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Effect of compost of *Parthenium hysterophorus* weed on germination and growth of maize

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ABSTRACT

The term weed is applied to any plants that grow and reproduce aggressively and invasively and it competes with crop plants for light, air, moisture and nutrients. Presence of weeds is a constraint and the effect is further accentuated by their improper management. Parthenium is one of the most problematic weed, which is not only harmful to agriculture but also cause human and animal health hazards. It is important to find alternative weed management techniques or some ecofriendly technologies so as to minimize loss in crop production and least disturbance to the ecosystem. Composting effectively reduces the viability of the weeds and it also allows the safe reuse of the nutrients and organic matter available in the weed material. Compost of Parthenium weed has been made with good results. But a concern is also associated with it and that is the effectiveness of the method in destroying weed seeds, while preparing compost. If the weed seeds are destroyed in the composting process, then only that weed will not spread on application of this compost. In the present experiment, viability of the weed seeds in as-prepared compost was seen and its impact on germination and growth of maize (Zea mays) was also observed.

Keywords: compost, growth, maize, Parthenium, weed.

I. Introduction

The ever growing human population is decreasing per capita availability of land and water along with other associated adverse impacts on the environment. It has stretched the flexibility of the natural resources to a level of calamity. The compulsion to produce more food because of increased requirement has further compounded the problems leading to unsustainability of the agricultural production system all over the world. Therefore, development of efficient resource management strategies is crucial for sustained agricultural production. Our past efforts to promote the use of fertilizers have caused a clear shift in the soil fertility management characterized by over-dependence on chemical fertilizers, which was wrongly conceived as substitute to organic manure, probably due to the nonavailability of the latter. This has slowly but surely resulted in a decline in soil organic matter, optimum nutrient balance and consequently, deterioration of physical, chemical and biological functioning of soils in many intensively cropped areas. The chemical fertilizers and pesticides not only polluted the environment but they have also increased hazards of problematic weeds such as *Parthenium hysterophorus*, *Celosia argentea*, *Cyperus rotundus*, *Cynodon dactylon*, *Eichhornia* sp., etc., (Tchobanoglous and Burton, 1991). It calls for reversion of present chemical based soil fertility management strategy to the one, based on integrated nutrient management strategy.

Organic agriculture is a production system, which avoids or largely excludes the use of synthetic compounded fertilizers, pesticides, growth regulators and livestock feed additives (NPCS Board of Consultants and Engineers, 2008). Soil as living system because of microbes, develops some beneficial activities of organisms. It requires the use of organic manures and natural methods of plant protection instead of using synthetic fertilizers and pesticides. Organic farming is not mere non-chemicalism in agriculture; it is a system of farming based on integral relationship. So, one should know the relationships among soil, water, plants, microflora and above all, relationship between plants and animal kingdom. It is the totality of these relationships, which is the backbone of organic farming. Organic farming system relies on crop rotations, crop residues, animal manures, legumes, green manures, off-farming organic wastes and aspect of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests.

The art of composting is very old and some of the basic principles have been appreciated and used in practice for centuries. Compost was already known to the Romans and the Greeks and there are numerous references to the cultivation of the soil in the Bible. Composting as a recognized practice dates back to at least the early Roman era since Pliny the Elder (AD 23-79), who referred to compost in his writings. The word compost comes from old French word *composte* (from Latin word *composita*, *compositum* and *componere,* which means something put together). Composting has been the basis of organic gardening and farming since the days of Sir Albert Howard, father of the organic method. He spent some time in India (1905-1934) and devised Indore method of compost making (Martin and Gershuny, 1992). This widespread technology destroys pathogens and converts potentially harmful waste products into an odourless and inoffensive material and it may also have some positive effects on the physical, chemical and biological characteristics of soil by increasing vegetation, a protective layer to prevent soil erosion (Labud et al., 2003; Anastasi et al., 2005; Brandli et al., 2005).

The decomposition or stabilization of organic matter by biological action has been taking place in nature since life appeared on our planet. Man has attempted to control and directly utilize the process for reclamation of organic waste material, and this process has been termed composting and the final product of composting has been called compost. Compost is the product of an aerobic decomposition process. The aerobic composting process involves the oxidation of relatively complex organic compounds to simple organic compounds by micro-organisms. Materials used to feed compost microbes are referred to as compost feedstock. In order to blend these materials in suitable proportions (sometimes referred to as the recipe), several factors must be taken into consideration, particularly the C/N ratio, moisture content, and porosity. Composting is the biological process of breaking up organic waste such as food waste, manure, leaves, grass trimmings, paper worms and general house hold wastes etc. into an extremely useful humus-like substance by various micro-organisms including bacteria, fungi and actinomycetes in the presence of oxygen (Bellamy, 2007) (Figure 1).

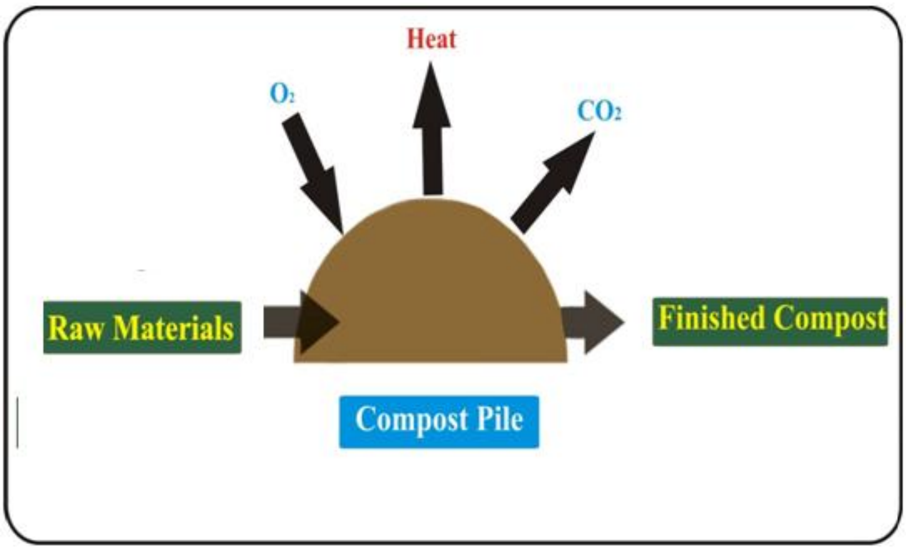

Figure. 1 Composting Process

Composting is one of the four universally accepted methods of waste disposal and it is a method of converting organic materials into a drier-odoriferous form through bacterial action, primarily to supply humus to the soil (Ayuba, 2005). It is a good environmental practice, and an inexpensive way of adding nutrients back into the soil. Composting process creates stable, soil-enriching humus and concentrates the nitrogen (N), phosphorous (P), potassium (K), calcium (Ca) and magnesium (Mg) contents (Eneji *et al.*, 2001). Everything that is compostable is biodegradable, but everything that is biodegradable may or may not be compostable. A wide variety of waste materials such as sewage sludge, organic refuse and leaves, industrial wastes resulting from brewing, antibiotic fermentation, herbal medicine industry and food processing, tree barks, agricultural residues and animal manure can be composted (Johri et al., 1999).

Under ideal conditions, composting proceeds through three major phases:

- **Mesophilic phase:** It is an initial phase, in which the decomposition is carried out under moderate temperatures by mesophilic microorganisms.
- **Thermophilic phase:** As the temperature raises, a second phase starts and here, the decomposition is carried out by various thermophilic bacteria under high temperatures.
- **Maturation phase:** As the supply of high energy compounds diminish gradually in size, amount or strength, the temperature starts to decrease. The mesophiles becomes again predominate in the maturation phase.

It is known that weeds compete with crop plants for light, air, moisture and nutrients. Weed problems have become more noticeable and prominent with the increase in the use of inputs like seeds of high yielding varieties, fertilizer and irrigation.

Management of weeds is an important component of production techniques because elimination of weeds is expensive and hard to achieve. Production losses caused by weeds should be minimized, though weeds may exist as a part of the whole ecosystem. A number of mechanical, ecological and chemical methods to control weed have been developed. In order to prevent the accumulation of chemical residues in the soil to a toxic level and to prevent shift in weed population, it is important to find alternative weed management techniques. The nutrients and organic matter available in the weed material can be reused safely through composting and it also reduces the viability of the weeds effectively. Depletion of non-renewable sources of energy, rising cost of fertilizers and deteriorating environment quality made it mandatory to review various approaches focusing on the use of available renewable sources of plant nutrition for sustainable agricultural production. The utilization of weed for more useful purposes is in progress in different countries, which may induce man to harvest weed extensively. Thus, they can be indirectly controlled through utilization, extraction of leaf protein (Pirie, 1970), green manure and composting (Balasubramanian et al., 1972, Gaur et al., 1973).

Parthenium is a fast maturing annual weed, which is spreading throughout the world. It is one of the most problematic, obnoxious and toxic weed, which not only menace to agriculture but also cause human and animal health hazards (Kohli and Rani, 1994). *Parthenium* has been originated as a result of natural hybridization between *Parthenium confertum* and *Parthenium bipinnatifidum* (Nath, 1988). *Parthenium* grows luxuriantly in fallow land, rock crevices, city waste-dumped areas, road sides, railway tracks, orchards, construction sites, forestlands, flood plains, agricultural areas, shrublands, urban areas and overgrazed pastures (Singh et al., 2004). *Parthenium* is a prolific seed producer and a fully grown plant, can produce more than 15,000 seeds in its lifetime (Dhileepan and Strathie, 2009). Its seeds are mainly dispersed through water currents, animals and the movement of vehicles, machinery, livestock, grain, stock feed and other produce, and to a lesser extent by the wind (Kaur et al., 2014). The sesquiterpene lactones namely parthenin and coronopilin present in the trichomes of leaves and stems of *Parthenium*, are responsible for causing various allergies like contact dermatitis, hay fever, asthma and bronchitis in human beings (Wiesner et al., 2007; Kapoor, 2012). Although, huge quantities of this weed is produced in India, but its economic use as a food source is impaired by its toxicity. Therefore, composting might be a useful alternative to convert the weed biomass to a useful material that could be used as soil conditioner (Anbalagan and Manivannan, 2012; Jelin and Dhanarajan, 2013). Many factors such as temperature, pH, moisture, C/N ratio and aeration affect the composting process (Boulter *et al.*, 2000). The C/N ratio of *Partenium hysterophorus* found in this locality was 10:1 (Ameta et al., 2016a). *Parthenium* compost is a good source of nitrogen as it consist 3 times more nitrogen than simple farm yard manure (Ameta et al., 2016b). Looking this encouraging potential of weed in formation of compost, now recycling of the nutrients of the weed using different methods of composting and vermicomopsting is practiced (Ameta et al, 2016b; Ameta et al, 2016c; Naikwade, 2012).

II. Materials and Method

2.1 Materials

Parthenium compost, maize seeds, etc.

Parthenium compost used in the experiment was prepared using *Parthenium* plants, cow dung, rock phosphate and *Trichoderma viride* fungi culture powder etc. (Ameta et al., 2016b).

2.2 Methodology

Two plots having an area of about 210 x 270 cm^2 were selected and maize seeds were sown in desired quantity in them; viability of weed seeds was determined and germination and growth of maize plants were also observed simultaneously.

Figure. 2 *Partheinum* compost applied in the plot

III. Results and Discussion

Generally, if compost is produced by scientific means, the temperature generated during composting process destroys most weed seeds and pathogen. It is necessary that method should be suitable for destroying the weed seeds during the process of composting, so that the weeds can not be spread on application of compost. The effect of compost of *Parthenium* weed on germination and survival of radish (*Raphanus sativus*) had been carried out by Ameta et al. (2015) and its impact on germination and yield of wheat (*Triticum aestivum*) had also been recorded. *Parthenium* compost gave good results, when applied on these crops.

Some positive results were also observed in the present experiments as good germination and growth of maize was seen i.e. almost all the seeds sown were germinated and all the plants were intense green in colour and were looking healthy (Figure 3-6).

Figure. 3 Germination of maize after 7 days

Figure. 4 Growth of the plants after 15 days

Figure. 5 Growth of the plants after 20 days

Figure. 6 Growth of the plants after 25 days

Any viable seed of *Parthenium* weed was not present in the as-prepared compost as any *Parthenium* plant was not grown in the plot on using this compost. So, it may be also concluded that the method (Ameta et al., 2016b) used in preparing *Parthenium* compost is appropriate and it destroyed the weed seeds quite effectively.

IV. Conclusion

Although some work has already been carried out on composting of *Parthenium hysterophorus* weed but it is not generally practised. There may be an apprehension in the farmers that the weed would spread in the fields or whether weed seeds are completely destroyed during composting process? Compost prepared from the weed by this method gave good germination of maize as well as growth of the plants. This is supported by the fact no *Parthenium* plant was germinated after application of compost, which may also encourage end users about its composting.

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