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EFFECT OF FERMENTED FISH SILAGE MANURE ON THE GROWTH AND YIELD OF OKRA (*Abelmoschus esculentum (L.) Moench*)

S. Tanuja* & S.K. Nayak
ICAR-Central Institute for Women in Agriculture, Plot No. 50-51, Mouza - Jokalandi, P.O. - Baramunda, Bhubaneswar - 751003, Odisha, India
*Corresponding author's email: tanujasomarajan@gmail.com

ABSTRACT
Fish processing operations produce waste in the solid form like fish carcasses, viscera, skin and heads. Quantum of waste generated through fish processing varies from 10% to 80% of the weight of the fish according to the processing activities. The organic components of the waste have a high biological oxygen demand and if not managed properly, can pose serious environmental pollution, thereby contributing to global climate change. It could be converted to valuable by products like fish silage. Fish silage has immense potential to be used as manure because of its rich nutrient content. The present study investigates the effect of application of fish silage liquid manure on the growth and yield of Okra (*Abelmoschus esculentum (L.) Moench.*). Fish silage was prepared from the dressing waste (gut and gills) of fresh water carps using the fermentation process. The experiment was conducted in ICAR-Central Institute for Women in Agriculture, Bhubaneswar, Odisha, Lat 20^0 17'17.43"N and Longitude $85^0$47'8.97E. Treatments consisted of 100% cowdung (10t/ha) (T1), 50% fermented silage (5000L/ha) and 50% cowdung (5t/ha) (T2) and 100% fermented silage (10t/ha) (T3). NPK at the rate of 20:100:100kg/ha was applied in all the treatment plots. The experiment was laid out in a randomized complete block design (RCBD) in three replicates with plot size 2.0 m × 2.0 m each. Data of growth and yield parameters; plant height, number of leaves, leaf length, number of pods, length of pods, fresh weight of pods and average yield were measured. The result revealed that T2 (50% FYM and 50% fish silage) gave higher pod weight (14.88±3.72g), pod length (12.8±2.39cm), pod number (7.61±4.63) and average yield of 116.72 ±94.58g) which is 12.98%, 0.2%, 10.93% and 31.85% higher than 100% FYM (T1). The result shows that fermented fish silage, a byproduct from fish dressing waste, could be used in combination with cowdung to increase the productivity of the soil and yield in okra production and thereby reduce the pollution caused by the fish wastes.

KEY WORDS: Fermented fish silage, Okra.

INTRODUCTION

India stands second in global fish production with an annual fish production of around 10 million metric tonnes. Around 85% of fish produced is consumed in the fresh form (DAHD, 2014) and 10.51 lakh tonnes is exported. India is home to more than 60 minor fishing harbours, around 1500 fish landing centres, 350 seafood processing factories and innumerable number of fish markets where a huge amount of processing waste is being generated. Fish marketing and processing operations produce waste in the solid form like fish carcasses, viscera, skin and heads. Quantum of waste generated through fish processing varies from 10% to 80% of the weight of the fish according to the processing activities. Presently in India, around 960 million tonnes of solid waste is being generated. By 2050, our country would need 9 times the area of land for dumping of wastes which we all know is not feasible taking into account the exponential population growth. The organic components of the fish waste have a high biological oxygen demand and if not managed properly, can pose serious environmental pollution, thereby contributing to global climate change. Production of by products like fish silage is a feasible solution for managing the fish waste is a liquid product which can be made from waste of fish or whole fish that are liquefied by the action of natural enzymes present in the fish (FAO, 2003). Fish silage has immense potential to be used as manure because of its rich nitrogen content. Over the last 50 years, there has been severe depletion in soil fertility of many agricultural soils due to intensive cultivation and excessive application of inorganic fertilizers.This has resulted in degradation of soil structure. There is a need to revitalize these soils with practices such as addition of organic amendment (Magdoff and Weil, 2004). Worldwide, fish meal (Ndiaye *et al.*, 2000) and soluble fish emulsion (El-Tarbily *et al.*, 2003) have been used as fertilizers, either singly or in combination with other amendments to improve yields of many greenhouse and field crops has been used as a soil amendment with great success in vegetable production systems. But reports on the use of fish silage as liquid manure on horticultural crops in India is very limited. The present study investigates the effect of application of fish silage liquid manure on the growth and yield of Okra (*Abelmoschus esculentus*). Okra, or Ladies finger, which is also known as 'Bhindi ', is one of the important vegetables of India. Okra has a good potential as a foreign exchanger crop and accounts for 60% of the export of fresh vegetables. It is cultivated in 0.349 M ha area with the production of 3.344

M mt and productivity of 9.6 mt/ha and Odisha is a major producing state.

MATERIALS & METHODS

Fresh viscera and gills, from dressing wastes of Indian major carps (IMCs), were collected from the local market and transported to the laboratory in ice. The raw material was washed in potable water and minced. 20% w/w jaggery was dissolved in 30% (v/w) water by heating and added to the mince after cooling down to room temperature. Ensilation was done in airtight plastic containers at ambient temperature (28 ±2°C). The mixture was strirred twice daily for 4-5 days till the product attains a semi liquid consistency.

A field experiment was conducted in ICAR- Central Institute for Women in Agriculture, Bhubaneswar, Odisha, Lat 20^0 17’17.43”N and Longitude $85^0$47’8.97E to evaluate the effect of fermented fish silage on the growth and yield of *A. esculentum*. The experimental field soil had a pH of 5.41±0.06, conductivity of 0.05 ±0.02 (dSm^1), Organic carbon 0.38 ±0.11(%), available nitrogen 137.67 ±9.81 (kg/ha), available phosphorus 40.33 ±2.52 (kg/ha) and available potash 132.0 ±40.04 (kg/ha). The nitrogen content in fresh cowdung ranged from 0.4-0.5%. whereas nitrogen content in fermented fish silage manure ranged from 2.55-2.63%.

Experiment was laid out in complete block design with plot size 2.0 m × 2.0 m. Randomized Complete Block Design (RCBD) method was followed with 3 replications and 3 treatments were followed in the study. The okra seeds were planted at a spacing of 60x60 cm. Treatments were 100% cowdung (10t/ha) (T1), 50% fermented silage (4t/ha) and 50% cowdung ((T2)(4t/ha) and 100% fermented silage (10t/ha). NPK at the rate of 20: 100: 100kg/ ha was applied in all the treatment plots.

Data on plant height, number of leaves and leaf length taken from 5 plants /plot were recorded from thirty days after planting. Pods were harvested at three day intervals from 60^{th} day onwards with a total of 10 harvests. Average yield, number of pods, weight of pods and pod length were also determined. Data sets were analysed parameter wise using Analysis of Variance (ANOVA) and all possible pair wise treatments were compared using Tukey’s Honestly Significant Difference (HSD). The data were statistically analysed by statistical package SAS 9.3. The differences between the experimental groups were considered significant at a level of $P<0.05$

RESULTS & DISCUSSION

The result of the study showed that the treatments are capable of improving crop yield and that okra responded well to the fish silage manure. Plant height is an important component that helps to determine plant growth. Plant height ranged from 10.9cm to 15.1 cm in 20 Days, 18.65 to 24.88 in 60 days, 32.07 to 50 cm in 50 days and 44.33 to 59cm in 60 days (Fig. 1). Although plants treated with 100% fish silage (T3) were the tallest, there was no significant difference in height of plants under the different treatments ($P>0.05$). Plants treated with only cow dung had the lowest height. The comparatively higher growth in terms of height in T3 plants might be because of the readily available and easily absorbable form of nutrients from the fish silage manure.

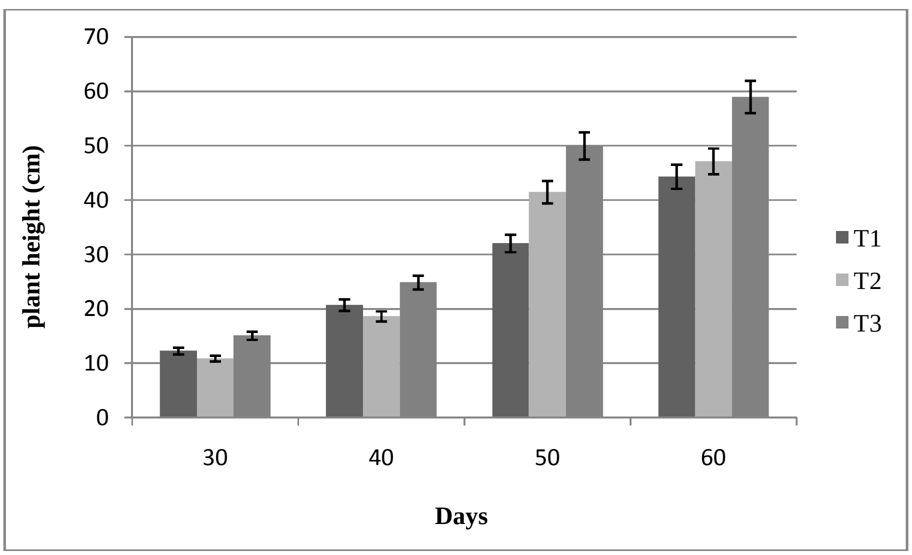

FIGURE 1: Effect of fermented fish silage application on the plant height of Okra

T1= 100% cowdung (10t/ha), T2=50% cowdung (5t/ha)+50% fermented fish silage(5t/ha), T3=100% fermented fish silage (10t/ha).

Changes in the number of leaves are bound to affect the overall performance of a plant as the leaves serve as photosynthetic organ of the plant. There was no significant difference in leaf number and leaf length between the treatments (Table 1). Although non significant, T1 plants which received nutrients from cowdung and fish silage in 1:1 ratio had the highest leaf number/plant and leaf length. This could be attributed to the increased supply of nitrogen to the soil through application of liquid fish silage. The comparatively low values in T3 plants might be because of the low organic carbon content in the fish silage.

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The comparative increase in pod weight, pod number and pod length of okra in T2 treatment may be because 1) 1: 1 ratio of cow dung and fish silage could have supplied the enough nutrients to the plants and 2) the already soubilised protein in the fish silage could have improved the ava8iibality of nitrogen to the plants. Premsekhar and Rajashree (2009) have reported that higher yield response in organic manure applied okra (*A. esculentus*) could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to the plants. The post harvest parameters of number of pods, pod weight and pod length was significantly low in T3 treatment plants. Although the average yield was not significantly different (p>0.05) in T1 and T2, there was an increase of 31.84% yield when fish silage was applied to plots in combination with cowdung. Irshad & Javed (2006) have reported that high yield were obtained for mung bean and okra cultivation when using fish as fertilizer compared to Nitrogen-Phosphorous-Potassium (NPK) and urea fertilizer. The yield was significantly low (p<0.05) in plants which received nutrients from fermented fish silage manure alone. The reduced carbon: nitrogen ratio in the fish silage manure could be a reason for the negative effect

TABLE 1: Effect of fish silage manure application on the growth and harvest parameters of Okra

Treatments	Leaf number	Leaf length (cm)	Average yield	No of pods	Pod weight (gm)	Pod length (cm)
T1	$8.67^{a} \pm 0.12$	$32.53^{a} \pm 0.96$	$88.52^{a} \pm 40.14$	$6.86^{ab} \pm 3.12$	$13.17^{a} \pm 3.99$	$12.78^{a} \pm 2.25$
T2	$8.81^{a} \pm 0.60$	$36.69^{a} \pm 1.09$	$116.71^{a} \pm 31.1$	$7.62^{a} \pm 4.65$	$14.88^{a} \pm 4.09$	$12.81^{a} \pm 2.55$
T3	$8.47^{a} \pm 0.83$	$31.73^{a} \pm 5.83$	$54.62^{b} \pm 24.22$	$4.29^{b} \pm 1.53$	$12.73^{a} \pm 3.79$	$12.21^{a} \pm 3.27$

T1= 100% cowdung (10t/ha), T2=50% cowdung (5t/ha)+50% fermented fish silage(5t/ha), T3=100% fermented fish silage (10t/ha). The values indicate Mean±SD of 3 replications. The same superscript alphabets across a column indicate non significant difference (P>0.05)

Conclusion and Recommendation

The results obtained showed that okra responded well to the application of fermented fish silage manure in combination with cowdung in 1:1 ratio. The production of fish silage manure from fish waste will not only prove as an excellent source of organic manure but will also help to alleviate the environmental pollution caused by the dumping of fish waste in and around human habitations. Fermented fish silage manure could be farm made by the farmers because of its ease of preparation and low cost involved in production.

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