



Study on yield and quality of flowered and non-flowered turmeric (*Curcuma longa* L.) plants

K. Kandiannan*, M. Anandaraj, Utpala Parthasarathy, C.K. Thankamani and T. John Zachariah

ICAR-Indian Institute of Spices Research, Kozhikode-673 012, Kerala, India

(Manuscript Received: 07-07-14, Revised: 23-11-14, Accepted: 30-12-14)

Keywords: *Curcuma longa*, curcumin, dry recovery percentage, flowering, yield, quality

Turmeric belongs to the genus *Curcuma* of the tribe Hedychieae in the family Zingiberaceae. Nambiar *et al.* (1982) reported two distinct types in turmeric viz., flowering and non-flowering. Philip (1978) has found that out of nineteen turmeric collections evaluated, only 15 were flowered. In crop like sugarcane, flowering was found to reduce the cane yield and quality (Rao, 1977). Similarly, tuber quality in yam bean (a leguminous root crop) was also affected by flowering compared to non-flowered plants (Vimala and Nambisan, 2005). But in turmeric, effect of flowering on yield and quality was not known and hence, this study.

The study was conducted at Experimental Farm, ICAR-Indian Institute of Spices Research (IISR), Peruvannamuzhi, Kozhikode, Kerala, India (11°34'N, 75°48'E and 60 m above MSL) during 2008–09, 2009–10 and 2010–11 under rainfed condition. Annual rainfall received during the years 2008, 2009 and 2010 were 3778 mm, 5420 mm and 4121 mm, in 145, 158 and 167 days, respectively. The mean annual maximum temperature was 31.7 °C, 31.8 °C, 31.5 °C, and mean annual minimum temperature recorded was 21.9 °C, 22.3 °C, and 22.3 °C respectively, during these years. Soil of the experimental site was laterite. There were eleven turmeric varieties viz., BSR 2, Duggirala Red, IISR Alleppey Supreme, IISR Kedharam, IISR Prathibha, Megha Turmeric-1, Narendra Haldi-1, Rajendra Sonia, Rasmi, Roma and Suranjana, planted on raised bed during first week of June. Standard cultivation practices were adopted. The flowered

plants in each variety were tagged during September to December period and equal number of non-flowered plants were also selected randomly. Crop was harvested during first week of February at maturity and their fresh yields were recorded after cleaning. After processing, dry weight was recorded and dry recovery percentage was worked out. Curcumin was estimated from the powdered and sieved sample by American Spice Trade Association (ASTA) procedure (ASTA, 1968). The comparison of flowered and non-flowered plants was done using t-test.

The differences in flowering among turmeric varieties were noted. Out of eleven varieties studied, Megha Turmeric-1 which was introduced from North-east India, did not flower in all the three years and only one plant of variety Duggirala Red (from Andhra Pradesh) flowered during 2010-11. Variety Narendra Haldi-1 did not flower during first year but it flowered in next two years, varieties IISR Alleppey Supreme and IISR Prathibha did not flower during third year. Maximum of four plants in BSR 2 flowered during first year out of 200 planted, in second year maximum of six plants in IISR Kedharam flowered out of 240 and in third year, maximum five plants out of 200 in each of BSR 2 and Rajendra Sonia were flowered. The percentage of plants flowered during first (2008-09), second (2009–10) and third years (2010–11) were 1.3 to 2.0, 0.6 to 2.0 and 0.5 to 2.5, respectively. Velayudhan *et al.* (1999) has found that the genus *Curcuma* showed a tendency of shy flowering and

*Corresponding Author: kandiannan@spices.res.in

Table 1. Effect of flowering on yield and quality of turmeric

Varieties	Turmeric plants flowered (%) (Mean of 3 yrs)	Fresh rhizome yield (g plant ⁻¹)						Dry rhizome yield (g plant ⁻¹) (mean of 2 yrs)		Dry recovery (%) (mean of 2 yrs)		Curcumin content (%) (mean of 2 yrs)	
		2008-09		2009-10		2010-11		F	NF	F	NF	F	NF
		F	NF	F	NF	F	NF	F	NF	F	NF	F	NF
BSR 2	2	413	263	638	845	917	817	62.1	66.3	12.1	12.8	5.17	4.57
Duggirala Red	0.2	-	625 [#]	-	640 [#]	940	817	-	-	-	-	4.38	4.35
IISR Alleppey Supreme	0.7	513	375	535	500	-	770 [#]	96.1	81	18.3	18.4	4.05	5.1
IISR Kedharam	1.4	128	325	523	460	658	748	52.5	80	16.4	19.8	4.09	5.06
IISR Prathibha	0.8	250	413	588	560	-	1010 [#]	75.3	97.3	18.8	19.8	-	-
Megha Turmeric-1	0	-	500 [#]	-	915 [#]	-	775 [#]	-	-	-	-	-	-
Narendra Haldi-1	1.2	-	650 [#]	980	1230	1120	943	-	-	-	-	-	-
Rajendra Sonia	2.1	650	863	1263	860	953	960	97.2	109	10	12.7	4.44	4.36
Rasmi	1.5	340	638	425	485	730	693	67.7	107.7	17.6	19.2	4.54	4.64
Roma	1.6	225	363	370	280	730	760	59.3	61.6	19.2	19.5	4.06	4.75
Suranjana	1.7	463	263	745	890	863	770	88.2	93.6	14.7	17.7	4.05	3.73
Mean	1.1	372.5	437.5	673.9	678.9	864	813.5	74.8	87.1	15.9	17.5	4.35	4.57
t Stat		-0.682		-0.037	-0.037			0.801		-0.991		-1.076	
t Critical		2.145		2.12	2.12			2.145		2.145		2.145	

not included in the analysis; F: Flowered plant; NF: Non-flowered plant

it took a few years for the plant to flower once established in a new niche and flowering was erratic and unpredictable in some cases. They also noted varietal differences in turmeric flowering. Philip (1978) has evaluated 19 turmeric collections and reported that only 15 were flowered. Two distinct types in turmeric *viz.*, flowering and non-flowering were observed (Nambiar *et al.*, 1982). In our study, percentage of plants flowered in three years varied between 0.2 and 2.1 (Table 1), whereas, turmeric plants flowered in the range 1.2 per cent to 17.4 per cent as reported by Philip (1978), two of his collections *viz.*, Amalapuram and Dindrigam Ca 69, flowered at 92.7 per cent and 95.3 per cent, respectively and tillers of these two collections also flowered but not from others and these two belonged to *C. aromatica*.

The fresh yield of flowered and non-flowered plants during first, second and third years were 128–650 and 263–863 g; 370–1263 and 280–1230 g; 658–1120 and 693–1010 g, respectively. The mean fresh yield (g per plant) between flowered and non-flowered plants during 2008-09, 2009-10, 2010-11 were 372.5 and 437.5; 673.9 and 678.9; 864.0 and 813.5, respectively. Mean dry yield of rhizome of flowered and non-flowered plants during first (2008-09) and second (2009-10) years varied with a mean of 94.1 g and 105.1 g; 55.5 g and 69 g; 74.8 g and 87.1 g, respectively and they did not differ each other statistically as indicated by t-test (Table 1). Slight yield variations between flowered and non-flowered plants were noted, however, it was not consistent among varieties and year.

Two important quality traits of turmeric are curing percentage and curcumin content. These parameters were estimated for first two years. The mean dry recovery (%) between flowered and non-flowered plants was 15.8 and 16.5; 16.0 and 18.3, respectively during 2008-09 and 2009-10, and mean curcumin content (%) between flowered and non-flowered plants were 4.25 and 4.36; 4.44 and 4.78, respectively, during 2008-09 and 2009-10. The statistical t-test indicated that flowered and non-flowered plants did not differ in dry recovery and curcumin content (Table 1).

The existence of variability for yield and quality of turmeric has been documented well. The variations in fresh yield of improved varieties ranged 9.2 to 39.1 t ha⁻¹ (Ravindran *et al.* 2007).

Ratnambal (1986) evaluated 120 cultivars/ accessions of turmeric and found that dry recovery percentage varied between 13.5 and 30.5, and curcumin varied from 2.7 to 10.9 per cent. Variation in curcumin content of the same variety in different locations was also reported (Zachariah *et al.*, 1999). This variation in phyto-constituent (curcumin, oleoresin and essential oils) of turmeric might be attributed to the difference in climate and soil condition of different agroclimatic zones (Singh *et al.*, 2013). In the present study, fresh and dry yield, dry recovery and curcumin content did not differ between flowered and non-flowered plants and it is concluded that flowering in turmeric would not have any impact on yield and quality.

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