Research Article

Foliar Spray of Fish Amino Acid as Liquid Organic manure on the Growth and Yield of Amaranthus

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Abstract

A field experiment was conducted during *Winter*, 2018 (*Thaipattam*) at Anbil Dharamalingam Agriculture College and Research Institute, Tiruchirappalli to study the effect of foliar spray fish amino acid (FAA) as organic liquid manure on the growth and yield of amaranthus. The experiment was laid out in Randomized Block Design (RBD), with three replications. Treatments consisted of different levels of fish amino acid (FAA) (0.5%, 1%, 2%, 3% and 4%), 2% urea and control. Foliar application of FAA and urea were done twice at 15 days after sowing and 7 days after first spray. Observations on plant height, number of leaves, leaf area index, leaf chlorophyll and green leaf vegetable yield were recorded. Economics were worked out based on the prevailing market price. The results revealed that foliar application of 2% urea registered significantly higher growth parameters of amaranthus than control. However, it was comparable with 1% fish amino acid foliar spray in terms of plant height, number of leaves per plant, fresh weight and dry weight of whole plant. This was followed by foliar spray of 0.5% FAA. Significantly, higher green leafy yield (1.52 t/ha), net returns (Rs.79900/ha) and benefit cost ratio (4.62) were obtained under 2 % urea foliar spray. This was followed by foliar spray of 1% FAA. Increased dose of FAA (>2%) reduced the growth of amaranthus. Thus, foliar spray of 2% urea could be recommended for commercial cultivation of amaranthus. Foliar spray of 1% FAA could be recommended as liquid organic input to get higher growth and yield of amaranthus.

Keywords: Amaranthus, Liquid Organic Manure, Fish Amino Acid, Urea, Foliar Spray, Growth, Yield

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Introduction

Amaranthus (*Amaranthus sp L.*) is the most important leafy vegetable cultivated and consumed in Southern India. It is widely known as 'poor man's spinach, one of the cheapest, most accepted and commercially cultivated leafy vegetable. It is mostly cultivated in Kerela, Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh and Telengana states. It is the most common leafy vegetable grown during summer and rainy season in India. It is very nutritive and highly suitable crop for kitchen gardening and commercial cultivation. It could be a very valuable source for combating under-nutrition and malnutrition. The leaves and succulent steam are good source of iron (305 mg/100g), calcium (397 mg /100g), vitamin A (8340mg/100g) and vitamin C (99mg/100 g). It fits well in crop rotations because of its short-duration and large yield per unit area.

Recently, use of various indigenous organic preparations *viz*., panchakavya, amirthakaraisal, amrithpani, fish amino acid (FAA), egg amino acid (EAA) and vermiwash etc., are being noticed in organic farming for improving the crop growth and development. Among these organic preparations, panchakavya has been scientifically evaluated for its physical, chemical and biological properties as well as effect on growth and development of many crops. But in case of fish amino acid, research findings on it's constitute and growth effects on crops are very meager. The fish amino acid is liquid organic manure made from fish waste. Fish amino acid is of great value to both plants and microorganisms in their growth, because it contains various nutrients and types of amino acids. Foliar application or a soil drenching of fish amino acid could maximize uptake and minimize runoff or leaching, providing just enough N to the plant for the production of chlorophyll to maintain plant health. Foliar application of fish emulsions promoted seedlings growth of tomato [1] and increased the microbial action in the soil [2]. For leafy vegetables, spray weekly to improve yields, fragrance and taste [3].

Use of foliar formulations is gaining importance in crop production owing to its quick response in plant growth [4]. Foliar feeding has proved to be the fastest way of curing nutrient deficiencies and boosting plant performances at specific physiological stages. Besides inorganic nutrients, organic liquid manures contain several beneficial microbes which help to increase yield, impart resistance to diseases and insect pests, improve drought tolerance and enhance

crop quality [5]. Foliar application of nitrogen sources either organic or inorganic would improve the photosynthetic activity and vegetative growth of green amaranthus as well as quality and economics of cultivation. Foliar application of liquid organic manures as substitute to nitrogen for top dressing in amaranthus enhanced plant height, number of leaves per plant, crop yield and vitamin C content [6]. Predominant vegetable farmers of Karnataka using fish amino acid for getting better yield of vegetables [7].The effect of foliar application of FAA as organic liquid manure on the growth and yield of amaranthus needs to be studied before recommending as organic foliar nutrient. Hence, the present investigation has been undertaken.

Materials and Methods

A Field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Thiruchirapalli during winter season, 2018 (*Thaipattam*) to evaluate the effect of foliar spray of fish amino acid on growth and yield of amaranthus. The experimental farm is situated at 10° 45'N latitude and 78° 36' E longitude and at an altitude of 85 m above mean sea level. Soil of the experimental field was alkaline in reaction (pH 8.6) with low organic carbon (0.45%) and moderately drained. The initial soil status was low in available nitrogen (155 kg ha^{-1}), high in available phosphorus (31 kg ha^{-1}) and medium in available potassium (213 kg ha^{-1}). During the experimental period, mean maximum and minimum temperature of 33°C and 21°C and the mean relative humidity of 86.6 % and 46.1% respectively were recorded. Average wind velocity of 4.9 km/hr and mean daily evaporation of 5.9 mm were recorded. A total rainfall of 4.7 mm was received in one rainy day during the experimental period.

The experiment was laid out in Randomized Block Design (RBD), with three replications. The treatment consists of five levels of fish amino acid foliar spray (0.5%, 1%, 2%, 3% and 4%), 2% urea and control. Fish amino acid was prepared from fish waste obtained from local fish market. Equal amount of fish waste and jaggery were used (1 kg of each fish waste and jaggery). Fish waste was taken an air tight plastic jar/bottle and jaggery was added. The materials were mixed well and stored in a cool dry place. It was kept away from direct sun light. After 10 days, the liquid portion was filtered and used for spraying [8]. The fish amino acid was sprayed at 5, 10, 20, 30, 40 ml per litre of water for 0.5, 1.0, 2.0, 3.0 and 4.0 %, respectively at 15 Days after sowing and 7 days after first spray. Observations on plant height, number of leaves, leaf area index were recorded at 7 and 14 days after spray. The chlorophyll content of leaves was recorded using SPAD meter. Randomly selected ten fully opened leaves were used for SPAD reading and average was made. Green plants from the net plot area harvested and weighed and the yield was converted to green yield per hectare. Economics were worked out based on the prevailing market price. The net return was calculated by deducting costs of cultivation from gross return. Benefit cost ratio (BCR) was worked out by dividing gross returns (Rs/ha) with cost of cultivation (Rs/ha). Data on various characters studied during the course of investigation was statistically analyzed [9].

Results and discussion

Growth parameters

Growth parameters of amaranthus like plant height, number of leaves per plant and leaf area index were significantly influenced by foliar spray of fish amino acid and urea. Foliar spray of 2% urea produced significantly taller plants (9.5 and 11.4 cm), more number of leaves per plant (10.7 and 11.7 cm) and higher LAI (1.37 and 2.51) at 7 and 14 days after spray respectively than control. Foliar application of urea might have increased cell division, metabollic activity resulted in higher plant height and chlorophyll content. Nitrogen is important element for plant growth, which stimulate vegetative growth including plant height and LAI (Ali, 2006) [10]. Foliar spray of FAA did not influence significantly on growth parameters at 7 days after spray. However, the growth parameters were significantly varied at 14 days after spray (**Table 1**). Foliar spray of 1% FAA produced comparable growth parameters with 2% urea spray. Among the doses of FAA, 1 % FAA produced significantly taller plants (11.3 cm), more number of leaves per plant (11.6 cm) and higher LAI (2.46) at 14 days after spray than its higher doses (3 and 4%). However, it was comparable with 0.5% FAA in all the growth characters. Foliar application of FAA 1% increased the plant height, number of leaves per plant and chlorophyll content to the tune of 16.5,12.6 and 8.1% respectively over control. This might be due to that quick absorbtion and assimilation of macro and micro nutrients present in the FAA, improved the metabollic activity and cell division resulted in higher plant height, number of leaves and chlorophyll content. These results are accordance in findings of vasmathi (2001) [11] and sanjuthi *et al*. (2008) [12], who reported that spraying of organic preparation like panchagavya increased the plant height mainly due to the growth enzymes present in panchagavya which favoured rapid cell division and multiplication. Foliar spray of 4% FAA registered lesser values of growth parameters than 2% urea and 1% FAA spray. Foliar application of FAA at higher concentration (3% and 4%) affected the plant growth as compared to the lower doses. This may be due to that higher concentration of FAA

would have distrubted the stomatal opening, gas exchanges and ultimately of growth of the plant. However, it requires further thorough investigation on the negative effect of higher doses of FAA.

Table 1 Effect of foliar spray of fish amino acid on plant growth parameters of green amaranthus at 7 and 14 days after foliar spray

Treatments	Plant height (cm)		No of leaves (Nos./plant)		Chlorophyll (SPAD reading)		Leaf Area Index	
	7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS	7 DAS	14 DAS
T_1- Control	8.5	9.7	10.0	10.3	21.30	23.6	1.23	2.06
T_2- 2% Urea	9.5	11.4	10.7	11.7	26.10	26.5	1.37	2.51
T_3-0.5% FAA	9.0	11.2	10.3	11.3	25.10	25.1	1.31	2.41
T_4-1.0% FAA	8.7	11.3	10.7	11.6	25.37	25.5	1.27	2.46
T_5-2% FAA	8.6	10.7	8.7	10.0	23.40	23.7	1.26	2.39
T_6-3% FAA	8.7	10.3	7.3	9.0	22.77	22.1	1.35	2.28
T_7- 4% FAA	8.1	10.0	8.0	8.7	21.83	21.7	1.24	2.06
CD(P=0.05)	0.84	1.10	1.94	1.14	2.58	2.71	0.11	0.05

FAA- Fish Amino Acid

Chlorophyll content was measured using SPAD meter and revealed that foliar application of FAA and urea as nitrogen source significantly influenced the chlorophyll content of amaranthus. Significantly height chlorophyll content (26.10 and 26.5) was noticed with foliar spray of 2% urea than control and 4% FAA spray at 7 and 14 days after spray respectively (Table 1). However, this was on par with foliar application of FAA at 1% (25.37 and 26.5) and 0.5% (25.10 and 25.1). Higher concentration of FAA (3 and 4%) registered significantly lesser chlorophyll content than lower doses of FAA. Control plot recorded the minimum chlorophyll content (21.0 and 23.9) than other treatments. Similar findings were reported by Priyanka *et al.* (2019a) [13] who found that significant increase in leaf chlorophyll content of rice due to foliar spray of 1% FAA.

Fresh weight, dry weight and green leafy yield

Fresh and dry weights of amaranthus varied due to foliar application of FAA and urea. Significantly higher fresh weights (4.6 g/plant) and dry weight (0.7 g/plant) were recorded under foliar spray of 2% urea than FAA and control (**Table 2** and **Figure 1**). This was followed foliar spray of FAA 1 % (fresh weight – 3.7 g/plant and dry weight- 0.6 g/plant). The lowest fresh and dry weight of 2.8 and 0.05 g / plant respectively observed under foliar spray of FAA 4%. Green leafy vegetable yield of amaranthus was significantly altered by foliar spray of urea and FAA. Foliar application of 2% urea registered significantly higher green leaves yield (1.52 t/ha) than foliar spray of FAA and control. This was followed by foliar spray of FAA 1% (1.22 t/ha) and 0.5 % FAA (1.21 t/ha). Foliar spray of urea 2% increased the green leaf vegetable yield to the tune of 47.5% over control. The increment in yield was due to supply of nitrogen in the form of urea as a foliar spray induced the vegetative growth resulted in more chlorophyll content, LAI and photosynthetic activity which in turn improved the leaf vegetable yield (Gulser, 2005) [14]. Foliar application of FAA at 1% registered 18.4% higher green leaf vegetable yield over control. This might due to that supply of macro and micro nutrients and growth hormones present in the FAA improved the growth character such as plant height, more number of leaves and chlorophyll content which consequently increased the green leafy yield. These results are in accordance with the findings of Abbasi *et al*. (2003) [15] who reported that foliar spray of fish emulsion increased the total yield of tomato and pepper. Simialry, foliar application of 1% FAA increased the rice yield to the tune of 15.5 per cent over control (Priyanka *et al.,* 2019b) [16]. Higher doses of FAA reduced the green leafy yield of amaranthus. The lowest yield of 0.91t/ha was recorded under 4% FAA.

Net return and benefit cost ratio of amaranthus

Foliar spray of 2% urea gave higher net returns of Rs.79, 900/ha and benefit cost ratio (4.62) than other treatments (Table 2). This is mainly because of higher leaf vegetable yield obtained under this treatment. Among the FAA doses, foliar spray of FAA at 1% registered higher net returns of Rs.59, 760/ha and Rs.3.69 per rupee invested than other FAA doses. This was followed by FAA 0.5%, which gave Rs.59, 380/ha and BCR of 3.68. The minimum net returns of Rs. 37450/ha and B:C ratio of 2.64 was obtained under FAA 4% mainly due to lesser green vegetable yield and cost of treatment.

Table 2 Effect of fish amino acid foliar spray on fresh weight, green leafy yield and economics of green amaranthus

Treatments	Fresh weight (g/plant)	Green leafy yield (t/ha)	Net return (Rs/ha)	B:C ratio
T_1- Control	3.1	1.03	48000	3.29
T_2- 2% Urea	4.6	1.52	79900	4.62
T_3- 0.5% FAA	3.6	1.21	59380	3.68
T_4-1.0% FAA	3.7	1.22	59760	3.69
T_5- 2% FAA	3.4	1.13	51020	3.27
T_6- 3% FAA	3.3	1.09	52780	3.32
T_7- 4% FAA	2.8	0.91	37540	2.64
CD(P=0.05)	0.4	0.12	-	-

FAA- Fish Amino Acid

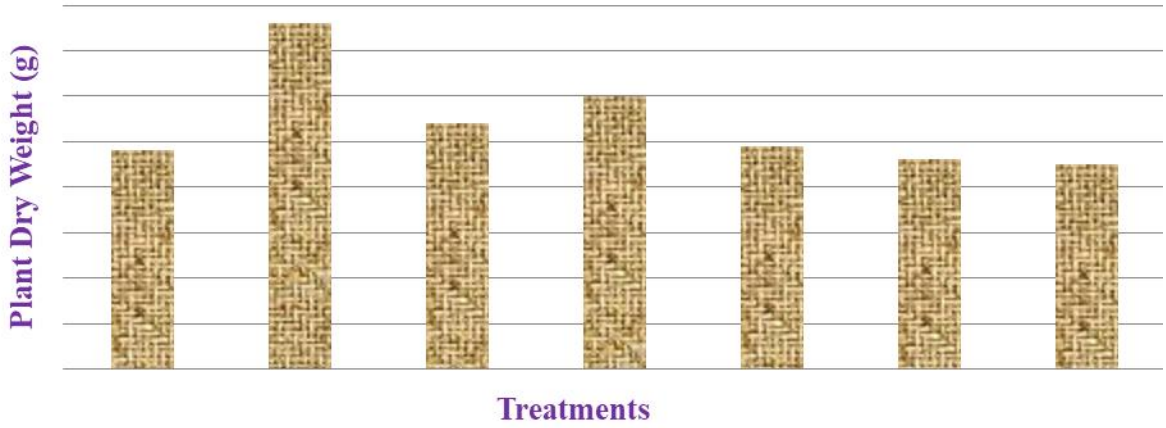

Figure 1 Effect of fish amino acid foliar spray on dry weight per plant (g) of green amaranthus

Thus, fish waste obatined from fish market could be converted as nutrient source by preparing fish amino acid and used as liquid organic manure to crops. It could be considred as good nutrient source for organic farming. From the field study, it could be concluded that foliar spray of 2% urea could be recommended for commercial cultivation of amaranthus. Foliar spray of 1% FAA could be recommended as liquid organic input to get higher growth and yield of green amaranthus.

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