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Effect of Fish Waste Compost Pellets on Yield, Yield Attributes and Quality of Chilli

Nongmaithem Leindah Devi[1*], Athokpam Herojit Singh[2], Jotish Nongthombam[3], Santosh Kumar[3] and K.P. Chaudhary[3]

[1]Post Doctoral Fellow, Soil Science and Agricultural Chemistry, KVK, College of Veterinary Science and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram India.

[2]Department of Soil Science and Agricultural Chemistry, College of Agriculture, Central Agricultural University, Iroisemba, Imphal Manipur India.

[3]K.V.K. College of Veterinary Science and Animal Husbandry, Central Agricultural University, Selesih, Aizawl Mizoram India.

(Corresponding author: Nongmaithem Leindah Devi)*

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ABSTRACT: Prior to the trending deterioration in climatic factors that has imposed significant challenges in practicing effective agricultural operations, increasing faulty use of synthetic fertilizers and pesticides has inversely effected human and environmental health. It is essential to check and mitigate such inverse affects using viable techniques that can replace such harmful synthetic fertilizers/ pesticides. Present study demonstrates use of compost pellets developed from fish waste which rather would be thrown or dumped in the environment. Experimental research was conducted at KVK, Aizawl, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Mizoram with an objective to study the effect of fish waste compost pellets on yield, yield parameters and quality in chilli. The experiment was laid out in randomized block design (RBD) with eleven treatments and three replications consisting of control, inorganic fertilizer applications, fish waste compost pellets as basal fertilizer, foliar application of vermiwash, three different bio pesticides namely *Artemesia nilgarica*, *Vitex negundo* and *Phlogacanthus pubinervius* were given as foliar spray at 21 DAS (Days after sowing) and 50 DAS and 120 DAS. Treatments coupled with fish waste compost pellets have significantly performed better giving enhanced yield and other yield parameters of Chilli. Fish waste that are rather thrown or dumped in the nature can be utilized for developing compost pellets which are suitable for enhancing yield, yield attributes and quality of chilli crop.

Keywords: Fish compost pellets, yield, yield attributes, quality, chilli.

INTRODUCTION

Trending climatic deterioration has poses significant challenges to sustainable agriculture. Rising temperatures, changing rainfall patterns and extreme weather events such as floods and droughts adversely affects crop growth and livestock production. Faulty use of synthetic fertilizers, pesticides, etc. degrades soil properties leading to decline in agricultural production and its qualities. It is vital and important to excess a way as to tackle such trending issue with environment friendly solutions. Organic farming provides a natural way forward for crop cultivation by using environment friendly, animal and plant based local organic resources that are highly enriched in nutrients required for crop plants. It enhances the microbial activities and increases soil health. Organic farming is an efficient and promising agricultural approach for environmental sustainability as it provides yield stability, improves soil health. There are different agricultural approaches working on reducing environmental concerns but use of organic farming, no doubt, the best scientifically proved environment friendly approach in maintaining environmental balance of our agriculture and ecological systems (Varun, 2020). The used of organic fertilizer is a vital option for sustaining the environment (Ainah *et al.,* 2018). Agricultural wastes such as animal wastes, agriculture and industrial effluents, municipal waste water, and bio solids are enrich with plant nutrients and are used as a fertilizer for crop growth (Chang *et al.,* 2010; López *et al.,* 2011; Balkhandev, 2020). Fish wastes have also been traditionally used as fertilizer, given their wealth of nutritive elements (principally N and P) and their rapid decomposition (Megha and Chitra 2021). 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 Tejada and Gonzalez (2003); Ainah *et al.* (2018). Composting initiatives using fish offal derived mainly from aquiculture have been carried out in various parts of the world in search of alternative and viable techniques for transforming fish waste into useful agricultural products (Frederick *et al.,* 1989; Liao *et al.*, 1997; Kinnunen *et al.,* 2005). Owing to the fact that fish waste can be used as raw material for preparation of nutrient input, its inclusion in compost possible forms can be explored. In the context discussed herein, the present study was conducted to assess the effect of fish waste compost pellets on yield, yield attributes and quality of chilli.

MATERIALS AND METHODS

Preparation of fish waste compost: Prior to compost preparation, the chemical composition of fish waste, saw dust, banana, jaggery were analysed as to check its nutrient contents**.** The solid fish waste i.e. gut, head, skin, bones, fins, scale and intestine were collected and chopped it into finer formed. The chopped fish waste (w/w) 80% were mixed with saw dust (20%), whole banana, jiggery and distilled water were placed layer by layer in the compost basket bin. the compost was later stirred continuously in the interval of 3-4 days until the final fish compost was formed. It took 120-140 days to form fish waste compost. The mature fish waste compost was sieved using a 20 mm mesh screen and its analysis was done. Further, using motor operated pallet machine, the fish waste compost was transformed into pellets (Fig. 1). Pelletizing, fish waste compost is compressed in to high-density, cylindrical shaped pellets. Pellets with uniform length and diameter can be placed precisely under the soil surface next to the seed for more immediate effect and enable mechanical fertilization using seeding equipment. The nutrient content of the fish compost pellets was analyzed the value were given in Table 1.

Preparation of biopesticides and collection of vermiwash: Locally available biopesticide such as *Artemesia nilgarica* (Leibakngou), *Vitex negundo* (Urikshibi) and *Phlagacanthus pubinervius* (*Nomangkha angangba*) were used in this study. 500 gm of *Artemesia nilgarica* leaves were crushed and the extract was dilute to 500 ml of distilled water. Similarly for Vitex negundo and *Phlagacanthus pubinervius* were prepared separately. For the study, 50% concentration solutions of each extract were used for foliar spray during the critical growth stages of the crop growth. Vermiwash collected from demonstration farm of KVK Aizawl, Central Agricultural University, Selesih, Mizoram was also used for foliar spraying at periods of crop growth. The nutrient content of biopesticides and vermiwash was analyzed the value were given in Table 1.

Experimental site and treatment details. Chilli (*Capsicum annuum*) was planted at KVK, Aizawl farm. The variety, Arka Meghana was used as a test crop for field experiment. This variety is a high yielding chilli F_1 hybrid (IHR 3905 (CGMS) X IHR 3310), plants medium tall and spreading dark green foliage, released by IIHR Bangalore in the year 2005. Plant to plant spacing was 45 × 45 cm. The recommended dose of 45:30:45 kg N, P_2O_5 and K_2O ha^{-1} in form of urea, single super phosphate and muriate of potash were used. The soil of experiment field was soil was loamy in texture with 485.2kg/ha Available N, 9.93 kg/ha P_2O_5, 323.4 kg/ha Available K_2O and having pH of 5.40 (Table 2).

The experiment was laid out in randomized block design (RBD) with eleven treatments and three replications consisting of control, inorganic fertilizer application, fish waste compost pellets as basal fertilizer (2.50 kg/ sq m was incorporate with the soil), foliar application of vermiwash, three different bio pesticides i.e.: *Artemesia nilgarica*, Vitex negundo and *Phlogacanthus pubinervius* were given foliar spray at 21 DAS (Days after sowing) and 50 DAS and 120 DAS. The concentration of the biopesticides applied to plants is 50%. The treatment details are given as: T_1: Control, T_2: Inorganic fertilizer (100%) (RFD:180:80:60 Kg/ha Nitrogen, P_2O_5 and K_2O), T_3: Fish compost (100%), T_4: Vermiwash (50%)(foliar spray), T_5: *Artemesia nilgarica* (Leibakngou) (50%) (foliar spray), T_6: Vitex negundo (Urikshibi) (50%) (foliar spray), T_7: Phlagacanthus pubinervius (*Nomangkha angangba*) (50%) (foliar spray), T_8: Fish compost (100%) + Vermiwash (50%), T_9: Fish compost (100%) + Vermiwash (50%) + *Artemesia nilgarica* (50%), T_{10}: Fish compost (100%) + Vermiwash (50%) + Vitex negundo (50%), T_{11}: Fish compost (100%) + Vermiwash (50%) + *Phlagacanthus pubinervius* (50%).

Data for yield attributes such as plant height (cm) was measured at 21 DAT, 50 DAT and 120 DAT, no. of branches per plant, no. of fruits per plant, length of the chilli, fruit girth (cm) and weight of the chilli per plant (g) are recorded. Ascorbic acid content in green chilli and red chilli were analyzed as quality parameter for chilli (Hudson *et al.,* 1986).

Statistical analysis. All the data of observations recorded in the experiments were statistically analysed and the critical differences (CD) were worked out at 5% probability level.

RESULT AND DISCUSSION

Influence of fish waste compost pellets on crop growth and yield of chilli. Results reveal that plant height increased with increased in growth stage (Table 3). Plant height of chilli was increased in the treatments that received fish waste compost pellets with vermiwash in all the growth stages (Fig. 2). Maximum plant height was recorded in T_9 and T_{10} in 21 DAT (12.4 cm), in 50 DAT it was recorded higher in T_{10} and T_{11} (46.7 cm) and at 120 DAT maximum height was obtained at T_9 (73.7 cm). This shows that application of organic fertilizers help to improve growth of chilli plant. Natesh *et al.* (2010) state the organic fertilizer influenced significantly the growth parameter. This might be due to the improvement in soil physical condition for the plant growth along with increased availability of N, P and K at the early stage of crop growth (Patil, *et al.,* 2004). Nitrogen, phosphorus and potassium contained in organic fertilizer have great

effects in plant growth and development (Mohammad *et al.,* 2017). Similarly Megha and Chitra (2021) reported that fish waste fertilizer sprayed (foliar spray) significantly 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 *Amaranthus dubius* and *Trigonella foenum- graecum.* Number of branches per plant of chilli was recorded the highest in 100% fish waste compost pellets with vermiwash (50%) and *Phlogacanthus pubinervius* (50%), T_{11} with 15.8 numbers of branches per plant (Table 3). Lower number of branches per plant, 10.4 was observed in control. Mohammad *et al.* (2017) reported lowest number of branches in control plant with average of 5 branches per plant. An organic fertilizer contains macro and micro nutrients along with NPK. These contains provides the plants with significant effects on branches per plant (Baloch *et al.,* 2008). The number of fruits per plant was recorded maximum at T_{11} with value 138.2 which was followed by T_{10} (137.2) and lowest was recorded with 52.1 numbers at control (Table 3). Such pattern was also observed by Mkhabela *et al.* (2020) using vermicompost compared to other organic amendments. An enhanced in yield attributes of maize was also displayed in works of Thuy *et al.* (2015) with application of compost, vermicompost and biochar. Length of the chilli was maximum in T_9 and T_{11} with 12.9 cm and minimum in control, T_1 with 8.2 cm, the details of which listed in Table 3. The results are in agreement with Roychaudhury *et al.* (1995) who reported_improvement in fruit size with increasing nitrogen contents in organic fertilizer. Bade *et al.* (2017) also observed increased in length of chilli by applying organic manures. Fruit girth was found maximum at T_{10} with 3.7 cm as shown in Table 3. The increased might be an influenced of fish compost pellets that enhanced the availability of nutrient to the crop thereby increasing the yield attributes of the plant. This finding was in accordance with Anupam and Suddhasuchi (2017) that organic manure with different level of inorganic fertilizer also influenced the fruit girth to a considerable extent. Similarly, Ann and Suthin (2015) found that fish compost at 12.5 ton/ha results in maximum growth and yield parameters of chilli. Prasetyo (2014) reported significant difference in fruit weight of chili plants with application of organic fertilizer. Weight of the chilli per plant was larger in the treatments where application of fish waste compost pellets was given (Table 3). Maximum chilli weight was observed in both T_{10} and $T_{11}$with a value of 117.3 g. Similarly, Chopra *et al*. (2005) found superior yield of chilli genotypes with organic and inorganic nutrient combination. There was a significant positive correlation between yield and yield attributes parameters as shown in Table 4. Parallel to the present study Shahsavani *et al.* (2017); Khandaker *et al.* (2017) also reported increased growth and yield in *Vigna sinensis* and *Capsicum annuum* grown in fish waste fertilizer.

Influence of fish waste compost on ascorbic acid content in chilli. Ascorbic acid content was analyzed in both the green and red chilli. Result shows that red chilli content higher amount of ascorbic acid than that of green chilli. Improvements in the ascorbic acid were higher in those treated with fish waste compost pellets. The details of ascorbic acid content of chilli are listed in Table 3. Ascorbic acid content in green chilli was higher in T_{10} (172.3 mg/100gm) and in red chilli it was found in T_8 (239.6 mg/100gm). High content of ascorbic acid was seen in red ripening chilli compared to that of the green this may be due to decrease in the moisture content infruits. In diverse cultivar of *Capsicum* L. similar observation was highlighted by Osuna-Garcia *et al.* (1998); Lalitha Kumari *et al.* (1999); Gnayfeed *et al.* (2001); Owk and Sape (2009); Robi and Sreelatha (2004). With application of fewer quantities of fish protein hydrolysates (Madende and Hayes 2020) displayed an increase in crop yield, fruit and vegetable qualities. Present study reflected that the beneficial content of ascorbic acid in chilli can be efficiently enhanced by incorporation of fish waste compost.

Fig. 1. Pellet machine and fish waste compost pellets.

Table 1: Nutrient content in the fish waste compost pellets nutrient content in the fish compost and biopesticides.

Parameters	Fish waste compost pellets	Vermiwash	*Phlogacanthus pubinervius*	*Artemesia nilgarica*	*Vitexnegundo*
pH	6.80	7.48	6.43	6.51	6.48
EC (dS/m)	2.97	0.25	0.15	0.19	0.15
OC (%)	0.81	0.008	0.002	0.002	0.002
N (%)	3.66	0.01	0.0090	0.008	0.009
P (%)	1.03	0.0025	0.0004	0.0005	0.0005
K (%)	1.2	0.063	0.031	0.038	0.037

Table 2: Physico-chemical properties of initial soil of chilli field.

Parameters	Result Values
pH	5.40
EC	0.16 dS/m
OC	1.83%
N	485.2 kg/ha
P	9.93 kg/ha
K	323.4 kg/ha
Soil texture	Loam
Bulk density	0.89 Mg m^{-3}

Table 3: Yield, yield attributes and ascorbic acid content of chilli.

Treatment details	Plant height (cm)			No. of branches per plant	No. of fruits per plant	Length of the chilli (cm)	Fruit girth (cm)	Weight of the chilli per plant (g)	Ascorbic acid (mg/100gm)	
	21 DAT	50 DAT	120 DAT						Green Chilli	Red Chilli
T_1	8.2	28.3	52.4	10.4	52.1	8.2	2.3	60.1	99.3	172.5
T_2	8. 3	32.7	58.2	12.3	70.6	9.1	2.8	66.5	122.8	197.4
T_3	11.2	42.4	72.5	15.1	132.8	12.4	3.3	113.2	157	234
T_4	10.5	37.8	66.2	14.8	130.2	12.1	3	112.7	150.6	225.7
T_5	9.2	32.1	52.7	13.0	72.1	9.5	2.5	67.2	104.2	199.6
T_6	9.6	33.7	53.0	12.9	73.2	9.2	2.4	67.6	101.7	181.5
T_7	9.5	33.9	53.5	13.1	72.9	9.3	2.4	67.8	103.9	202.9
T_8	12.1	46.1	73.3	15.4	136.5	12.6	3.6	116.4	168.1	239.6
T_9	12.4	46.1	73.7	15.6	136.9	12.9	3.6	116.9	165.4	236.2
T_{10}	12.4	46.7	73.3	15.5	137.2	12.8	3.7	117.3	172.3	237.8
T_{11}	12.0	46.7	73.6	15.8	138.2	12.9	3.6	117.3	169.5	236.3
Sem	0.15	0.66	0.74	0.17	1.86	0.173	0.041	1.59	2.27	2.64
CD	0.45	1.77	2.19	0.50	5.49	0.511	0.121	4.70	6.70	7.79

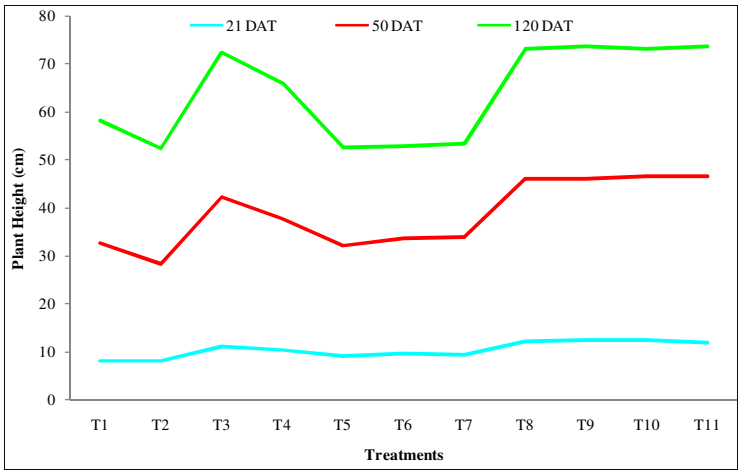

Fig. 2. Plant height (cm) at different growth stages with different treatments in chilli.

Table 4: Correlation studies between yield attributes and yield of chilli.

	No. of branches per plant	No. of fruits per plant	Length of the chilli (cm)	Fruit girth (cm)	Weight of the chilli per plant (g)
No. of branches per plant	1				
No. of fruits per plant	0.961	1			
Length of the chilli (cm)	0.966	0.997	1		
Fruit girth (cm)	0.895	0.938	0.948	1	
Weight of the chilli per plant (g)	0.936	0.996	0.993	0.937	1

CONCLUSIONS

Present study revealed well satisfying aspects of the performance of fish waste compost pellets when used as basal fertilizer to Chilli. Its application when coupled with vermiwash and biopesticides can significantly increase plant yield, yield parameters and quality of chilli. Therefore, in the context of the finding and discussion mentioned herein, compost pellets developed from fish waste which rather would be thrown or dumped in the environment can be utilized effectively as a basal fertilizer and may be seen as a viable techniques that can replace harmful synthetic fertilizers/ pesticides.

FUTURE SCOPE

Adoption of organic farming by combination of waste materials of fishes (fish compost pellets), bio-pesticide and vermiwash will be a novel strategy, which could have great implications to trigger a techno-green revolution. It will also help to identify locally made organic manures as more eco-friendly alternatives or supplements to synthetic fertilizers.

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