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EFFECTS OF DIFFERENT ORGANIC APPLICATIONS ON GROWTH AND YIELD OF *Raphanus sativus* (RADDISH)

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ABSTRACT

Radish is an edible root vegetable belonging to the Brassicaceae family. It is a vegetable that matures quickly and is simple to grow. More farmers are switching to use of organic manure as a result of rising knowledge of the risks associated with chemical fertilizers. A field experiment was conducted at the University of Colombo Institute for Agro-Technology and Rural Sciences in Hambantota, Sri Lanka, to evaluate the effects of several organic preparations on the growth and yield of radish. Thirteen treatments were replicated four times following RCBD design. Different organic preparations namely Newly Modified Panchagavya (NMPG), fish tonic, compost tea and a commercially available preparation of Crop Master were used in various concentrations based on the previous research findings and recommendations. Water was applied as a control. Data on plant height, number of leaves, leaf length (cm), leaf width (cm), fresh leaf weight (g), fresh root weight of plant and total yield per treatment (Kg/ha) were recorded and analyzed statistically using ANOVA in SAS 9.1.3 package. The treatment means were compared using DMRT at 5% significance level. The results revealed that, application of NMPG had a significant higher effect on most of the tested parameters. Further, 4% of the NMPG showed better values compared to other concentrations. It was followed by the 3% and 2% of NMPG. Compost tea and crop master followed values next to NMPG. Based on the present findings it can be concluded that, Newly Modified Panchagavya can be used as organic application to cultivate Radish plants with a better growth and yield to obtain potential yield of radish.

Keywords: Newly Modified Panchagavya, Compost tea, Fish tonic, Organic preparations, Radish

INTRODUCTION

The edible section of radish contains 14.8 mg of vitamin C and a range of other nutrients. Othiocyanate is what gives radish its distinctively sour flavor (Kushwah, 2016). It is used to treat piles, piles-related insomnia, persistent diarrhea, and neurological migraines (Singh and Bhandari, 2015). Radish growth and yield are highly reliant on soil and climate factors. For each variety to perform at its best, the soil and climate conditions must be varied. One of the key agro techniques that affects the growth and production of radish is nutrition. The crop's nutritional needs are influenced by soil type, soil fertility, agroclimatic conditions, and variety. The root growth should be quick and unbroken because this crop has a short lifespan and grows quickly. Therefore, optimal fertilization using organic, inorganic, and biofertilizers is necessary to yield good grade radish (Dhanajaya, 2007).

To increase the production of vegetables, excessive amounts of chemical fertilizers are used. Negative consequences on soil resulted from a complete reliance on inorganic fertilizers. Due to growing public awareness, there is an increase in the demand for organic food (Bhatta et al., 2008). In 2018 saw a global market for organic food reach $100 billion USD. But there is a gap between the supply and demand of organic food. In 2017, the percentage of organic vegetable production in overall vegetable production was 1.1%. (Willer and Lernoud, 2019).

It has become necessary to use integrated nutrient management, which uses organic sources like farmyard manure, vermicompost, poultry manure, and neem cake, in order to address the issue of the high cost of chemical fertilizers, meet crop nutrient requirements from a single source, and address the issue of soil health. The application of these organic manures to increase crop production and preserve soil fertility and productivity has gained popularity in recent years. Positive effects of organic manure on soil's water-holding capacity and texture (Kale et al., 1991).

There are many different organic applications on the market, however, there are not quality products to be used. Further, it lacks the knowledge and research findings to use them effectively. In order to determine how various organic applications affect for radish growth and yield, this study was carried out. Its specific objective was to ascertain how does the effective percentage of organic application effect on growth and yield parameters of Radish.

METHODOLOGY

A field study was conducted at the farm field of University of Colombo Institute for Agro-Technology and Rural Sciences, Weligatta, Hambantota, Sri Lanka from 2022 March to May 2022. The field was ploughed and the ground was levelled before preparing the beds. The length and width of a bed was 1m x 1m. Seeds were planted in beds with the spacing of 10cm x 30cm between plants and rows. Watering was done daily.

Application of organic applications

One and a half weeks after planting the seeds, organic liquid applications were applied to the beds. After that, they were applied once a week. When applying treatments, it was applied 500 ml per bed. Application has done as a foliar application.

Treatment structure

The field Experiment was laid out in Randomized Complete Block Design (RCDB) with 13 treatments and four replicates in each. Various organic preparations with different concentrations were used as treatments as follows;

T1 – Newly Modified Panchagavya (NMPG) 2%

T2 - NMPG 3%

T3 - NMPG 4%

T4 – Fish tonic 5%

T5 – Fish tonic 10%

T6– Fish tonic 15%

T7 – Compost tea 30%

T8 – Compost tea 40%

T9 – Compost tea 50%

T10 – Crop master 2%

T11 – Crop master 3%

T12 – Crop master 4%

T13 – Control (Water)

Preparation of the fish tonic (for 5L)

Fish tonic was prepared using 6kg of fish waste and 2kg of sugar to prepare 5 Litres. Fish waste was chopped and added into a plastic bucket and 2kg of sugar was added to the mixture. Then it was mixed once a week and maintained for 2 weeks and then 1 Litre of water was added. Then the mixture was allowed for fermentation for one month. Fermented fish tonic was applied as fertilizer by diluting with water.

Preparation of compost tea (for 150L)

The ingredients used to prepare the compost tea were; 5kg of compost and 250g of sugar. The ingredients were mixed with chlorine free water amount of 150 Litre and it was kept for 7 days while aerating. Later, it was filtered into another container and stored at room temperature in darkness.

NMPG and Crop Master

Commercially available NMPG and Crop Master were used for the experiment.

Analysis of organic preparations

Fish tonic, NMPG , Crop Master and compost tea were tested for its proximate components such as N, P, K, pH and EC.

Data collection

Plant height, number of leaves, length and width of leaves were taken as growth parameters from 40 plants leaving border rows. After harvest, the weight of the plant, the weight of the tuber and total yield were recorded as yield parameters in 40 plants / treatment.

Plant height (cm) was measured in cm using a measuring scale from the soil surface to the end of the leaf. Number of leave per plant were observed in ten plants of each plot. Each leaf was measured after reaching the maximum length, from the sharp section at one end to the point where it joined the stalk at the other, using a ruler. A line of intersection between the cross section and the leaf width serves as the point at which the leaf width is measured to obtain average leaves size (length, width). After harvesting, the weight of the whole radish plant was measured to obtain fresh weight of the total plant and the weight of the leafy part of the radish plant was measured to get Fresh weight of the above ground part. The weight of the root part of the radish plant was measured to obtain fresh weight of the below ground part

Soil Analysis

Random soil samples were taken from the field before the experiment. The sample was kept in a polythene bag. The sample was afterwards dried at room temperature before being sent to TRI Galle for examination of the soil's chemical properties, including its pH, EC, N, P, and K levels.

Analysis of the NMPG, Fish tonic, Crop master and Compost Tea

The nutrient values N, P, K, pH and EC of NMPG manure and fish tonic, Crop Master and compost tea manure were examined.

Data Analysis

To determine the significance at the treatment level, the measured data were statistically evaluated using the Analysis of Variance (ANOVA) using the SAS program version 9.1. The Duncan Multiple Range Test (DMRT) was used to compare the variance between treatment means.

RESULTS AND DISCUSSION

Plant height

It was found that, there were significant differences between the treatments on different organic applications on plant height at 4th week. The higher plant heights were obtained at NMPG in 2% and 3% concentration levels. NMPG was followed by the compost tea and crop master in measured variable. According to Kumaravelu et al. (2009), growth was encouraged at two under Panchagavya irrigation. In almost all of the treatments, Panchagavya encouraged epicotyl extension. The plant height and seedlings' fresh and dry mass are often reserved for panchagavya irrigation. The comparable observations have been made by Muthuvel (2002). In Green gram. The plants significantly doubled in size in a pot study after receiving a 3% Panchagavya spray at ten days after application. At 3% and 4% treatment, the number of nodules, fresh and dry mass, and lateral roots of the plants greatly increased. Growth matched that of management at 5% foliar spray. Additionally, 2% and 3% Panchagavya spray were added, doubling the plant's total leaf area. The number of branches per plant and plant height increased after four Panchagavya sprays at 3%, according to The results of the current research showed that foliar spraying of NMPG at 3% significantly improved yield attributes. The findings of Birendra and Christopher 2007 and Swaminathan et al., 2007 are also in agreement with this observations for Black Gram.

Number of leaves

It was found that, there were significant differences between the treatments on different organic fertilizers on number of leaves. The higher number of leaves was observed in Newly Modified Panchagavya applied with various concentrations. The number of leaves did not significantly alter as the leaf concentration was increased. According to a study by Velmurugan (2005), seed treatment with foliar spray of panchagavya (3%), as opposed to other treatments, resulted in plants that were taller (26.75 cm) and had more leaves (14.0). This was further underlined by Somasundaram and Singaram (2006), who discovered that panchagavya spray had a favorable impact on the development of numerous field crops.

Leaf length

It was found that, there were significant differences between the treatments on different organic fertilizers on Leaf length 4th week. The highest was obtained at Newly Modified Panchagavya 4% concentration level. Increasing the concentration of Newly Modified Panchagavya showed a significant effect on length of the leaves.

Leaf width

It was found that, there were significant differences between the treatments on different organic fertilizers on Leaf width 4th week. The higher values in leaf width were obtained at Newly Modified Panchagavya with 3% and 4% concentration levels. Somasundaram and Amanullah have reviewed and documented the good effects of panchagavya on crop growth and productivity (2007). According to Papen et al. (2002), panchagavya contains phosphobacteria, azotobacter, and azospirillum. In addition to minerals, Panchagavya also contains microorganisms that promote plant growth. According to Sutar et al. (2019), panchagavya spray at 7.5% resulted in noticeably greater growth of the cowpea.

It was found that, there were significant differences between the treatments on different organic applications on plant bio mass. The highest value was obtained at Newly Modified Panchagavya at 4% concentration level.

According to Tharmaraj et al. (2011), the use of Panchagavya significantly increased the number of pods/plant, the number of seeds per pod, the yield of grains, and the look-at weight by 20, 7, 4.2 Kg, and 3.9 g in comparison to NPK and management. The outcomes for the NPK-treated plants were marginally worse to those for the Panchagavya-treated plants. The large improvement in nitrogen content, chlorophyll content, and dry matter accumulation that was demarcated higher than may be attributed to Panchagavya's greater yield and yield qualities In addition, Selvaraj (2003) discovered a 360% increase in French bean yield when Vermicompost and Panchagavya were used. Due to an increase in the biological potency of crop plants, Natarajan (2002) reported that Panchagavya spraying increased the yield of agricultural plants.

Leaf weight

It was found that, there were significant differences between the treatments on different organic fertilizers on leaf weight. The highest was obtained at the Newly Modified Panchagavya 4% concentration level. It was followed by the other tested concentration levels of Newly Modified Panchagavya. Plants sprayed with panchagavya invariably produce larger leaves and create a denser canopy, according to Somasundaram and Amanullah (2007); Tharmaraj et al. (2011).

Table 1: Proximate analysis of organic preparations

Parameters	NMPG	Fish tonic	Compost tea	Crop Master
pH	3.37	4.40	6.50	6.70
EC	-	9.48	1.50	1.40
N	2.76	Not detected	0.03%	2.2%
P	0.25%	2.80%	Not detected	1.5%
K	2.41%	1.28%	0.17%	2.00%

Above table 1 is indicating the pH, EC, N, P and K components of the used organic preparations.

Table 2: Effect of different organic applications on growth parameters. Plant height, number of leaves, leaf length and leaf width (Mean values of 40 plants)

Treatment	Plant height cm	Number of leaves	Leaf length cm	Leaf width cm
T1	15.33 ± 0.02^{a}	10.17 ± 0.05^{a}	11.06 ± 0.02^{c}	5.91 ± 0.01^{b}
T2	15.53 ± 0.72^{a}	10.20 ± 0.16^{a}	11.20 ± 0.13^{b}	5.72 ± 0.48^{a}
T3	13.05 ± 0.02^{b}	10.32 ± 0.12^{a}	11.33 ± 0.02^{a}	5.98 ± 0.00^{a}
T4	7.94 ± 0.01^{cd}	5.50 ± 0.08^{e}	6.63 ± 0.03^{g}	3.61 ± 0.00^{d}
T5	7.96 ± 0.01^{cd}	5.50 ± 0.11^{e}	6.64 ± 0.01^{g}	3.62 ± 0.01^{d}
T6	7.98 ± 0.00^{cd}	5.52 ± 0.09^{de}	6.66 ± 0.01^{g}	3.63 ± 0.00^{d}
T7	9.81 ± 0.02^{c}	5.72 ± 0.12^{c}	9.58 ± 0.05^{e}	4.30 ± 0.00^{c}
T8	9.88 ± 0.01^{c}	5.80 ± 0.08^{c}	9.60 ± 0.00^{de}	$4,32\pm0.00^{c}$
T9	9.95 ± 0.01^{c}	5.85 ± 0.05^{bc}	9.66 ± 0.01^{d}	4.33 ± 0.02^{c}
T10	9.44 ± 0.06^{c}	5.52 ± 0.22^{de}	8.67 ± 0.05^{f}	4.20 ± 0.01^{c}
T11	9.47 ± 0.06^{c}	5.70 ± 0.00^{cd}	8.65 ± 0.07^{f}	4.23 ± 0.00^{c}
T12	9.48 ± 0.06^{c}	6.00 ± 0.08^{b}	8.68 ± 0.09^{f}	4.22 ± 0.02^{c}
T13	6.93 ± 0.02^{d}	5.22 ± 0.05^{f}	4.94 ± 0.01^{h}	3.52 ± 0.01^{d}
Sig.	*	*	*	*

The values indicate the mean ± standard error of four independent samples. According to DMRT, means with identical superscripts in the same column are not statistically different at the 0.05 probability level. "" and "ns" indicate significance at P0.05 and non-significance, respectively.*

Table 3: Effect of different organic applications on yield parameters

Treatment	Leaf Fresh weight/plant (g)	Root fresh weight/plant (g)	Yield (Kg/ha)
T1	131.48 ± 0.11^{c}	95.50 ± 0.00^{b}	22600.98 ± 0.11^{c}
T2	136.80 ± 0.53^{b}	96.10 ± 0.06^{a}	23200.90 ± 0.60^{b}
T3	138.56 ± 0.28^{a}	96.56 ± 0.02^{a}	23500.16 ± 0.29^{a}
T4	45.00 ± 0.17^{g}	85.46 ± 0.40^{e}	13000.48 ± 0.57^{f}
T5	45.30 ± 0.15^{g}	86.08 ± 0.08^{d}	13100.39 ± 0.22^{e}
T6	45.21 ± 0.04^{g}	87.45 ± 0.28^{c}	13200.70 ± 0.26^{d}
T7	63.15 ± 0.03^{d}	40.23 ± 0.46^{h}	10300.38 ± 0.45^{j}
T8	63.20 ± 0.00^{d}	40.62 ± 0.07^{h}	10300.82 ± 0.07^{j}
T9	63.22 ± 0.02^{d}	40.71 ± 0.69^{h}	10300.89 ± 0.37^{j}
T10	51.71 ± 0.03^{f}	53.68 ± 0.03^{g}	10500.42 ± 0.38^{i}
T11	51.90 ± 0.06^{f}	54.61 ± 0.23^{f}	10600.51 ± 0.28^{h}
T12	52.51 ± 0.48^{e}	55.15 ± 0.02^{f}	10700.66 ± 0.49^{g}
T13	30.07 ± 0.59^{h}	23.20 ± 0.25^{i}	5300.28 ± 0.18^{l}
Sig.	*	*	*

The values indicate the mean ± standard error of four independent samples. According to DMRT, means with identical superscripts in the same column are not statistically different at the 0.05 probability level. "" and "ns" indicate significance at P0.05 and non-significance, respectively.*

Root weight

It was found that, there were significant differences between the treatments on different organic fertilizers on root weight. The higher values in root weights were obtained at 3% and 4% concentrations of Newly Modified Panchagavya. This was proved with several previous studies also. *Abelmoschus esculentus* yield parameters were multiplied in three times panchagavya spray when compared to control and varied concentrations, claim Rajasekaran and Balakrishanan (2002). According to Tharmaraj et al. (2011), the use of panchagavya improved production and disease resistance in a variety of pulse plant species, including Radish, *Vigna mungo*, *Arachis hypogea*, *Cyanopsis tetragonoloba*, *Lablab purpureus*, *Cicer arietinum*, and *Oryza sativa*. According to Boraiah et al. (2017), the use of Jeevamrutha, cow urine, and Panchagavya half-percent spray resulted in significantly higher fruit yields than other organic liquid formulations.

According to Kanimozhi et al. (2003), Panchagavya application at 4% spray was discovered to be superior in terms of root yield. Furthermore, Suchitra Rakesh et al. (2017) noted that when *Abelmoschus esculentus* was sprayed with different concentrations of panchagavya, yield parameters including fruit weight and number were presented. When compared to control and other concentrations, the plants sprayed with 3% concentration of panchagavya produced the highest yield parameters, including fruit weight and number (30.67 mg/fruit).

Subramanian et al. (2005) claim that employing panchagavya increases yield, improves product quality, is less expensive, and is more environmentally friendly with no negative side effects. When compared to control and other concentrations, the yield metrics of Abelmoschus esculentus (fruit number and weight) were increased with 3% panchagavya spray. Similar results were seen in *Vigna mungo*, *Oryza sativa*, black and green grams (Brito and Girija, 2006), groundnut, and *Vigna mungo* and *Oryza sativa* (Rajasekaran and Balakrishanan, 2002). (Ravikumar et al., 2012). Panchagavya improves the keeping quality of vegetables and fruits as well as the growth and vigor of crops by fostering resistance to pests and illnesses (Natarajan, 2002). In terms of increased growth and productivity, panchagavya spray was reported to be more effective on all crops than the prescribed nutrients and growth (RFS).

CONCLUSIONS

Considering the growth and yield performances of radish, Newly Modified Panchagavya (NMPG) with tested concentrations showed significant higher values compared to other organic applications. Further, 4% of NMPG solution can be recommended for obtaining the better growth and yield of *Raphanus sativus* as a eco-friendly cultivation strategy with optimum production.

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