International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 18, 2020, pp.-10223-10227.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON THE GROWTH AND YIELD OF TURMERIC *VAR.* BSR2 IN THE RED SOILS OF KRISHNAGIRI DISTRICT, TAMIL NADU

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Received: May 27, 2020; Revised: September 12, 2020; Accepted: September 13, 2020; Published: September 30, 2020

Abstract: Field experiments were conducted during *kharif* 2010 and 2011 on turmeric (*Curcuma longa* L.) variety BSR2 at Regional Research station, Tamil Nadu Agricultural University, Paiyur on alfisol soil with ten treatments. The experiment was laid out with graded levels of nitrogen (150 and 200 kg/ha), Phosphorus (60,75kg/ha) and potassium (108,150 and 180 kg/ha). The pooled results of two years indicated that the growth parameters like the plant height (68.10cm), number of leaves (8.40), leaf length (72.07cm), leaf breadth (18.41cm) and number of tillers (4.20) and the yield characters like weight of mother rhizome (176.80g), weight of primary rhizome (343.42g), weight of secondary rhizome (241.43g) ,weight of clump per plant (846.82g) and fresh rhizome yield (44.43t/ha) were the highest by the application of 200-75-180 kg NPK along with FYM (25t/ha) + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ha). The optimum dose of fertilizer to increase the yield of turmeric is 200-75-180 kg NPK/ha whenever the inorganics alone are applied while it is 200-75-180 kg NPK/ha + FYM (25t/ha) + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ha) whenever integrated nutrient management practice is adopted.

Keywords: *Integrated nutrition, Growth and Yield, Turmeric BSR2, Red Soils*

Citation: S. Srividhya, *et al*., (2020) Effect of Integrated Nutrient Management on the Growth and Yield of Turmeric *var.* BSR2 in the Red Soils of Krishnagiri District, Tamil Nadu. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 18, pp.- 10223-10227.

Introduction

Turmeric (*Curcuma longa*) is used as condiment, dye, drug and cosmetic in addition to its use in religious ceremonies. India is a leading producer about 78% and exporter of turmeric in the world. China is second largest supplier of the spice. Andhra Pradesh alone occupies 35.0% of area and 47.0 % of production while 21 % is by Tamil Nadu. In India during 2008-2009, the country produced 8,92,213 tonnes of turmeric from an area of 1,94,358 ha while in Tamil Nadu the production is 1,75,390 tonnes from an area of 30,350 ha. Turmeric consumes greater amount of nutrients from the soil as well as from applied fertilizers for a prolonged period [1]. The crop is usually controlled by a cultivar's genetic potential and environmental setting.

However, crop nutrition plays an important role by allowing full exploitation of a cultivar's genetic potential. Nutrient management influences directly on the quality and quantity of the final produce. Thamburaj (1991) [2] reported a favorable effect on yield with increased K_2O up to 90 kg K_2O/ha. Experiments conducted on open field conditions indicated significant improvements in rhizome yield of turmeric with increased N levels up to 120 kg N/ha [3].

Borah and Langthasa (1994) [4] recorded that turmeric variety 'Tall Clone' registered higher plant height, number of tillers per plant and higher yield (202.14 q ha^{-1}) at 90 kg N ha^{-1} than the control (115.16 q ha^{-1}). Dayankatti and Sulkeri (2000) [5] also stated that the highest values on biometrical parameters was observed by the application of 125 kg N ha^{-1}.

Meenakshi *et al.* (2001) [6] stated that application of varying levels of P_2O_5 and K_2O increased the height of plant, number of tillers, number of leaves, leaf area and total dry matter production and enhanced the levels of P_2O_5 and K_2O besides resulted in higher growth rate in turmeric. Jadho *et al.* (2005) [7] stated that best performance on growth parameters was observed in turmeric cv Waigaon, when fertilized with 120:60:60 kg N, P_2O_5 and K_2O ha^{-1} + 30 kg $ZnSO_4$ ha^{-1}.

Sanwal *et al.* (2007) [8] stated that the application of 90:60:90 kg N, P_2O_5 and K_2O ha^{-1} produced 21.58 fingers per plant exhibiting a weight of 430.00 g per plant with an overall total yield of 29.58 t ha^{-1}. Decreasing non-renewable reserves all over the world and high cost have necessitated the demand for alternate renewable sources to meet the need of plant nutrients. Organic manure and biofertilizers are considered to be alternate sources. Knowing the deleterious effect of using only chemical fertilizer use of soil microorganisms, which can fix atmospheric nitrogen, solubizing phosphorus, stimulating plant growth through synthesis of growth promoting will be environmentally benign approach for nutrient management of ecosystem. Velmurugan (2007) [9] stated that the combined application of FYM along with biofertilizers expressed tallest plants with a greater number of tillers, a greater number of leaves and greater leaf area.

Application of organics, biofertilizers in addition with the required number of inorganics, with an aid of utilizing natural resource, is the main trend in sustainable agriculture. The management of native soil N which is the principle N shows for crops and biological N_2 fixation may play a role in sustaining the soil N under intensive cropping system. Biological N fixation is an important process in farming systems because it is an inexpensive source of N for increasing the productivity in crop like turmeric.

Phosphorus solublizing bacteria and mobilizing organisms supply phosphorus source in available form to the crop which has significantly increased the yield in turmeric. Yet low awareness in the nutrient management and nutrient mining has led to low productivity of fresh rhizome yield in the major turmeric growing regions. In order to study the effect of graded levels of nitrogen, phosphorus and potassium on turmeric production and on its quality attributes of the crop a field experiment was carried out on the alfisol soil series in the north western zone of Tamil Nadu.

Materials and method

An experiment was carried out at the Regional Research Station, Paiyur, Tamil Nadu Agricultural University, Krishnagiri during 2010- 2012 to assess the "Integrated nutrient management on the growth and yield of Turmeric variety BSR2 in red soils of Krishnagiri district". The soil of the experimental site was red non calcareous sandy loam of entisol with EC 0.35 dSm^{-1}, pH 7.1, organic carbon 0.37%, available nitrogen 140 kg/ha, available phosphorus 15kg/ha and available potassium 280 kg/ha. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments replicated threefold. The details of experiment are given in the [Table-1].

Table-1 *Experimental details*

T1 150-60-108 kg N P_2O_5 K_2O (RDF)
T2 150-60-150 kg N P_2O_5 K_2O
T3 150-60-180 kg N P_2O_5 K_2O
T4 200-75-150 kg N P_2O_5 K_2O
T5 200-75-180 kg N P_2O_5 K_2O
T6 T1+FYM (25t/ha) + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ha) Soil application
T7 T2+FYM (25t/ha) +Biofertilizer (*Azospirillum* & *Phosphobacteria* 10kg each/ ha)
T8 T3+FYM (25t/ha) +Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha)
T9 T4+FYM (25t/ha) +Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha)
T10 T5+FYM (25t/ha) +Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha)

FYM and Full dose of Phosphorus while N and K_2O in 6 equal splits (basal and at 30, 60, 90,120 and 150 days after sowing) were given as basal dose. Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha) as soil application one month after sowing. The experiment was conducted for two years. Plot size of 5 x 2.5m was used with the experimental site being previously prepared in broad ridge and furrow for sowing of the rhizomes. Rhizomes were planted at a spacing of 20 cm between plants and 45 cm between ridges. Standard cultural practices recommended for turmeric were followed. During crop growth, growth parameters during 4th and 7th month *viz*., like height of the pseudostem, mean number of leaves, leaf length and breadth, number of tillers were recorded. The crop was harvested 240 days after planting and yield parameters like weight of mother rhizome(g), primary rhizome (g) and secondary rhizome (g) and clump yield per plant, yield of fresh rhizomes fresh rhizomes was documented. Quality parameter *viz*., curcumin (yellow pigment of turmeric) content of rhizome samples was estimated by the method suggested by ASTA (1968) [10]. Standard procedure of Panse and Sukhatme (1985) was adopted for the statistical scrutiny of the data.

Result and Discussion

Height of the Pseudostem

The data were recorded during active growth phase (4th month) and during the rhizome development phase (7th month). The data on height of the pseudostem showed significant difference among the treatments. The height of the pseudostem reached maximum of 59.80 cm (4th month) and 70.80 cm (7th month) in the first crop and 54.96 cm (4th month) and 68.10 cm (7th month) in the second crop through the application of 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha (T10) [Table-1 and -2].The increase in height of turmeric plants with enhancement of nitrogen levels could be attributed to the rapid meristamatic activity in plants due to enhanced cell division. The *Azospirillum* produces phytohormones, which stimulate growth and induce changes in root morphology in turn influencing the assimilation of nutrients.

Mean number of leaves

The treatment that received 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha recorded the highest mean number of leaves of 8.10 and 7.90 during 4th and 7th month respectively in the 1st year crop [Table-1]. In 2nd crop also the same treatment recorded higher mean number of leaves with 10.03 and 8.90 [Table-2].

Leaf length and Breadth

Application of 200-75-150 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha recorded a leaf length of 48.70 cm in the 4th month however during 7th month, application of 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha showed 64.70 cm length in the first-year crop as shown in [Table-1]. While leaf breadth was maximum of 18.17 cm by the application of 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha with 18.17 cm and 17.91 cm in the 4th month of first and second year crop and application of Application of 200-75-150 kg NPK+25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha showed more leaf breadth with 19.17cm and 19.00 in the 7th month crop of 2010 and 2011 [Table-1 and 2]. The application of fertilizer, bio-fertilizer and organic manure on the protein synthesis and hormonal synthesis would have an effect on the leaf expansion and the leaf length.

Number of tillers

Application of 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha, 200-75-150 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha and application of 200-75-180 kg NPK without organic manures and biofertilizer recorded 3.40, 3.40 and 3.13 number of tillers during 7th month respectively for the first year crop and same treatments produced 5.00, 4.63 and 4.43 number of tillers during 7th month for the second year crop respectively [Table-1] and [Table-2].

Clump weight per plant

Application of 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ha recorded 529.2 g per plant of single plant clump weight in the 1st season crop [Table-4] followed by application of 200-75-180 kg NPK without organic manure and biofertilizer treatment with 504.5 g/plant. The biofertilizer application increased the uptake of macro nutrients thereby plants grown vigorously and better translocation of nutrients to the sinks led to the increased clump weight of turmeric. In the 2nd plant crop also, the same treatments T10 and T5 recorded the higher clump weight of 1164.44 g per plant and 1060.56 g per plant [Table-5] respectively [11]. A similar increase of over 37% in fresh rhizome yield was recorded over control no farm yard manure (FYM) by the application of 25 t FYM per ha.

Weight of mother rhizome and primary rhizomes

Significant difference among the treatments was observed with regard to mother and primary rhizomes. The application of 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ha produced the maximum weight of mother rhizome by 140.0g and 213.60in 1st and 2nd crop respectively [Table-4]. The highest weight of primary rhizome 236.5g and 450.33 g was obtained by the application of 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each per ha in the first and second crop respectively [Table-4] and [Table-5].

Weight of secondary rhizome

Among the ten treatments under study, application of 200-75-180 kg NPK + 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each per ha produced the maximum weight of secondary rhizome with 152.30g and 330.56g in the first and second year crop followed by the application of 200-75-180 kg NPK alone 133.9g in 1st plant crop and 310.00g in the 2nd plant crop [Table-4] and [Table-5].

Fresh rhizome yield per hectare

The results on turmeric rhizome yield per plot showed significant differences among the treatments indicating the increase in the yield nitrogen and potassium at critical stages of crop growth along with biofertilizer inoculation and manure application. Response to added level of nitrogen and potassium increased progressively and highest yield was obtained by the application of 200-75-180 kg NPK + 25t/ha FYM + Bio fertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha with an yield of 31.22 t/ha in the first year and the same treatment yielded 57.63 t/ha in the second year also [Table-4] and [Table-5] followed by the application of 200-60-180 kg NPK alone produced 28.97 t/ha in the first year of while the application of 200-75-180 kg NPK alone produced 55.74 t/ha in the second year of planting [Table-4] and [Table-5]. The Application of200-75-180 kg NPK + 25t/ha FYM + Bio fertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha showed 71.06 and 32.84 percent increase over the RDF respectively for 1st and 2nd year.

Table-1 *Morphological characters of turmeric var BSR-2 during 4th and 7th month of growth for 1st year crop*

Treatment	Plant height (cm)		Number of leaves		Leaf length (cm)		Leaf Breadth (cm)		Number of Tillers	
	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month
T_1	34.10	47.20	6.40	6.00	41.80	55.80	15.10	13.90	2.20	2.07
T_2	34.90	48.10	6.93	6.90	44.10	50.20	16.00	13.30	2.33	2.13
T_3	39.70	49.80	7.00	7.10	44.30	47.60	15.50	16.60	2.27	2.33
T_4	45.20	55.80	7.20	6.80	45.30	55.60	16.50	18.80	2.80	2.73
T_5	52.70	60.70	7.40	6.90	43.80	51.80	15.70	16.20	3.30	3.13
T_6	38.20	49.10	7.06	7.20	44.60	57.20	15.40	15.60	2.20	2.27
T_7	39.10	50.10	7.10	6.50	42.40	54.10	15.20	14.50	2.80	2.73
T_8	42.30	53.70	7.30	7.10	42.40	53.40	14.60	17.90	3.13	3.07
T_9	48.70	62.50	7.90	7.50	48.70	55.10	17.20	19.17	3.40	3.40
T_{10}	59.80	70.80	8.10	7.90	47.20	64.70	18.17	17.30	3.67	3.40
SEd±	1.96	0.51	0.12	0.99	1.01	4.82	0.47	1.32	0.16	0.12
CD at 0.05	4.04	1.04	0.24	2.03	2.06	9.90	0.98	2.71	0.34	0.25

Table-2 *Morphological characters of turmeric var BSR-2 during 4th and 7th month of growth for the 2nd crop*

Treatment	Plant height (cm)		Number of leaves		Leaf length(cm)		Leaf Breadth (cm)		Number of Tillers	
	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month
T_1	39.62	49.62	6.59	6.33	53.74	58.84	14.61	13.41	3.11	2.87
T_2	40.03	50.03	7.13	6.90	57.38	62.48	15.30	14.10	3.56	3.53
T_3	42.73	52.73	7.20	7.18	60.67	65.77	15.76	14.56	3.56	3.80
T_4	45.94	55.94	7.77	7.28	62.64	67.54	16.12	14.92	4.22	3.87
T_5	49.68	65.10	9.20	8.00	63.78	61.68	16.20	15.20	4.67	4.43
T_6	41.03	53.03	7.07	6.85	55.78	62.98	15.00	14.00	3.56	3.63
T_7	41.71	57.90	7.53	7.36	62.89	70.09	15.96	14.96	4.00	3.87
T_8	45.01	60.95	8.47	7.90	64.10	71.30	16.47	16.97	4.22	4.00
T_9	49.39	62.39	8.87	8.83	66.56	77.56	16.90	16.30	5.00	4.63
T_{10}	54.96	68.10	10.03	8.90	68.44	79.44	17.91	18.41	5.33	5.00
SEd±	2.14	2.50	0.36	0.32	1.78	2.25	0.265	0.26	0.14	0.25
CDat0.05%	4.40	5.15	0.74	0.65	3.67	4.47	0.544	0.53	0.28	0.52

Table-3 *Pooled analysis for the morphological characters of turmeric var BSR-2 during 4th and 7th month of growth*

Treatment	Plant height (cm)		Number of leaves		Leaf length (cm)		Leaf Breadth (cm)		Number of Tillers	
	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month	4th Month	7th Month
T_1	36.86	49.62	6.49	6.165	47.77	57.32	14.855	13.41	2.655	2.47
T_2	37.465	50.03	7.03	6.900	50.74	56.34	15.65	14.1	2.945	2.83
T_3	41.215	52.73	7.10	7.140	52.485	56.68	15.63	14.56	2.915	3.07
T_4	45.57	55.94	7.48	7.040	53.97	61.57	16.31	14.92	3.51	3.30
T_5	51.19	65.10	8.30	7.450	53.79	56.74	15.95	15.2	3.985	3.78
T_6	39.615	53.03	7.06	7.025	50.19	60.09	15.2	14	2.88	2.95
T_7	40.405	57.90	7.31	6.930	52.645	62.09	15.58	14.96	3.4	3.30
T_8	43.655	60.95	7.88	7.500	53.25	62.35	15.535	16.97	3.675	3.54
T_9	49.045	62.39	8.38	8.165	57.63	66.33	17.05	16.3	4.2	4.02
T_{10}	57.38	68.10	9.06	8.400	57.82	72.07	18.04	18.41	4.5	4.20
SEd±	2.33	2.31	0.48	0.38	2.74	4.17	0.55	1.13	0.16	0.17
CD at 0.05%	4.79	4.73	1.00	0.78	5.63	8.59	1.13	2.33	0.23	0.35

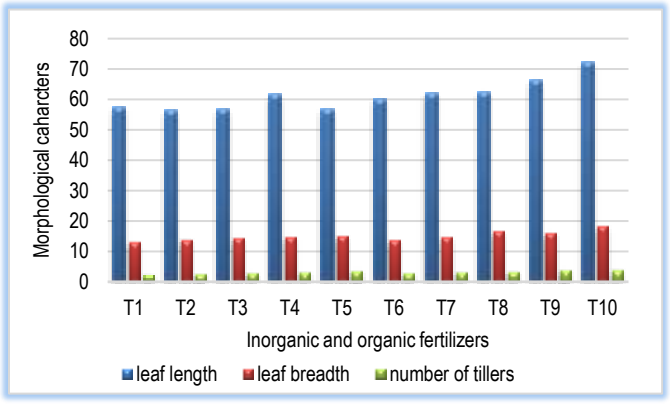

Fig-1 Integrated nutrient management on the morphological characters of turmeric var BSR2 during 7th month of growth

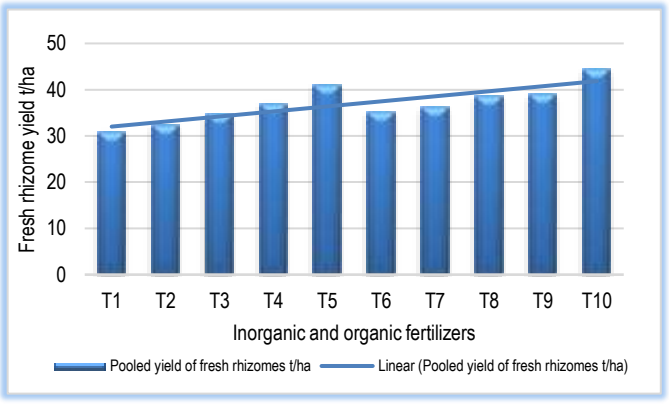

Fig-2 Effect of integrated nutrient management on fresh rhizome yield t/ha of turmeric var BSR2

Organic matter and the biological activity that it generates have a major influence on the physical and chemical properties of soils. Soil structures aggregation and stability increases with organic matter content. These, in turn, increase infiltration rate and available water capacity of the soil, as well as resistance against erosion by water and wind. SOM also improves the dynamics and bioavailability of major plant nutrient elements [12,13].

Curcumin Content

There were no significant differences among the treatments and the application of highest dose of fertilizer plus organic matter *i.e.*, 200-75-180 kg NPK + 25t/ha FYM + Bio fertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha gave the highest 4.70 % curcumin.

Table-4 *Yield and yield characters of turmeric var BSR-2 for the 1st year crop*

Treatment	Weight of mother rhizome(g)	Weight of primary rhizome (g)	Weight of secondary rhizome(g)	Clump yield/plant (g)	Fresh yield of rhizomes t/ha	% yield increase over RDF	BCR
T_1	75.0	189.6	87.5	352.1	18.25	-	3.40
T_2	63.3	196.6	96.6	356.5	18.52	1.48	3.44
T_3	93.6	168.0	101.6	363.2	22.49	23.23	4.17
T_4	120.0	214.6	125.6	460.2	25.79	41.31	4.75
T_5	125.6	219.5	133.9	504.5	26.32	44.21	4.83
T_6	93.0	193.5	98.7	385.2	23.28	27.56	3.54
T_7	97.1	200.9	100.2	397.4	24.87	36.27	3.77
T_8	103.3	210.3	115.7	429.0	28.97	58.73	4.39
T_9	130.4	228.0	142.6	498.6	27.28	49.47	4.11
T_{10}	140.0	236.5	152.3	529.2	31.22	71.06	4.69
SEd±	2.91	3.76	1.66	6.82	2.94		
CD at 0.05%	5.99	7.74	3.41	14.03	6.05		

Table-5 *Yield and yield characters of turmeric var BSR-2 for the 2nd year crop*

Treatment	Weight of mother rhizome(g)	Weight of primary rhizome (g)	Weight of secondary rhizome(g)	Clump yield/plant (g)	Fresh yield of rhizomes t/ha	Curcumin content%	% yield increase over RDF	BCR
T_1	144.68	338.08	202.22	737.03	43.38	4.10	-	3.64
T_2	147.04	342.49	245.37	776.16	46.17	4.10	6.42	3.87
T_3	173.77	375.00	251.00	783.63	47.05	4.10	8.44	3.95
T_4	175.08	375.99	272.22	865.62	48.03	4.17	10.70	3.99
T_5	180.30	382.53	310.00	1060.56	55.74	4.30	28.50	4.76
T_6	146.56	343.82	304.44	806.67	46.97	3.97	8.26	3.85
T_7	151.55	347.33	254.44	823.33	47.50	4.20	9.54	4.29
T_8	183.70	403.78	260.56	906.67	48.33	4.40	11.44	4.38
T_9	190.40	432.52	297.22	1040.00	50.63	4.40	16.70	4.19
T_{10}	213.60	450.33	330.56	1164.44	57.63	4.70	32.84	5.42
SEd±	15.76	27.87	28.66	73.98	3.24	NS		
CD at 0.05%	32.40	57.31	58.94	152.11	6.66			

Table-6 *Pooled analysis of the yield and yield characters of turmeric var BSR-2 for two seasons*

Treatment	Weight of mother rhizome(g)	Weight of primary rhizome (g)	Weight of secondary rhizome(g)	Clump yield / plant (g)	Rhizome yield / plot (12.5m²)	Fresh yield of rhizomes t/ha	% yield increase over RDF	BCR
T_1	109.84	263.84	144.86	544.57	38.75	30.82	4.96	3.52
T_2	105.17	269.55	170.99	566.33	40.67	32.35	12.81	3.65
T_3	133.69	271.50	176.30	573.42	43.72	34.77	19.75	4.06
T_4	147.54	295.30	198.91	662.91	46.42	36.91	33.12	4.37
T_5	152.95	301.02	221.95	782.53	51.60	41.03	13.98	4.79
T_6	119.78	268.66	201.57	595.94	44.17	35.13	17.42	3.69
T_7	124.33	274.12	177.32	610.37	45.52	36.19	25.40	4.03
T_8	143.50	307.04	188.13	667.84	48.62	38.65	26.41	4.38
T_9	160.40	330.26	219.91	769.30	48.99	38.96	44.15	4.15
T_{10}	176.80	343.42	241.43	846.82	55.87	44.43		5.05
SEd±	8.69	19.75	17.27	57.99	2.56	2.04		
CD at 0.05%	17.88	40.61	35.52	119.24	5.27	4.30		

This may be due to added levels of potassium in the inorganic fertilizer which would have helped the better production of curcumin in turmeric. The application of 200-75-150 kg NPK+ 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha and application of 150-60-180 kg NPK+ 25t/ha FYM + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ ha were on par with 4.40 % of curcumin [Table-5].While the application of inorganic fertilizer alone *i.e.*, 150-60-108 kg NPK (RDF),150-60-150 kg NPK and 150-60-180 kg NPK showed curcumin percentage of 4.1.Results confirm with the earlier studies that graded doses of potassium as well as nitrogen and phosphorus significantly improved the curcumin content of rhizomes at harvest.

Pooled Analysis

The pooled analysis for the turmeric crop raised during 2010 to 2012 showed that the growth parameters like the plant height(68.10cm) , number of leaves (8.40), leaf length (72.07), breadth(18.41) and number of tillers(4.20) were the highest by the application of 200-75-180 kg NPK+ FYM (25t/ha) + Biofertilizer (*Azospirillum* & *Phosphobacteria* 10 kg each/ha) and the yield characters like weight of mother rhizome (176.80g),weight of primary rhizome (343.42g) , weight of secondary rhizome (241.43g) ,weight of clump per plant (846.82g) and fresh rhizome yield (44.43t/ha) were the highest [Table-3], [Fig-1] and [Fig-2].

There was a linear gradual increase in turmeric yield from T2 to T3 and also from T4 toT5 over the RDF and also overall from T2 to T5 revealing that turmeric crop responds well to the enhanced dose of K_2O in addition to the increased level of N&P from T2 to T5 over the RDF emphasizing the need to enhance the NPK fertilizer dose from the existing RDF. The results revealed that the optimum dose of fertilizer to increase the yield of turmeric was 200-75-180 kg NPK/ha + FYM (25t/ha) + Biofertilizer (*Azospirillum* &*Phosphobacteria* 10 kg each/ha) (T10) whenever integrated nutrient management practice was adopted which are in line with the results of Rethinam *et al.*1994 [14].

Conclusion

Turmeric crop requires integrated nutrition with enhanced level of nitrogen, phosphorus and potassium up to 200:75:180 kg NPK /ha in conjunction with bio-fertilizer inoculation @10kg/ha and farmyard manure @ 25t/ha was found beneficial to increase the growth and fresh rhizome yield (44.43t/ha) as well as secure higher benefit cost ratio of 5.02 as observed in the present experiment in corroboration with results of Sadanandan and Hamza (1998) [15].

Application of research: Turmeric nutrient management studies for high yield and quality.

Research Category: Nutrient Management

Acknowledgement / Funding: Authors are thankful to Regional Research Station, Paiyur, Krishnagiri, 635112, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India

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Research project name or number: University Research Project at Regional Research station, Paiyur

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Krishnagiri District, Tamil Nadu

Cultivar / Variety / Breed name: Turmeric *var.* BSR2

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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