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EFFECT OF ORGANIC NUTRIENT SOURCES AND ENRICHED BIODIGESTED LIQUID (EBDLM) ORGANIC MANURE ON GROWTH AND YIELD OF CHILLI HYBRIDS (*CAPSICUM ANNUM L.*)

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KEYWORDS

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ABSTRACT

Field experiments were conducted during *kharif* season of 2013 and 2014 in red sandy clay loamy soil in farmer's field at Talaku Village of Chitradurga (District) Karnataka to assess the effect of various organic sources nutrients and enriched biodigested liquid manure (EBDLM) on chilli growth and yield. The treatments comprised of three chilli hybrids (V) and four organic nutrient sources (S) laid out in a FRCBD design. Among the nutrient sources tested, significantly more plant height (80.7 cm), number of branches (31.9 plant⁻¹), LAI (1.96), total dry matter production (253 g plant⁻¹), number of fruits plant⁻¹ (127), fruit length (9.6 cm), 100 fruit weight (97.27 g), fruit yield plant⁻¹ (105.7 g) and dry fruit yield (2935 kg ha⁻¹) were observed with the application vermicompost, silkworm waste and goat manure (75 kg N equivalent ha⁻¹ as basal dose at 1:1:1) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + 3 sprays of PG (3 %) at 25, 50 and 75 DAT (S₃) and which was at par with recommended chilli cultivation practices (S₄). Therefore it was more effective nutrient management practices (S₃) for getting higher yield with favourable effect on soil quality and protecting environment due to application of fertilizers.

INTRODUCTION

Chilli (*Capsicum annum* L.) is popularly known as "king of spices" and one of the most important commercial spice and vegetable crop of crops of India grown in area of 7.93 lakh ha with a production and productivity of 14.48 lakh tones and 1824 kg/ha respectively, which accounting to 45 and 25% of world acreage and production, respectively (Anon, 2011). Chilli is an indispensable condiment of every Indian home. Chillies are consumed in both fresh as well as dried form. It is good choice for generating higher profit. It can be cultivated in many types of soils, well drained loamy soil having rich organic matter are best suited for its cultivation. On sandy loamy soil, crop can be grown successfully, provided, manuring is done heavily and crop is irrigated properly and timely (Hosmani, 1993). A large number of constraint limit the production of chilli which include low yielding ability of genetic material, imbalanced supply of nutrient, pest and disease, etc., so screening of genotype / variety/hybrids is most important for getting higher yield as well as higher income. With respect to management, nutrient management is most important factor for higher productivity (Patil, 1998).

Due to the prohibitive cost of chemical fertilizers, majority of marginal and small Indian farmers rarely apply the recommended dose of fertilizers. They are using indigenous organic manures as sources of nutrients. These organics are bulky in nature but, contain reasonable amount of nutrients. Our experiences reveal that the supply of nutrients through organics alone has failed to maintain yield level in a short period. Therefore, combined application of organics such as FYM, vermicompost, silk worm waste, goat manure, green leaf manure, compost etc. and liquid organics *viz.*, biodigested liquid manures, Jeevamrut, Beejamrut, Gomutra, Panchagavya Vermiwash etc., which contain microbial load and a plant growth promoting substances (PGPR) stimulate growth, yield and quality of crops (Shashidhara and Shivamurthy, 2008). Further it helps to build soil organic matter status besides minimizing the cost of cultivation. Panchagavya a promising natural liquid manure is being used by many organic farmers in many crops in different parts of our country (Anon., 2005).

Therefore, keeping in this view, the present investigation is carried out to identify / screen suitable chilli hybrids with better nutrient management practices for getting higher dry fruit yield of chilli, to reduce cost of cultivation and protecting the environment from fertilizer application.

MATERIALS AND METHODS

A field experiments were conducted at Talaku village situated at 14°26' N latitude and 76°40' E longitude of Challakere Taluk, Chitradurga District, during *Kharif* season of 2013 and 2014 in red sandy clay loamy texture having (coarse sand 33.58 %, fine sand 37.81 %, silt 6.8 % and clay 21.0 %), with a bulk density of 1.47 g cc⁻¹. The soil pH was slightly alkaline (7.7) and the electrical conductivity was normal (0.25 dSm⁻¹). The soil was low in organic carbon (0.47%), medium in available nitrogen (289.7 kg ha⁻¹), phosphorus (52.4 kg ha⁻¹) and potassium (165.2

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kg ha⁻¹). The study included 12 treatment combinations comprising three chilli hybrids viz., KBCH-1, Arka Meghana and Devanur Deluxe and four organic nutrient sources viz., vermicompost (75 kg N equivalent ha⁻¹ as basal dose) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + 3 sprays of panchagavya (3 %) at 25, 50 and 75 DAT (S₁), vermicompost and silkworm waste (75 kg N equivalent ha⁻¹ as basal dose at 1:1) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + 3 sprays of panchagavya (3 %) at 25, 50 and 75 DAT (S₂), vermicompost, silkworm waste and goat manure 75 kg N equivalent ha⁻¹ as basal dose at 1:1:1) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + 3 sprays of panchagavya (3 %) at 25, 50 and 75 DAT (S₃), recommended chilli cultivation practices (150:75:75 kg NPK ha⁻¹) (S₄). The NPK was supplied through urea, SSP and MOP. The experiment was laid in a randomized complete block design and each treatment replicated three times. Six weeks old seedlings were transplanted in the main field at 60 cm x 60 cm spacing on 08-08-2013 and 22-07-2014. All the treatments were provided with 25t FYM per hectare. Three sprays of 3% panchagavya and EBDLM were done 25, 50 and 75 days after transplanting (DAT) in their respective treatments. The organic manures and enriched biodigested liquid organic manure were applied on nitrogen equivalent basis. BDLM was prepared by using *Gliricidia sepium* green biomass chopped material which was biodigested using fresh dung, cattle urine and water in 3:1.5:2:10 ratio, respectively, in a cylindrical drum incubated for 45 days under aerobic condition and stirred regularly (Reddy et al., 2011) and Pradeep Gopakkali and Sharanappa (2014). This was enriched with 10% neem cake. All the manurial sources used were analysed for their nutrient concentration and total quantity of manure required was computed on N equivalent basis. Panchagavya was prepared by using fresh cowdung (7 kg) and ghee (1 kg), which were mixed together and kept as such in plastic container for two days. On 3rd day, 1 L cow urine, 10 L each of curd, milk and tender coconut water, 100 g yeast, 250 g jaggery and 12 ripened bananas were added to it. The contents were stirred for 15 days thoroughly thrice a day and then filtered through thin muslin cloth and was used as foliar spray at 3% (Somasundaram and Singaram, 2006). Farmyard manure, vermicompost, silkworm waste and goat manure were collected in the farmers field. The NPK content was analysed for their nutrient composition as per the standard procedure (Table 1). FYM at 25t/ha was applied two weeks before sowing of the crop and incorporated into soil. The quantity of vermicompost, silkworm waste and goat manure required for

each treatment was computed based on nitrogen content and applied as basal to individual treatments and mixed thoroughly into the soil.

Various growth and yield parameters such as plant height, number of branches per plant, leaf area index, dry matter production were recorded at 30, 60, 90 DAT and at harvest (Adhikary, 2014). The crop was transplanted on 08-08-2013 (1st crop) and 22-07-2014 (2nd crop) and harvested 15th of January, 1st, 15th of February 2014 (1st crop) and 25th of December of 2014 and 12th and 22nd of January of 2015 (2nd crop). Yield parameters such as number of fruits per plant, fruit length, 100-fruit weight, fruit weight per plant and fruit yield (kg ha⁻¹) were recorded after harvest of chilli (Ajeet Singh et al., 2013). The data was subjected to statistical analysis (Gomez and Gomez, 1984) using factorial analysis of variance.

RESULTS AND DISCUSSION

Growth parameters

The application of vermicompost, silkworm waste and goat manure 75 kg N equivalent ha⁻¹ as basal dose at 1:1:1) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + 3 sprays of panchagavya (3 %) at 25, 50 and 75 DAT (S₃) gave significantly higher plant height, number of branches plant⁻¹, leaf area index plant⁻¹ and total dry matter (Table 2) and it was on par with the recommended chilli cultivation practices (S₄). The increase in growth parameters due to the application of different source of organic manures could be attributed to the balanced and continuous supply of all the essential nutrients throughout the crop growth period (Santhosh Kumar Kattimani and Shashidhara, 2006 and Chandrakala 2011). This might have resulted in higher photosynthesis, maximum metabolic activities and translocation of photosynthate to the sink. The findings are in accordance with Pradeep Gopakkali and Sharanappa (2014) and Sable et al. (2007). Panchagavya comprises coconut water which contains kinetin which might have increased the cytokinins in leaf as a consequence there was increase in chlorophyll content of leaf and photosynthetic activity for longer period. The development of leaf area is an important factor that affects crop response to added nitrogen. Larger leaf area development aids in more interception of more solar radiation leading to higher dry matter production. Production and distribution of dry matter in various plants parts is very important in regulating crop yield. Humic acid sources (EBDLM) provided protoplasmic elements, viz., N, P & K which promoted plant physiological process such as

Table 1: Nutrient composition of organic source of nutrients used in the study

Sl. Particulars	FYM	VC	SW	GM	NC	PG	EBDLM	Method employed
1. pH	7.85	7.28	7.14	7.45	7.4	6.01	7.9	Potentiometer(Piper, 1966)
2. EC (dSm ⁻¹)	0.15	0.37	0.28	0.36	0.41	3.02	0.09	Conductivity bridge(Jackson, 1973)
3. Organic carbon (%)	9.98	14.83	14.45	14.25	31.12	0.71	1.08	Walkely and Black Wet oxidation method (Jackson, 1973)
4. Total Nitrogen (%)	0.54	2.36	1.77	1.84	5.68	0.04	0.6-0.9	Modified Microkjeldhal method (Jackson,1973)
4. Total Phosphorus (%)	0.22	0.53	0.62	0.79	0.78	0.02	0.27	Vanadomolybdate yellow colour method (Jackson,1973)
5. Total Potassium (%)	0.45	0.88	1.03	1.22	1.32	0.03	0.49	Flame photometer (Jackson,1973)

Note: FYM: Farmyard manure; VC: vermicompost; SW: Silk worm waste; GM: Goat; manure; NC: Neem cake; PG: panchagavya; EBDLM: Enriched biodigested liquid manure

Table 2: Effect of organic nutrient sources and enriched biodigested liquid organic manure (EBDLM) on growth parameters of chilli hybrids at harvest (pooled data of 2 years)

Treatments	Plant height (cm)	Branches (No. plant ⁻¹)	LAI	Dry matter accumulation (g plant ⁻¹)
Nutrient source*				
S ₁	71.4	26.0	1.64	222.9
S ₂	74.3	26.8	1.74	227.3
S ₃	80.7	31.9	1.96	253.0
S ₄	80.5	31.3	1.96	251.9
S Em +	2.06	0.9	0.06	6.04
CD 0.05	6.02	2.71	0.19	17.67
Chilli Hybrids				
KBCH-1	83.5	32.1	2.01	258.5
Arka Meghana	74.5	28.9	1.83	242.3
Devanur Deluxe	72.2	26.1	1.64	215.5
S. Em +	1.78	0.80	0.06	5.23
CD 0.05	5.22	2.34	0.16	15.30
Interaction (NS x V)				
S. Em +	3.57	1.60	0.10	10.46
CD 0.05	NS	NS	NS	NS

S₁: Vermicompost (75 kg N equivalent ha⁻¹ as basal dose) + Enriched biodigested liquid manure (EBDLM) (75 kg N equivalent ha⁻¹ top dressing) + PG spray at 3%; S₂: Vermicompost and silkworm waste (75 kg N equivalent ha⁻¹ as basal dose at 1:1) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + PG spray at 3%; S₃: Vermicompost and silkworm waste and goat manure (75 kg N equivalent ha⁻¹ as basal dose at 1:1:1) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + PG spray at 3%; S₄: Recommended chilli cultivation practices (150, 75 and 75 kg N, P₂O₅ and K₂O per ha); Note: All the nutrient sources were supplied with FYM at 25 t ha⁻¹; PG: Panchagavya was sprayed on foliage at 25, 50 & 75 days after transplanting (DAT) NS: Non significant; Enriched biodigested liquid manure (EBDLM) was applied to soil at 25, 50 & 75 DAT

Table 3: Effect of organic nutrient sources and enriched biodigested liquid organic manure (EBDLM) on yield parameters and dry fruit yield of chilli hybrids (pooled data of 2 years)

Treatments	Fruits plant ⁻¹ (No.)	100 fruitweight (g)	Fruit length(cm)	Fruit yield per plant (g)	Yield(kg ha ⁻¹)
Nutrient source (NS)					
S ₁	110	92.91	8.71	88.2	2646
S ₂	115	94.07	8.83	90.1	2699
S ₃	127	97.27	9.62	99.0	2939
S ₄	126	97.25	9.60	98.5	2935
S. Em +	3.36	1.02	0.26	2.4	66.5
CD0.05	9.56	2.91	0.75	7.0	189.2
Chilli hybrids (V)					
KBCH-1	141	83.04	8.30	101.6	3020
Arka Meghana	114	99.30	9.32	95.4	2845
Devanur Deluxe	104	103.78	9.96	84.8	2551
S. Em +	2.91	0.89	0.23	2.1	57.6
CD0.05	8.28	2.52	0.65	6.0	163.8
Interaction (NS x V)					
S. Em +	5.82	1.77	0.46	4.24	115
CD 0.05	NS	NS	NS	NS	NS

S₁: Vermicompost (75 kg N equivalent ha⁻¹ as basal dose) + Enriched biodigested liquid manure (EBDLM) (75 kg N equivalent ha⁻¹ top dressing) + PG spray at 3%; S₂: Vermicompost and silkworm waste (75 kg N equivalent ha⁻¹ as basal dose at 1:1) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + PG spray at 3%; S₃: Vermicompost and silkworm waste and goat manure (75 kg N equivalent ha⁻¹ as basal dose at 1:1:1) + EBDLM (75 kg N equivalent ha⁻¹ top dressing) + PG spray at 3%; S₄: Recommended chilli cultivation practices (150, 75 and 75 kg N, P₂O₅ and K₂O per ha); Note: All the nutrient sources were supplied with FYM at 25 t ha⁻¹; PG: Panchagavya was sprayed on foliage at 25, 50 & 75 days after transplanting (DAT); NS: Non significant; Enriched biodigested liquid manure (EBDLM) was applied to soil at 25, 50 & 75 DAT; NS: Non significant

chlorophyll and protein synthesis and were also driven by the beneficial effects as growth regulators. This resulted in substantial increase in the assimilatory surface area and promoted higher photosynthesis and their distribution in plant parts. The results corroborate those of Pradeep Gopakkali and Sharanappa (2014), Chandrakala *et al.* (2011) and Jaipaul *et al.* (2011).

Amongst the chilli hybrids significantly higher plant height, number of branches plant⁻¹, leaf area index plant⁻¹ and total dry matter accumulation was observed in KBCH-1 as compared to Arka Meghana and Devanur Deluxe (Table. 1). Santhosh Kumar Kattimani and Shashidhara (2006) reported

similar findings in Vietnam 2 as compared to Bydagi Dabbi and Bydagi Kaddi under integrated nutrient management practices whereas, Manju and Sreelathakumary (2002) reported the better performance of CC 12 and CC 7, cultivars under organic nutrient management. The interaction between organic nutrient sources and chilli hybrids was non-significant.

Yield and yield parameters

The number of fruits plant⁻¹, fruit yield plant⁻¹, fruit length and 100 fruit weight and yield were significantly higher vermicompost, silkworm waste and goat manure 75 kg N equivalent ha⁻¹ as basal dose at 1:1:1) + EBDLM (75 kg N

equivalent ha⁻¹ top dressing) + 3 sprays of panchagavya (3 %) at 25, 50 and 75 DAT (S₃). However, it was at par with the recommended chilli cultivation practices (Table 3). Higher yield attributes and yield might be due to supply of all the required macro- and micro-nutrients through different organic nutrient sources, the release of which matched with crop demand, besides improving the soil condition, which enhanced root proliferation and source sink relationship. Similar results were reported by Santhosh Kumar Kattimani and Shashidhara (2006) and Pradeep Gopakkali and Sharanappa (2014), Sharma *et al.* (2013), Jaipaul *et al.* (2011) and Chandrakala *et al.* (2011). The application of panchagavya promoted the transfer of nutrients applied to plant through foliar spray and the quantities of IAA and GA present in panchagavya (Latha and Sharanappa, 2014) and (Somasundaram and Singaram, 2006) which might have stimulated plant system to enhance production of growth regulators in cell system. This in turn might have stimulated the growth and development in plants leading to better yield. Among the chilli hybrids KBCH-1 (V₁) gave significantly higher number of fruits plant⁻¹, dry fruit yield plant⁻¹ followed by Arka Meghana and Devanur Deluxe (Table 3). Even though significantly higher 100 fruit weight and fruit length were observed in Devanur Deluxe, the yield was significantly lower. Santhosh Kumar Kattimani and Shashidhara (2006) reported better performance of Vietnam-2 (1108 kg/ha) in Zone 8 of Karnataka, India.

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