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RESEARCH ARTICLE

THE POTENTIAL EFFECT OF FISH WASTE FERTILIZER ON THE GROWTH AND YIELD OF *AMARANTHUS DUBIUS* AND TRIGONELLAFOENUM-GRAECUM

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Abstract

The present investigation has been designed to prepare the organic fertilizer from fish waste and to study the efficacy of fish waste fertilizer on the growth and yield of the plants *Amaranthus dubius* (amaranthus) and *Trigonella foenum- graecum* (coriander). Fish wastes collected from the slaughter house has been converted into fertilizer and the nutrient quality in terms of protein, carbohydrate, nitrogen, phosphorous and potassium contents in the fish waste fertilizer were tested using standard procedures. For assessing the potential effect of prepared fertilizer on growth and yield, fish waste fertilizer sprayed (foliar spray) on the experimental plants in the interval of seven days and up to 35 days of experimental period. Triplicates experimental setup were maintained for both the experimental plants and Control (water). During the experimental period, plants in both control and experimental pots were randomly selected which had nearly same height in order to record various growths and yield parameters. The impact of treatment has been studied in terms of growth and yield parameters such as plant height (cm), shoot length (cm), number of leaves (cm), number of branches (cm), leaf length (cm), length of internodes (cm), root length (cm) and stem diameter (cm).

Introduction:-

Wastes are the remains of anything that we use; they are also main pollutants of our environment. Wastes are of different types depending on their source, slaughterhouses are serving a social cause for the flies and pathogenic microbes, as breeding grounds for these disease causing and disease spreading agents. These wastes are easily broken down by a class of microbes known as decomposers (Balkhandev, 2020). Fish remains have also been traditionally used as fertilizer, given their wealth of nutritive elements (principally N and P) and their rapid decomposition. Nearly 75% of the total weight of the fish was generated as solid waste in the form of gut, head, skin, bones, fins and frames after processing. The fish wastes rich in nitrogen, potassium, phosphorus and trace minerals can serve as raw material for the production of many nutritive and nonnutritive products. Application of organic waste in soil is a suitable method for the maintenance of soil organic matter, improve soil fertility and supply nutrients needed by plants. Organic fertilizers are organic materials that are more environmentally friendly compare to chemical fertilizer (Ellyzatul et al., 2018).

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Fermentation process converts the solid substrates in to simple molecules with the aid of microbes. It is one of the hopeful technologies which convert the fish waste in to valuable organic manure, an expensive resource for agriculture without the formation of fusty odor. The nutrients in the fish emulsion stimulate the growth of the plants through growth promoting rhizobacteria, fixing up the atmospheric nitrogen and increasing the uptake of essential nutrients. Fish waste contains essential minerals like calcium, phosphorus, potassium, sodium, magnesium, zinc, manganese and copper similar to the nutritive value as fish. The amount of protein, amino acids, calcium and phosphorus were found to be increased after the fermentation of the fish waste. Amino acid is one chief forms of nitrogen, used by the plants for their growth.

Radziemska et al., (2018) evaluated the effect of compost from fish waste as a fertilizer for agricultural use. A pot experiment was conducted to compare the effects of compost from fish waste on the yield and macro and microelemental composition of ice lettuce (*Lactuca sativa* L.). Ndubuisi (2019) conducted a study on response of fish pond effluent as organic fertilizer on growth of cucumber (*Cucumis sativus*) and soil chemical properties in Igbariam, South Eastern Nigeria. Ahuja et al., (2020) conducted a study about the production and uses of fertilizers from fish and fish waste that may be applicable for certified organic farming, with a focus on crop and horticultural plants. Da et al., (2020) assessed fish waste based fertilizer on the cucumber (*Cucumis sativus* L.) vegetable growth and yield. Devi et al., (2020) conducted an experiment to assess the influence of foliar application of organic liquid manures prepared on the growth, yield and quality of amaranthus. With this background, the present study has been designed to prepare the organic fertilizer from fish waste and to study the efficacy of fish waste fertilizer on the growth of the plants *Amaranthus dubius* and *Trigonella foenum- graecum*.

Materials and Methods:-

The present investigation has been designed to prepare the organic fertilizer from fish waste and to study the efficacy of fish waste fertilizer on the growth of the plants (*Amaranthus dubius* and *Trigonella foenum- graecum*).

Collection of Fish Waste

Well blended mixture consisting of the head portion, intestines and gills of the fish waste were collected from the local fish market at Mananthavady, Wayand, and Kerala. Raw materials needed for the preparation of fish waste fertilizer such as jaggery (2 kilograms), bananas were collected from the local shops.

Preparation of Fish Waste Fertilizer

A clean clay pot of 10 liters capacity was taken and filled with 5 litter of water. 2 kg of powdered native jaggery was added and stir well to dissolve. Then 2 Kg of fish waste including skin, intestine, head, gills and gut was added and mixed thoroughly. Two well blended bananas were added in to the mixture and mixed thoroughly. The mouth of the pot was covered with a cotton cloth to prevent the entry of flies. The content of the pot was mixed every day. After 15 days, the contents were filtered and the filtrate was used as organic liquid fertilizer. Filtrate was diluted in 1:10 ratio with water for 5litres.

Parameters Analysed

Protein and carbohydrate contents in the fish waste fertilizer were estimated using the method of A.O.A.C. (1975). Nitrogen, phosphorous and potassium present in the fish waste fertilizer was tested using flame photometer.

Efficacy of Fish Waste Fertilizer on Growth parameters

Collection of Seeds

Healthy seeds of amaranthus and coriander were obtained from the agricultural nursery (at Bathery, Wayanad) and seeds were sown in pots and watered as required.

Experimental Growth Setup

Triplicates experimental setup were maintained for both the experimental plants. 10 ml of fish waste fertilizer was applied (Spray method) to the pots in the interval of seven days. A water control was also been setup to know a difference in the growth of the plant. Experiment was carried out for 35 days.

Growth Parameters

The plants in both control and experimental pots were randomly selected which had nearly same height in order to record various growths and yield parameters. The impact of treatment has been studied in terms of growth and yield

parameters: Plant height (cm), root length (cm), shoot length (cm), number of leaves, number of branches, leaf length (cm), length of internodes (cm) and stem diameter (cm).

Statistical Analysis
All data obtained from experiments were subjected to Students t - test to compare the significance between control and experimental plants. Significance was considered as 5% ($P<0.05$) level.

Results and Discussion:-

Application of organic waste in soil is a suitable method for the maintenance of soil organic matter, improve soil fertility and supply nutrients needed by plants. Organic fertilizers are organic materials that are more environmental friendly compare to chemical fertilizer. A biofertilizer means use of living organisms to continuously supply nutrients to the soil. It maintains the natural habitat of the soil. It has better growth and productivity of crops. They are less expensive than chemical fertilizers, easily producible, eco-friendly and one of the best organic growth regulators. However little information is available that demonstrate the potential of organic liquid fertilizer and their role in supplying a balanced nutrient supply, the present work was taken up in *Amaranthus dubius* and *Trigonella foenum- graecum* in order to evaluate the growth promoting effects of fish waste fertilizer.

The potential effect of fish waste fertilizer on the growth of plants (*Amaranthus dubius* and *Trigonella foenum-graecum*) has been tested and the results are presented in the tables 1-8.

Table 1:- Nutrient Value of Fish Waste Fertilizer.

Sodium	Potassium	Phosphorus	Protein	Carbohydrate
639± 0.01gm	634± 0.41gm	76.5±0.06 gm	0.20±0.10 gm	8.20±0.14 gm

Table 2:- Day of Germination of *Amaranthus dubius* and *Trigonella foenum- graecum*.

	Amaranthus dubius		*Trigonella foenum- graecum*	
Experiment	Control	Treatment	Control	Treatment
Day of germination	5th day	3rd day	6th day	3rd day

Table 3:- Plant height (cm) of *Amaranthus dubius* and *Trigonella foenum- graecum*.

Week	*Amaranthus dubius*		*Trigonella foenum- graecum*	
	Control	Treatment	Control	Treatment
1	4.5±0.55	9.2±0.60	3.2±1.98	10.2±0.18
2	5.8±0.41	11.5±1.02	4.6±0.60	11.5±0.20
3	6.5±0.19	20.5±1.36	5.2±0.41	17.6±0.10
4	7.9±0.07	32.5±2.11	7.1±0.10	30.3±2.35
5	10.2±1.22	39.5±1.26	9.2±0.12	37.1±0.41

Values are represented as mean± SE

Table 4:- Shoot length (cm) of *Amaranthus dubius* and *Trigonella foenum- graecum*.

Week	*Amaranthus dubius*		*Trigonella foenum- graecum*	
	Control	Treatment	Control	Treatment
1	3.4±0.21	6.2±1.00	3.2±0.32	5.8±0.40
2	4.2±0.43	6.9±1.96	4.1±3.16	6.7±0.60
3	5.4±0.11	10.4±3.29	4.3±0.22	10.2±0.17
4	6.8±0.39	15.6±0.20	6 .2±0.96	14.4±2.63
5	8.7±0.07	21.6±0.83	7.4±0.61	20.5±1.72

Values are represented as mean± SE

Table 5:- Leaf surface area (cm) of *Amaranthus dubius* and *Trigonella foenum- graecum*.

Week	*Amaranthus dubius*		*Trigonella foenum- graecum*	
	Control	Treatment	Control	Treatment
1	0.2±2.18	0.6±0.03	0.3±1.59	0.5±1.00
2	0.5±0.53	2.2±2.76	0.5±0.62	2.5±0.71

3	1.3±1.57	3.6±1.67	1.2±0.74	3.5±0.50
4	2.0±1.29	4.1±3.65	2.1±0.12	3.9±0.03
5	2.4±2.55	4.6±2.10	2.5±0.98	4.3±0.10

Values are represented as mean± SE

Table 6:- Length of internodes (cm) of *Amaranthus dubius* and *Trigonella foenum- graecum*.

Week	*Amaranthus dubius*		*Trigonella foenum- graecum*	
	Control	Treatment	Control	Treatment
1	0.1±0.03	0.1±0.60	0.1±0.81	0.2±1.62
2	0.5±0.62	2.1±0.04	0.4±0.07	2.4±2.31
3	1.2±0.16	3.5±0.73	1.1±0.05	3.7±1.43
4	1.7±1.07	4.6±1.02	1.8±0.11	4.8±1.02
5	2.5±0.02	5.8±0.84	2.7±1.00	6.0±1.80

Values are represented as mean± SE

Table 7:- Root length (cm) of *Amaranthus dubius* and *Trigonella foenum- graecum*.

Week	*Amaranthus dubius*		*Trigonella foenum- graecum*	
	Control	Treatment	Control	Treatment
1	0.7±2.20	4.1±0.16	0.6±0.72	4.2±1.47
2	1.8±1.20	6.5±1.90	1.7±1.67	6.2±1.65
3	2.3±1.70	7.7±0.24	2.6±0.13	7.3±0.19
4	5.7±0.01	8.1±0.10	5.4±1.35	8.1±0.62
5	6.6±1.33	9.6±0.21	6.4±1.10	9.4±0.70

Values are represented as mean± SE

Table 8:- Stem diameter (cm) of *Amaranthus dubius* and *Trigonella foenum- graecum*.

Week	*Amaranthus dubius*		*Trigonella foenum- graecum*	
	Control	Treatment	Control	Treatment
1	0.1±1.34	0.2±0.47	0.1±0.90	0.2±0.02
2	0.3±0.45	0.3±1.05	0.3±0.07	0.3±1.30
3	0.8±0.35	1.3±1.00	0.6±1.36	1.3±0.52
4	1.3±1.50	1.5±1.34	1.2±0.98	1.6±0.61
5	1.8±2.13	1.9±0.29	1.6±2.76	1.8±0.54

Values are represented as mean± SE

Application of fish waste fertilizer in the soil shortens the germination period and seeds of both the experimental plants were germinated on 3rd day. Foliar spray significantly ($P<0.05$) increased all the growth parameters and overall yield in terms of plant height, shoot length, leaf surface area, stem diameter root length, number of branches and length of inter nodes on the selected experimental plants *Amaranthus dubius* and *Trigonella foenum- graecum*. Maximum plant height (39.5±1.26 cm and 37.1±0.41 cm), shoot length (21.6±0.83 cm and 20.5±1.72 cm), leaf surface area (4.6±2.10 cm and 4.3±0.10 cm), length of internodes (5.8±0.84 cm and 6.0±1.80 cm), root length (9.6±0.21cm and 9.4±0.70 cm) and stem diameter (1.9±0.29 cm and 1.8±0.54 cm) were recorded in *Amaranthus dubius* and *Trigonella foenum- graecum* at the end of the experimental period of 35 days. Number of leaves (10.0±0.00) and branches (8.33±0.10) were also increased in the fish waste fertilizer treated plants than the control plants (7.33±0.10 and 6.0±0.00) during the experimental period. Parallel to the present study Shahsavani et al., (2017) and Khandaker et al., (2017) reported increased growth and yield in *Vigna sinensis* and *Capsicum annuum* grown in fish waste fertilizer.

The present results were also supported by Bhaskoro et al., (2020) reported that the addition of fishbone meal on the production of Gracilaria sp. liquid organic fertilizer increases nitrogen, phosphorus and potassium concentration. The highest concentration of nitrogen, phosphorus and potassium were obtained from 75% fish bone meal addition with 0.69%, 0.42%, and 0.43% respectively. The application of smaller quantities of fish protein hydrolysates in horticultural practices has resulted in increased crop yields and fruit and vegetable quality compared to chemical fertilizers in several studies. Fish processing waste products are currently being transformed into protein hydrolysate liquids or solids. The processing involves several steps such as chemicals or enzymatic hydrolysis, filtration, drying

and storage and many of the processing parameters of these steps are governed by the intended use of the final product (Madende and Hayes, 2020).

Da et al., (2020) also find out the highest fruit yield and fruit number were found when applying 50% of the maximum doses of inorganic and organic fertilizers for the crops both during the dry and wet seasons, whilst the lowest values were obtained when growing cucumbers with only organic fertilizer. The reutilization of fish waste as liquid fertilizer was particularly economical alternative at present, and plant- scale production would be necessary for commercialization (Suganya et al., 2015). The present results also supported by Devi et al., (2020) who studied that the effect of organic foliar spray on growth and yield of *Amaranthus dubius* var. Co-1 was taken up by and they reported that the better growth and yield in test plant. Radziemska et al., (2018) compared the effects of compost from fish waste on the yield and macro and microelemental composition of ice lettuce (*Lactuca sativa* L.). The phytotoxicity degree of the compost and compost effects on seed germination and primary root growth were determined with white mustard (*Sinapis alba* L.). Compost used in the study consisted of fish waste and pine bark and reported that the compost from fish waste is non-phytotoxic, mature, stable and suitable for use in agriculture.

The application fish waste fertilizer in this treatment provided enough nutrients to satisfy the requirements of the amaranthus and fenugreek plants and improved the yields. Tiwow et al., (2019) produced liquid organic fertilizer using this traditional fermentation technology and to analyse macro nutrients of N, P, K elements and micro nutrients of Zn, Mn, Fe, Cu, Ni, Co elements by using spectrophotometry method. The nutrient levels in most part of organic liquid fertilizer from the waste of tilapia fish met the general quality standard levels of the liquid organic fertilizer.

Conclusion:-

In this present investigation, organic fertilizer was prepared from fish waste. Nutritional qualities such as protein, carbohydrate, nitrogen, phosphorus and potassium of prepared fish waste fertilizer were tested using standard procedures. The influence of fish waste fertilizer on the growth and yield of two commercially important plant varieties (*Amaranthus dubius* and *Trigonella foenum- graecum*) was tested. From this study it could be concluded that fish waste fertilizer continuously supply nutrients to the soil. It also maintains the natural habitat of the soil and has better growth and productivity of the selected plants. Fish waste fertilizer is less expensive than chemical fertilizers, easily producible, eco-friendly and one of the best organic growth regulators. It is recommended that the use of fish waste fertilizer would be beneficial to the environment would reduce the use of inorganic fertilizers and promote sustainable agriculture.

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