From the Editor's Desk

Vermicomposting as an environment friendly Bio-fertilizer

Sinha Jayanta
Our Guest Editor from Department of Zoology, B.B. College, Asansol, West Bengal, INDIA
jayantasinha_02@yahoo.co.in

With the dawn of the first Green revolution which came during the 1950s and 60s of the twentieth century, there has been a widespread usage of various agrochemicals such as fertilizers and chemical pesticides. This green revolution have been quite successful in increasing the quantity of food item but in turn reduced the nutrient levels and also had a detrimental effect on the soil fertility through years. Thus the soil became ravenous of these chemical inputs to sustain its crop yield. There has been an augment of crop yield between the times periods of 1950 to mid 1980s, but after that plateau was reached. Further usage of chemical fertilizers triggered a wide spread destruction of soil friendly microbes which had a huge role in renewing and rejuvenating natural fertility.

Chemical fertilizers again impaired the ability of 'biological resistance' in crops making them susceptible to pests and diseases. Thus agro-chemicals acted as a slow poison for the soil having serious withdrawal symptoms. Studies point to a bitter but obvious fact that continued use of chemical pesticides as a prime input and vital requirement of 1st green revolution, there is good amount of 'residual pesticides' that contaminate crops and remain after their post harvest processing and ultimately enter the human and other animals after they are bought and/or consumed. Edible samples have been contaminated with 100% with HCH and 50% with DDT. Scientific reports proved that pesticide residues were found in meat, fish, egg, milk and milk product and also in mother's milk and human fat. There was cent percent contamination with HCH, nearly 70% with DDT and 43% with aldrin, which is quite alarming.

Extoxnet data revealed in 1996 that Chloropyrifos is a very common contaminant that mixes with urban streams. Plants depend upon the variety of soil microbes to transform the atmosphere nitrogen into nitrites and nitrates which plants can utilize. Glyphosate reduces the growth and also the activity of nitrogen fixing bacteria in soil and also in root nodules. In India, excessive use of chemical fertilizers and pesticides was studied under Greenpeace in 2009, they conducted research in 50 villages in various districts of Punjab and revealed chemical, radiation and biological toxicity in Punjab.

Backlashes of the first green revolution have impelled agricultural scientist and other biologist to think for certain other alternatives for a much safer and environment friendly agricultural process and practice. Brundtland Commission Report (United Nations, 1987) advocated for '*Sustainable Development*' i.e. development (both social and economic) to meet the needs of present generation keeping in mind that the future generation are also to be accounted for their needs. Such development should also aim towards the advancement of total quality of life (i.e. the whole biosphere), therefore stewardship of both natural and human resource is of prime importance.

Searching for an alternative of the conventional agricultural practices, today scientists are genuinely searching for an economically stable, socially acceptable and environmentally sustainable alternative of the chemical aided agricultural practice.

One of the important approaches of sustainable agriculture is Organic farming or agriculture. This was developed as holistic and through an ecosystem based approach and is visualized as a feasible alternative to ecologically unsound conventional agriculture.

In India certified organic farming has enormous scope. About 30,000 ha of farmland were under certified agricultural production. In sustainable agriculture, especially organic farming there is employment of various novel methods that have been improvised from traditional knowledge. One of the most important methods of organic farming is the use of biofertilizers. The necessity of biofertilizers application has evolved primarily due to certain reasons i.e. despite the fact that chemical fertilizers boost soil fertility, crop productivity and production, but large scale / severe use of chemical fertilizers has caused grave concern of soil texture, soil fertility and other environmental backlashes, thus use of biofertilizers is both economical as well as environment friendly.

Vermicomposting is one of the most important biofertilizer that has a wide spread application. Vermicomposting is one of the age old traditions for generation of organic compost. Today use of this vermicompost as means for generation of organic fertilizer as a part of organic farming drive meets several requirement of sustainable agriculture. With the increment of 3Ps i.e. Population, Pollution and Poverty along with rapid industrialization and speedy urbanization, there is ever mounting problem of solid waste generation and disposal. These wastes pollute soil and damage it. So conversion of this solid waste into a nutrient rich material may be very important solution to such problems. This role can be played by an earthworm. Earthworms have been in

the process of waste and land management, soil improvement and farm production for 600 million years. That is why Charles Darwin referred them as 'Unheralded soldier of mankind and farmers', a friend working day and night under the soil.

Vermicomposting is a much uncomplicated biotechnological procedure in which certain earthworm species are utilized to enhance and augment the process of solid waste conversion and produce a better and useful end product. Vermicomposting is very much different from conventional composting procedure. Fundamentally, it is a mesophillic process that utilizes microbes and earthworm being active at 10^oC - 32^oC. The process is much faster than conventional composting and is rich in pant growth regulators, microbial activity and is supported with pest deterrent properties.

Being a decomposition process and involving a combined activity of earthworm and microbes; they act as mechanical strainers modifying the physical and chemical properties, slowly reducing C: N ratio and augmenting the surface area which is exposed to microbes helping higher microbial activity and also decomposition. Vermicomposting is found to be successful with variety of raw materials such as solids from waste water, effluent from breweries, paper wastes and urban residues and also from horticultural residues, processed potatoes and mushroom identity. Vermicompost are known to be as 'miracle' for plant growth.

Very importantly vermicompost functions as a 'soil conditioner' and its continued use year after year shows the way to total improvement and recovery in the quality of soil and farmland, even the degraded and sodic soils. They act as a supplier of nutrients to plant roots and trigger growth and increase soil organic matter that includes humus and humic acid and thus affect nutrient storage and supports root growth, which soil takes many years to produce through decomposition of organic matter. Humic acid in soil helps fertilizers to work more efficiently. Further, leaves in vermicast also help in scrubbing 'toxins', harmful fungi and bacteria from soil and protect plant.

Vermicompost has obtained 'hormone-induced activity' which is related to high quantity of nutrients. Vermicompost increased the rate of seed germination, growth of seedling and augmented certain growth promoting hormones viz. auxin, cytokinin, gibberlin being secreted by earthworm. Vermicompost is also very rich in microorganism and thus plays a pivotal role in improving soil fertility and increasing crop productivity and they are quite capable of atmospheric nitrogen fixation, solubilization of insoluble phosphorus and release of locked plant nutrents. It includes *Azotobacter, Actinomycetes, Nitrobacter, Rhizobium* and certain phosphate solubilizing bacteria.
The organic carbon present in the vermicompost helps in the release of nutrients slowly and steadily into the soil which helps the plants to absorb the nutrients available. Vermicompost was found to improve the trace element of the soil. Vermicompost has higher nitrate (more available form of nitrogen) where as conventional compost is higher in ammonium, it also supplies several other plant nutrients viz. phosphorus (P), potassium (K), sulfur (S) and magnesium (Mg). Soil treated with vermicompost has a significant augmentation in soil enzyme activities viz. urease, phophomonoesterase, phosphoodiesterase and arylsulphatase. Vermicompost is rich with enzymes such as lipase, amylase, chitinase and cellulose which help in break down of organic matter to the plant roots which are not feasible through the use of conventional chemical fertilizers.

Vermicompost acts as plant growth regulator and is a favoured nutrient supplier employed in organic farming. Vermicompost, especially those produced from various animal waste sources, generally have extra mineral elements than commercial plant growth media and many of these elements were transformed to forms which can be easily and readily taken up by the plants, such as nitrates, exchangeable phosphorus, and soluble potassium, calcium, and magnesium. In India, when vermicompost is applied during sorghum cultivation, crop exhibited appreciably increased growth morphological parameters viz. plant height, shoot biomass, root length, root biomass, leaf number and area in the mixtures of vermicompost and soil compared to the mixtures of normal compost and soil. It has been reported that earthworms and their excreta augmented the growth of different plants such as clover, rye, spinach, peas, oat, barley and wheat and also in paddy. Soil enriched with vermicompost improved the chlorophyll content of leaves and fresh and dry weight of plants.

One can achieve quality production of tomato as reflected through increase in total soluble solids, titratable acidity, pH and fruit dry matter and nutrient concentration (K, Fe, Zn, Cu and Mn) in tomato shoot. It is also proved that use of different levels of vermicompost to *Chrysanthemum chinensis* affected in increased fresh weight of flowers, number of flowers per plant, flower diameter and yield with the application at the rate of 10 t / hectare of vermicompost. A study was made in Griffith University during 2006-2007 where corn plants grown with vermicompost in soil accomplished quick and outstanding growth and reached maturity (reflected through the appearance of male and female reproductive organs) very quickly whereas plants on conventional compost could not mature until the period of study i.e. 14 weeks.

Further, plants on beds enriched with worms that are provided with 'feeding materials' work better than those on conventional compost at the completion of study period of 14 weeks. So it was inferred that worms require adequate 'organic residues' in soil to nourish upon and change into vermicast which functions as a 'storehouse' of nutrients and the growth promoting factors of biochemical nature.

Due to application of vermicompost higher germination, growth and yield of mung bean (*Vigna radiate* L.) compared with the control have been achieved. The use of vermicompost in the contribution of Ca and Mg macronutrients in lettuce production represented more availability of the above mentioned nutrients in relation to compost. Vermicompost application increased photo-synthetic pigments and leaf gas exchange in red pepper (*Capsicum annum* L.). When *Vinca rosea* and *Oryza sativa* were grown in 50:50 soil to vermicompost mixtures, it was noticed that length, weight, number of seeds, number of shoots in *Vinca* and tillers in *Oryzae* increased.

Sometimes vermicompost is used in combination with chemical fertilizers (NPK-90:75:60), it has been observed that there is a substantial increase in growth and yield in wheat crop where diminished dose i.e. three quarter dose of chemical fertilizer was adjuncted with full dose of vermicompost @ 2.5 t/ha. Even though vermicompost alone can work as 'driving force' but when chemical fertilizers are appended as 'helping hand', it can perform little better.

In recent years one can find many evidences regarding the ability of earthworms and its vermicompost to act as a plant protection agent against various pests and diseases either by suppressing or repelling them or by inducing biological resistance in plants to fight them or by killing them through pesticidal action. Relatively small applications of commercially-produced vermicomposts resisted or suppressed attacks by *Pythium*(fungus) on cucumbers, *Rhizoctonia* on radishes in the greenhouse and by *Verticillium* on strawberries and *Phomopsis* and *Sphaerotheca fulginae* on grapes in the field. This was due to microbial antagonism by the microbes present in vermicompost.

Moreover, earthworm excreted actinomycetes fungus in their vermicast produce chemicals that destroy parasitic fungi, such as *Pythium* and *Fusarium.* Stripted cucumber beetle (*Acalymma vittatum*), spotted cucumber beetle (*Diabotrica undecimpunctata*) and larval hornworms (*Manduca quinquemaculata*) damage on tomatoes can be reduced by application of vermicompost, both in greenhouse and field experiments. According to a study of aphids, mealy bug, spider mite populations decreased significantly, along with a subsequent reduction in plant damage in tomato, pepper and cabbage trials with 20% and 40% vermicompost additions. Field treatments of soil with vermicomposts reduced the incidence of leaf miner *Aproaerema* on groundnuts. Jassids (*Empoasca verri*) and aphid (*Aphis* sp.) attacks were decreased in response to field applications of vermicompost.

Vermicompost is an eco- friendly, economical and non-toxic biofertilizer that uses low energy input for composting and is a recycled biological material.

******