Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; SP3: 130-134

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National conference on "Conservation, Cultivation and Utilization of medicinal and Aromatic plants"
(College of Horticulture, Mudigere Karnataka, 2018)

Evaluation of turmeric (*Curcuma longa* L.) genotypes for yield, curcumin and essential oil content in northern dry zone of Karnataka

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Abstract
Turmeric (*Curcuma longa* L.) belonging to Zingiberaceae family is one of the most useful herbal medicinal plants. Extensive researches have proven that most of the turmeric activities of the turmeric are due to curcumin. It has the protective against various cancers, diabetes, allergies, arthritis, Alzheimer's disease and other chronic and hard curable diseases. It also is used as nephro protective, anticoagulant and anti-HIV to combat AIDS. Curcumin exhibits great promise as a therapeutic agent. The field experiment was taken up to evaluate the turmeric genotypes for its quality at the Department of Plantation, Spices, Medicinal and Aromatic Crops, Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka during 2014-2015. There was significant variation for quality among genotypes. The curcumin content ranged between 2.08 and 4.73 per cent. Maximum curcumin content was recorded in var. Prathibha (4.73 %) followed by var. Suroma (4.58 %), while the minimum was recorded in genotype CLI-327 (2.08 %).

Keywords: Turmeric genotypes, Curcumin, Essential oil, Oleoresin, Therapeutic effects

Introduction
Medicinal plants have provided a reliable source for preparation of new drugs as well as combating diseases, from the dawn of civilization. The extensive survey of the literature revealed that turmeric (*Curcuma longa* L) is highly regarded as a universal panacea in the herbal medicine with a wide spectrum of pharmacological activities *viz.*, antioxidant anti inflammation, ulcer and cancer. And it also has antifungal, antimicrobial, renal and hepatoprotective activities [1]. It has very low toxicity and the global scenario is now changing towards the use of non-toxic plant products having traditional medicinal use, development of modern drugs from turmeric should be emphasized for the control of various diseases [2]. Turmeric is a plant distributed throughout tropical and subtropical regions of the world. It is widely cultivated in Asian countries, mainly in India and China. Apart from the uses as spice, it is used as traditional medicine in Asian countries such as India, Bangladesh and Pakistan because of its beneficial properties. Traditionally its powder is used against gastrointestinal diseases, especially for biliary and hepatic disorder, diabetic wounds, rheumatism, inflammation, sinusitis, anorexia, coryza and cough [3]. The coloring principle of turmeric is called curcumin, which has yellow color and is the essential component of this plant. Recent studies have authenticated turmeric as anticancer, anti-diabetic, antioxidant, hypolipidemic, anti-inflammatory, antimicrobial, anti-fertility, anti-venom, hepatoprotective, nephroprotective, anticoagulant, etc. These medicinal properties of turmeric caused it to be considered as a spice with multifunctional medicinal properties [4]. Hence, the present investigation was therefore under taken with objective to estimate the yield and quality attributes of turmeric genotypes under northern dry zone-3 of Karnataka.

Materials and Method
Estimation of Curcumin content through HPLC method
All the solvents of HPLC grade were purchased from authorised source (SRL laboratories) water purified by milli Q purification was used.

The standard curcumin was purchased from sigma Aldrich (India). The stock solution 10mg/10ml was prepared and was stored in amberware bottles. Aliquots of curcumin 20, 40, 60, 80 and 100 ppm were prepared. The HPLC system included 2 LL 20 AT solvent delivery system system (dual pump), a SPD -20A UV/Vis detector and a 7725i rheodyne injector with a 20 µL loop volume coupled with CBM 20 Alite system controller. Separation was achieved using Luna Su C18 column. The solvent system consisted of 50mM potassium dihydrogen orthophosphate (3.5 pH): Acetonitrile (40:60 v/v) was pumped isocratically at a flow rate of 0.8mL/min. the detection was carried out using a SPD -20A UV/Vis detector [5].Sample rhizome powder from 18 turmeric genotypes was prepared by extracting 0.2g of sample using Soxhlets apparatus and was concentrated using flash evaporator and made up to 10ml and filtered through 0.45µ nylon filter.

Non volatile ether extracts (Oleoresin) content

Pre-weighed 100 g finely ground turmeric powder was extracted for 18 h. in soxhlets apparatus with anhydrous petroleum ether. The extract was transferred to a capsule and kept for evaporation at room temperature. Then it was dried in hot air oven at 110^0 C till the loss in weight between successive weighing was less than two mg. The amount of non volatile ether extract was computed by using the formula given below [6].

Volatile oil

Volatile oil content on fresh weight basis was obtained by steam distillation of freshly harvested rhizome using Clevenger type apparatus adopting standard procedure and expressed in percentage on v/w basis [7].

$$\text{NVEE (\% by weight on dry weight basis)} \quad \frac{\text{Loss in weight of sample (g)}}{\text{Weight of sample taken (g)}} \times 100$$

Fig 1: View of High Performance Liquid Chromatography Liquid System (HPLC)

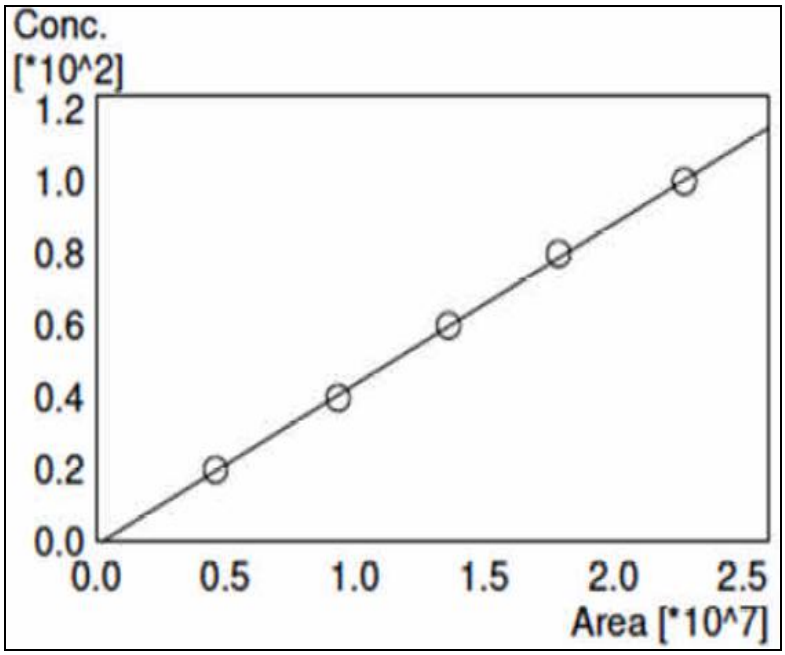

Fig 2: Standard calibration curve of turmeric curcumin standard

Table 1: Fresh rhizome yield per hectare, curing percentage, cured yield per hectare and harvest index of turmeric genotypes

Treatment	Genotype	Estimated Fresh yield (t/ha)	Curing per cent	Cured yield (t/ha)	Harvest Index (%)
T_1	Alleppey	19.74	25.55	5.04	60.16
T_2	Bidar Local	17.62	19.37	3.41	57.73
T_3	BSR- 2	24.53	21.50	5.27	65.60
T_4	CLI 14	13.72	19.09	2.62	53.08
T_5	CLI -325	20.12	19.18	3.86	60.56
T_6	CLI -327	15.02	20.03	3.01	53.50
T_7	CO-1	33.57	21.50	7.22	72.80
T_8	CO -2	22.55	18.36	4.14	63.57
T_9	Cudappa	37.01	19.23	7.12	74.88
T_{10}	Erode Local	30.04	19.43	5.84	70.32
T_{11}	Krishna	19.24	16.50	3.16	59.60
T_{12}	Prabha	18.95	19.50	3.70	59.25
T_{13}	Prathibha	21.82	18.50	4.04	62.16
T_{14}	Rajapuri	30.24	22.93	6.93	70.76
T_{15}	Salem	42.53	25.19	10.71	79.76
T_{16}	Suroma	42.07	24.89	10.47	76.25
T_{17}	Tekurpeth	27.64	22.30	6.16	68.42
T_{18}	Phule Swaroop	26.98	21.43	5.78	66.22
	S. Em±	0.49	0.41	0.14	1.59
	C. D. at 5%	1.40	1.18	0.39	4.57
	CV (%)	11.28	10.41	13.31	8.22

Table 2: Percentage of curcumin, essential oil and oleoresin content in turmeric genotypes

Treatment	Genotype	Curcumin (%)	Essential oil (%)	Oleoresin (%)
T_1	Alleppey	2.25	4.18	15.69
T_2	Bidar Local	3.60	3.80	7.20
T_3	BSR- 2	3.08	3.60	4.00
T_4	CLI 14	3.11	2.80	6.59
T_5	CLI -325	2.86	3.40	8.89
T_6	CLI -327	2.08	3.57	9.12
T_7	CO-1	2.48	3.70	6.70
T_8	CO -2	3.35	3.52	6.92
T_9	Cudappa	3.34	3.93	5.60
T_{10}	Erode Local	3.51	4.25	9.60
T_{11}	Krishna	2.93	2.03	3.80
T_{12}	Prabha	2.70	6.50	15.01
T_{13}	Prathibha	4.73	6.20	16.20
T_{14}	Rajapuri	2.98	4.80	13.60
T_{15}	Salem	3.95	4.50	12.80
T_{16}	Suroma	4.58	4.40	13.10
T_{17}	Tekurpeth	3.61	3.46	7.60
T_{18}	Phule Swaroop	2.76	3.41	7.55
	S. Em±	0.051	0.15	0.33
	C. D. at 5%	0.13	0.43	0.96
	CV (%)	7.49	6.19	6.14

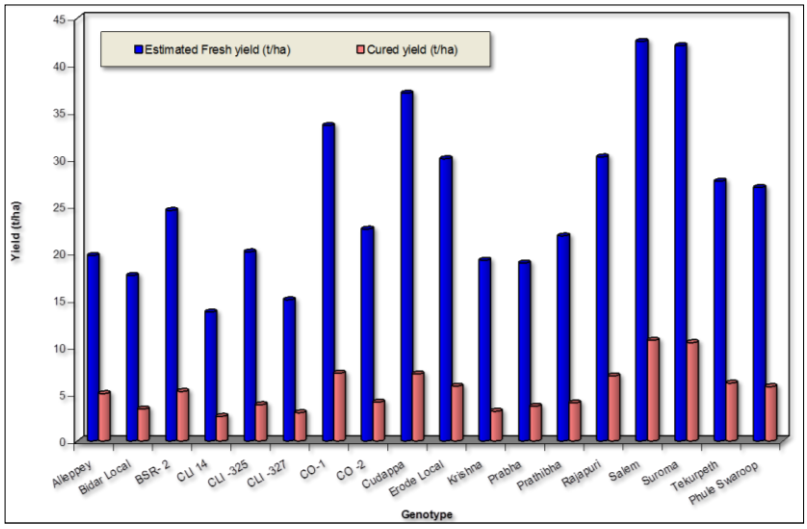

Fig 3: Estimated fresh rhizpme yield (t/ha) and cured yield (t/ha) in different turmeric genotypes

Results

Yield and yield attributes parameters

The estimated fresh yield per hectare ranged between 13.72 tons per hectare and 42.53 tons per hectare. The maximum estimated fresh yield per hectare was recorded in cv. Salem (42.53 t/ha) and was on par with var. Suroma (42.07 t/ha). The minimum was recorded in genotype CLI-14 (13.72 t/ha). The curing (%) ranged between 16.50 and 25.55. The maximum curing (%) was recorded in var. Alleppy (25.55 %) and was on par with cv. Salem (25.19 %) and var. Suroma (24.89 %). The minimum was recorded in genotype var. Krishna (16.50 %). The Cured yield per hectare ranged between 2.62 tons per hectare and 10.71 tons per hectare. The maximum Cured yield per hectare was recorded in cv. Salem (10.71 t/ha) followed by var. Suroma (10.47 t/ha). The minimum was recorded in genotype CLI-14 (2.62 t/ha). The harvest index (HI) ranged between 53.08 and 79.76. The maximum harvest index (HI) was recorded in cv. Salem (79.76 %) and was on par with var. Suroma (76.25 %). The minimum was recorded in genotype CLI-14 (53.08 %).

Quality parameters

There was significant difference among 18 turmeric genotypes for curcumin content oleoresin (%) and essential oil (%). The curcumin content ranged between 2.08 and 4.73 per cent. Maximum curcumin content was recorded in var. Prathibha (4.73 %) followed by var. Suroma (4.58 %), while the minimum was recorded in genotype CLI-327 (2.08 %).The Oleoresin content ranged between 3.80 and 16.20 per cent. Maximum oleoresin content was recorded in var. Pratibha (16.20 %) which was on par with var. Alleppy (15.69 %) while the minimum was recorded in var. Krishna (3.80 %). The essential oil content ranged between 2.03 and 6.50 per cent. Maximum essential oil content was recorded in var. Prabha (6.50 %) which was on par with var. Pratibha (6.20%), while the minimum was recorded in var. Krishna (2.03 %).

Discussion

Yield and yield attributes parameters as influenced by turmeric genotypes

The maximum yield per plant was recorded in cv. Salem (574.16 g) which was on par with var. Suroma (568.12 g).The minimum was recorded in genotype CLI-14 (185.18 g). The maximum estimated fresh yield per hectare was recorded in cv. Salem (42.53 t/ha) and was on par with var. Suroma (42.07 t/ha). The minimum was recorded in genotype CLI-14 (13.72 t/ha). The maximum curing (%) was recorded in var. Alleppy (25.55 %) and was on par with cv. Salem (25.19 %) and var. Suroma (24.89%). The minimum was recorded in genotype var. Krishna (16.50 %). The maximum Cured yield per hectare was recorded in cv. Salem (10.71 t/ha) followed by var. Suroma (10.47 t/ha). The minimum was recorded in genotype CLI-14 (2.62 t/ha). The maximum harvest index (HI) was recorded in cv. Salem (79.76 %) and was on par with var. Suroma (76.25 %). The minimum was recorded in genotype CLI-14 (53.08 %). Jagadish (2000) recorded maximum fresh rhizome yield per hectare in turmeric var. Suvarna (18.20 t/ha) under Dakshina Kannada region of Karnataka. Shanmugasundaram *et al.* (2001) [8]. Recorded the highest yield in turmeric genotype PTS-43 (7.17 t/ha) followed by Roma (5.69 t/ha) and BSR-2 (4.48 t/ha) under Coimbatore (Tamil Nadu) conditions. Higher yield components contribute positively for the higher yield in crop plants.

Quality parameters as influenced by turmeric genotypes

There was significant difference in quality parameters viz., curcumin, oleoresin and essential oil content of turmeric genotypes. Maximum curcumin content was recorded in var. Prathibha (4.73 %) followed by var. Suroma (4.58 %) while the minimum was recorded in genotype CLI-327 (2.08 %). Maximum oleoresin content was recorded in var. Pratibha (16.20 %) which was on par with var. Alleppy (15.69 %) while the minimum was recorded in var. Krishna (3.80 %). And the maximum essential oil content was recorded in var. Prabha (6.50 %) which was on par with var. Pratibha (6.20%), while the minimum was recorded in var. Krishna (2.03 %). The variation in curcumin content among different cultivars could be related to the genetic character of the cultivars. Anusuya (2004) [9], recorded the highest curcumin content in Suroma under Arabhavi condition. Hrideek *et al.* (2006) [10], recorded maximum curcumin content in turmeric variety Prabha (5.56 %) had followed by the local variety (2.08 %). Alleppy supreme had the lowest value for curcumin content (3.45%) under Western Ghat conditions.

Summary

Yield parameters

Significantly highest estimated fresh yield per hectare was recorded in cv. Salem (42.53 t/ha) and was on par with var. Suroma (42.07 t/ha). The lowest was recorded in genotype CLI-14 (13.72 t/ha). Significantly highest curing (%) was recorded in var. Alleppy (25.55 %) and was on par with cv. Salem (25.19 %) and var. Suroma (24.89 %). The lowest was recorded in genotype var. Krishna (16.50 %). Significantly highest cured yield per hectare was recorded in cv. Salem (10.71 t/ha) followed by var. Suroma (10.47 t/ha). The lowest was recorded in genotype CLI-14 (2.62 t/ha). Significantly highest harvest index (HI) was recorded in cv. Salem (79.76 %) and was on par with var. Suroma (76.25 %). The lowest was recorded in genotype CLI-14 (53.08 %).

Quality parameters

Significantly highest curcumin content was recorded in var. Prathibha (4.73 %) followed by var. Suroma (4.58 %) and Salem (3.95 %). The lowest was recorded in genotype CLI-327 (2.08 %). Significantly higher content of oleoresin was recorded in var. Prathibha (16.20 %) which was on par with var. Alleppy (15.69 %) while the lowest was recorded in var. Krishna (3.80 %). Significantly highest essential oil content was recorded in var. Prabha (6.50 %) followed by var. Pratibha (6.20%) while the lowest was recorded in var. Krishna (2.03 %).

Conclusion

Turmeric is the unique source of various types of chemical compounds, which are responsible for a variety of activities. Although, a lot of experiments have been done on turmeric, however, more investigations are needed to exploit other therapeutic utility to combat diseases. A drug development programme should be undertaken to develop modern drugs. Although crude extracts from leaves or rhizomes of the plant have medicinal applications, modern drugs can be developed after extensive investigation of its pharmacotherapeutics, bioactivity, mechanism of action, and toxicities, after proper standardization and clinical trials. As the global scenario is now changing towards the use of non-toxic plant products having traditional medicinal use, development of modern drugs from *C. longa* should be emphasized for the control of various diseases. Further evaluation needs to be carried out on

C. *longa* in order to explore the concealed areas and their practical clinical applications, which can be used for the welfare of mankind.

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