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EFFECT OF COMPOST OF *PARTHENIUM HYSTEROPHORUS* ON SEED GERMINATION AND SURVIVAL OF RADISH (*RAPHANUS SATIVUS*): A COMPARATIVE STUDY

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Abstract: Seed germination and survival of radish (*Raphanus sativus)* in soil affected with inorganic chemical fertilizers and in *Parthenium* compost was observed and a comparative study was made. Synthetic chemical fertilizers are indiscriminately used these days, which have several deleterious long term effects on environment and human health. Nitrogen and phosphate-based synthetic fertilizers leach into groundwater, causing water pollution. They also damage the natural makeup of soil in the long term. Therefore, integrated use of organic and inorganic sources of nutrients will not only supply essential nutrients to the soil but may also have some synergistic interaction to increase their efficiency and thereby, reduce environment hazards.

Key words: Chemical fertilizers; *Parthenium;* Sustainability; Seed germination; Productivity.

INTRODUCTION

India is an agricultural country. Agriculture provides the principal means of livelihood for the major Indian population. Out of the 329 million hectares of geographical area of the country, about 114 million hectares are under cultivation (Raghuvanshi, 2012). Agriculture sector in India contributes 16% of GDP and 10% of exports earnings. A healthy soil environment is required for desired crop production, which means it should have all the essential nutrients. Nutrients are used in significant amounts by growing plants and hence, they must be replaced periodically to sustain productivity and for this purpose, fertilizers are used in the fields. Plants require at least 16 elements for normal growth and completion of their life cycle. Elements used in the largest amounts are- carbon, hydrogen and oxygen. These are non-mineral elements supplied by air and water. The other 13 elements are taken up by plants only in form of mineral from the soil or otherwise, these must be added as fertilizer.

A fertilizer is a material of natural or synthetic origin that is applied to soils or to plant tissues to supply one or more plant nutrients essential for the growth of plants. Conservative estimates report that 30 to 50% of crop yields are attributed due to use of natural or synthetic commercial fertilizers (Stewart *et al.,* 2005; Gowariker *et al.,* 2009). Chemical fertilizers are essential to enhance proper growth and crop yield, but these fertilizers may endanger ecosystems, soil, plants, and human & animal lives also (Mishra, 2014). Fertilizers act as catalysts in providing nutrients to the plants for their better growth and yield. They can be roughly categorized into three types: chemical, organic and bio-fertilizers. Organic fertilizers are materials derived from plant and animal parts or residues e.g. Compost, manure, seaweed and worm castings. Synthetic fertilizers are "Man made" inorganic compounds e.g. are Ammonium nitrate, ammonium phosphate, superphosphate, potassium sulphate etc. A bio-fertilizer is a substance, which contains living microorganisms and when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant (Vessey, 2003) e.g. Rhizobium, azotobacter, azospirilium and blue green algae (BGA).

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Despite the past gains in rice production through chemical fertilizers, recent observations of stagnant or declining yields have raised concerns about the long-term sustainability of the crop production (Khan *et al.,* 2010). Continuous use of inorganic fertilizers resulted in deficiency of micronutrients, imbalance physicochemical properties of soil and unsustainable crop production (Jeyathilake *et al.,* 2006). Chemical fertilizers have some adverse effects on the environment and human health and they should be replenished in every cultivation season, because the synthetic N, P and K fertilizer is rapidly lost by either evaporation or by leaching in drainage water causing environmental pollution (Aisha *et al.,* 2007).

Total organic C storage in soil is a principal attribute of biological and physical quality of soil. Organic compounds and AMF (arbuscular mycorrhizal fungal) hyphae are important in binding soil particles (Caravaca *et al.,* 2002; Wilson *et al.,* 2009) into macroaggregates and microaggregates (Singh *et al.,* 2009). Thus, depletion of soil organic matter (SOM) and the degradation of soil structure can adversely affect soil fertility and crop productivity (Lal, 2009). Combined organic/inorganic fertilization both enhanced C storage in soils, and reduced emissions from nitrogen fertilizer use, while contributing to high crop productivity in agriculture (Pan *et al.,* 2009). Chemical fertilizers add nutrients to the soil, but they don't add anything else. Plants needs more than just nutrients to survive. They also need organic matter and living organisms. Compost and organic material introduces some beneficial micro-organisms. Micro-organisms commonly found in soil and compost convert organic nitrogen into inorganic nitrogen, a process called mineralization. Plants may then take up the nutrients released by these. Composts contain an astonishing variety of microbes, many of which may be beneficial in controlling pathogens also.

The use of farm yard manure (FYM) alone as a substitute to inorganic fertilizer is not enough to maintain the present levels of crop productivity of high yielding varieties (Efthimiadou *et al.,* 2010). Therefore, integrated nutrient management is the most effective method to maintain a healthy and sustainably productive soil, where

both; organic manures and inorganic fertilizers are used simultaneously (Mengistu and Mekonnen, 2012). Zhao *et al.* (2009) also found that farm yard manure combined with chemical fertilizer resulted in higher increase in maize yield, soil organic matter, available N and P as compared with those found under mineral fertilizer treatment.

Emerging evidences indicate that integrated soil fertility management involving the judicious use of combinations of organic and inorganic resources is a feasible approach to overcome soil fertility constraints (Efthimiadou *et al.,* 2010). Jeyathilake *et al.* (2006) also reported that integrated use of bio-fertilizer, organic manure and chemical fertilizers resulted in increase of onion yield in comparison with the exclusive application of chemical fertilizers. Organic sources like farm yard manure, poultry manure (PM), green manuring, compost etc. not only supply the organic matters but also increase the fertility status of soil (Chang *et al.,* 1991; Brady, 1996; Chung *et al.,* 2000; Keupper and Gegner, 2004; Sharpley *et al.,* 2004).

There is no complete substitute of chemicals fertilizers (NFDC, 1997). The integration of organic and inorganic sources of nutrients not only supplied essential nutrients but also has some positive interaction with chemical fertilizers to increase their efficiency and thereby, reduce environment hazards (Ahmad *et al.,* 1996). Combined use of FYM and inorganic fertilizers is helpful for consistent cropping. The long term effects of the combined application of organic and inorganic fertilizers on improving soil fertility and crop yield have been well demonstrated. (Lin and Lin 1985, Xie *et al.,* 1987, Chen *et al.,* 1993, Liu *et al.,* 1996).

Fuchs *et al.* (1970) reported that nutrients from mineral fertilizers enhance the establishment of crops while those from mineralization of organic manure promoted yield on combining both the fertilizers. Concentrations of soil organic C (SOC) and Total soil N (TSN) were significantly higher in soils receiving organic fertilizers than those in soils receiving chemical fertilizers. Organic manure plays a vital role to bring stability and sustainability to agriculture and also avoid over dependence of chemical fertilizers (Wijewardana, 1995). The use of organic manure will reduce approximately one-third of inorganic fertilizer requirement and improve soil organic matter content over a longer period (Joshi *et al.,* 2006). Although, it has been assumed that indiscriminate use of inorganic chemical fertilizers is a cause of reduced natural fertility of soil, but present day's intense agricultural patterns are also responsible for this problem. As a proper crop cycle is also not commonly practiced by the farmers, which may also add to the problem.

There is need for further research on complementary application of organic and inorganic fertilizers under intercropping system in order to improve both; the physical and chemical as well as biological soil properties also. Therefore, the present work was undertaken.

MATERIALS AND METHODS

Pots, soil of the field, *Parthenium* compost, radish seeds, etc. *Parthenium* compost used in the experiment was prepared using *Parthenium* plants, cow dung, rock phosphate and *Trichoderma viride* fungi culture powder etc.

Two pots were taken. The first one was filled with the soil of field, in which chemical fertilizers were used for crop production while second pot was filled with the same soil but *Parthenium* compost was used in it as an additive or organic fertilizer for providing nutrients to the plants. Then, few radish seeds were placed in both these pots. Seed germination rate and growth rate as well as survival of the plants were examined in each pot for a month with an interval of 5 days.

RESULTS AND DISCUSSION

Percent seed germination in the pots are reported in Table 1. Similarly, percent of survival of the plants in both the soils was observed for one month. The observations are given in Table 2. A gradual decrease was seen in first pot due to lack of naturally available nutrients.

Table 1: Seed germination

Days	Seed germination (%)	
	First pot	Second pot
5	40	90
10	60	90
15	80	100
20	-	100
25	-	100
30	-	100

Table 2: Survival of radish

Days	Survival (%)	
	First pot	Second pot
10	60	90
15	80	100
20	40	100
25	20	100
30	0	100

The seed germination and growth of the plants was also observed and the results are presented in Fig. 1-3

Figure 1: Seed germination and growth of radishes after 5 days

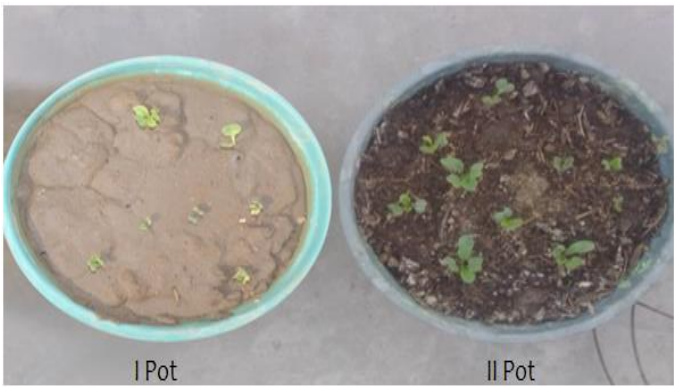

Figure 2: Seed germination and growth of radishes after 20 days

Figure 3: Seed germination and growth of radishes after 30 days

Due to indiscriminate use of chemical fertilizers, soil has become much dependent on them to supply nutrients to the plants and without using them, its fertility approaches to almost zero. Plants need organic matter and living organisms too, which is not supplied by chemical fertilizers and it resulted in impaired soil properties making it unsuitable for obtaining goal of sustainable agriculture. The prolonged overuse of chemicals on soil results in deterioration of soil health.

As external nutrient source was not provided in first pot i.e. any chemical fertilizer, it was observed that only 80% seeds were germinated in first 15 days and it also took comparatively a longer time than the seeds in second pot. Later on, they also died due to lack of naturally available nutrients. Growth rate of the plants was observed in both these pots, and it was surprising that plants did not show even a normal growth in first pot while, plants show relatively much better growth in the second pot, where compost prepared from waste weed *Parthenium* was used. Percentage of survival of the plants in both the pots (after one month of planting) clearly indicated the worst scenario of using chemical fertilizers for growing plants. The survival of the plants in the first pot was 0% while, in the second, it was 100% within a month.

CONCLUSION

Today, a boost crop production is required from the same geographical area to maintain balanced ratio of demand and supply of food. Synthetic chemical fertilizers are so commonly practiced in the country on a large scale for this purpose instead of organic fertilizers, which provides essential nutrients to the crop plants in eco-friendly manner. The use of chemical fertilizers is time, labour and money saving and therefore, the slow working organic fertilizers are not used. These easily available chemicals do harm soil's microbial environment, human health and entire biosphere. If one uses synthetic chemical fertilizers indiscriminately, it will definitely fulfil our requirements but it will also badly affect the goal of achieving sustainable agriculture by disrupting soil quality. Sustainable agriculture requires maintenance of a non-negative trend in productivity while, maintaining the soil quality. Use of chemical fertilizers and pesticides is harmful for the useful micro-organisms presents in the soil and therefore, there is an urgent need to take some immediate steps to achieve the goal of sustainable agriculture. One must go with some eco-friendly technologies to secure natural wholesomeness of our priceless seed bank and carbon source. Although the use of organic fertilizers alone as a substitute to inorganic fertilizer is not enough to maintain the present levels of crop productivity and hence, integrated nutrient management, where both organic manures and inorganic fertilizers are used simultaneously may prove worthwhile in improving soil fertility and crop yield, and this must be practiced.

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