Effect of Certain Conventional Bioregulators on Reclamation of Chemical Contaminated Croplands – A Literature Review

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ABSTRACT

Reduced soil fertility is one of the most vital constraints on improved agricultural production. Chemical fertilizers are used to improve crop production, but intensive inorganic fertilizer use/abuse has led to severe reduction in soil health and increased environmental pollution. Hence, "Conventional Bioregulators" could be an alternative tool for chemical fertilizer, which solves many issues including soil degradation and environmental pollution. These bioregulators are derived from biological materials and play a major role in increasing the heterotrophic bacterial biomass, which in turn improves soil structure, fertility and enhances crop growth. The organic carbon content of these conventional bioregulators can be equal or greater of importance than their nitrogen and phosphorus content. This review article discusses the effects, preparations and futuristic application of conventional bioregulators as a soil amendment.

Keywords: Conventional bioregulators, Fertilizers, Bacterial biomass

Introduction

Healthy soil is living soil, which involves trillions upon trillions of living microorganisms consuming first organic matter, and releasing nutrients (Phillips, 2017). Soil health is the ability for the soil to function as a living body and to provide ecosystem services for plants, animals, and society (Doran and Zeiss, 2000). Declining soil fertility is one of the most significant constraints to increased food production in world (Ayalew and Dejene, 2011). Continuous cultivation of cropswithout nutrient or chemical fertilizerinputs results in degraded soils, accelerated soil erosion, depletion of soil nutrient reserves, reduced soil organic matter contents,

loss of soil physical structure, and reduced crop productivity (Esilaba*et al.*, 2000).During the last five decades the indiscriminate use of agro-chemicals has adversely affected the soil fertility, crop productivity, quality of agriculture and natural products with particularly the environment (Annonymous, 2011).

Continuous use of inorganic fertilizers causes soil infertile (Bhatt*et al*., 2019), environmental pollution, land degradation, water arises, soil aggregation, poor root anchorage (Samuthiravelu*et al*., 2012) and damage soil fertility (Jaffri, 2021).Land degradation was caused by natural or induced by humans. It is affect natural resources, food security, and the livelihood of the world population (Imran *et al*., 2020). Soil organic matter (SOM) plays a central role in maintaining soil functions and preventing soil degradation. Organic matter and microorganism serve as a reservoir of plant nutrients (Imran*et al*., 2019). Microbes also help to build soil structure and provide other benefits. (Ali*et al*., 2019).The organic manures play an important role in increasing bacterial biomass in soil, supplying macro and micronutrients to plants and improve the physical, chemical and biological property of the soil (Samuthiravelu*et al*., 2012).

Restoring the soil quality for crop production through the appropriate soil management and conservation techniques is important for all nations (Imran *et al*., 2019).

The conventional bioregulators is an efficient plant growth stimulant that enhances the biological efficiency of crops and it is used to activate biological reactions in the soil. It promotes immense biological activity in soil and enhance nutrient availability to crops (Gore and Sreenivasa, 2011). The conventional bioregulators production method is commercially viable since benefit-cost ratio than recommended dose of fertilizers in crop production (Kumar, 2021).This article reviews the importanceof conventional bioregulators, preparation of certain organic formulations, discusses their roles and mechanism of action in soil reclamation.

Soil Microorganisms

Every gram of soil contains a million of single celled microorganisms. There are many different species of bacteria, each with its own role in the soil environment. One of the major benefits bacteria provide for plants is in making nutrients available to them. Some species release nitrogen, sulfur, phosphorus, and trace elements from organic matter and some break down soil minerals, releasing potassium, phosphorus, magnesium, calcium, and iron. Still, other species make and release plant growth hormones, which stimulate root growth (Imran, 2018). The plant growth promoting *Rhizobacteria*, *Bacillus pumillus* and *B.licheniformis* produce high amount of physiologically active Gibberellins (Gutierrez *et al*., 2001). To increase the mycorrhizal fungi, reduce chemical use and synthetic fertilizer, reduces soil temperature, improves soil moisture condition and in turn helps in soil bacterial growth. Thus, it also helps in building a soil carbon sponge, which absorbs water and make available to the plants (Daily *et al*., 1997).Using organic formulations enhance the soil fertility, crop productivity and also provide food grains free from the health hazards and also used an alternative against chemical fertilizers and pesticides.

Organic Formulations

Organic formulations preparations has been an age old practice in India. Vedic literatures (Vrikshayurveda) have clearly outlined a systematized agricultural practices that insisted on the use of conventional bioregulators to enhance the biological efficiency of crop plants and the production of fruits and vegetables (Chandra*et al*., 2019).Organic farming in India has gained importance over recent years because of its quality produce, environmental safety and profitable livelihood (Thangasamy*et al*., 2018). The use of conventional farm based products like cow waste, peat, animal wastes and plant waste enriching the soil with indigenous microorganisms have also enhanced the rate of mineralization of the soil nutrients (Amareswari and Sujathamma,

2014).The farmers cannot purchase high cost inputs like chemical fertilizer, pesticides, etc. Hence organic production systems, there is always a way to improve soil fertility and management of pests by organic techniques (Chandra *et al*., 2019).

Preparation of Conventional Bioregulators

Indigenous technological knowledge is the real knowledge of a specific community that represents tradition-based experiences and more recent experiences with modern technology (Haverkort, 1995). The use of traditional fertilizing agents such us compost, domestic waste and manure are marked by environmental suitability. Biofertilizers are an efficient alternative to such synthetic chemical fertilizer due to their sustainable nature and eco-friendliness (Jaffri, 2021).

Jeevamirtham

Jeevamirtham is a very good source of biomass, natural carbon, nitrogen, phosphorous, calcium and other nutrients which are essential for plant growth and development. To make 20 L of Jeevamirtham, 1kg Cow dung, 1 litre Cow urine, 200 g Jaggery, 200g pulse flour and 100 g soil from the same field mix them in a big tank and keep the tank in shade and cover it with jute bag. The mixtures were kept for incubation under shade for 5 days and stirred vigorously for 10-15 minutes three times a day with a wooden stick. Then the freshly prepared Jeevamirtham was taken in sterile glass beaker for further use.

Beejamirtham

Five kg cow dung was put it in a cloth then bond it by tape. Hang this with in the 20 liter water up to 12 hours. Finally add 5 liter cow urine in that solution and add limewater and stir it well. It plays important role to promote germination, complete seed rejuvenator, Roots Protector. It can add strength to nursery plants during transplantation. Beneficial microorganisms present in it are

usually protects the crop from seed borne and soil borne pathogens (Shyamsunder and Menon, 2021).

Ghanajeevamrithm

Twenty kilogram of Cow dung and 1L cow urine are mixed with pulse flour and jaggery made into ball like structures and dried under shade. The dried product is stored in gunny bags and finely powdered before applying in the field. The farmers apply the Ghanajeevmirtham by broadcasting method before sowing of the crop.

Panchagavya

Panchagavya was prepared by mixing of 4kg cow dung slurry, 1kg fresh cow dung, 3Lcow urine, 2L vcow milk, 2Lcurd, 1kg ghee, well ripened banana - 12 nos. The composition gives approximately 20L of Panchagavya, sugarcane juice and coconut water are reported to accelerate fermentation, also helps in minimizing the bad odour (Das, 2014).

Fish Amino Acid (FAA)

Equal amount of fish waste and jaggery were used to prepare FAA. The fish waste was taken an air tight plastic jar and equal amount of jaggery was added in it. The materials were mixed well and stored in a cool dry place. It was kept away from direct sun light. After 10 days, the liquid portion was filtered and used for spraying (Maghirang, 2011).

Amirthakaraisal

Amirthakaraisal derived from the four ingredients, 1kg fresh cow dung, 1L cow urine, 250gjaggeryand 10L of water. The ingredients were mixed well and stirred 3 times per day. Within the 24 hours the manure was ready. Manure was kept under the shade covered with a white mesh or plastic mosquito. Amirthakaraisal is an effective stimulator, growth

promoter,proved its value by providing strength and resistance to the crop. One liter of solution is diluted withten liters of water (Ketsiyal, 2021).

Agni Astra

To prepare *Agni Astra* put10 liter cow urine in a pot. 1 kg crushed tobacco, 500 gram crushed green chilli, 500 gram of garlic, 5kgneem leaves were add it with cow urine. Boil it for 5 times continuously. Leave the solution to ferment for 24 hours. Filter this by cloth. This will be usable for three months. Agni astra act against pest like leaf roller, stem borer, fruit borer, pod borer.

Themor Karaisal

Prepare buttermilk which is 60% of the mix. Leave to ferment for 5 days. On the sixth day and coconut milk which is the remaining 40% of the mix. Then let them ferment for another 4 days. The Themor Karaisal was taken in sterile glass beaker for further use.

Neem Astra

Cow dung, cow urine, neem leaves, and water are used for preparing the Neem Astra. 5Kg neem leaves are grinded into paste and added with water. Neem paste is added with 2kg of cow dung, 10L of cow urine, handful of soil. The solution is fermented for about 48 hours.It will be directly apply to the soil without any further dilution and it will be useable for 6 months.

Brahmastra

Three kg neem leaves are used along with the other bitter-tasting leaves, like custard apple, chillies, etc. Around 20-30 litres of cow urine is used and is boiled for about 2-3 hours. The solution is cooled for 12 hours and is filtered using fine cloths. The solution is further diluted with about 15 litres of water for every 1L of *Brahamastra*. The solution will be usable for six months.

Dashparini Kashyam

It was prepared from ten plant leaves. The leaves of 2kg *Azadirachta indica* A.Juss., 2kg *Aeglemarmelos* (L.) Correa leaves, 2kg *Calotropis gigantea* (L.) W.T.Aiton; leaves, 2kg *Senna auriculata* (L.) Roxb. leaves, 2kg *Carica papaya* L. leaves, 2kg *Annona reticulata* L. leaves, 2kg *Psidium gaujava* L. leaves, 2kg *Vitex negundo* L. leaves, 2kg *Nerium oleander* L. leaves, 2kg *Ocimum sanctum* L. leaves, 2kg *Aloe vera* (L.) Burm.f. leaves, 2kg *Nicotiana tobacum* L. leaves, 2kg *Datura metel* L. leaves, 2kg *Lantana camara* L. leaves and 2kg *Pongamia pinnata* (L.) Pierre leaves were used to preparing the solution. 1kg green chilli and 500g ginger are crushed and added to this solution. It was mixed with 20 litres of cow urine. Then kept it under fermentation for 45 days. The solution is filtered and diluted about 1:10 ratio.

Effect of organic formulations on crop growth and yield

Traditional organic formulation contain numerous plant growth-promoting bacteria (PGPB), which enhance plant growth by nitrogen fixation, growth hormone production and control phytopathogens (Amalraj *et al.*, 2013; Naik and Sreenivasa, 2009). Milk provides protein, fat, carbohydrates, amino acid and calcium; Curd provides lactobacillus which act as catalyst in the digestion of organic waste; Ghee provides vitamins A and B, calcium and fat, These contents stimulate the growth and yield of all vegetable crops (Rakesh*et al*., 2017). The best utilization of Panchagavya + Beejamrutha + Jeevamrutha was found rapid growth and increased nutrient levels (Sakthivel *et al.*, 2022). Fish emulsions present in Fish Amino Acid have been documented to promote seedling growth (Murray and Anderson 2004), fruiting (Aung and Flick 1980). Application of conventional bioregulators in the field enhances germination percentage, root length, shoot length, and wet weight. Application of organic formulations has a very good

effect on the chlorophyll content leading to enhanced photosynthesis and protein content (De Vasconcelos and Chaves, 2019). Jeevamirtham is considered to be an excellent source of natural carbon, biomass, nitrogen, phosphorous and potassium and lot of other micronutrients required for the crops (Sharma, 2019).The Conventional bioregulatorscontain beneficial microorganisms, growth hormones, essential macro and micronutrients, crucial for the physiological growth and development of plants and they are rich in quality properties, which are excellentsource of organic carbon, biomass, Nitrogen, Phosphorus, Potassium and lot of other micronutrients that are essential for the metabolic activity of plants **(**Rijal *et al*., 2021). Panchagavya plays an important role in the overall growth and development of crop plants and increase of yield and profits (Kumar and Singh, 2020). It is rich in growth enhancing substances like organic compounds, hormones, micro and macro nutrients and minerals besides having anti-bacterial and insecticidal properties (Swaminathan *et al*., 2007). Panchagavya 3% on plants was found to improve the growth, yield and quality of different crops considerably (Natarajan, 2003). The soil fertilization, supplying the major and micro nutrients, stimulating growth promoting hormones and enhances the growth and yield potential of crops (Kumar, 2013). It not only enhances the shelf-life of vegetables, fruits and grains but also improves their taste (Sharma, 2019). Growth regulatory substances such as Indole Acetic Acid (IAA), Gibberlic Acid (GA3), Cytokinin and essential plant nutrients from Panchagavya which caused a tremendous influence on the growth rate in crops (Mathivanan *et al*., 2006).

Role of Conventional bioregulators on soil

Use of organic liquid manures results in increase in soil microbial activity and microbial biomass. The application of liquid organic inputs like Panchagavya, Jeevamrirthamand Amritpani, etc. results in increase in number of beneficial microbes and also shows profound

effect on soil enzymes activity. Thus can help in sustaining of safe environment and crop productivity (Brar*et al*., 2019). Conventional bioregulators on soil amendments to improve the root proliferation and plant growth environment, which includes improving water holding capacity (WHC), soil structure and nutrient accessibility, and the living conditions for microbes that are essential for plant growth. Improved soil texture and root growth also help to avoid soil degradation during windy areas or heavy rains (Singh *et al*., 2022). Soil organic matter (SOM) plays an important role in the terrestrial ecosystems and agroecosystems. *Beejamrutha* and *Jeevamrutha* were found to have higher number of beneficial microorganisms.Cow dung acts as catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity. During the 48-hour fermentation process, the aerobic and anaerobic bacteria present in cow dung and urine multiply as they eat up organic ingredients (like pulse flour) (Amareswari and Sujathamma, 2014). Jeevamirtham is low cost improvised preparation that enriches the soil with indigenous microorganism required for mineralization from native cow dung, cow urine and jaggery (Gore and Sreenivasa, 2011). Soil application of Fish Amino Acid increase microbe action in the soil (El-Tarabily *et al*., 2003). When applied organic formulations, in acidic soil increases pH and in alkaline soil decreases pH, thus creates favorable condition for availability of maximum nutrients to plants, pH 6.5 to 7.8. This condition increases the crop yield, and cuts down an entire expenses of chemical fertilizer (Gutierrez *et al*., 2001). The presence of the beneficial microorganisms and the plant macro and micronutrients in these preparations would have played an important role in plant growth promotion. However, their effect on plant growth and soil fertility need to be studied to ascertain its efficiency (Balakumar, 2021). This methodology of natural cultivation is an eco-accommodating, earth safe, contamination free and the contaminated soil was reclaimed and leads to soil fertile.

Conclusion

The green revolution is exhibiting second generation problem owing to over exploitation and mismanagement of soil. Under these circumstances, maintenance of soil fertility and crop productivity are the major constraints in agriculture. The conventional bioregulators contains enormous amount of microbial load which multiply and act as soil tonic. Its application enhances microbial activity in the soil and ultimately ensuring the availability and uptake of nutrients by the crops. The application of either organic input have potential for the sustainable crop production system, that assist to boost in food production and provides nutritional security for human as well as savethe soil health and environment. The organic farming method is a slow process, but the profit is worth the effort because the key concept is "To Feed the Soil and Not the Plant" and thus the nutrients remain in the soil and the soil remains fertile.

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