International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; SP-8(5): 15-18

Received: 15-07-2020
Accepted: 20-08-2020

S Shenbagavalli
Department of Soil Science and Agricultural Chemistry, AC&RI, Killikulam, Tamil Nadu, India

T Prabhu
Krishi Vidyan Kendra, Nagerkovil, Tamil Nadu, India

S Ponmani
Mother Therasa Agricultural College, Pudukottai, Tamil Nadu, India

Corresponding Author:
S Shenbagavalli
Department of Soil Science and Agricultural Chemistry, AC&RI, Killikulam, Tamil Nadu, India

Effect of Fishwaste compost on nutrient content and uptake of black gram

S Shenbagavalli, T Prabhu and S Ponmani

DOI: https://doi.org/10.22271/chemi.2020.v8.i5a.10363

Abstract
The main objective of this study was production of compost from fish waste generated from the seafood processing unit and fish market. The fish waste was acidic in pH (6.1) with EC of 3.8 dSm^{-1}. The total N, P, K of the fish waste was 10.17, 0.20 and 0.74% respectively. It also had an appreciable amount of organic carbon content 46.22%. The calcium and magnesium content of fish waste were 1.86 and 0.15% respectively. A compost pile was created using the windrow method. The fish waste compost (FWC) was neutral in pH (7.1) with low soluble salts (EC = 0.38 dS m^{-1}). It was 28% of organic carbon content and appreciable amount of N (1.6%), P (0.16%) and K (0.21%). A pot study was conducted to examine the effect of fish waste compost on growth and yield parameters of black gram. Among the different treatment, application of FWC @ 4t/ha (T5) enhance the growth and yield parameters of black gram.

Keywords: Fish waste compost, growth parameter, yield parameter, black gram

Introduction
In India many restaurants specialize in sliced raw fish, and large amounts (approximately 2100 t/day) of fish waste are generated every day. These wastes are dumped in the vicinity of the seafood processing plants and they lead to environmental pollution. Hence ways and means of utilizing these wastes for productive purposes need to be examined. Direct use of fish waste for land manuring has been discouraged primarily due to the obnoxious odour of putrefied fish.
Fish waste can also be converted as fertilizer through acid digestion and solubilisation of fish waste with urea. However, the fertilizer produced deploying the above method showed poor balance among components like N, P and K. The solid wastes of finfish and shell fish in seafood processing plants and the sludge generated in the wastewater treatment plants can both be converted into manure by composting - a bio-conversion process. Fish manure contains NPK and micronutrients are necessary for plant growth. (Chand *et al.*, 2006) [1]. In this context, fish waste samples are collected and produced compost and then used for crop growth experiment.

Materials and Methods
Collection and Characterization of Fish wastes
Fish wastes were collected from the Fish market and seafood processing unit, Thoothukudi District, which contains head, tail, shells, intestine, fins, dead fishes and etc. The collected fish wastes were cleaned and washed with water to remove dirt and slick. The sample was dried at 60^0C in oven followed by reduced into fine powder using pestle and mortar. It was sieved using a sieve with 0.2mm and stored for further analysis. The aqueous extracts (substrate/water 1:5 v/v) were used to determine the pH, electrical conductivity. After acid digestion with H_2SO_4 and H_2O_2 30%, Ca and Mg levels were determined by atomic absorption and Na and K by emission. Levels of P were analysed using colorimetry.
The C: N ratio of the compost were measured by the method followed by Knnunen, *et al.*, 2005 [3]. Moisture was determined by drying the samples in oven at 105 °C to constant weight (Egan *et al.*, 1997) [2]. All parameters were determined in triplicate and the data shown are mean values. The characteristics of fish waste are presented in Table.1.

Composting of Fish waste

A compost pile was created using the windrow method. Fish wastes were collected from the Fish market and seafood processing unit, Thoothukudi District, which contains head, tail, shells, intestine, fins, dead fishes and mixed with cowdung. To increase the C/N ratio in the composting materials, saw dust (particle size 10- 20mm) from local saw mill was added. These materials were spread in a compost pile 2 m wide at the base, 1 m high and 6 m long, with a total final volume of 10 m^3. To avoid nutrient washout, the pile was set on an impermeable base and sheltered above. The proportion of fishwaste, cowdung and saw dust was 1:1:2.The total duration of the composting process was four months. The compost pile was turned weekly during the first two months and every 15 days during the last two months. The temperature and O_2 levels were tested weekly to monitor the correct development of the process. Once the compost was considered mature, it was sifted using a 20- mm mesh screen and stored for further studies.

Evaluation of fish waste compost on black gram

The effect of fishwaste compost on blackgram(*Vigna mungo* (L).) variety KKM 1 was examined through a pot experiment. The varietal characters of the cultivars are given below.

Table 1: Varietal characteristics of KKM-1 black gram

Characters	Descriptions
Parentage	COBG 643 x VBN 3
Habit	Determinate
Maturity duration (Days)	65 - 70
Plant height (cm)	45 - 60
Days to 50% flowering	35
Colour of seed	Dull black
100 grain weight (g)	4.47
Average yield (kg ha^{-1})	607

The air dried samples were used in the crop growth experiments. Physical, chemical and biological characteristics of soil were determined as per the standard procedure. The soil collected for the pot culture experimentation *i.e.,* sandy clay loam soil from the garden land of AC & RI, Killikulam. Mud pots were utilized for this experimentation. Each pot was filled with 15 kg of soils. The amendments such as RDF and fish waste compost were mixed well with respective pots as per treatment plan. The recommended dose of fertilisers for black gram is 25: 50: 25 kg of N, P_2O_5 and K_2O per hectare. The following treatments with three replication each were imposed.

T_1 -Recommended dose of fertilizer; T_2-RDF + FWC (1 t ha^1)
T_3 -RDF + FWC (2 t ha^{-1}); T_4-RDF + FWC (3 t ha^{-1})
T_5 -RDF + FWC (4 t ha^{-1}); T6 -RDF + FWC (5 t ha^{-1})

After a week of equilibration, black gram (KKM 1) seeds were sown. After establishment, a single healthy plant was allowed to grow in the pots. Irrigation was given as and when required to maintain optimum moisture condition throughout the experiment. The pots were arranged in a randomized block design.The height of plant, 50% flowering, Root length, Number of nodules were recorded at vegetative, flowering and harvest stages of the crop. Pods were harvested after maturity and yield was recorded for each pot. Dry matter yield, Number of pods $plant^{-1}$, Number of grains pod^{-1}, hundred grain weight, Haulm and grain yield were recorded at harvest stage of the crop.

Results and Discussion

The fish waste was acidic in pH (6.1) with EC of 3.8 dSm^{-1}. The total N, P, K of the fish waste was 10.17, 0.20 and 0.79% respectively. It also had an appreciable amount of organic carbon content 46.22%. The calcium and magnesium content of fish waste were 1.86 and 0.15% respectively. Saw dust recorded the highest C:N ratio of 75:1. The total NPK content of the saw waste is very low. Some important characteristics of the fish waste compost are presented in Table 2. The results revealed that the compost was neutral in pH (7.1) with low soluble salts (EC = 0.38 dS m^{-1}). It was 28% of organic carbon content and appreciable amount of N (1.6%), P (0.16%) and K (0.21%).

Table 2: Characteristics of raw materials used for composting (on Dry Weight basis)

S. No.	Parameters	Fish waste	Saw dust
1.	pH (1: 5)	6.1±0.61	7.5±0.75
2.	EC (1: 5) (dSm^{-1})	3.8±0.38	0.78±0.08
3.	C:N Ratio	4.5±0.45	75±7.50
4.	Organic carbon (%)	46.2±4.62	31.5±3.15
5.	Total Nitrogen (%)	10.17±1.02	0.42±0.04
6.	Total Phosphorus (%)	0.2±0.02	0.06±0.01
7.	Total Potassium (%)	0.79±0.08	0.65±0.07
8.	Total Calcium (%)	1.86±0.19	0.31±0.03
9.	Total Magnesium (%)	0.15±0.01	0.29±0.03

Mean value ± Standard deviation

Table 3: Characteristics of final harvested fish waste compost

S. No.	Parameters	Fish waste Compost (FWC)
1.	pH (1: 5)	7.1±0.71
2.	EC (1: 5) (dSm^{-1})	0.38±0.04
3.	C:N Ratio	17.1±2.80
4.	Organic carbon (%)	28±0.16
5.	Total Nitrogen (%)	1.6±0.02
6.	Total Phosphorus (%)	0.16±0.02
7.	Total Potassium (%)	0.21±1.71

Effect on nutrient content and uptake of black gram

Nitrogen content &uptake

A progressive increase in the nitrogen content was documented over control. The N content in haulm ranged from 0.95 to 1.09 per cent (Table 4). T_5 receiving RDF + FWC @ 4 t/ha recorded the maximum nitrogen content of 1.20 per cent. whereas, the N content in grain ranged from 1.95 to 2.20 per cent.

Table 4: Effect of FWC on N (%) content and uptake ($mgplant^{-1}$) of black gram

Treatment	N content(%)		N uptake ($mgplant^{-1}$)	
	Grain	Haulm	Grain	Haulm
T_1	1.95	0.95	42.42	61.47
T_2	2.06	0.98	46.14	65.34
T_3	2.01	0.97	44.47	63.87
T_4	2.11	1.02	53.04	73.00
T_5	2.18	1.20	65.80	103.79
T_6	2.20	1.09	58.76	85.02
Mean	2.13	1.09	58.97	87.03
SEd	0.08	0.04	2.37	3.04
CD (0.05)	NS	0.10	4.88	6.26

The maximum N content in grain (2.20%) was recorded in T_6 (RDF + FWC @5 t/ha). The nitrogen content of black gram was least under control both for haulm (0.95%) and grain (1.95%).

Significant impact was noted on the N uptake by the black gram owing to the integrated application of RDF and FWC. The total N uptake by the black gram ranged from 42.42 to 58.97 mg plant^{-1} in grain and 61.47 to 103.79 mg plant^{-1} in haulm. Among the treatments, T_5 recorded the highest N uptake both in grain (65.80 mg plant^{-1}) and haulm (103.79 mg plant^{-1}) respectively.

The lowest uptake of N (42.42 mg plant^{-1}) in grain and (61.47 mg plant^{-1}) in haulm was duly observed with T_1at harvest stage of the crop growth (Table 4).

The application of FWC significantly increased the nutrient availability and enhanced the nutrient uptake in black gram. Different levels of application of FWC increased the nitrogen content in black gram and concurrently accumulated higher N in plant biomass.

The higher N availability from the soil through inorganic fertilization, conducive soil condition created by the organics and slow release of nitrogen from the FWC (Manna *et al.*, 2005) might be reason for this higher N accumulation in black gram. Similar findings were observed.

Phosphorus content &uptake

Phosphorus content of black gram was considerably influenced by FWC at harvest stage of crop. It varied from 0.39 to 0.60 per cent in grain and 0.17 to 0.27 per cent in haulm of the black gram.

Table 5: Effect of FWC on P content (%) and uptake (mgplant^{-1}) of black gram

Treatment	P content%		P uptake (mg plant^{-1})	
	Grain	Haulm	Grain	Haulm
T_1	0.40	0.17	8.70	11.00
T_2	0.39	0.17	8.74	11.34
T_3	0.39	0.17	8.63	11.19
T_4	0.44	0.21	11.06	15.03
T_5	0.60	0.27	17.96	23.35
T_6	0.54	0.23	14.42	17.94
Mean	0.50	0.22	14.16	18.02
S.Ed	0.01	0.008	0.64	0.78
CD (0.05)	0.03	0.017	1.32	1.61

The phosphorus content in grain was significantly higher (0.60%) with the treatments that received RDF and FWC@4 t/ha (T_5) which was followed by T_6 (0.54%). All these treatments were statistically on par. Similar treat mental effect was observed for P content in the haulm too. The control displayed minimum P content of 0.17 per cent in haulm and 0.4% in grain.

The P uptake of black gram was ranged from 8.63 to 17.96 mg of plant^{-1} in grain and 11 to 23.35 mg plant^{-1} in haulm (Table 5). Among the combinations of treatments, the highest P uptake in grain was recorded (17.96 mg plant^{-1}) in T_5 receiving RDF and FWC@4 t/ha. The lowest P uptake in haulm (11 mg plant^{-1}) recorded in T_1 and grain (8.63 mg plant^{-1}) was observed in T_3.

Similar trend of nutrient accumulation was observed both for P and K. The higher P accumulation in biomass is predominantly due to the supply of P from the added inorganic fertilizer.

Further, the releases of organic acids from the decomposition of FYM reduce the P fixation in soil solid, which resulted in enhanced P availability to plants. Wakudkar *et al*., (2018) observed similar trend in black gram.

Potassium content & uptake

The data affirmed that K content in black gram grains ranged from 1.10 to 1.31 per cent (Table 15). The application RDF with FWC considerably influenced K content in crop. T_5 receiving RDF + FWC @ 4 t/ha recorded maximum grain K content (1.31%), Similar treatmental effect was observed for haulm K content too. The lowest K content in grain recorded (1.10%) with T_2 and haulm (0.82%) in control.

Table 6: Effect of FWC on K content (%) and uptake (mgplant^{-1}) of black gram

Treatment	K content (%)		K uptake (mg plant^{-1})	
	Grain	Haulm	Grain	Haulm
T_1	1.15	0.82	25.02	53.06
T_2	1.10	0.83	24.64	55.34
T_3	1.12	0.82	24.78	53.99
T_4	1.19	0.91	29.91	65.13
T_5	1.31	1.01	39.54	87.36
T_6	1.24	0.95	33.12	74.10
Mean	1.22	0.93	33.97	74.69
S.Ed	0.05	0.03	1.38	2.26
CD	0.10	0.06	2.84	4.66

The K uptake in black gram ranged from 53.06 to 87.36 mg plant^{-1} in haulm of black gram. The highest grain K uptake of 39.54 mg plant^{-1} was recorded in treatment combinations of RDF + FWC @ 4 t/ha (T_1). This was followed by recommended dose of RDF + FWC@5 t/ha (T_6) with 33.12 mg plant^{-1}. The lowest grain K uptake in black gram was recorded 24.64 mg plant^{-1} in T_2.

The higher biomass K in black gram is contributed by many factors. Being rich in available potassium, soil supplies sufficient K from the soil to plant. Further, K is supplied through K fertilization, which additionally supplied the K to plant besides the positive influence of FWC. The findings are in agreement with Navsare *et al*., (2018) [11].

Increased the levels of application of FWC in soil, enhanced the content and uptake of nutrient in black gram. Compost applied soil easily absorbed and translocated to the plants directly without spending energy for their transport and without any loss in transit, resulted in increased NPK content and uptake by the crop. Similar results were earlier reported by Ravi *et al*., (2010)

Conclusion

The seafood processing plant and capture fisheries produce huge amount of solid waste. The waste from fishes are viscera, offal, skin, scales, shells and other body parts are rich in variety of plant nutritive elements and devoid of hazardous contaminants and pathogens. Disposal of solid waste generated from seafood processing plant has always been a problem for seafood processors. The inappropriate disposal of solid fish wastes may result in environmental problems, such as groundwater and surface water pollution through the leaching due to its high nutritive content. These wastes could be converted into eco-friendly compost through bioconversion process. Composting is a biotechnological process by which different microbial communities acted upon complex organic matter and convert it into simpler nutrients. Composting of fish waste is a relatively new, practical and an environmentally sound alternative to fish waste disposal. It is economical, fairly odourless and a biologically beneficial practice for seafood operations.

References

1. Chand S, M Anwar, DD Patra. Influence of long-term application of organic and inorganic fertilizer to build up soil fertility and nutrient uptake in mint-mustard cropping sequence. Commun. Soil Sci. Plant Anal. 2006; 37:63-76.
2. Egan H, RS Krik, R Sawyer. Pearsons'chemical analysis of foods. 9th ed., Longman, London, 1997, 634.
3. RE Kinnunen, MC Gould, P Cambier. Composting Commercial Fish Processing Waste from Fish Caught in the Michigan Waters of the Great Lakes, Michigan State University Extension, USA, 2005.
4. Shewry PR, NG Halford. Cereal seed storage proteins: structures, properties and role in grain utilization. Journal of experimental botany. 2002; 53(370):947-958.
5. Amruta N, J Maruthi, G Sarika, C Deepika. Effect of integrated nutrient management and spacing on growth and yield parameters of black gram cv. LBG-625 (Rashmi). The Bioscan. 2015; 10(1):193-198.
6. Marimuthu S, U Surendran. Effect of nutrients and plant growth regulators on growth and yield of black gram in sandy loam soils of Cauvery new delta zone, India. Cogent Food & Agriculture. 2015; 1(1):1010415.
7. Vidyashree N. Isolation and characterization of zinc solubilizing bacteria from stone quarry dust powder. International Journal of Agriculture Sciences, 2016. ISSN: 0975-3710.
8. Ramesh A, SK Sharma, MP Sharma, N Yadav, OP Joshi. Inoculation of zinc solubilizing Bacillus aryabhattai strains for improved growth, mobilization and biofortification of zinc in soybean and wheat cultivated in Vertisols of central India. Applied Soil Ecology. 2014; 73:87-96.
9. Goteti PK, LDA Emmanuel, S Desai, MHA Shaik. Prospective zinc solubilising bacteria for enhanced nutrient uptake and growth promotion in maize (Zea mays L.). International journal of microbiology, 2013.
10. Khande R, SK Sharma, A Ramesh, MP Sharma. Zinc solubilizing *Bacillus* strains that modulate growth, yield and zinc biofortification of soybean and wheat. Rhizosphere. 2017; 4:126-138.
11. Navsare R, S Mane, S Supekar. Effect of potassium and zinc solubilizing microorganism on growth, yield and quality of mungbean. IJCS. 2018; 6(1):1996-2000.
12. Raut A, A Durgude, A Kadlag. "Effect of zinc solubilizing bacteria on zinc use efficiency and yield of summer groundnut grown in Entisol. IJCS. 2019; 7(1):1710-1713.
13. Selvakumar G, S Reetha, P Thamizhiniyan. Response of biofertilizers on growth, yield attributes and associated protein profiling changes of blackgram (*Vigna mungo* L. *Hepper*). World applied sciences journal. 2012; 16(10):1368-1374.
14. Malewar G, M Mangnale, V Malewar. Chemical composition and quality of mung genotypes as influenced by zinc fertilization. Legume Research. 1990; 13(2):59-64.
15. Kumar PS, SA Geetha, P Savithri, R Jagadeeswaran, K Ragunath. Effect of Zn enriched organic manures and zinc solubilizer application on the yield, curcumin content and nutrient status of soil under turmeric cultivation. Journal of Applied Horticulture. 2004; 6(2):82-86
16. Newaj M, MS Hossain, MN Islam, M Anam, A Haque. Effect of Indoleacetic Acid (IAA) on Yield of Mungbean (*Vignaradiata* L.). Pakistan J of Biol. Sci. 2002; 5:897-899.
17. El Karamany MF, MS Sadak, BA Bakry. Improving quality and quantity of mungbean plant via foliar application of plant growth regulators in sandy soil conditions. Bulletin of the National Research Centre. 2019; 43(1):61.