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Influence of organic nutrient management and variety on the productivity and quality of turmeric at the foothills of Eastern Himalayas

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ABSTRACT

Field experiment was conducted with an objective to increase the productivity and quality of turmeric through organic management and variety during the year 2017-18 to 2019-20 in FRBD with four replications. The college is perched on the picturesque bank of river Siang at the foothills of Eastern Himalayas. Geographically it is located at latitude 28°06'N, longitude 93°32'E and altitude of 153 m MSL, hailing to the subtropical hot humid climatic condition and is one of the major production belts of turmeric. The soil type of the experimental field is sandy loam with pH value of 5.3. Result of the three years of experimention as well as pooled mean indicated significantly taller plant, higher fresh weight of clump and yield per hectare with the treatment of organic package developed by IISR (GRB 35 capsule, FYM @ 20t/ha, Neem cake @ 2t/ha, Vermicompost @ 2t/ha, Ash @ 0.5t/ha and IISR turmeric booster micronutrient @ 5g/litre) as compared to recommended package of SAU (FYM @ 25t/ha and Vermicompost @ 5t/ha). Other characters such as number of tillers/plant, days to 80% maturity and dry recovery under study could not be significantly influenced by the treatments. Among the three varieties considered, the variety NDH 98 recorded significantly taller plant, higher fresh weight of clump, yield per hectare and maximum number of days to attain 80% maturity during the three years of investigation and also the pooled mean. However, the dry recovery and number of tillers were higher in variety Prathibha compared to variety NDH 98 and Megha Turmeric-1 but remained at par with the variety NDH-98 in case of numbers of tillers. The significantly highest curcumin content was recorded in the variety Megha Turmeric 1. Application of different organic treatments could not remarkably enhance the quality parameters considered.

Key words: *Curcuma longa*, organic manure, curcumin, yield.

INTRODUCTION

Turmeric is traditionally used in India for medicinal, religious, culinary, cosmetic and dye purpose (Shah, 17). It is cultivated in India in an area of 2.48 lakh ha with a production of 11.49 lakh tones (Anon., 3). India is the largest producer, consumer and exporter of turmeric. Though, India leads in production of turmeric, but average productivity is very low owing to imbalanced and suboptimal dose of chemical fertilizers and organic manures (Kandiannan and Chandaragiri, 10). Turmeric being a long duration crop extracts lot of the nutrients from the soil. The use of fertilizers has tremendously increased the production of turmeric in the country, however, continuous and indiscriminate use of chemical fertilizer has resulted in several problems such as acidity, alkalinity, deficiencies in micronutrients, soil and ground water pollution, etc. Thus, there is a need to maintain proper co-ordination among resources like soil, water, organic matter, biotic life and plant nutrient supply to maintain crop production at higher level (Shroff *et al*., 18). Use of organic such as FYM, Vermicompost, neem cake and biofertilizer not only improve the soil health but will help to sustain maximum production. Turmeric crop has wide genetic variability and not much work has been done in the state for selection of the most suitable variety which is well adapted to the soil and climatic condition of the area so as to obtain higher yield and quality. The variation in growth characters, production potential and quality among different varieties of turmeric were also observed by Kumar *et al.* (11) and Desmukh *et al*. (5). As the information on these aspects is lacking under the agro-climatic condition of Arunachal Pradesh, hence the present study was undertaken.

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MATERIALS AND METHODS

A field experiment was carried out at College of Horticulture and Forestry, Central Agricultural University during 2017-18 to 2019-20 consecutively for three years. The experimental site is located at latitude $28^0$06'N, longitude $93^0$32'E and altitude of 153 m above mean sea level. The soil of the experimental field is sandy loam in texture with slightly acidic in nature (pH 5.3), having high organic carbon (1.3 %), medium in available nitrogen (310 kg N/ha), low in available phosphorus (25 kg P_2O_5/ha) and high in available potassium (362 kg K_2O/ha). Geographically it is located at latitude of $28^0$06'N, longitude of $93^0$32'E and altitude of 153 m MSL,

hailing to the subtropical hot humid climatic condition and is one of the major production belts of turmeric. The treatment consisted of two organic nutrient management (T1 -GRB 35 capsule, FYM 20t/ha, Neem cake 2t/ha, Vermicompost 2t/ha, Ash 0.5t/ha and IISR turmeric booster micronutrient 5g/litre, T2 - FYM 25t/ha and Vermicompost 5t/ha) and three varieties (V1- NDH 98, V2- Megha Turmeric-1and V3- Prathibha). The experiment was laid out in factorial randomized block design with three replications. Healthy rhizomes having 2-3 buds were planted at 30 cm apart in rows keeping 25 cm plant to plant distance. The entire recommended package of practices was followed to raise a good crop. Five plants were randomly selected from each plot to record observations on quantitative characters like plant height (cm) and number of tillers per clump. The days to maturity, rhizomes yield (t/ha) and dry recovery were observed and workout. The qualitative characters like curcumin (%), essential oil (%) and oleoresin content were also recorded. The curcumin content was estimated as per the methods of ASTA (Anon., 2) proposed by Manjunath *et al.* (13).

$$\text{Curcumin content (per cent)} = \frac{\text{OD value} \times 125 \times 0.0025}{0.42 \times 0.1 \times 1}$$

The oleoresin content was calculated using the following formula and expressed as per cent (AOAC, 1).

$$\text{Oleoresin content (per cent) (air dry)} = \frac{W2 - W1}{10} \times 100$$

Where,
W1 = weight of empty beaker
W2 = weight of beaker with air dried oleoresin

The essential oil content was estimated as per the methods suggested by ASTA (Anon., 2). The volume was measured and the oil content was calculated as

$$\text{Essential oil content (per cent)} = \frac{\text{Volume of oil (ml)}}{\text{Weight of sample (g)}} \times 100$$

The mean values were subjected to statistical analysis of data for each character as per method given by Panse and Shukhatme (15).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) in respect of plant height, number of tiller per plant and days to 80% maturity exhibited significant differences amongst the varieties. The variety NDH 98 recorded significantly the tallest plant in all the years and pooled mean with an exception in 2017-18 where taller plants was observed in the variety Megha Turmeric 1. The minimum plant height was found in the variety Prathibha during the three years of study as well as pooled mean. The differences in plant height might be attributed to variation in the genetic makeup of the variety. The variation in plant height due to variety was also reported earlier by Singh *et al.* (19). Among the varieties Prathibha recorded the maximum number of tillers per plant and it remain at par to NDH 98 but significantly higher to Megha Turmeric 1 in all the three years of investigation and the pooled mean. Dhatt *et al.* (6) also reported similar variations in number of tiller among the genotype of turmeric under different agro-climatic conditions.

Table 1. Growth characters of turmeric as influence by organic treatment and variety.

Treatment × Variety	Plant height (cm)				No. of tillers/plant				Days to 80% maturity			
	2017-18	2018-19	2019-20	Pooled mean	2017-18	2018-19	2019-20	Pooled mean	2017-18	2018-19	2019-20	Pooled mean
Organic treatment												
T1 (IISR)	96.20	100.60	113.20	102.00	1.86	2.73	3.12	2.67	213	224	203	213
T2 (SAU)	92.28	94.31	109.20	98.30	1.71	2.70	3.01	2.58	213	223	206	214
SEm±	1.74	1.18	0.32	0.38	0.08	0.10	0.02	0.02	0.73	2.15	0.32	0.43
$CD_{0.05}$	NS	3.59	5.83	NS	NS	NS	NS	NS	NS	NS	NS	NS
Varieties												
V1 (NDH 98)	98.09	113.15	131.80	114.50	2.05	2.76	3.15	2.88	220	230	208	219
V2 (Megha Turmeric 1)	113.99	103.81	120.40	111.50	1.10	2.46	2.86	2.00	207	218	203	210
V3 (Prathibha)	70.65	75.19	81.50	74.50	2.25	2.93	3.19	3.00	212	221	202	212
SEm±	2.13	1.45	0.50	0.60	0.10	0.13	0.03	0.03	1.09	2.64	0.49	0.67
$CD_{0.05}$	6.48	4.40	3.00	3.50	0.29	0.40	0.10	0.16	6.63	8.03	2.95	3.93
SEm± (TxV)	3.01	2.04	1.00	1.10	0.14	0.18	0.07	0.05	2.18	3.73	0.97	1.29
$CD_{0.05}$ (TxV)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

The maximum number of days taken to attain 80 per cent maturity was observed in variety NDH 98 and it differed significantly as compared to Megha Turmeric 1 and Prathibha. Whereas the minimum number of days taken for 80 per cent maturity was recorded with the variety Megha Turmeric 1 and it did not significantly differ with Prathibha. The differences in crop maturation among the different genotypes of turmeric were also reported by other researchers (Singh and Prasad, 20; Singh *et al.,* 19).

All the growth parameters studied except for the plant height could not be significantly increased due to two organic nutrient management T1 (GRB 35 capsule, FYM 20t/ha, Neem cake 2t/ha, Vermicompost 2t/ha, Ash 0.5t/ha and IISR turmeric booster micronutrient 5g/litre) and T2 (FYM 25t/ha and Vermicompost 5t/ha). Kadam and Kamble, (8) also reported earlier that in turmeric the number of tillers per plant was not significantly affected among the different organic sources such as FYM, vermicompost, poultry manure and pressmud compost. The tallest plant was recorded in the treatment T1 which was significantly higher than T2 only during the year 2018-19 and 2019-20, respectively.

In the three years of study and the pooled mean the highest fresh weight of the clump was observed in the variety NDH 98 and it was significantly higher to the other two varieties. The least fresh clump weight was recorded in the variety Prathibha which was significantly lower to the variety Megha Turmeric 1 and NDH 98. Significant variation in fresh rhizome yield among the variety was observed and followed similar trend as the fresh clump weight with NDH 98 recording the maximum. The lowest rhizome yield was found in the variety Prathibha and it was significantly lesser to the variety NDH 98 and Megha Turmeric 1. Negi *et al.* (14) reported variability for rhizome yield among genotypes of turmeric. The highest dry recovery was recorded with the variety Prathibha and it was significantly higher as compared to all the other varieties in the pooled mean as well as in the three years of study with an exception in 2018-19 where the variation with Megha Turmeric 1 was found to be not significant. The lowest dry recovery was observed in NDH 98 which remained at par to Megha Turmeric 1 in all the years of investigation.

A perusal of Table 2 revealed significant variation in clump fresh weight and rhizome yield of turmeric due to organic treatment. Higher clump weight and rhizome yield was recorded with the application of GRB 35 capsule, FYM 20t/ha, Neem cake 2t/ha, Vermicompost 2t/ha, Ash 0.5t/ha and IISR turmeric booster micronutrient 5g/litre (T1) as compared to FYM 25t/ha and Vermicompost 5t/ha (T2). The increase in yield of turmeric with the application of FYM, vermicompost, neem cake and ash was found earlier by different workers (Sarma *et al.,* 16; Datta *et al.,*4). Higher rhizome yield of turmeric with the application of IISR micronutrient mixture was also

Table 2. Yield of turmeric as influence by organic treatment and variety.

Treatment × Variety	Fresh wt. of clump (g)				Yield (t /ha)				Dry recovery (%)			
	2017-18	2018-19	2019-20	Pooled mean	2017-18	2018-19	2019-20	Pooled mean	2017-18	2018-19	2019-20	Pooled mean
Organic treatment												
T1 (IISR)	275	343.33	300.00	306.17	31.48	34.47	36.35	34.00	22.11	23.60	23.68	22.67
T2 (SAU)	244	305.83	260.00	269.92	27.15	30.06	32.53	29.83	20.86	22.75	22.75	22.00
SEm±	6.07	12.38	1.05	0.87	0.88	1.21	0.20	0.22	0.54	0.41	0.10	0.06
$CD_{0.05}$	18.46	17.65	18.90	15.58	2.69	3.69	3.61	1.37	NS	NS	NS	NS
Varieties												
V1 (NDH 98)	336	521.25	370.88	409.38	39.52	42.17	38.15	39.88	20.06	21.73	22.48	21.38
V2 (Megha Turmeric 1)	238	235.00	249.63	240.75	26.01	29.91	34.99	30.13	21.17	23.48	22.73	22.38
V3 (Prathibha)	205	217.50	219.50	214.00	22.41	24.71	30.18	25.75	23.23	24.33	24.45	23.25
SEm±	7.43	15.16	1.58	1.96	1.08	1.49	0.30	0.22	0.67	0.50	0.15	0.10
$CD_{0.05}$	22.61	16.11	9.60	11.92	3.29	4.52	1.83	1.37	2.02	1.52	0.89	0.58
SEm± (T × V)	10.51	21.44	6.38	3.92	1.53	2.10	0.60	0.45	0.94	0.71	0.29	0.19
$CD_{0.05}$ (T × V)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

reported by Indhumathi *et al*. (7). However, the organic treatment could not significantly enhance the dry recovery of turmeric in all the three years of study. The interaction of variety and organic treatment could not significantly influence all the charecters considered.

The data presented in Table 3 indicated significant variation on curcumin content among the varieties. The maximum curcumin content was recorded in the variety Megha Turmeric 1 and it showed signifcant superiority as compared to the variety Prathibha and NDH 98. The differences in curcumin content among the different genotypes were reported earlier by Deshmukh *et al.* (5) and Kamble *et al.* (9). However, significant difference in other quality parameters like essential oil and oleoresin content was not observed among the varieties.

All the quality parameter like curcumin, essential oil and oleoresin content could not be significantly enhanced by the appication of different organic treatment. Kumar *et al*. (12) also found earlier that the curcumin content did not vary significantly among the different organic sources supplied in the form of FYM, vermicompost and neem seed cake.

Table 3. Quality of turmeric as influence by organic treatment and variety.

Treatment × variety	Curcumin content (%)	Essential oil (%)	Oleoresin (%)
Organic treatment			
T1 (IISR)	5.83	6.47	11.89
T2 (SAU)	5.63	6.58	11.60
SEm±	0.03	0.04	0.04
$CD_{0.05}$	NS	NS	NS
Varieties			
V1 (NDH 98)	5.40	6.68	11.46
V2 (Megha Turmeric 1)	6.10	6.74	11.29
V3 (Prathibha)	5.70	6.15	12.48
SEm±	0.05	0.06	0.40
$CD_{0.05}$	0.29	NS	NS
SEm± (TxV)	0.09	0.12	0.13
$CD_{0.05}$ (TxV)	NS	NS	NS

DECLARATION

The authors declare no conflict of interest.

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