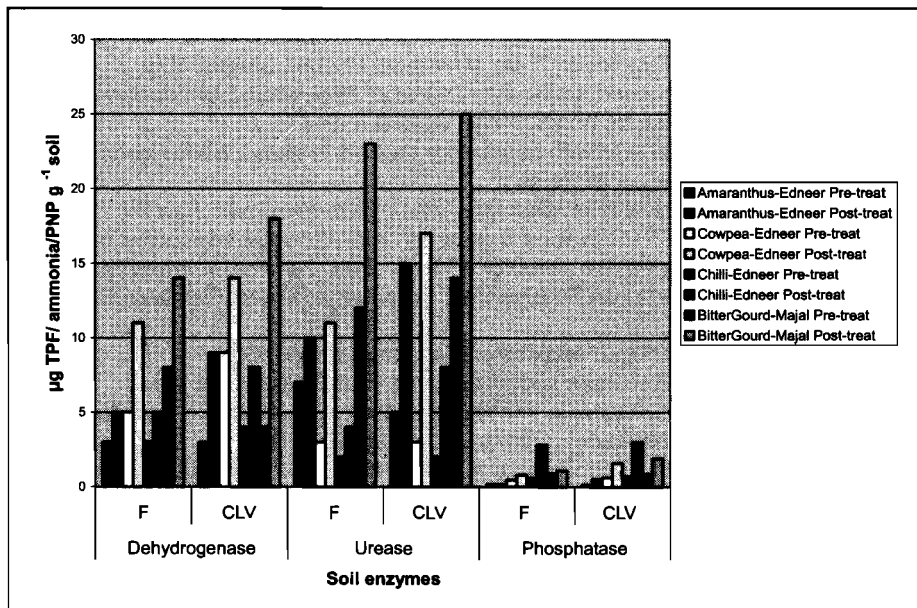


Fig. 25.4. Effect of coconut leaf vermiwash on soil enzyme activities in rhizosphere of vegetable crops

Similarly, the activities of three important soil enzymes viz. dehydrogenases, phosphatases and ureases increased sharply in the vermiwash applied plots compared to the poultry manure + neem cake and inorganic fertilizer applied plots (Fig. 25.4). Thus, we observed in vermiwash treated plots, a clear correlation between increase in microbial population with increased enzyme activities, as much of the soil enzymes originate from microbial biomass. This clearly indicated that vermiwash had a positive influence in building up the soil quality and health when compared to farmer's inputs, which must have resulted in production of quality vegetables. Improvement in soil fertility and biodiversity in organic farming has been well documented by many workers (Mäder *et al.*, 2002). In another recently reported study, the effect of vermiwash in improving the growth of cowpea has made it as a potential eco-friendly soil conditioner (Zambare *et al.*, 2008).

CONCLUSIONS

Application of coconut leaf vermiwash as soil drenching was able to produce cowpea, amaranthus, chilli and bitter gourd yield on par or slightly less compared to the plot receiving farmer's regular inputs of organic and inorganic fertilizers. However, the produce was of superior quality as opined by the farmers themselves. In addition to this, the application of vermiwash increased the soil microbial populations, particularly the plant beneficial ones, along with increase in soil enzyme activities. Thus, it can also be concluded that CLV can be used as a component of organic farming for sustainable soil health.

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