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Use of Organic Fertilizer and the Potential Influence on *Brassica rapa* L. and Soil Nutrient Composition

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ABSTRACT
The Organic farming can be defined as a farming method or process that inclusively involves growing and nurturing crops without the use of any kind of synthetic based fertilizer and harmful pesticides while no genetically modified organisms are permitted. It is the best and the most valuable alternative for traditional farming techniques. Main components of organic farming are organic manure, organic fertilizers which is an excellent alternative to chemical fertilizers. The word mustard is used to refer to several species of plants. Brassica rapa is the scientific name of field mustard. The plant seeds are used as condiment and spices. It grows pretty well in cold atmosphere at 4.4 degree Celsius with a pH range of soil from 4.9 - 8.2. This article throws light on the response of mustard plant on different soil conditions. The plant was given four treatments i.e., T1 (only Soil), T2 (Soil+NPK), T3 (Soil+Vermicompost) and T4 (only Vermicompost). Difference in physical traits of the plants was observed in the four conditions. Tallest shoot length was observed in T3 treatment i.e., 13 cm and tallest root length was seen in T2 treatment i.e., 7.5 cm. The number of leaves was same in T2 and T3 treatment i.e., 4 and also same in T1 and T4 treatment i.e., 3.
Keywords: *Brassica rapa, Fertilizers, NPK, Organic farming, Vermicompost*

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INTRODUCTION

Organic farming or chemical- free farming is a method which includes the growing of plants in natural ways. It emerged in 20th century in response to fast switch in farming implementation [1]. It is defined as a system which practices the use of bio-pesticides and bio-fertilizers [2]. Excessive use of insecticides and fungicides damages the soil and destroys the nutrient content of the soil, this is where organic cultivation of plants come into play which is a broad, extensive and integrated administration approach that encourages harmony with the soil and environment and also it has been found that by applying organic method we can get maximum output than conventional method [3].

Organic fertilizers are mainly derived from human and animal wastes and also from vegetable matter. They are made up of several items such as cowpat, bark chips, phosphate rock etc. which are beneficial for the soil. They come in many forms like solid, in the form of solution and also in pulverished manner, depending on their use they are applied accordingly [4]. The chemical free fertilizer plays a major role in the soil and plant health. Several factual survey claims that a union of both inorganic and organic strategy is excellent for better yield and productivity [5]. However, use of only intensive farming which uses a lot of chemicals is not profitable as it pollutes the soil and ground water [6]. Application of organic fertilizers such as compost and manure encourage the growth of vital microorganisms [7].

Brassica rapa otherwise known as field mustard is a crop which is vastly grown as important oilseed crop. It belongs to the Brassicaceae family [8]. The Brassicaceae family (Cruciferae) has about 338 genera and 3709 species [9]. It is an upstanding plant that completes its life cycle within one or two year. The plant grows up to about 90 to 120 cm with stem having multiple offshoots. The leaf lacks hair and occasionally masked with a white layer. The bottom leaves can be 30 cm long and top leaves are small in size with tapering end. The floret is dazzling yellowish in appearance which is congregated at top of the stem with four petals. The floweret blooms from January to September according to the environmental conditions. It is an exceedingly versatile plant that can sprout in gritty soil to dense clay soil [10].

Mustard plant is ephemeral in nature and it grasps the nutrition from the soil very quickly [11]. Use of inorganic fertilizers on the mustard seed can lengthen the stem and also increase the leaves number and chlorophyll amount in the leaves but no changes have been found in the root enhancement whereas

natural fertilizers like vermicompost can boost up the root length, leaf count with high yield. In addition, microbial activity also intensifies inside the soil which leads to proper soil aeration [12]. Mustard plant has a wide range of nutrients like Vitamin C and Vitamin K and both the leaf and seeds are consumable [13]. Mustard has been found to accelerate our metabolism, decrease high blood pressure and also helps in recovering from the bee sting [14]. Brassica and further similarly associated cruciferous crop plants are extensively grown all over the globe as an important vegetable crop for our intake as flavouring and relish spices and as forage for nourishment of herd and cattle. But mostly these plants are cultivated for comestible oil making [15].

Several mustards which are found are sown and raised broadly in North-west India, Pakistan and Nepal [16]. Canada has been found the largest manufacturers of mustard seeds i.e., it has exported 141,660 metric tons of mustard in last 5-7 years [17]. Other countries such as Russia, Myanmar, Ukraine, U.S.A, China are also the major contributor of mustard production [18]. In France, mustard is consumed in large amount i.e. (1.5 lbs./person/year) [19]. The plant is grown mainly under mild and pleasant weather and is also cultivated in humid and subtropics as a cold crop [20]. Mustard plants can sprout pretty well in cold atmosphere with 4.4 degree Celsius and the sapling can endure some fine verglas but excess may destroy the plant. Soil having pH range 4.9 and 8.2 is best for the plant to grow [21].

Mustard is considered as one of the most crucial spice following salt and pepper. It is the supreme native spice [22]. A study done on the effect of organic and inorganic fertilizers under severe drought stress environment by using compost and Zinc (Zn) on the *Brassica napus* variety of mustard for the yield and increment observed that by increasing the amount of compost the plant showed extremely good results [23]. Another study on the productivity and quality of mustard seeds was done based on the mineral nutrition and the chemical fertilizers under the southern black soil and showed the response of mustard plant to the N and P fertilizers depending on the amount of nutrients present in the soil [24]. A study on the effect of applying rice dish water and manure as organic fertilizer on the *Brassica juncea* L. found that the highest height of the plant was seen in 20ml/liter in rice washing water and 15 mg of manure application. There were no other major changes observed between the application of rice washing water and manure on the growth and yield of the mustard variety [25]. A reasearch work on the effects of chemical fertilizers, bio-fertilizer and fungicides was done separately and in combination on the growth of *Brassica nigra*. It was observed increase in the growth rates of the plant at the biochemical parameters of the plants in comparison with the control. The fungus Trichodermahamatum and the rhizobial isolates remedy alone and together with each other along with chemical fertilizers was found to be efficacious in progressing the root and shoot length, chlorophyll content, protein, carbohydrate and mineral i.e., Nitrogen and phosphorus in *Brassica nigra*. It showed biofertilizers can be a good substitute of chemical fertilizers and fungicide for upgrading the length and yield of *B. nigra* plant [26]. A study observed that the use of bio-fertilizers, farm yard manure along with 40 kilograms of nitrogen resulted in seed productivity equal to the 80 kilogram of nitrogen per hectare alone. Highest seed productivity was gathered in the use of maximum doses of nitrogen fertilizers in combination with bio-fertilizer along with farm yard manure in case of mustard variety of *B. juncea* [27].

MATERIAL AND METHODS

Geographical location: This experiment was conducted in the Centurion University of Technology and Management situated in the city of Bhubaneshwar which is a very old city in India's Eastern state of Odisha. The city lies between 20°15' N latitude and 85°52' E longitude in the district of Khurda.

Soil type: The soil type of Centurion University of Technology and Management is fertile red soil.

Conditions: The mustard seeds were collected from the local market and was sown in four different pots under four different treatments i.e., T1 (only Soil), T2 (Soil + NPK), T3 (Soil + Vermicompost in 1:1 ratio) and T4 (only Vermicompost). The mustard seed were sown in all the four conditions in a wired house and the NPK fertilizer were given in T2 every week in lesser amount.

Morphological study: Seeds were sown in four different conditions in different pots to study their growth [Fig 1]. Plants from each of the four pots were taken and their root and shoot length were measured. The primary and secondary leaves were counted and their length was also measured [Fig 2].

Chlorophyll estimation: The chlorophyll evaluation is beneficial for the analysis and study of distinct pigments in the plant. Spectrophotometer is an instrument which is used for measuring the differences in color intensities of solutions to estimate chlorophyll content. A beam of light having a particular wavelength is passed through test solution and the amount of light absorbed (or transmitted) is measured electronically. 0.5 grams of fresh leaves were taken. It was homogenized in chilled 80% acetone in motor pestle. Homogenates were then centrifuged at 10000 rpm for 10 minutes at 4°Celsius in the dark [28].

Soil test: Soil test analysis was done in the ATC lab, CUTM, Bhubaneswar. Soil sample of about 1 gram from each of the four pots were taken and was given to the lab XRF analysis [29].

RESULTS AND DISCUSSION

Morphological analysis

The morphological traits shown by the plant under different soil conditions were studied and their physical growth was shown [Fig 3]. The shoot length was highest in Soil + Vermicompost condition i.e., 13cm followed by Soil + NPK and few centimeters difference was seen in only soil and only Vermicompost treatment i.e., 10 cm and 9.5 cm respectively. In case of root length, highest length was seen in Soil + NPK condition i.e., 7.5 cm and least was seen in only Soil condition i.e., 3.5 cm. Only Vermicompost and Soil + Vermicompost showed 5.5 and 4.5 cm respectively. Number of leaves were counted and found that in case of only Vermicompost the leaves were 3 (3 primary leaves + 0 secondary leaves), in Soil + Vermicompost the leaves were 4 (3 primary leaves + 1 secondary leaf), in Soil + NPK the leaves were 4 (2 primary leaves + 2 secondary leaves) and in only soil the leaves were 3 (2 primary leaves + 1 secondary leaf). Primary leaf length was same i.e., 9.5 cm both in only Vermicompost and Soil + NPK and 9 cm both in Soil +Vermicompost and only soil. While secondary leaf length is 11, 12 and 10 cm in Soil + Vermicompost, Soil + NPK and only soil respectively [Table 1]. Similarly three separate other measurement were taken under different conditions and their average reading were calculated [Table 2].

Chlorophyll Estimation

The chlorophyll content of the plant under control (only soil) condition was evaluated and the following reading was taken. The chlorophyll a content was found to be 10.54, chlorophyll b was 7.53 and their ratio was 1:4. The total chlorophyll content is 18.07 [Table 3].

Soil Analysis

The soil analysis of the controlled condition was done and metal in their oxide form was found. Essential heavy metal oxides such as Fe_2O_3 (10.989%), CuO (113.4ppm), ZnO (108.8ppm), MnO (0.168%), NiO (136.8ppm), CaO (0.286%) was discovered in the soil. Oxides of some heavy metals which are considered toxic are also found such as Al_2O_3 (20.635%), V_2O_5 (491.1ppm), Cr_2O_3 (266.8ppm), Ga_2O_3 (43.5ppm), As_2O_3 (3.4ppm), SrO (39.9ppm), PbO (88.7ppm). The highest metal oxide element found is SiO_2 i.e., 63.073% [Fig 5]. After analysing report 1, their nutrient contents were shown in graphical format [Fig 6]. The soil analysis of Soil: Vermicompost in 1:1 ratio was carried out and the highest metal oxide element found was SiO_2 (63.492%). Some of the heavy metals which are considered toxic their oxides were found such as Al_2O_3 (19.257%), V_2O_5 (523.5%), Cr_2O_3 (239.9ppm), Ga_2O_3 (49.4ppm), A_s2O_3 (20.8ppm), SrO (45.3ppm) and PbO (75.8ppm). Some metals which are considered as nutrients for plant growth were found in traces such as CaO (0.512%), MnO (0.210%), NiO (141.4%), CuO (133.0ppm), ZnO (151.4ppm) and Fe_2O_3 (11.167%) [Fig 7].

[Fig 1. Sowing of Seeds in Pots under Different Conditions]

[Fig 2. Growth of Plants in Four Pots under the fair conditions]

[Fig 3. Physical Traits of *Brassica rapa* under different soil conditions]

Table 1: Morphological Traits Measurement of *Brassica rapa* in Four Conditions

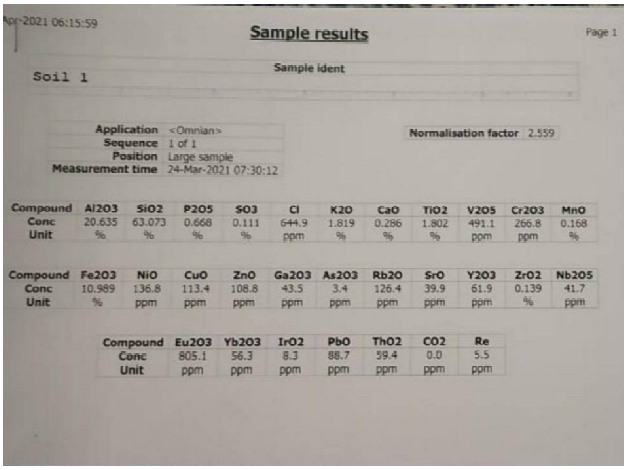
Plant Traits	Only Vermicompost	Soil + Vermicompost	Soil + NPK	Only soil
Shoot length	9.5	13	12.5	10
Root length	5.5	4.5	7.5	3.5
Number of leaves	3	4	4	3
Number of primary leaves	3	3	2	2
Number of secondary leaves	0	1	2	1
Primary leaf length	9.5	9	9.5	9
Secondary leaf length	0	11	12	10

Table 2: Represents the average reading of three samples of each four pots. N= number of plants sample reading and X = average. Length is measured in CM.

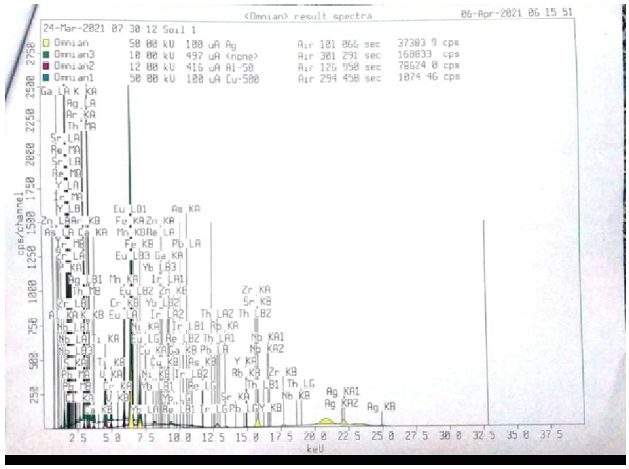
Plant traits	Only Vermicompost		Soil + Vermicompost		Soil + NPK		Only soil	
	N	X	N	X	N	X	N	X
Shoot length	3	10	3	10.83	3	12.5	3	10.7
Root length	3	5.43	3	5.17	3	7.17	3	3.17
Number of leaves	3	2.7	3	3.7	3	4.7	3	3.3
Number of primary leaves	3	2.3	3	2.3	3	2	3	2
Number of secondary leaves	3	0.7	3	1.3	3	4.3	3	1.3
Primary leaf length	3	10.5	3	9.7	3	9.5	3	8.17
Secondary leaf length	3	10	3	10.83	3	12.5	3	10.7

Table 3: Chlorophyll Estimation of *Brassica rapa*

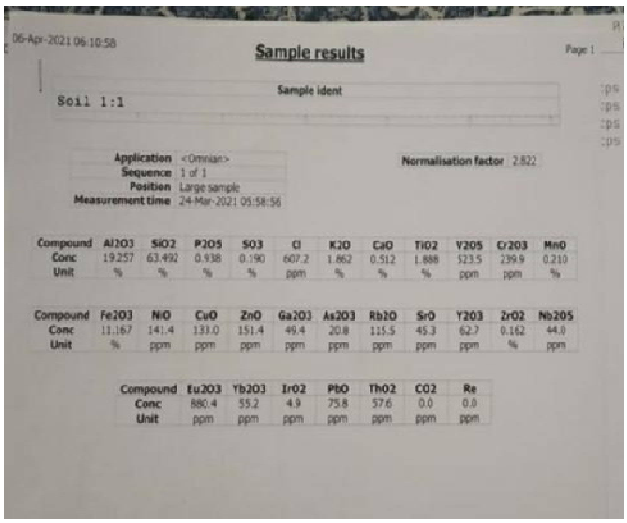
Parameters	Value
Chl a content (µg/ml)	10.54
Chl b content (µg/ml)	7.53
Chl a/chl b ratio	1.4
Total chlorophyll content (µg/ml)	18.07



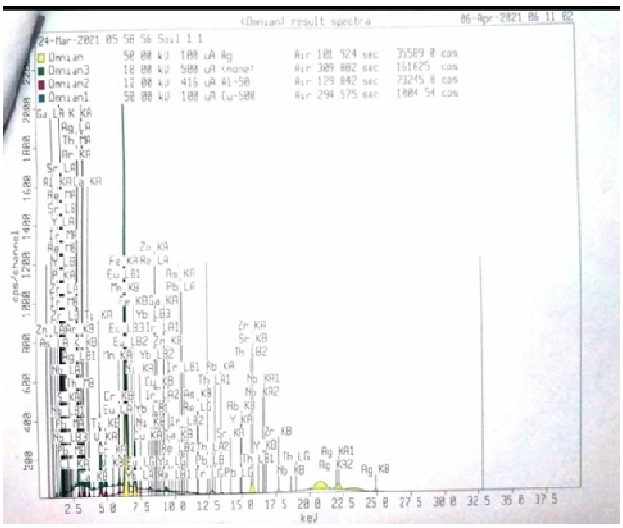
[Fig 4. Soil Analysis Report of Only Soil Condition]



[Fig 5. Graphical Representation showing Nutrient Content in Soil Condition]



[Fig 6. Soil Analysis Report of Soil Type (Soil: Vermicompost in 1:1 ratio)]



[Fig 7.Graphical Representation showing Nutrient Content in Soil: Vermicompost Condition in 1:1 ratio]

CONCLUSION

The above experiment was conducted to know the effect of organic fertilizer such as Vermicompost on the growth of *Brassica rapa* mustard plant and to compare it with the use of chemical fertilizer such as NPK. It was observed that the plant under treatment of the given organic fertilizer i.e., Vermicompost showed better results in terms of morphological traits. Highest shoot length was shown by the plant which was grown in combination of soil and Vermicompost and highest root length was seen in the plant grown in the combination of soil and NPK.

CONFLICT OF INTEREST

All the authors hereby declare no conflict of interest.

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