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Sustainable Production Packages for Turmeric

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Abstract

Field experiment was conducted at Tamil Nadu Agricultural University to study the effect of organic sources of nutrients on growth, yield and quality parameters of turmeric. The results showed that higher Leaf area index (LAI) of 12.30 at 180 days after planting (DAP) and rhizome yield (26,076 kg ha^{-1}) was recorded with the application of 100% RDF + 40% Wellgro soil. Similarly application of Wellgro soil and chemical fertilizer registered higher curcumin, oleoresin and essential oil content (4.34, 9.38 and 3.82, respectively), which was on par with 75% RDF + 40% Wellgro pellets. Higher benefit cost ratio (2.82) was also recorded with the application of 100% RDF + 40% wellgro soil. This indicates that wellgro formulations have positive influence on yield and quality of turmeric under soil and climatic conditions of Tamil Nadu, India.

Introduction

India is called as the "Spice bowl of the world" as it produces variety of spices with quality. Though India leads in production of turmeric, but average productivity is very low due to imbalanced and suboptimal dose of chemical fertilizers, organic manure, bio-fertilizers and micronutrients (Kandiannan and Chandragiri, 2008). Since, turmeric is a nutrient responsive crop and removes large amount of nutrients from soil, sufficient quantities of nutrients have to be applied in order to obtain sustainable yield levels. Organic source of nutrients (wellgro formulations) would augment the nutrient uptake, yield and economics of turmeric. Therefore, the present investigation was carried out to test the effect of Wellgro organic formulations on growth and yield of turmeric under irrigated conditions.

Materials and Methods

A field experiment was conducted during June 2010 – March 2011 at Northern Block Farm, Agricultural Research Station (Tamil Nadu Agricultural University), Bhavanisagar, Erode district of Tamil Nadu. The soil of the experimental field was red sandy loam in texture having slightly acidic pH (6.27) with medium soluble salts (0.75 dSm-1), medium in organic carbon content (0.50%t), low in available N (205 kg ha-1), medium in available P(15.7 kg ha-1) and high in available K (376 kg ha-1). The field experiment was laid out in Randomized Block Design with three replications. Three different wellgro formulations (wellgro soil, wellgro pellets and wellgro grains) were applied in 12 different treatments at 20% and 40% of total Weight of chemical fertilizer applied. Two treatments consisted of farm yard manure (well decomposed cow dung) at the rate of 12.5 t ha-1. Recommended dose of fertilizers 150: 60: 100 kg NPK ha-1 was applied (to meet the nutrient requirement of turmeric) along with wellgro formulations as six equal splits at 0,30,60,90,120 and 150 DAP, where as full dose of P was applied as basal.

In today's cultivation many commercial organic types of manure are being used because of their application in lesser volume and also enriched with nutrients. One such commercial organic manure used in the study is *Wellgro*
(Yet to be commercialized). *Wellgro* organic manures are a product of Indian Tobacco Company (ITC) and are developed for soil application. These products are made from non-timber forest produce and rich source of nutrients and organic carbon. Across the country, its efficacy was examined in different agro climatic conditions on various crops.

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Table 1. Nutrient status of Wellgro organic manure.

Character	Wellgro soil	Wellgro pellets	Wellgro grains
Total nitrogen (%)	2.24	1.77	2.52
Total phosphorus (%)	0.52	0.35	0.43
Total potassium (%)	1.30	2.70	1.70
Organic carbon (%)	39.50	31.70	34.80

Results and discussion

The growth characters of turmeric *viz.,* plant height, leaf area index, and dry matter production were significantly influenced by application of wellgro organic manures. Among the different wellgro formulations, turmeric applied with 100% RDF + 40 % wellgro soil registered significantly higher values of LAI (12.3) at 180 DAP and it was closely followed by 100% RDF + 40% wellgro grains. The minimum values were noticed with the application of 100% RDF with the values of (8.19). Similarly, application of recommended dose of fertilizers along with 40% wellgro soil recorded higher dry matter accumulation (10316kg ha^{-1}) at 180 DAP. This was due to higher underground rhizome mass. The higher uptake of nutrients could have led to maximum dry matter accumulation. Addition of organic manure was found to improve soil health and microbiological process. Application of 100% RDF + 40% wellgro soil recorded increased organic carbon accumulation. Incorporation of organic manure resulted in increased total N content of soil and formation of stable complex with humic substances supplied through wellgro soil. It might be due to decreased soil bulk density, increased soil organic matter, total porosity, water infiltration into soil as noticed with the earlier report of Obi *et al.* (1995).The results of the present influenced by the application of wellgro formulations (Table 2).

Table 2. Influence of wellgro formulations on growth and physiological parameters of turmeric

Treatments	Days to rhizome sprouting	Plant height @ 180 DAP	LAI at 180 DAP	DMP at 180 DAP(kg/ha)
T_1 - 100 % RDF	27.03	107.19	8.19	6493
T_2-100 % RDF + 20% Wellgro Soil	25.31	120.17	10.55	8997
T_3 - 100 % RDF + 40%Wellgro Soil	18.02	131.01	12.30	10316
T_4- 75 % RDF + 20% Wellgro Soil	24.20	118.65	10.15	8251
T_5-75 % RDF + 40%Wellgro Soil	20.86	119.18	10.61	8780
T_6 - 100 % RDF + 20% Wellgro Pellets	22.25	118.43	9.15	7952
T_7 - 100 % RDF + 40%Wellgro Pellets	21.92	122.13	9.45	8570
T_8- 75 % RDF + 20% Wellgro Pellets	25.42	117.96	10.29	7730
T_9 - 75 % RDF + 40%Wellgro Pellets	20.19	120.72	10.10	9671
T_{10} - 100 % RDF + 20% Wellgro Grains	24.16	118.76	9.04	7304
T_{11} - 100 % RDF + 40%Wellgro Grains	20.62	130.41	11.17	8187
T_{12}- 75 % RDF + 20% Wellgro Grains	24.96	116.31	9.35	7825
T_{13} - 75 % RDF + 40%Wellgro Grains	21.45	118.06	10.08	7738
T_{14} - 100% RDF + FYM	21.51	122.20	10.65	7897
T_{15} - 75 % RDF + FYM	21.94	116.46	10.4	7822
SEd	0.45	3.36	0.40	218
CD (P=0.05)	0.92	6.87	0.81	448

In general, organic sources of nutrients in turmeric recorded significantly higher yield over control. among the treatments, application of 100% RDF + 40% wellgro soil recorded the maximum yield of mother rhizome (10,590 kg ha^{-1}) and finger rhizome (15,451 kg ha^{-1}), which was followed by 75 % RDF + 40% wellgro pellets

(9,347 and 14305kg ha^{-1}, respectively). Simultaneously higher economic yield of rhizome (26,076 kg ha^{-1}) was recorded by the application of 100% RDF + 40% wellgro soil over all the treatments, Lower yield of (17,257 kg ha^{-1}) was obtained due to application of 100 % RDF (Table 3). Humus substance present in organic product could have mobilized the reserve food materials to the sink through increased activity of hydrolyzing and oxidizing enzymes. This product would help the better availability and utilization of nutrients. This in confirmation with findings of Mato and Mendez (1970). Application of 100% RDF + 40% wellgro soil recorded higher curcumin, oleoresin and essential oil content. Organic manures produce more chelated phosphates, which are more soluble in water. This easily available form might have triggered the oleoresin content of rhizomes. The possible reason for higher essential oil content in wellgro soil is that it stimulates the nitrate reductase activity in plants. This enzyme regulates nitrogen availability to plants. Improved nitrogen metabolism particularly through nitrate reductase activity might have exerted higher essential oil content in rhizomes. Application of 100 % RDF + 40 % wellgro soil significantly increased B: C ratio which might be due to the synergistic effect of wellgro soil which in turn could have triggered the highest rhizome yield of turmeric.

Table 3. Effect of organic sources of nutrients on yield, quality and economics of turmeric

Treatment	Yield parameters and B:C ratio of turmeric				Quality of turmeric		
	Mother rhizome (kg ha^{-1})	Fingers (kg ha^{-1})	Cured rhizome yield (kg ha^{-1})	B: C ratio	Curcumin	Oleoresin	Essential oil
T_1	6806	10521	3400	1.62	3.72	8.54	3.35
T_2	8438	12014	4377	2.08	3.92	8.88	3.55
T_3	10590	15451	5960	2.82	4.34	9.38	3.82
T_4	8716	12916	4650	2.23	3.99	9.05	3.66
T_5	9035	13195	5125	2.45	4.16	9.19	3.59
T_6	7917	12882	4704	2.24	3.72	8.91	3.67
T_7	8160	12083	4476	2.12	4.09	9.23	3.54
T_8	7847	11757	4039	1.93	3.88	9.13	3.56
T_9	9347	14305	5278	2.52	4.13	9.33	3.78
T_{10}	8472	12326	4529	2.16	3.87	8.87	3.53
T_{11}	7986	13506	4260	2.02	4.10	9.12	3.60
T_{12}	8576	13160	4490	2.15	4.06	9.08	3.45
T_{13}	7708	1257	4074	1.94	4.04	8.84	3.59
T_{14}	8944	12673	4521	2.10	3.86	8.88	3.53
T_{15}	8611	12639	4308	2.02	3.91	8.80	3.53
SEd	378	486	117	-	0.07	0.073	0.05
CD(P=0.05)	774	996	239	-	0.14	0.15	0.11

Conclusion

From the field investigation, it is concluded that turmeric responded favorably to wellgro formulations. Taking into consideration of the growth and productivity of crops and economic benefits it is inferred that application of 100% RDF along with 40% wellgro soil could be a viable practice. Hence, integrated nutrient management practice of 100% recommended dose of fertilizer + 40% wellgro soil w/w of chemical fertilizer in turmeric crop has been found to be an ideal option to sustain the soil fertility, crop productivity besides higher economic benefits.

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