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# Evaluation of Genetic Variability and Characterization of Some Elite Turmeric Genotypes in Terai Region in India

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**A B S T R A C T**

Turmeric (*Curcuma longa* L.) is an herbaceous perennial plant belong form the family zingiberaceae. In the present investigation, 27 genotypes from different sources of the country were taken into consideration for genetic variability analysis and evaluation of different characters as specified by the DUS characters evaluated by Indian Institute of Spices Research. Randomized Block Design was adopted for evaluating the genotypes about the performances in this region. The characterization was done in genotypes and grouped according to the DUS groups of all the genotypes. Here, 7 genotypes of turmeric were found to be the best among the 27 genotypes investigated in this terai region of West Bengal compared to local check variety TCP 2 and national check variety Prativa. So 7 genotypes were recognized and advised to consider for growing which will give better result in this region of West Bengal.

## Introduction

Turmeric (Curcuma) is a herbaceous perennial plant (Chan, 2009) belongs to the Kingdom- Plantae, Order- Zingiverales, genus- Curcuma, family zingiberaceae. This genus consists of approximately 70 species (Smart and Simmonds, 1992). Turmeric has been distributed in India, south-east Asian countries and north Australia. Indian Institute of Spices Research (IISR), Calicut, collects and conserves turmeric genotype by both in-situ and ex-situ conservation. Till date, the National Genotype Repository of Spices at IISR maintains more than 700 accessions of turmeric, including land races, improved varieties, open pollinated progenies (OP), related species and taxa (Shamina *et al.*, 1998). The origin of Turmeric is in South-East Asia (Peter, 1999). Curcuma longa L. is the most common and important plant among the species of Curcuma reported and studied till date. Turmeric is known as the "Golden spice" as well as the "Spice of life" (Ravindran *et al.*, 2007). The highest diversity is concentrated in India and Thailand, with at least 40 species in each area, followed by Burma, Bangladesh, Indonesia and Vietnam

(Hikmat *et al.*, 2012). The genus curcuma was named by Linnaeus (1753) (Ravindran *et al.*, 2007). The generic epithet is derived from the Arabic word karkum, meaning yellow, referring to the yellow colour of the rhizome, and Curcuma is the latinized version (Purseglove *et al.*, 1981; Sirirugsa, 1999). This Curcuma genus is mainly distributed in south and south-east Asia (Ravindran *et al.*, 2007).

The present investigation is conducted in the university field gene bank in the following points: To characterize plant characters according to the DUS descriptors of all the genotypes. To characterize rhizome characters according to the DUS descriptors of all the genotypes and to evaluate the performances of genotypes against national check and local check and also to suggest the best performing genotypes in the terai region of West Bengal.

## Materials and Methods

The present investigation was conducted during the summer season of 2013-14, 2014-2015 and 2015- 2016 at the University Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar. The farm is situated at 26°19°86° N latitude, 89°23°53°E longitude with an altitude of 43 m above the mean sea level. The experiment was carried out under normal sowing condition with normal rate of irrigation.

### Meteorological features of the experimental site

The experimental site falls under sub Himalayan terai agro-climatic condition. The average annual rainfall is 3000 mm and most of which is received during June to September. The temperature begins to rise from the end of February reaching maximum towards the July-August.

### Experimental layout

Total experimental area was divided into unit plots of 3 m x 1 m size according to the need for each experiment to accommodate all the treatments each having three replications. Channel of 40 cm width demarcated each replication and each plot was separated by 0.25 meter width furrow. Healthy finger and mother rhizomes of all genotypes with well-developed buds were used for planting after proper sorting. Completely dried rhizomes were started planting from April-May, in 2013, 2014 and 2015 with spacing of 30 cm between the rows at a depth of 4.5 cm. RCBD was done in all the 27 turmeric genotypes in gen-res software for statistical analysis.

### Genotype sources

27 genotypes were taken for the investigation and the sources of genotypes were given in Table-1.

## Results and Discussion

### Plant characteristics of turmeric

### Plant height

Genotypes CL-34(127.6cm), CL-52(128.1cm) and TCP-129(124.5cm) were found significantly higher plant height than the local check TCP-2(123.7) and genotypes CL-34(127.6cm), CL-52(128.1cm), PTS-8(131.3cm), SLP-121(122.8cm), TCP-129(124.5cm) and TCP-2(123.7cm) were found significantly higher plant height than national check Pratibha (122.4m) (Table 2).

Plant height was used for characterizarion by Narayanpur and Hanamashetti (2003) and they found that plant height determines the yield potential of the turmeric Genotype. So the plant height was a very important morphological character by which the

selection of rhizome yield could be made. According to Chaveerach *et al.,* (2008) Curcuma sattayasaii and C. zedoaroides on their experiment plant height ranged from 70-100 cm.

Sunita *et al.,* (2014) in their work they use plant height character of turmeric plant for the characterization of 10 different cultivars and measured it in centimetres from the soil surface to the tip of the tallest leaf. According to Abbasi *et al.,* (1995) observed that reduction in plant height may improve their resistance to lodging and reduce substantial yield losses.

Similar observations have been recorded by Kamal and Yousuf (2012) and Lokhande *et al.,* (2013). 27 genotypes of turmeric of pooled data for plant height trait we observed, 1 Genotype was found under 'Short', 3 genotypes were under 'medium' and 23 genotypes were under 'tall' according to DUS characterization (Table 3and4).

## Number of shoots per plant

From the local check TCP-2(2.0) the genotypes like ACC-79(2.2), NDH-8(2.3), Lucknow-1(2.3), Lucknow-2(3.0), Pratibha (2.3), RH-4.6(2.2), RH-410(2.3), TCP-64(2.7), TCP-70(3.0), SLP-121(3.2) and TCP-161(2.3) found significantly higher number of shoots per plant and genotypes like Lucknow-2(3.0), TCP-64(2.7) and TCP-70(3.0) were found significantly higher than the national check Pratibha (2.3) (Table 2). Padmadevi *et al.,* (2012) found on their study on the effect of different grades of rhizomes on growth and yield of turmeric, that the growth characters of turmeric with respect to the parameter such as number of tillers.

Tomar *et al.,* (2005) take number of tillers character of turmeric plant for their study on character association and path analysis for yield components. These characters are also suggested by Singh and Choudhary (1977).

In the grouping of pooled data according to DUS characterization under the table (Table 3 and 4), 1 Genotype was found under 'many', 6 genotypes are under 'medium' and 20 genotypes are under 'few' in this terai region of West Bengal.

## Number of leaves per plant

Genotypes NDH-79(8.3), NFH-8(8.2), NDH-98(7.7), Pratibha(8.0), PTS-12(7.7), PTS-8(8.3), RH-410(7.5), SLP-389/1(6.7), TCP-14(8.3), TCP-161(7.5), TCP-64(7.8) and TCP-70(6.7) were found significantly higher number of leaves than the local check TCP-2 (6.5) and from the national check Pratibha (8.0) ACC-79(8.8), CL-32(9.0), CL-34(9.0), CL-52(9.5), CL-54(9.3), NDH-79(8.3), NDH-8(8.2), Lucknow-2(9.8),PTS-55(9.2), PTS-8(8.3), RH-406(8.8), RH-407(9.5), SLP-121(9.5), TCP-129(8.7), TCP-14(8.3) and TCP-70(8.2) genotypes were found significantly higher number of leaves (Table 2).

According to DUS characterization Out of 27 genotypes 3 genotypes were found under the group 'many', 24 were under 'intermediate' and none of the genotypes was under 'few' category from the characterization table (Table 3and4).

## Petiole length (cm)

The genotypes like CL-32 (39.4cm), PTS-55 (40.7cm), PTS-8 (39.5) and SLP-389/1 (37.6cm) were found significantly higher petiole length than the local check TCP-2 (37.0cm) and the genotypes ACC-79 (30.1cm), CL-32 (39.4cm), TCP-110 (29.7cm) and TCP-64 (34.0cm) are found significantly higher petiole length than the national check Pratibha (29.3cm) (Table 2). Hikmat *et al.,* (2012) they use plant

quantitative character like leaf petiole length (cm) for the characterization of 20 turmeric genotypes.

By the characterization according to DUS, 15 Genotype were found under 'long', 10 genotypes were under 'intermediate' and 2 Genotype were under 'short' from the characterization table (Table 3and4) in this region of West Bengal.

## Lamina length (cm)

As compare with the local check TCP-2(58.0cm) the genotypes like CL-34(62.0cm), CL-52(60.8cm), NDH-79(59.7cm), Pratibha (58.3cm), PTS-8 (62.1cm), SLP-389/1 (59.5), TCP-14 (63.9), TCP-17 (61.5cm) and TCP-70 (60.4cm) were showing significantly higher lamina length and the genotypes CL-34(62.0cm), CL-52(60.8cm), NDH-79(59.7), PTS-8(62.1cm), SLP-389/1(59.5cm),TCP-14(63.9cm), TCP-17(61.5cm) and TCP-70(60.4cm) were showing significantly higher lamina width than the national check Pratibha (58.3cm) (Table 2). Similar result was found by Hikmat *et al.,* (2012) that on the bases on collection of Genotype from different geographical areas having different environmental conditions turmeric showed variation in lamina length so this variation is special.

Roy *et al.,* (2011) taken Leaf length(cm), Leaf width (cm) for their study and found that the large variation for rhizome weight/ plant, suckers/ plant, yield/ plot and plant height in the work of Agro-morphological diversity in turmeric (Curcuma longa) accessions collected from north-eastern India. Chandra *et al.,* (1997) studied the performance of twenty-five turmeric genotypes of Meghalaya region with the help of length of leaf. Traditionally, characterization of Genotype collections was based primarily on the morphological descriptors (Fajardo *et al.,* 2002) which include phenotypic characteristics like leaf length.

Out of 27 genotypes according to DUS characterization, 26 genotypes were in under 'long', only 1 Genotype was under 'medium' and no genotypes was in under 'short'(Table 3and4).

## Lamina width (cm)

Genotypes like ACC-79(16.7cm), CL-32(16.4cm), CL-34(18.4cm), CL-52(15.7cm), Pratibha (16.6cm), PTS-55(16.3cm), PTS-8(16.8cm), RH-407(15.4cm), SLP-389/1(16.0cm), TCP-110(16.5cm), TCP-129(17.6cm), TCP-161(17.1cm) and TCP-70(15.8cm) were found significantly higher lamina length than the local check TCP-2(15.3cm) and as compare to the national check Pratibha (16.6cm) ACC-79(16.7cm), CL34(18.4cm), PTS-8 (16.8cm), SLP-121(18.4cm), TCP-129 (17.6cm) and TCP-161(17.1cm) genotypes were found significantly higher lamina length (Table 2).

Manohar Rao *et al.,* (2005) use lamina width (cm) character for the characterization of different Genotype of turmeric.

Nybe *et al.,* (1982) studied the morphological characters of ginger accessions and reported that the morphological character breadth of leaf was found to vary among the accessions. Chandra *et al.,* (1999) studied the performance of twenty-five turmeric genotypes of Meghalaya region with the help of lamina width. According to Ntundu *et al.,* (2006); Kumar *et al.,* (2007), in modern times the cultivars are illustrated through traits like leaf blade width. In the study of Reddy *et al.,* (1989) indicated that there was significant variation among the turmeric varieties in respect of growth character such as leaf breadth. For lamina width characterization of 27 Genotype of turmeric according to DUS, 17 genotypes were under 'broad', 10 genotypes were under 'medium' and none was under 'narrow' (Table: 3and4).

### Plant diameter (cm)

Here only one Genotype TCP-161(10.1cm) was found significantly higher plant diameter than the local check TCP-2(9.7cm) and CL-32(8.4cm), PTS-8(7.4cm), RH-407(7.5cm), SLP-121(7.5cm), SLP-389/1(7.8cm) and TCP-14(8.4cm) genotypes were found significantly higher plant diameter than the national check Pratibha-(7.2cm) (Table 2). Padmadevi *et al.,* (2012) found on their study on the effect of different grades of rhizomes on growth and yield of turmeric, that the growth characters of turmeric with respect to the parameter such as Plant diameter. Chandra *et al.,* (1999) studied the performance of twenty-five turmeric genotypes of Meghalaya region with the help of stem diameter.

### Rhizome characters of turmeric

### Primary rhizome length (cm)

From the pooled data analysis, genotypes Pratibha (7.7cm), PTS-55(7.7cm), TCP-64(7.7cm) and TCP-70(7.7cm) were found significantly higher rhizome length than the local check TCP-2(7.4cm) and genotypes CL-52(8.1cm), NDH-79 (8.7cm) and (NDH-98 (8.1cm) were found significantly higher rhizome length than the national check Pratibha (7.7cm) (Table: 2). According to DUS characterization, out of 27 Genotype 6 genotypes were under 'long', 21 genotypes under 'medium' and none was under 'short'(Table 3and4).

### Number of mother rhizome

In the analysis of pooled data the genotypes like CL-52(2.3) and SLP-121(2.3) were found significantly higher number of mother rhizome per plant than the local check TCP-2(2.2) and the genotypes like ACC-79(1.3), Lucknow-1(1.2), NDH-79(1.2), NDH-98(1.3),TCP-129(1.3), TCP-14(1.3) and TCP-64(1.2) were found significantly higher number of mother rhizome per plant than the national check Pratibha (1.0) (Table 2).

Under grouping of 27 turmeric genotypes according to DUS characterization, 8 genotypes under 'One', 19 genotypes under 'Two-Three' and none was in under 'More Than Three' (Table 3and4).

**Table.1** Collections of 27 genotypes of turmeric

| S.No. | Genotype | Place of origin | Latitude | Longitude | Altitude | District | State |
|---|---|---|---|---|---|---|---|
| 1 | ACC-79 (Turmeric) | IISR | 22.930 N | 88.530E | 9.75m | Kozhikode | Kerala |
| 2 | CL -32,34,52,54 (Turmeric) | Coimbatore | 11.0' N | 76°95′ E | 432 m | Coimbatore | TN |
| 3 | NDH-79,8,98 (Turmeric) | Kumarganj | 25.21° N | 88.0632°E | 98m | Faizabad | U.P |
| 4 | Lucknow-1,2 (Turmeric) | Lucknow | 26° 55' N | 80° 59' E | 123m | Faizabad | U.P |
| 5 | Pratibha (Turmeric) | IISR | 22.930 N | 88.530E | 9.75m | Kozhikode | Kerala |
| 6 | PTS12,55,8, (Turmeric) | Pottangi | 37°34'N | 126°57'E | 87m | Koraput | Orissa |
| 7 | RH-406,407,410 (Turmeric) | Dholi | 25.99 N | 85.58 E | 55 m | Muzaffarpur | Bihar |
| 8 | SLP-121,389/1 (Turmeric) | Solan | 30.90° N | 77.10° E | 1502m | Solan | H.P |
| 9 | TCP-110,129,14,161,17,2,64,70 (Turmeric) | Pundibari | 26.52 N | 89.10 E | 66 m | Coochbehar | W.B. |

**Table.2** Mean Performances of 27 genotypes of turmeric in terai region of West Bengal in India

| SL No. | Genotypes | Plant height (cm) | Number of leaves | No. of Shoots | Petiole Length (cm) | Lamina length (cm) | Lamina width (cm) | Plant Diameter (cm) | Rhizome Length (Primary) (cm) | No of Mother Rhizomes | Internode pattern (cm) | Single rhizome wt (gm) | Per plot yield ($3m^2$) (Kg.) | Projected Yield (t/ha.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean |
| 1 | ACC-79 | 108.9 | 8.8 | 2.2 | 30.1 | 44.8 | 16.7 | 6.6 | 9.9 | 1.3 | 1.0 | 281.0 | 9.8 | 26.3 |
| 2 | CL-32 | 134.9 | 9.0 | 0.5 | 39.4 | 67.8 | 16.4 | 8.4 | 8.3 | 1.8 | 0.9 | 297.4 | 10.1 | 27.1 |
| 3 | CL-34 | 127.6 | 9.0 | 2.0 | 23.6 | 62.0 | 18.4 | 9.3 | 7.0 | 1.0 | 0.9 | 245.0 | 9.1 | 24.2 |
| 4 | CL-52 | 128.1 | 9.5 | 2.0 | 14.6 | 60.8 | 15.7 | 8.9 | 8.1 | 2.3 | 1.0 | 395.2 | 8.8 | 23.4 |
| 5 | CL-54 | 103.2 | 9.3 | 1.8 | 13.3 | 48.7 | 15.1 | 6.7 | 10.1 | 1.8 | 1.2 | 382.4 | 7.9 | 21.0 |
| 6 | NDH-79 | 113.0 | 8.3 | 1.7 | 26.8 | 59.7 | 14.5 | 6.5 | 7.2 | 1.2 | 1.0 | 272.7 | 10.5 | 28.0 |
| 7 | NDH-8 | 112.6 | 8.2 | 2.3 | 25.9 | 50.3 | 14.5 | 5.5 | 6.8 | 1.0 | 0.9 | 173.6 | 13.0 | 34.6 |
| 8 | NDH-98 | 109.7 | 7.7 | 1.5 | 26.4 | 50.5 | 14.1 | 5.6 | 8.1 | 1.2 | 1.0 | 300.0 | 10.2 | 27.3 |
| 9 | Lucknow-1 | 94.0 | 10.8 | 2.3 | 17.4 | 44.7 | 13.9 | 6.4 | 9.1 | 1.0 | 1.1 | 323.8 | 9.9 | 26.5 |
| 10 | Lucknow-2 | 96.8 | 9.8 | 3.0 | 16.4 | 51.0 | 12.3 | 5.8 | 8.1 | 1.3 | 1.0 | 279.9 | 8.7 | 23.3 |
| 11 | Pratibha | 122.4 | 8.0 | 2.3 | 29.3 | 58.3 | 16.6 | 7.2 | 7.7 | 1.0 | 1.2 | 220.1 | 10.1 | 26.8 |
| 12 | PTS-12 | 92.2 | 7.7 | 1.7 | 23.4 | 44.6 | 14.7 | 5.6 | 8.4 | 1.0 | 1.0 | 297.9 | 10.1 | 26.9 |
| 13 | PTS-55 | 139.4 | 9.2 | 1.8 | 40.7 | 57.5 | 16.3 | 15.6 | 7.7 | 1.0 | 1.0 | 323.8 | 10.7 | 28.5 |
| 14 | PTS-8 | 131.3 | 8.3 | 1.8 | 39.5 | 62.1 | 16.8 | 7.4 | 7.0 | 1.7 | 1.0 | 455.9 | 13.8 | 36.9 |
| 15 | RH-406 | 111.2 | 8.8 | 2.2 | 18.4 | 51.0 | 13.2 | 6.7 | 8.9 | 2.0 | 1.8 | 440.3 | 10.2 | 27.1 |
| 16 | RH-407 | 105.1 | 9.5 | 3.5 | 15.5 | 53.8 | 15.4 | 7.5 | 9.1 | 1.0 | 0.9 | 247.8 | 8.8 | 23.5 |
| 17 | RH-410 | 84.5 | 7.5 | 2.3 | 28.5 | 38.6 | 10.7 | 3.3 | 9.0 | 1.0 | 1.0 | 252.9 | 9.5 | 25.2 |
| 18 | SLP-121 | 122.8 | 9.5 | 3.2 | 18.6 | 57.0 | 18.4 | 7.5 | 11.7 | 2.3 | 1.5 | 391.6 | 10.7 | 28.4 |
| 19 | SLP-389/1 | 138.2 | 6.7 | 4.7 | 37.6 | 59.5 | 16.0 | 7.8 | 10.8 | 1.8 | 1.1 | 385.5 | 10.2 | 27.1 |
| 20 | TCP-110 | 149.7 | 10.5 | 4.8 | 29.7 | 68.3 | 16.5 | 9.5 | 10.3 | 1.8 | 2.0 | 302.9 | 12.8 | 34.1 |
| 21 | TCP-129 | 124.5 | 8.7 | 1.8 | 16.0 | 56.4 | 17.6 | 9.4 | 6.9 | 1.3 | 0.8 | 336.0 | 12.0 | 32.0 |
| 22 | TCP-14 | 150.8 | 8.3 | 1.5 | 48.9 | 63.9 | 15.2 | 8.4 | 8.5 | 1.3 | 1.2 | 389.5 | 9.9 | 26.4 |
| 23 | TCP-161 | 145.3 | 7.5 | 2.3 | 16.8 | 73.7 | 17.1 | 10.1 | 11.4 | 2.0 | 1.0 | 334.5 | 9.7 | 25.9 |
| 24 | TCP-17 | 149.3 | 10.7 | 5.5 | 29.0 | 61.5 | 14.1 | 9.1 | 10.8 | 1.5 | 1.3 | 248.0 | 12.9 | 34.4 |
| 25 | TCP-2 | 123.7 | 6.5 | 2.0 | 37.0 | 58.0 | 15.3 | 9.7 | 7.4 | 2.2 | 0.9 | 599.3 | 9.1 | 24.3 |
| 26 | TCP-64 | 114.7 | 7.8 | 2.7 | 34.0 | 56.5 | 14.8 | 6.4 | 7.7 | 1.2 | 0.9 | 293.7 | 8.2 | 21.8 |
| 27 | TCP-70 | 137.3 | 8.2 | 3.0 | 18.0 | 60.4 | 15.8 | 8.7 | 7.7 | 1.5 | 1.3 | 379.0 | 7.2 | 19.2 |
| **Range** | | 150.8-85.5 | 10.8-6.5 | 5.5-0.5 | 48.9-13.3 | 73.7-38.6 | 18.4-10.7 | 15.6-3.3 | 11.4-6.4 | 2.3-1.0 | 2.0-0.8 | 599.3-173.6 | 13.8-7.2 | 36.9-19.2 |
| **SEm (±)** | | 3.832 | 0.714 | 0.363 | 1.877 | 2.315 | 0.952 | 0.441 | 0.161 | 0.146 | 0.104 | 16.408 | 1.36 | 2.764 |
| **CD (P=0.05)** | | 10.747 | 2.026 | 1.030 | 5.327 | 6.570 | 2.702 | 1.251 | 0.451 | 0.409 | 0.292 | 47.960 | 2.45 | 6978 |
| **CV%** | | 17.48 | 21.59 | 25.46 | 17.54 | 10.17 | 19.42 | 13.97 | 18.56 | 24.00 | 22.71 | 17.080 | 19.02 | 18.97 |

**Table.3** DUS character evaluation in turmeric PPV and FRA act (Bavappa *et al.*, 2007)

| S. No. | Characters | States | Stage of observation | Type of assessment |
|---|---|---|---|---|
| 1 | Plant: Height (cm) | Short (<85) | 150 days of sowing | MS |
| | | Medium (85-100) | | |
| | | Tall (>100) | | |
| 2 | Plant: Number of shoots | Few(<3) | 150 days of sowing | MG |
| | | Medium (3-5) | | |
| | | Many (>5) | | |
| 3 | Plant: Number of leaves on main shoot | Few (<5) | 150 days of sowing | MG |
| | | Inter mediate (5-10) | | |
| | | Many (>10) | | |
| 4 | Leaf: Petiole length (cm) | Short (<15) | 150 days of sowing | MS |
| | | Inter mediate (15-25) | | |
| | | Long (>25) | | |
| 5 | Leaf: Lamina length (cm) | Short (<30) | 150 days of sowing | MS |
| | | Medium (30-40) | | |
| | | Long (>40) | | |
| 6 | Leaf: Lamina width (cm) | Narrow (<10) | 150 days of sowing | MS |
| | | Medium (10-15) | | |
| | | Broad (>15) | | |
| 7 | Primary Rhizome Length (cm) | Short (< 5 cm) | At harvest | MS |
| | | Medium (5 - 10 cm) | | |
| | | Long (> 10 cm) | | |
| 8 | Rhizome: Internode pattern (cm) | Close (< 1) | At harvest | MS |

**Table.4** Grouping based on plants characters
(According to evaluation of characters of Table 2 and3)

| **1. Plant Height** | | |
|---|---|---|
| **Short** | **Medium** | **Tall** |
| RH-410 | Lucknow-1, Lucknow-2 | ACC-79, CL-32, CL-34, CL-52, CL-54, NDH-79, NDH-8, NDH-98, Pratibha, PTS-12, PTS-55, PTS-8, RH-406, RH-407, SLP-121, SLP-389/1, TCP-110, TCP-129, TCP-14, TCP-161, TCP-17, TCP-2, TCP-64, TCP-70 |

| **2. Number of shoots** | | |
|---|---|---|
| **Few** | **Many** | **Medium** |
| RH-410, ACC-79, CL-32, CL-34, CL-52, CL-54, NDH-79, NDH-8, NDH-98, Pratibha, PTS-12, PTS-55, PTS-8, RH-406, TCP-129, TCP-14, TCP-161, TCP-2, TCP-64, Luckno-1 | TCP-17 | RH-407, SLP-121, SLP-389/1, TCP-70, TCP-110, Luckno-2 |

| **3. Number of leaves on main shoot** | | |
|---|---|---|
| **Few** | **Inter mediate** | **Many** |
| - | Luckno-2, RH-410, ACC-79, CL-32, CL-34, CL-52, CL-54, NDH-79, NDH-8, NDH-98, Pratibha, PTS-12, PTS-55, PTS-8, RH-406, RH-407, SLP-121, SLP-389/1, TCP-129, TCP-14, TCP-161, TCP-2, TCP-64, TCP-70 | Luckno – 1, TCP-110, TCP-17 |

| **4. Petiole length** | | |
|---|---|---|
| **Short** | **Inter mediate** | **Long** |
| CL-32, CL-54 | CL-34, PTS-12, RH-406, TCP-129, TCP-161, Luckno-1, Luckno-2, RH-407, SLP-121, TCP-70 | RH-410, ACC-79, CL-32, NDH-79, NDH-8, NDH-98, Pratibha, PTS-55, PTS-8, TCP-14, TCP-2, TCP-64, TCP-17, SLP-389/1, TCP-110 |

| **5. Lamina length** | | |
|---|---|---|
| **Short** | **Medium** | **Long** |
| - | RH-410 | CL-34, PTS-12, RH-406, TCP-129, TCP-161, Luckno-1, Luckno-2, RH-407, SLP-121, TCP-70, ACC-79, CL-32, NDH-79, NDH-8, NDH-98, Pratibha, PTS-55, PTS-8, TCP-14, TCP-2, TCP-64, TCP-17, SLP-389/1, TCP-110, CL-52, CL-54 |

| **6. Rhizome Length** | | |
|---|---|---|
| **Short** | **Medium** | **Long** |
| - | ACC-79, CL-32, CL-34, CL-52, Luck-1, Luck-2, NDH-79, NDH-8, NDH-98, Pratibha, PTS-12, PTS-55, PTS-8, RH-406, RH-407, RH-410, TCP-129, TCP-14, TCP-2, TCP-64, TCP-70 | CL-54, SLP-121, SLP-389/1, TCP-110, TCP-161, TCP-17 |

| **7. Number of mother rhizomes** | | |
|---|---|---|
| **One** | **Tow-Three** | **More than three** |
| CL-34, Luck-2, NDH-8, Pratibha, PTS-12, PTS-55, RH-407, RH-410 | CL-54, SLP-121, SLP-389/1, TCP-110, TCP-161, TCP-17, ACC-79, CL-32, CL-52, Luck-1, NDH-79, NDH-98, PTS-8, RH-406, TCP-129, TCP-14, TCP-2, TCP-64, TCP-70 | - |

| **8. Rhizome internode pattern** | |
|---|---|
| **Close** | **Distant** |
| CL-34, Luck-2, PTS-55, RH-407, RH-410, TCP-161, ACC-79, CL-32, CL-52, Luck-1, NDH-79, NDH-98, PTS-8, TCP-129, TCP-2, TCP-64 | NDH-8, Pratibha, PTS-12, CL-54, SLP-121, SLP-389/1, TCP-110, TCP-17, RH-406, TCP-14, TCP-7 |

## Rhizome internode pattern (cm)

From the local check TCP-2(0.9cm) it was found that genotypes like ACC-79(1.0cm), CL-54(1.2cm), Lucknow-1(1.0cm), NDH-79(1.0cm), NDH-8(1.1cm), NDH-98(1.0cm), Pratibha(1.2cm), PTS-12(1.0cm), PTS-8(1.0cm), PTS-55(1.0cm), RH-410(1.0cm), SLP-389/1(1.1cm) and TCP-161(1.0cm) had significantly higher internode pattern and from national check Pratibha(1.2) genotypes TCP-17(1.3cm) and TCP-70(1.3cm) were found significantly higher internode pattern (Table 2).

According to DUS characterization of turmeric out of 27 genotypes, 16 genotypes were under 'Close' and 11 genotypes were under 'Distant' group (Table 3and4).

## Single rhizome weight

Here no Genotype was found which had significantly higher rhizome weight than the local check TCP-2(599.3g). As compare with the national check Pratibha (220.1g), CL-34(245.0g), RH-407(247.8g), RH-410(252.9g) and TCP-17(248.0g) genotypes were found significantly from the weight of single rhizome (Table: 2).

Chaudhary *et al.*, (2006) and Srivastava and Singh (2003) reported that the variation in the yield among all the turmeric cultivars grown under the same agro climatic condition can be attributed to genetic factor. Chaudhary *et al.*, (2006) and Srivastava and Singh (2003) reported that the variation in the yield among all the turmeric cultivars grown under the same agro climatic condition can be attributed to genetic factor.

Hazra *et al.*, (2000) Found that high genotypic coefficient of variation was depend on initial weight of rhizome, and wet rhizome yield per plant. Singh and Tiwari (1995) reported that rhizome yield per plant is correlated with weight of mother, primary and secondary rhizomes per plant. Rattan, (1988) proposed that the number of primary fingers is correlated with the rhizome yield per plot. Rajyalakshmi *et al.*, (2013) proposed that high estimates of heritability were observed for the rhizome yield which indicating that a major part of the phenotypic variability and this character was contributed by additive gene effects.

## Per plot yield (kg)

RH-410, TCP-161, ACC-79, TCP-14, NDH-8, PRATIBHA, PTS-12, CL-32, SLP-389/1, RH-406, NDH-79, Luck-1, SLP-121 and PTS-55 were found which had significantly higher per plot yield than the local check TCP-2. As compare with the national check Pratibha,SLP-389/1, RH-406, NDH-79, Lucknow-1, SLP-121, PTS-55, PTS -8 and TCP-129 genotypes were found significantly from the per plot yield (Table: 2).

## Projected yield (t/ha)

RH-410(19.2t/ha), TCP-161(19.7t/ha), ACC-79(20.0t/ha), TCP-14(20.1t/ha), NDH-8(20.2t/ha), PRATIBHA(20.4t/ha), PTS-12(20.5t/ha), CL-32(20.6t/ha), SLP-389/1(20.6t/ha), RH-406(20.7t/ha), NDH-79(20.8t/ha), Lucknow-1(21.3t/ha), SLP-121(21.7t/ha), PTS-55(21.7t/ha), PTS-8 (28.1t/ha), TCP-129(24.4t/ha) genotypes were found which had significantly higher projected yield than the local check TCP-2(18.5t/ha). As compare with the national check Pratibha (20.4t/ha); PTS-12 (20.5t/ha), CL-32 (20.6t/ha), SLP-389/1 (20.6t/ha), RH-406 (20.7t/ha), NDH-79(20.8t/ha), Lucknow-1(21.3t/ha), SLP-121(21.7t/ha), PTS-55(21.7t/ha), PTS-8 (28.1t/ha), TCP-129 (24.4t/ha), TCP-110 (26.0t/ha), TCP-17 (26.2t/ha) and Lucknow-2 (26.3t/ha) genotypes were found significantly higher from the projected yield (Table: 2).

In conclusion the important yield characters such as single rhizome weight, number of mother rhizome, yield per plot and projected yield are generally considered in turmeric, PTS-8, RH-410, TCP-14, TCP-129, Lucknow-1, SLP-121, NDH-79 and ACC-79 were found to be the best genotypes among the 27 genotypes according to their performance in the above mentioned two or three characters while considering the comparison from local check TCP-2 and national check Pratibha. Here, these 7 genotypes of turmeric were found to be the best among the 27 genotypes investigated in this terai region of West Bengal.

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