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Organic Practices for Enhanced Chilli Yield and Quality in Lateritic Soil: A Comparative Study of Soil and Foliar Application Approaches

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Abstract:-

Chilli pepper (*Capsicum annuum* L. cv. Sitara) is a vital crop prized for its culinary and health benefits. However, mechanized agriculture reduces organic matter availability, hindering sustainable cultivation of chilli, Which Created a need to develop an alternate source of plant nutrition. The ongoing research promises even better solutions for sustainable plant nutrition. Considering the above need a field investigation conducted during Rabi seasons (2020-21 & 2021-22) on lateritic soil at the Department of Agronomy, College of Agriculture, Dapoli (India), which evaluated the impact of organic soil amendment and diverse foliar sprays on the yield and quality of chilli pepper (*Capsicum annuum* L. cv. Sitara).

A randomized block design with three replications and sixteen treatment combinations were implemented. Treatments included soil application of vermicompost at 100 % recommended nitrogen (N) dose and foliar application of cow urine, vermiwash, moringa leaf extract, glyricidia leaf extract, and pongamia leaf extract at varying N concentrations (0.02, 0.04 and 0.06 %). Vermicompost at 100 % N equivalence and the highest vermiwash concentration (0.06% N) significantly ($p < 0.05$) enhanced mean green pod yield (14.59 t ha^{-1}), mean fruit weight (251.02 g) per plant and quality parameters like mean ascorbic acid content (105.21 mg kg^{-1}), mean capsaicin content (0.240 mg 100 g^{-1}) and mean anthocyanin content (28.99 mg 100 g^{-1}). The finding suggested that foliar application of these organic inputs hold promise as sustainable alternatives for improving chilli production and quality.

Keywords: Lateritic soil, Chilli, Vermicompost, Vermiwash, Ascorbic acid, Capsaicin

Introduction

Chilli peppers (*Capsicum annuum* L.), a fiery spice igniting taste buds worldwide, face a scorching threat: conventional farming practices that undermine both environmental health and human well-being. Seeking a more sustainable flame, this study explores the

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potential of organic amendments as allies in chilli cultivation. We delve into the fertile ground of vermicompost, teeming with nutrients and microbial life, and the invigorating foliar sprays of cow urine, vermiwash, moringa leaf extract, glyricidia leaf extract, and pongamia leaf extract. Each amendment offers unique benefits: vermicompost, a powerhouse of readily available nutrients; cow urine, a treasure trove of nitrogen, phosphorus, and potassium; vermiwash, a cocktail of growth-promoting hormones and enzymes; moringa leaf extract, rich in vitamins and micronutrients; glyricidia leaf extract, a source of readily available nitrogen and organic matter; and pongamia leaf extract, brimming with beneficial phenolics and nutrients. This field experiment ignites a quest to understand how these organic amendments, applied individually and in concert, influence the yield, quality, and key attributes of chilli peppers grown in lateritic soil. Our aim is not only to cultivate tastier harvests, but to discover sustainable solutions for chilli production, leaving a milder footprint on our planet.

Material and Methods

The field experiments were conducted during the Rabi seasons of 2020-21 and 2021-22 at the Department of Agronomy, College of Agriculture, Dapoli, India. The study area is located at 17^{o} 45' 02" North latitude and 73^{o} 10' 55" East longitude. The area falls under 19.2 Agro-ecological sub-region (AESR) i.e., Central and south Sahyadris region represented by hot moist sub humid to humid transitional ecological sub-region (ESR) with deep loamy to clay red and lateritic soils. The climate of the area is hot humid to per humid with well expressed three seasons viz., rainy (June to October), winter (November to February) and summer (March to May). The mean annual rainfall is 3500 mm, of which about 90 per cent received during the months June to October with about 95 to 100 rainy days in most of the years. The experimental soil was sandy loam in texture, moderately acidic in reaction and having low electrical conductivity, it was very high in organic carbon content, medium in available nitrogen, very low in available phosphorus and high in available potassium content indicating typical characteristics of lateritic soils of Konkan region.

Chilli cultivar Sitara was used as the test crop with a spacing of 60 cm x 45 cm in plots measuring 4.5 m x 3.0 m. A randomized block design (RBD) with three replications and sixteen treatment combinations were employed. Vermicompost was applied to soil based on the recommended 100% nitrogen dose as well as cow urine, vermiwash and plant leaf extracts were analysed for nutrient content (Table 1) and applied at 30, 60 and 90

days after transplanting (DAT) of chilli @ 0.02, 0.04 and 0.06% N content to specific treatment using a spray pump.

Observations and Measurements

Mature chilli fruits were harvested from each plot at each picking and weighed immediately. Data were summed and expressed as green pod yield (kg/plot) and chilli yield (t/ha). Average weight of fruits per plant (g) was determined by harvesting fruits from five randomly tagged plants per plot at each picking.

Ascorbic acid and anthocyanin content were measured in fresh green pod chilli samples using the 2,6-dichlorophenol indophenol method (3) and the colorimetric method, respectively (2). Red chilli pods were used for anthocyanin estimation by the ethanolic HCL method (3).

Results

Yield and Yield Attributes

The application of different organic sources significantly impacted green pod yield. The highest green pod yield (14.59 t/ha) was

Table 1: Effect of soil and foliar application of different organic sources on green pod yield of chilli

Treat. No.	Treatment details	Green pod yield (t ha^{-1})	Weight of fruits $plant^{-1}$(g)
T_1	100 % RDN through Vermicompost (VC)	11.38	182.68
T_2	T_1 + Foliar Spray of Cow urine @ 0.02 % N content	12.32	203.85
T_3	T_1 + Foliar Spray of Cow urine @ 0.04 % N content	12.90	232.00
T_4	T_1 + Foliar Spray of Cow urine @ 0.06 % N content	14.04	241.12
T_5	T_1 + Foliar Spray of Vermiwash @ 0.02 % N content	12.35	207.58
T_6	T_1 + Foliar Spray of Vermiwash @ 0.04 % N content	13.78	235.87
T_7	T_1 + Foliar Spray of Vermiwash @ 0.06 % N content	14.59	251.02
T_8	T_1 + Foliar Spray of Moringa leaf extract (MLE) @ 0.02 % N content	12.02	201.72
T_9	T_1 + Foliar Spray of Moringa leaf extract (MLE) @ 0.04 % N content	12.39	216.05
T_{10}	T_1 + Foliar Spray of Moringa leaf extract (MLE) @ 0.06 % N content	13.72	232.77
T_{11}	T_1 + Foliar Spray of Glyricidia leaf extract (GLE) @ 0.02 % N content	12.12	203.49
T_{12}	T_1 + Foliar Spray of Glyricidia leaf extract (GLE) @ 0.04 % N content	12.87	213.01
T_{13}	T_1 + Foliar Spray of Glyricidia leaf extract (GLE) @ 0.06 % N content	12.98	227.13
T_{14}	T_1 + Foliar Spray of Pongamia leaf extract (PLE) @ 0.02 % N content	11.88	193.71
T_{15}	T_1 + Foliar Spray of Pongamia leaf extract (PLE) @ 0.04 % N content	12.46	205.60
T_{16}	T_1 + Foliar Spray of Pongamia leaf extract (PLE) @ 0.06 % N content	13.01	224.14
	Mean	**12.80**	**216.98**
	SEm ±	**0.38**	**7.89**
	C.D. P=0.05	**1.16**	**22.79**

recorded with 100% N equivalent vermicompost and 0.06% N vermiwash foliar application i.e.T_7 treatment (Table 1). This increase might be attributed to soluble nutrient transfer and growth stimulants in vermiwash, triggering physiological processes like photosynthesis and cell division (5).

Conversely, the lowest green pod yield (10.26 and 12.25 t/ha) was observed in T_{14} (100% RDN vermicompost with 0.02% N pongamia leaf extract) and T_1 (100% RDN vermicompost alone), respectively.

Similar to green pod yield, 100% N equivalent vermicompost and 0.06% N

Table 2: Effect of soil and foliar application of different organic sources on Ascorbic Acid, Anthocyanin and Capsaicin content of chilli

Treat. No.	Treatment details	Ascorbic Acid (mg 100 g^{-1})	Anthocyanin (mg 100 g^{-1})	Capsaicin (%)
T_1	100 % RDN through Vermicompost (VC)	71.88	23.73	0.193
T_2	T_1 + Foliar Spray of Cow urine @ 0.02 % N content	81.25	24.76	0.199
T_3	T_1 + Foliar Spray of Cow urine @ 0.04 % N content	87.50	26.14	0.214
T_4	T_1 + Foliar Spray of Cow urine @ 0.06 % N content	96.88	28.35	0.231
T_5	T_1 + Foliar Spray of Vermiwash @ 0.02 % N content	85.42	24.95	0.210
T_6	T_1 + Foliar Spray of Vermiwash @ 0.04 % N content	98.96	26.26	0.228
T_7	T_1 + Foliar Spray of Vermiwash @ 0.06 % N content	105.21	28.99	0.240
T_8	T_1 + Foliar Spray of Moringa leaf extract @ 0.02 % N content	80.21	22.97	0.198
T_9	T_1 + Foliar Spray of Moringa leaf extract @ 0.04 % N content	85.42	25.89	0.214
T_{10}	T_1 + Foliar Spray of Moringa leaf extract @ 0.06 % N content	92.71	27.90	0.219
T_{11}	T_1 + Foliar Spray of Glyricidia leaf extract @ 0.02 % N content	84.38	24.22	0.204
T_{12}	T_1 + Foliar Spray of Glyricidia leaf extract @ 0.04 % N content	84.38	25.46	0.207
T_{13}	T_1 + Foliar Spray of Glyricidia leaf extract @ 0.06 % N content	88.54	25.93	0.211
T_{14}	T_1 + Foliar Spray of Pongamia leaf extract @ 0.02 % N content	79.17	24.31	0.201
T_{15}	T_1 + Foliar Spray of Pongamia leaf extract @ 0.04 % N content	82.30	25.21	0.206
T_{16}	T_1 + Foliar Spray of Pongamia leaf extract @ 0.06 % N content	82.50	26.28	0.212
	Mean	**86.67**	**25.71**	**0.212**
	SEm ±	**4.15**	**1.14**	**0.006**
	C.D. P=0.05	**12.01**	**3.29**	**0.019**

vermiwash foliar application (T_7) recorded the highest mean fruit weight (251.02 g) per plant (Table 2). This could be due to the abundance of macro/micronutrients, humic/fulvic acids, and growth regulators in high-dose vermiwash, potentially boosting physiological processes and contributing to increased growth parameters (1). The lowest mean fruit weight (182.68 g) was found in T_1 (100% N equivalent vermicompost alone).

Quality Parameters

The application of 100% RDN through vermicompost with 0.06% N through vermiwash foliar application (T_7) resulted in the highest mean ascorbic acid (105.21 mg/kg) content of chilli (Table 2). The increased ascorbic acid content in T_7 might be due to the potential of vermiwash to provide macro/micronutrients, hormones and amino acids, enhancing carbohydrate synthesis and ascorbic acid oxidase activity in plants.

Similarly, the mean capsaicin (0.240 %) and mean anthocyanin (28.99 mg 100 g^{-1}) content of chilli was higher due to application of 100 per cent RDN through vermicompost and foliar application of vermiwash @ 0.06 per cent N content. This could be attributed due to the presence of carbon-containing compounds like humic and fulvic acids in vermiwash, known to trigger capsaicin and anthocyanin synthesis in chilli.

Discussion

The combined application of 100% N equivalent vermicompost and 0.06% N through vermiwash foliar application (T_7) significantly improved both yield and quality parameters of chilli compared to other treatments. This effect can be attributed to the synergistic action of nutrients, growth stimulants and humic/fulvic acids present in vermiwash, enhancing physiological processes and impacting growth, nutrient uptake and secondary metabolite production. Further research could explore the optimal application rates and durations of vermiwash for maximized chilli yield and quality under varying agro ecological conditions.

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