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PERFORMANCE OF DIFFERENT GENOTYPES OF TURMERIC (*CURCUMA LONGA* L.) UNDER MANIPUR CONDITION FOR GROWTH, YIELD AND QUALITY

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ABSTRACT

The experiment was carried out at Horticulture experimental field, College of Agriculture, CAU, Imphal, during 2023-2024. The experimental plot was laid out in RBD with 3 replications. The genotypes Rajendra Sonia, NH2, NH1, Roma, IISR Prathiba, TCP11, Rajendra Sonali, Alleppey Supreme, NH4, Suguna, Kedaram, Rasmi and Lakadong were included in the experiment. The maximum plant height (112.07 cm), breadth of leaves (17.40 cm) and maximum length of leaves (58.27 cm) were recorded in Rasmi (T_{12}). Rajendra Sonia (T_1) were recorded maximum number of tillers (4.53), number of leaves per clump (19.73), maximum weight of the clump (251g), length of clump (14.50 cm), breadth of clump (18.20 cm), yield per plot (8.53 kg) and yield per hectare (28.41 t). Maximum dry recovery (27.66%) was recorded in NH1 (T_3). Maximum curcumin content (6.75%) and oleoresin content (12.33%) were recorded in IISR Prathiba (T_5). Essential oil content (7.30%) was recorded maximum in Alleppey Supreme (T_8). Through consideration of yield per hectare, gross return and benefit cost ratio the best genotype in Manipur conditions for growth and yield is (Rajendra Sonia).On the basis of curcumin content and oleoresin content the best genotype for quality is found to be IISR Prathiba.

***Key words*:** Genotypes, Rhizome, Turmeric, Yield

Introduction

Turmeric (*Curcuma longa* L.), referred to as “Indian Saffron” or “Golden Spice”, is a perennial plant. It belongs to the family zingiberaceae. It is one of the important spice crop grown in India since time immemorial. It is rich in minerals and vitamins. In addition, it has curcumin, the primary colouring ingredient and spicy fragrant taste of turmeric. India is regarded as the world’s biggest producer, importer and user of turmeric. India’s turmeric is regarded as having the highest curcumin content worldwide. Turmeric rhizome contains carbohydrates (69.4%), fat (5.1%), volatile oil (5.0-6.0%), protein (6.3%), lipids (5.1%) and fibre (2.6%) and also rich in minerals like calcium, phosphorous, iron and vitamin A (Srinivasan *et al*., 2016). The demand for turmeric is increasing due to its wide utility as a spice, dye in textile industries and cosmetics (Shah, 1997). The importance of turmeric in medicine took a new turn when it was discovered that the turmeric is very rich in particular type of phenolic compounds called curcuminoid (Shilpa and Niveditha, 2009). The colouring ingredient “curcumin” and the volatile oil “termerol” are responsible for the strong, aromatic smell and bright yellow colour of turmeric. The oleoresin of turmeric is extracted and utilised in brine pickles; to a lesser extent, it is employed as a colourant in non-alcoholic beverages, gelatins, butter, cheese, and other products. It has been used in traditional medicine as a domestic remedy for various illnesses, including biliary disease, anorexia, cough, diabetic wounds, hepatic problem, rheumatism and sinusitis (Chattopadhyay *et al*., 2004).

Turmeric is a tropical crop and for normal growth

Table 1: Growth characters of different genotypes of turmeric at 150 days after planting.

Genotypes	Plant height (cm)	Number of tillers	Number of leaves per clump	Length of leaves (cm)	Breadth of leaves (cm)
T_1-Rajendra Sonia	85.73	4.53	19.73	47.27	15.47
T_2-NH2	86.80	3.80	11.13	49.60	17.23
T_3-NH1	78.60	4.47	17.27	40.70	15.20
T_4-Roma	96.73	3.27	10.40	51.13	15.50
T_5-IISR Prathiba	75.33	3.40	12.17	39.07	14.87
T_6-TCP11	70.80	4.43	15.47	37.63	15.17
T_7-Rajendra Sonali	82.13	4.40	18.60	44.07	15.40
T_8-Alleppey Supreme	91.73	4.27	16.37	54.93	16.27
T_9-NH4	83.47	3.73	13.10	47.80	17.13
T_{10}-Suguna	70.33	4.33	15.23	37.47	14.90
T_{11}-Kedaram	88.47	4.45	15.10	51.00	17.30
T_{12}-Rasmi	112.07	3.20	10.67	58.27	17.40
T_{13}-Lakadong	92.93	4.00	12.63	47.27	15.30
S.Em (±)	4.65	0.07	1.24	1.21	0.61
CD 5%	11.72	0.20	3.63	3.53	1.79

requires an optimum temperature of 20-30°C and soil pH range of 5.0-7.5. The lack of the necessary high producing genotype, low curcumin and essential oil content, loss from disease and pests during cultivation and storage, and slow multiplication rate in the prevailing cultivars are the main drawbacks to growing turmeric.

The utility of turmeric varies with plant species, it is necessary to choose the right genotype. Most of the Curcuma species are well specified, but due to their similar morphological nature makes it difficult to distinguish (Laloo *et al*., 2020). To meet the growing demand across the country, there is an urgent need to improve its production and quality. Due to different environmental conditions, a genotype that performs better in one place might not perform well in another. Therefore, in order to choose the best genotype for a given agro climatic environment, genotypes must be gathered and evaluated.

Materials and Methods

The present study was performed during the kharif season of 2023 at the college of Agriculture, Central Agricultural University, Iroisemba, Imphal (24°45" N latitude and 93°56" longitude). The soil was clay in texture with pH of 5.3, containing organic carbon 2.1%, available N 238.33 kg/ha, P_2O_5 31.79 kg/ha and K_2O 196.50 kg/ha. The experiment was laid in RBD with 3 replications and 13 treatments *viz.*, T_1- Rajendra Sonia, T_2- NH2, T_3- NH1, T_4- Roma, T_5- IISR Prathiba, T_6- TCP11, T_7- Rajendra Sonali, T_8- Alleppey Supreme, T_9- NH4, T_{10}- Suguna, T_{11}-Kedaram, T_{12}- Rasmi and T_{13}- Lakadong.

Table 2: Yield characters of different genotypes of turmeric.

Genotypes	Weight of clump	Length of clump	Breadth of clump	Yield (kg/plot)	Yield (t/ha)
T_1-Rajendra Sonia	251.00	14.50	18.20	8.53	28.41
T_2-NH2	150.55	13.77	16.93	7.59	25.29
T_3-NH1	197.14	13.47	15.03	6.07	20.21
T_4-Roma	110.55	11.85	12.88	5.94	19.78
T_5-IISR Prathiba	179.59	12.95	15.96	6.37	21.23
T_6-TCP11	161.77	12.70	15.38	3.86	12.85
T_7-Rajendra Sonali	173.67	13.25	15.50	7.60	25.32
T_8-Alleppey Supreme	144.24	12.56	12.79	6.03	20.08
T_9-NH4	121.00	13.10	11.76	4.74	15.79
T_{10}-Suguna	157.56	12.92	14.95	4.03	13.42
T_{11}-Kedaram	129.56	13.03	12.52	4.25	14.16
T_{12}-Rasmi	117.80	10.42	13.31	6.36	21.19
T_{13}-Lakadong	180.32	12.37	15.36	8.22	27.38
S.Em (±)	3.32	0.63	0.76	0.11	0.36
CD 5%	9.68	1.83	2.22	0.32	1.05

Table 3: Quality characters of different genotypes of turmeric.

Genotypes	Dry recovery (%)	Curcumin content (%)	Oleoresin content (%)	Essential oil content (%)
T_1-Rajendra Sonia	19.06	5.09	10.07	5.43
T_2-NH2	22.66	3.83	8.17	6.50
T_3-NH1	27.66	4.44	9.17	6.58
T_4-Roma	18.66	4.71	9.67	5.37
T_5-IISR Prathiba	22.33	6.57	12.30	7.03
T_6-TCP11	23.36	5.74	8.60	6.36
T_7-Rajendra Sonali	24.00	5.51	8.57	6.50
T_8-Alleppey Supreme	24.30	2.98	10.90	7.30
T_9-NH4	20.02	2.82	8.20	6.37
T_{10}-Suguna	26.66	5.18	8.67	6.67
T_{11}-Kedaram	24.34	2.71	8.03	6.50
T_{12}-Rasmi	19.60	2.70	10.10	6.33
T_{13}-Lakadong	0.40	5.59	8.83	6.83
S.Em (±)	1.17	0.07	0.14	0.11
CD 5%	0.38	0.21	0.40	0.31

Selected healthy finger rhizomes with their 2-3 buds were used for planting. The rhizomes bits were treated with a solution mixture of Metalaxyl (3 g/l) and Dithane M-45 (3 g/l) for thirty minutes as seed treatment and were dried under shade. The treated seed rhizomes were planted in the raised beds to a depth of 3-5 cm at spacing of 25 cm × 25 cm.

The recommended dose of fertilizer NPK @ 150:60:150 kg/ha was applied in the field (Medda, 2000 and Kumar *et al*., 2022). The organic inputs, *i.e*. compost @ 25 t/ha, was applied as basal during the final land preparation. The total amount of fertilizers was applied in three split doses. 1/3rd of N and full dose of P were applied as basal dose whereas each split of 1/3rd N and 1/2nd K_2O were applied at 45 and 90 days after planting. The planting of the crop was done in the last week of May. The crop was mulched immediately after planting with paddy straw.

The observations for growth parameters namely, plant height (cm), number of tillers, number of leaves per clump, length of leaves (cm) breadth of leaves (cm) were recorded at 150 days after planting. Different yield and quality parameters like weight of clump (g), Length of clump (cm), Breadth of clump (cm), yield per plot (kg), yield (t/ha), dry recovery, curcumin content (%), oleoresin content (%) and essential oil content % were recorded at harvest.

Data analysis

The experimental data obtained were subjected to statistical analysis by adopting Fisher's method of analysis of variance technique. Significance of difference in the treatment effect was tested through 'F' test at 5% level of significance and CD (critical difference) was calculated, wherever the results were significant. The standard error of mean [S.Em (±)] and the value of critical difference (CD) to compare the difference between

Fig. 1: Harvested clumps of different genotypes of turmeric.

Table 4: Cost: benefit of different genotypes of turmeric.

Genotypes	Total cost (Rs./ha)	Yield (t/ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
T_1-Rajendra Sonia	279946	28.41	852300	572354	2.04
T_2-NH2	279946	25.29	758700	478754	1.71
T_3-NH1	279946	20.21	606300	326354	1.17
T_4-Roma	279946	19.78	593400	313454	1.12
T_5-IISR Prathiba	279946	21.23	636600	356654	1.27
T_6-TCP11	279946	12.85	385500	105554	0.38
T_7-Rajendra Sonali	279946	25.32	759600	479654	1.71
T_8-Alleppey Supreme	279946	20.08	602400	322454	1.15
T_9-NH4	279946	15.79	473700	193754	0.69
T_{10}-Suguna	279946	13.42	402600	122654	0.44
T_{11}-Kedaram	279946	14.16	424800	144854	0.52
T_{12}-Rasmi	279946	21.19	635700	355754	1.27
T_{13}-Lakadong	279946	27.38	821400	541454	1.93

means are provided in the tables of the results.

Results and Discussion

Growth Characters of different genotypes of turmeric

In the present investigation, at 150 days after planting (DAP), different turmeric genotypes shows significant variation with regard to plant height, number of tillers, number of leaves per clumps, length of leaves and breadth of leaves. The findings presented in Table 1 shows the maximum plant height (112.07 cm), breadth of leaves (17.40 cm), maximum length of leaves (58.27 cm) were recorded in Rasmi (T_{12}). Rajendra Sonia (T_1) recorded maximum number of tillers (4.53), which was statistically at par with NH1 (4.47), Kedaram (4.45), TCP11 (4.43), Rajendra Sonali (4.40) and Suguna (4.33). Maximum number of leaves per clump (19.73) was recorded in Rajendra Sonia which was statistically at par with Rajendra Sonali (18.60), NH1(17.27) and Alleppey Supreme (16.37).The variation in plant growth among varieties grown under the same agro ecological condition can be attributed to the genetic makeup of the varieties is reported by Dhatt *et al.*, (2008), Singh *et al.*, (2013) and Prasath *et al.*, (2016).Variation in growth among different cultivars of turmeric were also reported by Kumar *et al.*, (2015).

Yield characters of different genotypes of turmeric

The findings presented in Table 2 and Clumps of different genotypes of turmeric after harvest are presented in (Fig. 1) shows that the maximum weight of clump (251.00 g), length of clump (14.50 cm) and breadth of clump (18.20 cm) were observed in Rajendra Sonia (T_1). Maximum yield per plot (8.53kg) and yield per hectare (28.41 t/ha) were observed in Rajendra Sonia, respectively. The yield of the crop is governed by genetic and environmental factors and differs with genotypes. The variation in rhizome yield of different genotypes grown under different agro-ecological situations has been reported by Deb and Chakraborty, (2017) and Das *et al.*, (2020).

Quality characters of different genotypes of turmeric

The findings presented in Table 3 shows that maximum dry recovery was recorded in NH1 (27.66). The maximum dry recovery in Rajendra Sonia (26.6) was also reported by Das *et al.*, (2020)). Similar result was observed by Salimath *et al.*, (2016). Maximum curcumin content (6.75%) and oleoresin content (12.30%) were recorded in IISR Prathiba. The maximum essential oil yield (384.54 kg/ha) was recorded in Rajendra Sonali, which was statistically at par with NH2 (372.24 kg/ha). Essential oil rich turmeric genotypes are valuable for both nutritional and medicinal point (Bansal *et al.*, 2002). The variations among the cultivars under this study were highly significant on dry recovery percent and curcumin content. Similar results among different cultivars were also reported by Reema *et al.*, (2006) and Mariam Anal (2019).

Economics

The benefit cost ratio provided in Table 4 shows that maximum gross return (Rs.852300/ha) was recorded in Rajendra Sonia, followed by Lakadong (Rs.821400/ha) and minimum gross return (Rs.385500/ha) was recorded in TCP11. The maximum net return (Rs.572354/ha) was recorded in Rajendra Sonia, followed by Lakadong (Rs.541454/ha) and minimum net return (Rs.105554/ha) was recorded in TCP11. The maximum Benefit Cost ratio (2.04) was recorded in Rajendra Sonia, followed by Lakadong (1.93) and minimum Benefit Cost ratio (0.38) was recorded in TCP11.

Conclusion

Through consideration of yield per hectare, gross return and benefit cost ratio the best genotype in Manipur conditions for growth and yield is (Rajendra Sonia). On the basis of curcumin content and oleoresin content the best genotype for quality is found to be IISR Prathiba.

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