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A new short duration turmeric variety, IISR PRAGATI—a boon to Indian farmers

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Turmeric is a dried underground rhizome of perennial herb *Curcuma longa* L., of the family Zingiberaceae. It is traditionally used in Asian countries as condiment, dye, drug and cosmetic in addition to its use in religious ceremonies. India is the leading producer, consumer and exporter. Andhra Pradesh, Telangana, Tamil Nadu, Odisha, Karnataka, West Bengal, Gujarat, Meghalaya, Maharashtra and Assam are the important states that cultivate turmeric. In India, it is grown in 0.18 million ha with a production of 0.83 million tones.

India harbours rich diversity of *Curcuma*, especially species and cultivar diversity. There are many popular turmeric cultivars, which are specific to each region of cultivation. Duggirala, Armoor, Tekurpeta, Nandyal, Alleppey, Rajapuri, Salem, Erode, Gorakhpur, Mydukur, Lakadong, Waigaon etc. are some of the popular local cultivars which are essentially named after the places where they are grown extensively. Wide variability among the existing cultivars was recorded in respect of growth parameters, yield attributes, and resistance to biotic and abiotic stresses and quality characters. Collection, evaluation and conservation of turmeric genetic resources is one of the core areas of research in India. The turmeric conservatory of ICAR-Indian Institute of Spices Research (ICAR-IISR), Kozhikode, Kerala consists of 1450 accessions. In addition to ICAR-IISR, germplasm collections are also maintained at various AICRPS centers located in different turmeric producing states.

Generally, crop improvement programme in turmeric was restricted to clonal selection and induced mutation and subsequent selection. The main emphasis was yield, high

curing percentage and high curcumin content. Clonal selection played the most significant role in developing several high yielding varieties in turmeric. This was due to rare seed set in turmeric. The selection was mainly applied on land races collected from different turmeric growing areas of the country.

IISR-PRAGATI

The ICAR-Indian Institute of Spices Research, Kozhikode through its systematic breeding programme has developed a short duration, high yielding turmeric variety for the benefit of farmers. The variety, IISR PRAGATI (Fig. 1), is a clonal selection (Acc. 48) from the vast repository of turmeric germplasm maintained at the institute.

Screening of germplasm for disease and other attributes:

During 1996-2006, 253 turmeric germplasm accessions were screened against root knot nematode (*Meloidogyne incognita*) and seven nematode resistant accessions (Acc. 35, 48, 79, 130, 142, 146 and 200) were identified (Tables 1 and 2). These genotypes, along with a susceptible accession (Acc. 376) and a released variety IISR Prathibha, were evaluated during 2008-2012 to assess the yield performance under Kerala conditions.

Results indicated that in terms of yield, Acc. 79 and Acc. 48, performed significantly higher compared to the national check. Maximum yield per hectare was recorded in Acc.48 (31.94 t/ha) followed by Acc 79 (31.79 t/ha) over three years (Table 3). The stability parameters of Acc. 48 and Acc. 79 showed good stability for yield and it indicates general adaptability of these two genotypes over years.

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Table 1: Screening of turmeric germplasm accessions to root knot nematode, *Meloidogyne incognita* (mean of five replications)

No. of accessions screened	Egg Mass Index (EMI)	Promising accessions
253	< 2	Accs. 03, 21, 31, 35, 43, 48, 62, 64, 67, 72, 78, 79, 82, 84, 130, 142, 146, 150, 165, 178, 182, 193, 198, 199, 200, 203, 210, 223, 224, 228, 235, 237, 239, 243, 245, 246, 250, 252, 253, 255, 260, 262, 263

Table 2: Reaction of short-listed accessions on inoculation with root knot nematodes, *Meloidogyne incognita*

Entry	Gall index (GI)	Egg Mass Index (EMI)	Reproduction factor (R)	Host reaction
Acc. 35	2.0	0.2	0.67	Resistant
Acc. 48	2.7	3.0	1.07	Moderately Resistant
Acc. 79	2.0	2.0	0.03	Resistant
Acc. 130	2.0	1.8	0.24	Resistant
Acc. 142	3.0	2.0	0.00	Resistant
Acc. 146	1.0	1.2	0.56	Resistant
Acc. 200	1.3	0	0.12	Resistant
Acc. 376	3.3	4.3	2.07	Susceptible
IISR Prathibha	3.0	2.8	2.12	Susceptible

Table 3: Evaluation of turmeric accessions for yield

Entries	Fresh yield (kg/3m ²)				Kg/ha
	2010-11	2011-12	2012-13	Mean	
Acc. 35	12.00	9.92	15.25	12.39	27.26
Acc. 48	14.00	13.44	16.13	14.52	31.94
Acc. 79	14.00	13.34	16.00	14.45	31.79
Acc. 130	9.75	9.05	12.88	10.56	23.23
Acc. 142	9.75	11.42	14.56	11.91	26.20
Acc. 146	10.25	12.32	14.88	12.48	27.46
Acc. 200	10.50	9.67	10.38	10.81	23.78
Acc. 376	10.25	10.42	12.75	11.14	24.51

Table 4: Pooled yield data (2013-16) of turmeric in selected AICRPS centres

	Chintapalle	Coimbatore	Kammarpalli	Kozhikode	Raigarh	Mean (fresh yield/ha)	% NC	% LC	Rank	Dry recovery (%)	Dry yield/ha
Acc 48	38.83	34.04	27.12	51.79	14.20	33.19	30.74	30.89	II	20.22	6.71
Acc 79	29.98	32.22	24.79	40.01	10.14	27.43	8.02	8.15		21.28	5.84
SLP 389/1	24.27	30.67	21.80	26.60	13.80	23.43	-7.73	-7.62		21.99	5.15
NDH 8	40.15	27.97	27.79	31.58	8.33	27.16	6.98	7.10		19.15	5.20
NDH 79	35.74	28.25	25.85	30.45	15.28	27.12	6.79	6.92		19.41	5.26
NDH 98	46.22	29.17	25.79	48.85	23.20	34.65	36.46	36.62	I	20.59	7.13
TCP 64	25.96	30.43	18.96	26.34	8.59	22.06	-13.13	-13.03		23.36	5.15
PTS 12	29.33	33.39	22.47	32.31	6.75	24.85	-2.12	-2.01		21.73	5.40
PTS 8	31.34	27.63	17.37	37.93	8.91	24.64	-2.96	-2.85		22.21	5.47
PTS 55	27.87	28.61	23.95	34.02	6.18	24.13	-4.98	-4.87		21.98	5.30
Prathiba	27.68	29.78	21.28	37.82	10.41	25.39	0.01	0.13		22.55	5.73
Local	19.08	32.28	31.58	29.77	14.09	25.36	-0.13	-0.01		21.51	5.46
Mean	31.37	30.37	24.06	35.62	11.66						

Prathibha	15.23	10.62	12.25	12.70	27.94
Mean	11.75	11.13	13.90	12.26	
CD (0.05)	1.82	1.69	2.53	1.12	
CV (%)	10.62	8.80	12.48	10.57	

During 2010-14, this genotype was field tested as Acc. 48 along with other test varieties, for over three years in different turmeric growing regions of the country and under various climatic conditions through All India Coordinated Research Project on Spices (AICRPS). Among the genotypes evaluated, maximum yield per hectare was recorded in NDH 98 (a long duration variety, 240 days) followed by Acc. 48 (a short duration variety, 180 days) over three years pooled data (Table 4). It has 30 % and 35% yield increase over national and local turmeric varieties, respectively. This variety was identified for release during the XXVII All India Coordinated Research Project on Spices (AICRPS) Group Meeting held at NRC Seed Spices (Ajmer, Rajasthan) in 2016.

The characteristic features

- Short duration variety and takes only 180-200 days to harvest.
- High yielding variety with average yield of 38 t ha⁻¹ (fresh rhizomes). The potential yield is 52 t ha⁻¹ under favourable conditions.
- Stable and high curcumin content (5.02%) across locations (Table 5).
- Moderately resistant to root knot nematode infestation.
- The variety is suitable for cultivation in Kerala, Tamil Nadu, Andhra Pradesh, Telangana, Karnataka and Chhattisgarh states.

Table 5: Morphological and quality attributes of IISR Pragati

Morphological characters	
Plant height (cm)	94.75
Leaf length/breadth (cm)	45.8/15.0
No. of tillers per clump	2.5
No. of leaves per clump	13.8
Dry recovery (%)	20.04
Crop Duration	180 days
Yield	38.0 tonnes of fresh rhizomes/ha
Potential yield	52.0 tonnes of fresh rhizomes/ha
Quality attributes	
Curcumin	5.02%
Oleoresin	12.14%
Essential oil	3.60%

Short duration and high yield

The productivity of the local turmeric cultivars is low and often crop failures are experienced either due to shortage of irrigation water or disease occurrence. Also, most of the local cultivars and released varieties are long duration in nature (210-240 days). The improved high yielding short duration variety, IISR Pragati, is highly suitable for all such turmeric growing areas.

Stable and high curcumin

The primary active constituent of turmeric is an important secondary metabolite namely, curcumin. It is accepted that curcumin has wide range of beneficial properties, including anti-inflammatory, antioxidant, chemo-preventive and chemotherapeutic activity. Stability of curcumin and yield in turmeric is one of the concerns in spices industries, as genotypes perform differently across environments. IISR Pragati showed high stability for curcumin across environments and is suitable for spice industries aiming curcumin extraction.

Moderately resistant to root knot nematode

Root knot nematode (*Meloidogyne incognita*) is the most predominant nematode in turmeric, causing considerable crop loss in the states of Kerala, Tamil Nadu, and Andhra Pradesh. Planting of IISR Pragati is safe and effective strategy to manage nematode problems in turmeric.

Performance in turmeric growing regions

The on-farm trials conducted in farmer's fields clearly demonstrated its performance in many turmeric growing regions (Table 6). As per farmer's feedback, IISR Pragati is performing well in Andhra Pradesh, Tamil Nadu, Karnataka, Telangana and Himachal Pradesh.

Table 6: Performance of turmeric genotypes in on-farm trials

	Tamil Nadu				Andhra Pradesh			
	Fresh yield (t/ha)	Dry recovery (%)	Dry yield (t/ha)	Curcumin (%)	Fresh yield (t/ha)	Dry recovery (%)	Dry yield (t/ha)	Curcumin (%)
Prathiba	30.06	22.00	6.61	5.12	32.82	23.00	7.55	2.60
Acc. 48	38.04	19.00	7.23	5.62	41.31	21.50	8.88	5.01
Acc. 849	47.19	22.00	10.38	1.97	36.21	21.50	7.79	1.56
Acc. 79	29.37	19.00	5.58	5.62	32.64	23.30	7.61	4.06
Salem Local	30.21	17.00	5.14	4.80	34.93	21.50	7.51	3.85
PTS 10	29.33	20.00	5.87	4.48	-	-	-	-
Mydukkur	-	-	-	29.12	18.30	5.33	1.40	-

	Kerala				Karnataka			
	Fresh yield (t/ha)	Dry recovery (%)	Dry yield (t/ha)	Curcumin (%)	Fresh yield (t/ha)	Dry recovery (%)	Dry yield (t/ha)	Curcumin (%)
Prathiba	33.92	21.05	7.14	5.46	36.46	21.25	7.75	3.97
Acc. 48	51.95	17.60	9.14	4.96	43.14	18.96	8.18	4.52
Acc. 849	51.75	21.90	11.33	2.03	31.38	23.81	7.47	2.12
Acc. 79	38.94	17.50	6.81	4.54	28.02	18.56	5.20	4.52
Salem Local	32.64	19.00	6.20	-	-	-	-	-
Suguna	40.08	16.00	6.41	3.36	23.37	17.55	4.10	4.785

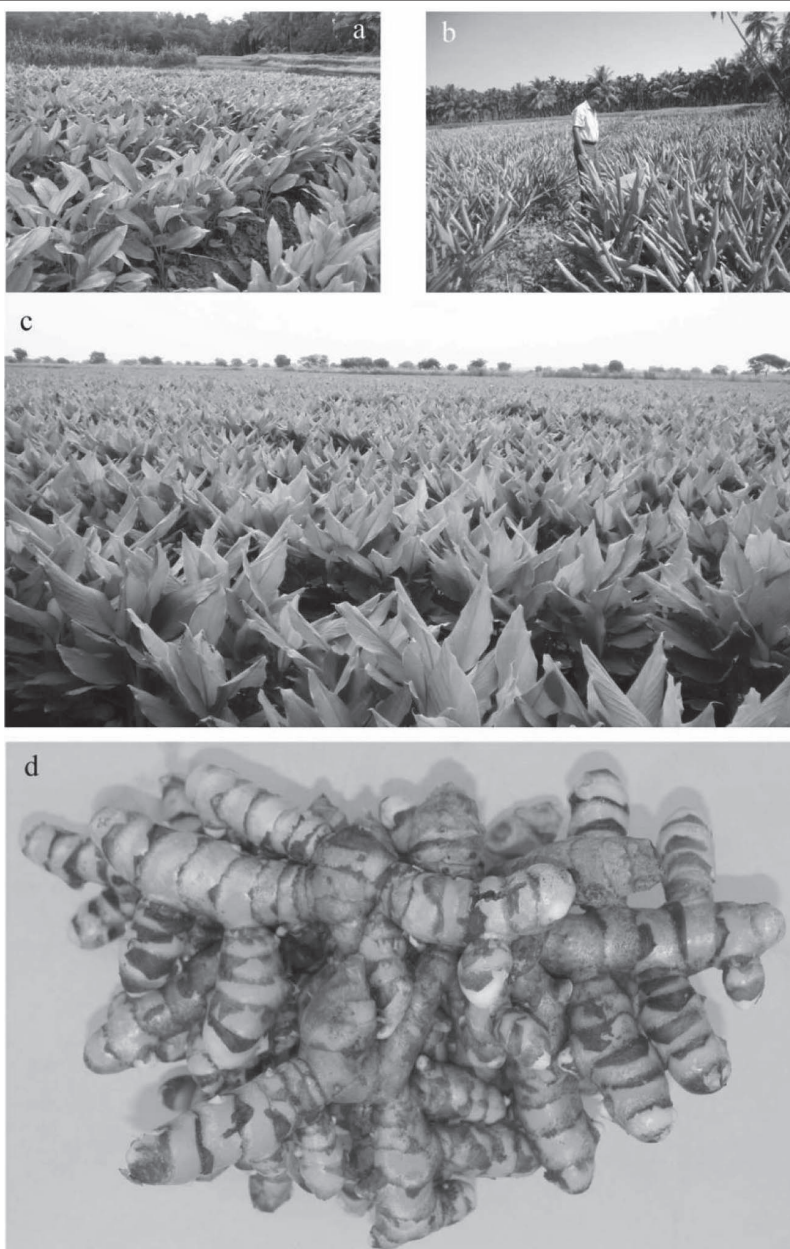


Fig. 1: Field view of IISR Pragati in a) Karnataka; b) Tamil Nadu; c) Telangana State; d) rhizome characters

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