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Original Research Paper

Natural Farming in Harmony with the Sustainable Ecosystem

N. Nandini, B. S. Anupama and S. Pavithra
Department of Environmental Science, Bangalore University, Bangalore-560 056, Karnataka, India

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ABSTRACT

The concept of sustainable agriculture serves a broad range of needs at the local level and is highly important for the quality of life. Agriculture systems purposefully disrupt natural systems, in an ecological sense, through patterns of human intervention. The increased consumption pattern of chemical fertilizers and chemical pesticides has led to changes in physicochemical and biological properties of soil. The chemical farming system has led to considerable loss of soil organic matter showing 0.66% when compared to natural farm soil, which shows 2.7% of organic matter. 86 mg/kg of heavy metals like chromium was detected in chemical farming, which is detrimental to the growth and development of plants.

INTRODUCTION

Soil is the major repository of all kinds of chemicals including pesticides, insecticides and herbicides. In modern agricultural practice, there is drastic increase in use of the chemical fertilizers and pesticides. The most current and broad concept of sustainable agriculture is one that includes a significant element of quality of life (Flora 1990). In a sense, it is a value added approach at the community level, enhancing the noneconomic as well as the economic value to the community of local agriculture. Extensive studies have shown that pesticides affect soil health by killing vital microbial fauna present in soil (Zafar et al. 2001). Each gramme of soil may contain millions of microbes which are important for sustaining plant life. Persistence of these chemicals alters soil microbial processes (Jayashree & Vasudevan 2007), and directly or indirectly influences the soil quality. Fate and behaviour of these chemicals in soil ecosystem is very important since they are degraded by various factors and have the potential to be in soil, water, etc. So it is indispensable to monitor the persistence and degradation of these chemicals in soil to maintain soil fertility. The objective of the present study is to compare quality of natural farming (NF) and chemical farming (CF) and the impact assessment of CF on the environment.

MATERIALS AND METHODS

Study area: The study area is a natural farm located about 11 km from Kollegala on the road to Malemahadeshwar hills in Doddinvadi village, Chamrajnagar district. It is about 6.5 acres land, rich in biodiversity and is teeming with life. Inspired by Ramon Magsaysay award winning, natural farming pioneer Masonob Fukuwoka Mr. Murthy started practising natural farming since 1998 on this farm. The land represents an exciting new kind of natural farm, where no artificial manures or pesticides are used for the past 15 years. More than 300 varieties of plant species grow on natural farm and some of them are medicinal plants. Agricultural crops grown are paddy, arecanut, cotton, mangoes, banana, papaya, coconut and vegetables. For comparison a private chemical farm was selected which is about 6 acres in Nagadasanahalli near Yelahanka in Bangalore District, where the major plantation

is mango. Pesticides like endosulfan and monocrotophos are used by the farmer in his land since 1998. He used to spray pesticides twice a year against leaf miners, thrips and caterpillars.

Soil sampling: The soil samples from NF and CF were collected following standard methods (Black 1965). Using an auger driven to plough depth of 15 cm, a minimum of 15 soil samples were collected from different sites having a history of repeated pesticides application and also from the land where no pesticides were used. Collected samples were air dried in shade, powdered and passed through 2mm sieve, mixed homogeneously and stored at 4°C for further analysis.

Physicochemical analysis: The parameters like pH, electrical conductivity (EC), soil texture, moisture content, water holding capacity, nitrogen, phosphate and potassium (N,P,K) content and organic matter content were analysed from CF and NF following standard methods. Heavy metals like cadmium, copper, iron, nickel, zinc and chromium were analysed using atomic absorption spectroscopy method.

RESULTS AND DISCUSSION

The pH was found to be 6.94 in CF soil, and 7.3 in NF soil. Above pH 8.5, the soil is too alkaline for most plants, while if the soil pH is below 3.5 it will be too acidic. Each layer of soil may have a different pH, which means that pH can vary within the soil. The pH of both chemical as well as natural farm is neutral and is optimum for growth of crop plants. The **EC** values of CF and NF were found to be 20.4 µS/ppm and 56.94µS/ppm respectively indicating the salt content of NF was comparatively higher than CF. The moisture content of the CF was 9.7%, and that of NF 10.1%. The amount of moisture found in soils varies greatly with type of soil, climate and amount of humus in that soil and, hence, natural farm soil had high moisture content due to high organic content. The water holding capacity (WHO) of soils from CF and NF were 33% and 54% respectively, because it depends on soil texture and soil organic matter. Therefore, organic matter percentage increases the water holding capacity and as the soil type is of sandy loam type having 55% sand 28% silt and 17% clay in CF, the water holding capacity found was lesser when compared to NF having loamy soil type with sand 43%, silt 30% and clay 27%. The available phosphorus content estimated in NF was 55kg/ha, and that of CF 80kg/ha. This might be due to accumulation of phosphorus as a result of external application of chemical fertilizers in CF. Potassium content in NF was 448kg/ha, and in CF 273kg/ha. A relatively high level of potassium activates some enzymes and plays a major role in maintaining the water balance and some carbohydrates transformations in plants. The potassium is high in natural farming when compared to chemical farming. The nitrogen content of NF was high at 672 kg/ha, and that of CF was 347kg/ha. The high N content is due to high organic matter in NF.

Organic matter of soil greatly influences plant, animal and microorganism populations. Many modern cropping systems combine frequent tillage with small amounts of residue, with resultant reductions in the organic matter content of many soils. The organic carbon content in NF soil was high showing 2.7%, whereas in CF it was only 0.66%. Here, we can see the drastic difference of 2.04% excess in natural farming, which implies that the nature itself decomposes organic matter and releases organic carbon required for the plants in zero cultivation (Table 1).

Heavy metals like copper, iron, nickel and zinc were found in NF, and copper, iron and chromium in CF. The iron content in NF and CF was 2080mg/kg and 14,620mg/kg respectively, which is more than the required quantity. Chromium was 86mg/kg in CF, which is beyond the permissible limit. Of the 90 or so chemical elements forming the earth's crust, 16 are known to be essential for plant

growth and reproduction. Seven elements needed in good quantity as macro nutrients are hydrogen, oxygen, nitrogen and carbon from air and water, and phosphorus, potassium and calcium from mineral particles in soil. The other nine elements needed only in small amount (micro nutrients) are magnesium, sulphur, boron, copper, iron, manganese, zinc, molybdenum and chlorine. The soil is a natural medium for plant growth and supplies nutrients in readily available form in sufficient amounts. With the exception of hydrogen, carbon and oxygen, all other inorganic plant requirements are obtained directly or indirectly from soil minerals, hence, these elements are called mineral nutrients. Several agricultural chemicals and fertilizers, which are added to control various diseases of plants, insects and pests are highly toxic and their application adversely affects the soil quality (Table 2).

CONCLUSION AND RECOMMENDATIONS

The present study enables to assess the importance of natural farming in sustainable agriculture. In natural farming, actual physical work and labour can be reduced up to 80% as compared to other agricultural systems, and it protects soil cover and the soil biodiversity, which is very essential for balancing the ecosystem. Healthy soil is the foundation of the food system. It produces healthy crops that in turn nourish people. Maintaining a healthy soil demands care and effort from farmers. The misuse and excessive use of chemical fertilizers and pesticides have often adversely affected the

Table 1. Physicochemical parameters of the soil samples of both CF and NF.

S No	Parameters	Chemical farming	Natural Farming
1	pH	6.94	7.3
2	EC	20.4 µS/ppm	56.94 µS/ppm
3	Organic carbon, %	0.66%	2.7%
4	Nitrogen, kg/ha	347.2	672
5	Phosphorus, kg/ha	80	55
6	Potassium, kg/ha	273.6	448.8
7	Soil type	Sandy loam soil	loamy soil
8	Sand, %	55	43
9	Silt, %	28	30
10	Clay, %	17	27
11	Moisture content, %	9.7	10.1
12	Water holding capacity, %	33	54

Table 2: Heavy metal analysis of NF and CF soil samples.

S.No	Parameters in mg/kg	Guidelines for heavy metals in soil in mg/kg Source: AMZECC	Natural farming (mg/kg)	Chemical farming (mg/kg)
1	Cadmium (Cd)	3	ND	ND
2	Copper (Cu)	60	44	52
3	Iron(Fe)	-	2080	14620
4	Nickel (Ni)	500	136	ND
5	Zinc (Zn)	200	20	ND
6	Chromium(Cr)	-	ND	86

NF - Natural farming, CF - Chemical farming, ND - Not detected, AMZECC - Australia and Newzeland Environment Conservation and Council.

environment and created many problems associated with food safety and quality, and human and animal health. Consequently, there has been a growing interest in natural farming and organic agriculture by consumers and environmentalists as possible alternatives to chemical-based, conventional agriculture. The majority of biochemical transformations in soil result from microbial activity and any compound that alters the number or activity of microbes could affect soil biochemical processes and ultimately influence soil fertility and plant growth. Hence, the use of pesticides has to be checked and the awareness programmes for farmers have to be carried out regarding harmful effects of pesticide use. Encouraging use of biopesticide in place of toxic chemical pesticides and restricting their use only for special purpose under thorough monitoring can be done. Thus, the challenge is to identify soil management practices that hinder the use of chemicals and promote soil organic matter formation and moisture retention and ensure productivity and profitability for farmers in the short term. A better understanding of the linkages between soil life and ecosystem function and impact of human interventions will enable reduction of negative impacts and more effective capture of benefits of soil biological activity for sustainable and productive agriculture.

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