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Research Article

EFFECT OF EARTHWORMS ON PRODUCTIVITY OF WHEAT PLANTS

***Sudesh Rani and Pooja Malik**
Department of Zoology, Maharishi Dayanand University, Rohtak, 124001, Haryana, India
**Author for Correspondence*

ABSTRACT
An experiment was carried out to study the effect of earthworms on productivity of wheat plants. For this, wheat seeds were grown in four pots which contained loamy soil, Organic manure, chemical fertilizer and live earthworms. Hence, total four treatments were set- P1, P2, P3 and P4. The results of present study showed that treatment P4 which contained loamy soil and earthworms have better growth than other pots. The color of leaves of wheat plants were also recorded dark green in P4 treatment. Results of this study indicated that earthworms definitely act more superior than that of organic/conventional fertilizers as well as chemical fertilizers. Thus, use of earthworms in soil not only increases the productivity of crops but also improved soil quality and eliminated the danger of chemical fertilizers.

Keywords: *Earthworms, Wheat, Organic Fertilizers, Chemical Fertilizers*

INTRODUCTION
Wheat *(Triticum aestivum*) is a Rabi crop which is sown in the beginning of winter October –November) and harvested in the beginning of summer (March-April). The time of harvesting differ in different region due to different climatic conditions. Wheat is the most widely grown and steady crop in the world. In India wheat is contributed about 75% of the total food production and it is second most common crop of the country.

In India chemical fertilizers play an important role to achieve self-sufficiency in agricultural production. Further, plant breeding technologies are available by which high yielding variety of seed can be developed. The heavy use of agrochemical since the Green revolution of 1960s and 1970s has increased the food productivity.

Hence, chemical fertilizer came as a mixed blessing for farmers. But on the other hand abundant use of these chemical fertilizers cause several environmental problems like decreased nutrition quality of food produced, destroy soil fertility, higher demand of water for irrigation, soil and water pollution, pesticide poisoning and impaired the biological resistance in crops to make them more susceptible to pest and diseases (Sinha, 1998 & 2004).

A study was carried out by Mittal *et al.,* (2014), where they describe an exceptional crisis of environmental health linked to arbitrary, excessive, and unsafe use of pesticides, and because of these fertilizers, Punjab has pushed the state to the edge of health hazard like blue baby syndrome and cancer. Hence to protect the ecosystem and human health from chemicals fertilizers, Organic farming which is use of bio fertilizers must be the better option. Because these can be a good alternative for chemical fertilizer to overcome their adverse effect (Li and Li, 2010). The use of organic manure such as animal manure, human waste, food waste, yard wastes, sewage sludge and composts has been proven effective for plant growth, yield and the maintenance of soil fertility. From last many years traditional methods of organic farming have been used by farmers. Now-a-days, new methods of vermicomposting have become more popular recently as they eliminate some harmful effect of organic waste from the soil. Further, Vermicomposting is a simple process of composting (Gandhi *et al.,* 1997), where earthworms are used to improve the process of waste alteration and hence produce a good product which ultimately enhances the productivity of crop. Hence, Vermicompost also has very 'high porosity', 'aeration', 'drainage' and 'water holding capacity' than the conventional compost and this again due to humus contents (Suhane, 2007). From the last century, many researchers describe the role of earthworm on nutrient cycling, soil structure, matter decomposition and plant productivity (Scheu and Wolters, 1991; Zhang and Schrader, 1993; Blair *et al.,* 1994 and Stephens *et al.,* 1995). The factors and the soil portion customized by

earthworm actions, including casts, burrow systems and gut processes etc. and by all these activities they influence plant growth (Brown *et al.*, 1999). Hence, considering the importance of earthworms the present study was carried out.

MATERIALS AND METHODS

The experiment was conducted in Central laboratory of Zoology, Department MDU Rohtak during the period between Nov 2016 and April 2017 (which is most appropriate time for the cultivation of wheat). The crop is grown in that area of laboratory where enough sunlight was reached.

Experimental Animal: Earthworm *(Eisenia fetida)* was taken as experimental animal for present study. The Earthworms (*E. fetida*) were collected from underground soil at MDU Campus, Rohtak, Haryana, India. The Earthworm was identified to species level using relevant text material (Edwards, 1998).

Collection of Soil: The loamy soil (Agriculture Soil) was collected from an agriculture field of Asthal Bohar Village, near MDU Rohtak and unwanted materials like stone, weeds and grass were removed manually.

Wheat: The wheat seeds *(Triticum aestivum)* were collected from agriculture seed shop Rohtak.

Organic Manure: The mixture of cow dung was collected from the Gaushala, near Asthal Bohar canal, Rohtak. The cow dung was totally decomposed and decayed by microbes and microorganism during collection time.

Chemical Fertilizer

Urea and DAP (Diammonium Phosphate): These were collected from Agriculture Seed Shop at Rohtak. These were used to compare the growth of wheat in presence of earthworm and in presence of urea.

Experimental Design

Altogether 4 pots each of 2 feet in height and 24.5cm in diameter were used.

Following treatments were designed (detail in Table-1)

Control (only soil), Organic manure, chemical fertilizer and live earthworm.

Table 1: Different Treatments and their Ratio Used in Experiment

S. No.	Treatments		Ratio
1	P1	Loamy **S**oil (Control)	6.5 kg
2	P2	Loamy **S**oil **+** Organic Manure	6 kg +500gm
3	P3	Loamy Soil + Chemical Fertilize (DAP+UREA)	6.5 kg +1.4 gm+4.8gm
4	P4	Loamy Soil + Live Earthworm	6.5kg + 20 Earthworm.

(Ratios were taken according to Ademba *et al.*, (2015) and soil quality website 2016 with manipulations**)**

10gm of Wheat plant (*Triticum aestivum*) seed were sown in each pot filled with 6.5 kg of loamy soil on 10th Nov 2016. The seeds were sowed at a depth of 5cm below the surface of soil. The pots with chemical fertilizer consisting of DAP and Urea. DAP was added at the time of sowing. UREA was added two times. The first dose of 2.4gm was added after 15 days of sowing and second dose was added after 30 days from first dose.

The irrigation of potted plant was done every 5-7 days. After of 4-5 days wheat plant was started coming out from the soil and the plant size was increased day by day. Various growth and yield parameters were recorded after every 10 days.

Growth and Yield Parameters:

Parameters like seed germination, mean plant height in cm, color of leaves, maturity time, Plant heights were recorded by using a meter rule from the base of the plants to the terminal growing parts.

Formula Used: $\text{Germination Percentage} = \frac{\text{n}}{\text{Total no.}} \times 100$

n= number of seed germinate

RESULTS AND DISCUSSION

Effect on Seed Germination

Seed germination percentage was found higher in the P4 treatment (Pot with live earthworms) that was 95%. Pot with chemical fertilizer P3 (85%) has higher seed germination percentage than the organic manure P2 (75%). Minimum number of seed germination percentage was occur in P1 (control) treatment (40%).

Table 2: Impact of Organic Manures, Chemical Fertilizer and Live Earthworm on Germination of Wheat Plant

Treatment	Germination (n)	Percentage
P1	80	40%
P2	150	75%
P3	170	85%
P4	190	95%

Figure 1: Seed Germination in P1 Treatment

Figure 2: Seed Germination in P2 Treatment

Figure 3: Seed Germination in P3 Treatment

Figure 4: Seed Germination in P4 Treatment

Growth of Wheat Plant (in cm)

Maximum growth in terms of height of wheat plants were recorded in P4 treatment followed by P3 and P2 treatment (Figure 5). Also, the color of leaves was found dark green in treatments P4, P3 and P2 as compared to treatment P1 where very light green color of leaves were recorded.

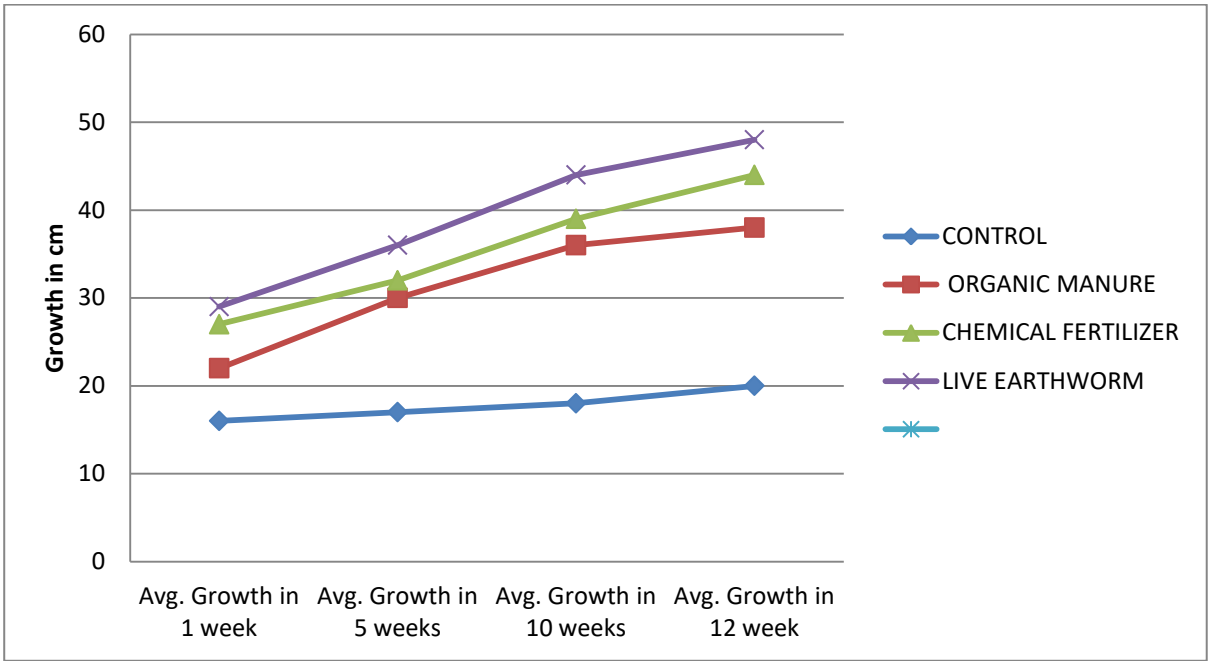

Figure 5: Growth Performance of Wheat Crops by Vermicompost and Earthworms Conventional Compost and Chemical Fertilizers in 12 Weeks Period

Hence, in the present study maximum growth in terms of height was recorded in wheat plants in P4 treatment where live earthworms were added, followed by pots with chemical fertilizer and organic manure. Similar results were observed by Agarwal *et al.,* (2010) where Worms and vermicompost promoted excellent growth in the vegetable crop with more flowers and fruits development. This may be because the activities of earthworm make soil porous and more fertile than any other thing. Arancon *et al.,* (2004) studied the agronomic impacts of vermicompost and inorganic (chemical) fertilizers on strawberries *(Fragaria ananasa*) separately as well as in combination. Their study indicated that was 35% greater on plants grown on vermicompost as compared to inorganic fertilizers. Similarly, Meena *et al.,* (2007) studied the growth impacts of organic manure (containing earthworm casts) on garden pea *(Pisum sativum)* and compared with chemical fertilizers.

The results showed that organic manure gave higher green pod yield as compared to chemical fertilizer. Palainsamy, (1996); Bhatia *et al.*, (2000); Sharma, (2001) and Suthar, (2005; 2010b) also reported better growth and yield of wheat crops with earthworms and its vermicompost in soil. Thus, earthworm worked like "miracle growth promoter" and is nutritionally superior to the organic manure and chemical fertilizers (Sinha *et al.,* 2010).

Conclusion

This experiment proved that earthworm and its excreta are excellent growth promoter, which enhance the productivity of crop plant and also act as superior to conventional compost and chemical fertilizer.

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