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Effect of planting materials, mulch levels and farmyard manure on growth, yield and quality of turmeric (*Curcuma longa*)

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ABSTRACT

A field experiment was conducted during 2007–08 and 2008–09 to study the effect of different planting materials, mulch levels and farmyard manure on growth, yield and quality of turmeric. Among the planting materials, use of mother rhizome resulted in better yield and quality compared to primary and secondary rhizomes. Mulching was also found to exert favourable effect on growth, yield and quality of rhizomes. Application of FYM increased the growth, dry matter accumulation, yield and quality of turmeric.

Key words: *Curcuma longa* L., Farmyard manure, Mulch, Planting materials

Turmeric (*Curcuma longa* L.) is a herbaceous plant belonging to family Zingiberaceae. It is extensively used as stimulant, blood purifier, tonic, as a carminative, remedy against the skin diseases, pain and anthelmintic (Srimul 1997). It possess anti-cancerous properties (Kuttan *et al.* 1985) and is considered cure for AIDS (Cohley *et al.* 2003). During 2007–08, Indian export of turmeric was 49,250 tonnes valued at Rs 15 700 lakhs, contributing 11% of total spices export (Selvan 2009). India is major producer, consumer and exporter of turmeric but major part of its produce is consumed within the country and export only accounts for about 5.9% of the total production (Selvan 2009). However, low productivity is observed under Punjab conditions. In the present study, effect of different planting materials, mulch levels and farmyard manure on growth, yield and quality of turmeric were studied to select the best combination.

MATERIALS AND METHODS

The field experiments were conducted at Punjab Agricultural University, Ludhiana in well-drained sandy loam soils under irrigated condition. The nutrient status of soil was low in available N and medium in P and K with *p*H of 7.8. The experiment consisted of 18 treatment combinations, comprising 3 levels of planting material (mother rhizome, primary and secondary finger), 3 levels of rice straw mulch (no mulch, 6.25 and 9.38 tonnes/ha) and 2 farmyard manure levels (30 and 45 tonnes/ha). The experiment was laid out in randomized block design (factorial) with 4 replications. Observations on periodic plant height, number of leaves and dry matter accumulation/plant were recorded and represented in the form of graphs. Number and weight of mother, primary and secondary rhizomes/plant were recorded at harvest. Fresh, dry and processed rhizome yield were calculated based on per plot yield expressed in tonnes/ha. The essential oil content (% w/v) was estimated by hydrodistillation using Clevenger's Apparatus. The curcumin content (%) was calculated by using the formula (Thimmaiah 1999).

RESULTS AND DISCUSSION

The highest plant height, number of leaves and dry matter accumulation/plant were recorded when mother rhizome were used as planting material and all the growth parameters decreased with decrease in size/weight of the planting material from mother rhizome (25–30 g) to primary (15–20 g) and then from primary to secondary finger (5–10 g) at all the stages of crop growth during both the years (Fig 1). The large sized rhizomes had more stored food material, which resulted in more vigorous plants, thus, the plant produced from mother rhizome had more height, number of leaves and dry matter accumulation. The plants raised from mother rhizomes produced highest number of mother, primary, secondary and total rhizomes/plant. The number of mother, primary, secondary and total rhizomes/plant decreased significantly with decrease in size/weight of planting material during both the years (Table 1). Weight of mother, primary, secondary and total rhizomes/plant was significantly more when mother rhizome was used as planting material as compared to primary and secondary finger planting material

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Table 1 Effect of different planting materials, mulch levels and farmyard manure on yield-attributing characters of turmeric

Treatment	Number/plant								Weight/plant (g)							
	Mother rhizome		Primary rhizome		Secondary rhizome		Total rhizome		Mother rhizome		Primary rhizome		Secondary rhizome		Total rhizome	
	2007–08	2008–09	2007–08	2008–09	2007–08	2008–09	2007–08	2008–09	2007–08	2008–09	2007–08	2008–09	2007–08	2008–09	2007–08	2008–09
Planting material																
Mother rhizome (25–30 g)	4.1	3.9	10.2	9.6	8.1	7.8	22.3	21.3	101.7	100.2	51.9	52.2	15.4	16.0	169.0	168.4
Primary finger (15–20 g)	3.1	2.7	8.4	8.0	7.2	6.9	18.7	17.3	74.7	72.6	45.5	42.3	13.0	12.3	133.2	127.1
Secondary finger (5–10 g)	2.4	2.2	6.5	6.0	5.9	5.5	14.8	13.7	39.4	32.5	32.4	24.3	9.4	8.2	81.2	80.0
CD (P=0.05)	0.3	0.3	0.5	0.5	0.6	0.4	1.5	2.1	8.7	7.9	2.3	6.0	1.2	1.4	7.6	11.3
Mulch levels (tonnes/ha)																
No mulch	2.1	1.9	4.9	4.5	4.7	4.2	11.7	10.5	48.9	49.0	27.0	25.9	8.9	8.2	84.7	83.1
6.25	3.3	3.0	8.2	8.5	7.3	7.0	19.5	18.4	72.4	75.2	46.2	42.8	13.1	12.2	131.7	130.2
9.38	4.3	4.0	11.2	10.7	9.3	8.9	24.8	23.6	94.5	90.0	56.6	56.3	15.8	15.4	166.8	161.7
CD (P=0.05)	0.3	0.3	0.5	0.5	0.6	0.4	1.5	2.1	8.7	7.9	2.3	6.0	1.2	1.4	7.6	11.3
FYM levels (tonnes/ha)																
30	3.0	2.8	7.8	7.8	6.6	6.2	17.3	16.4	66.6	67.4	41.1	38.0	11.8	10.9	119.5	116.3
45	3.4	3.1	8.8	8.4	7.5	7.2	19.5	18.6	77.3	75.5	45.4	45.4	13.0	12.8	136.0	133.7
CD (P=0.05)	0.3	0.3	0.5	0.5	0.6	0.4	1.5	2.1	8.7	7.9	2.3	6.0	1.2	1.4	7.6	11.3

during both the years. Similarly, primary fingers produced significantly more rhizomes weight/plant (mother, primary, secondary and total rhizomes) than the secondary finger planting material (Table 1). The results obtained in the experiment might be due to higher plant height with higher number of leaves, which resulted in accumulation of more photosynthates and ultimately led to higher number and weight of rhizomes/plant. The mother rhizome planting material produced significantly higher fresh, dry and processed rhizome yield than primary and secondary finger planting materials during both the years (Table 2). Similar trend was recorded on pooled data. The data revealed that the use of primary and secondary finger planting material resulted in 22.9 and 51.6% reduction in fresh rhizome yield, respectively as compared to mother rhizome planting material. Increased rhizome yield when mother rhizome was used as planting material might be due to better crop growth which had resulted in higher number and weight of rhizomes/plant and higher yield. Similar results were reported by Hossain *et al.* (2005) when mother rhizomes were used as planting material. The oil and curcumin content in turmeric rhizomes decreased with decrease in size of planting material during both the years of study, however the decrease was not significant (Table 2).

The plant height, number of leaves and dry matter accumulation/plant increased with increase in mulch levels at all the stages of crop growth during both the years (Fig 2). The highest dry matter accumulation, number of leaves and plant height was recorded when the crop was mulched @ 9.38 tonnes/ha during both the years of study. The favourable effect of mulch in modifying the soil environment and weed control might be the reason for more number of leaves, higher dry matter content and plant height (Mahey *et al.* 1986). Mulching @ 9.38 tonnes/ha produced maximum number of mother, primary, secondary and total rhizomes/plant during both the years. There was significant increase in mother rhizome, primary, secondary and total rhizomes/plant with the increase in mulching levels during both the years (Table 1). The highest weight of primary, secondary and total rhizomes/plant were recorded when mulched @ 9.38 tonnes/ha. The increased availability of moisture, nutrients and favourable temperature with mulch application have resulted in better crop growth which might have resulted in more number and weight of rhizomes/plant (Mahey *et al.* 1986). There was significant enhancement in yield of fresh, dry and processed rhizomes with the mulching during both the years of study. The highest fresh, dry and processed rhizome yield was recorded when crop was mulched @ 9.38 tonnes/ha during both the years of study. The increase in rhizome yield due to mulching might be attributed to the increase in number and weight of rhizomes/plant. There was enhancement in the oil and curcumin content due to mulching during both the years of study but the differences among the treatments were not significant (Table 2).

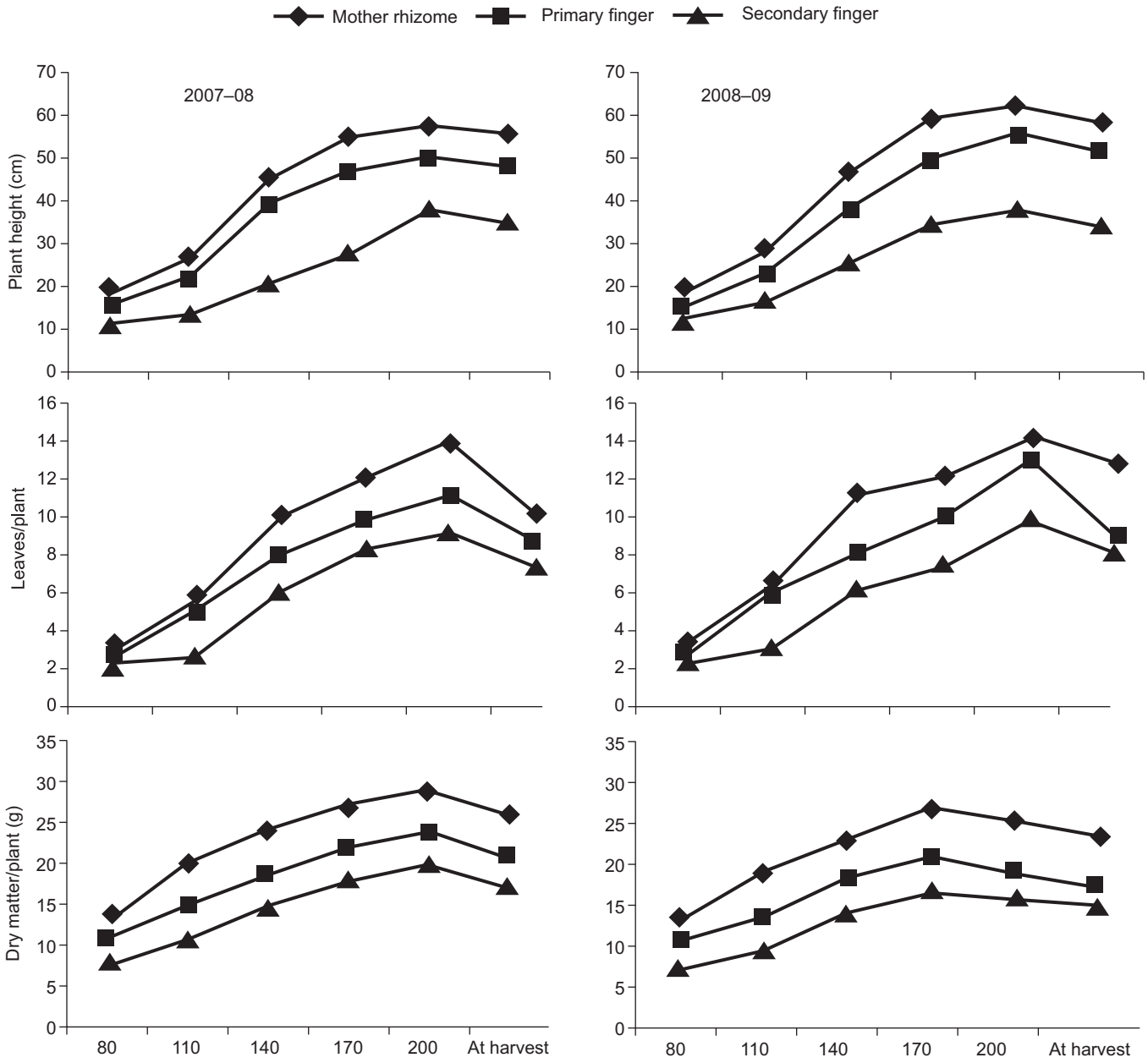


Fig 1 Periodic plant height, number of leaves and dry matter accumulation as influenced by different planting material

Table 2 Effect of different planting materials, mulch levels and farmyard manure on yield of turmeric

Treatment	Fresh yield (tonnes/ha)			Dry yield (tonnes/ha)			Yield of processed turmeric (tonnes/ha)			Oil content (% w/v)		Curcumin content (%)	
	2007–08	2008–09	Pooled	2007–08	2008–09	Pooled	2007–08	2008–09	Pooled	2007–08	2008–09	2007–08	2008–09
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Planting material													
Mother rhizome(25–30 g)	27.36	25.72	26.53	6.12	5.70	5.91	5.74	5.41	5.57	7.6	7.3	2.6	2.7
Primary finger(15–20 g)	21.15	19.74	20.44	4.73	4.59	4.66	4.45	4.25	4.35	7.4	7.1	2.5	2.5
Secondary finger(5–10 g)	12.95	12.69	12.84	2.89	2.62	5.75	2.64	2.34	2.49	7.3	7.1	1.9	1.7

(*Continued...*)

(*Table 2 concluded*)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
CD (*P*=0.05)	16.2	18.3	18.1	4.3	4.0	4.0	4.0	3.2	3.9	NS	NS	NS	NS
Mulch levels (tonnes/ha)													
No mulch	14.71	14.33	14.52	3.20	3.0	3.10	2.97	2.77	2.87	7.1	6.9	1.9	1.9
6.25	20.55	19.45	20.00	4.66	4.43	4.54	4.38	4.05	4.22	7.5	7.2	2.5	2.4
9.38	26.24	24.37	25.30	5.87	5.47	5.67	5.47	5.18	5.32	7.7	7.4	2.6	2.6
CD (*P*=0.05)	16.2	18.3	18.1	4.3	4.0	4.0	4.0	3.2	3.9	NS	NS	NS	NS
FYM levels (tonnes/ha)													
30	19.50	18.42	18.96	4.33	4.09	4.21	4.06	3.82	3.94	7.3	7.1	2.2	2.1
45	21.50	20.35	20.92	4.83	4.51	4.66	4.48	4.18	4.33	7.5	7.2	2.4	2.5
CD (*P*=0.05)	16.2	18.3	18.1	4.3	4.0	4.0	4.0	3.2	3.9	NS	NS	NS	NS

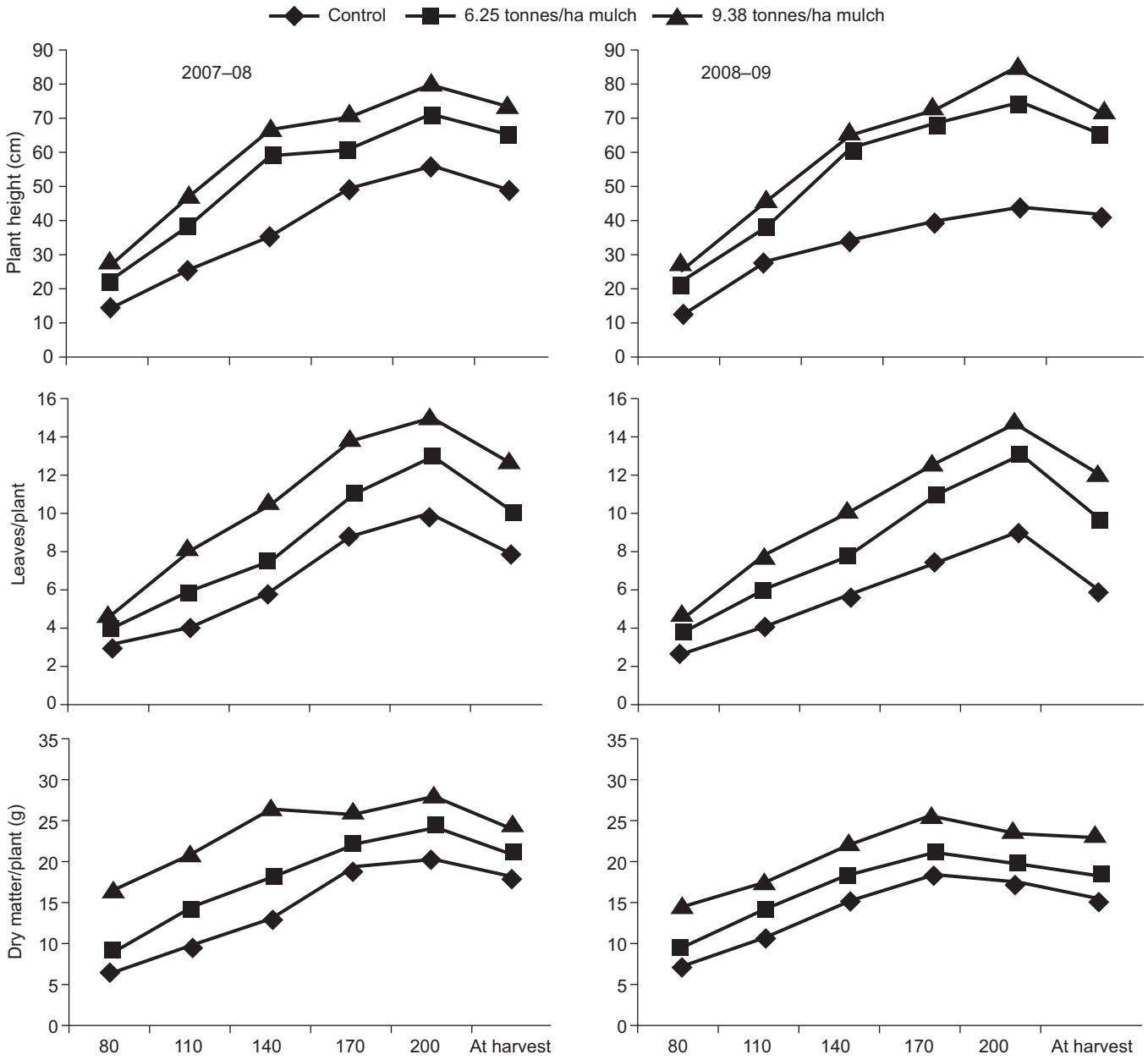


Fig 2 Periodic plant height, number of leaves and dry matter accumulation as influenced by different mulch levels

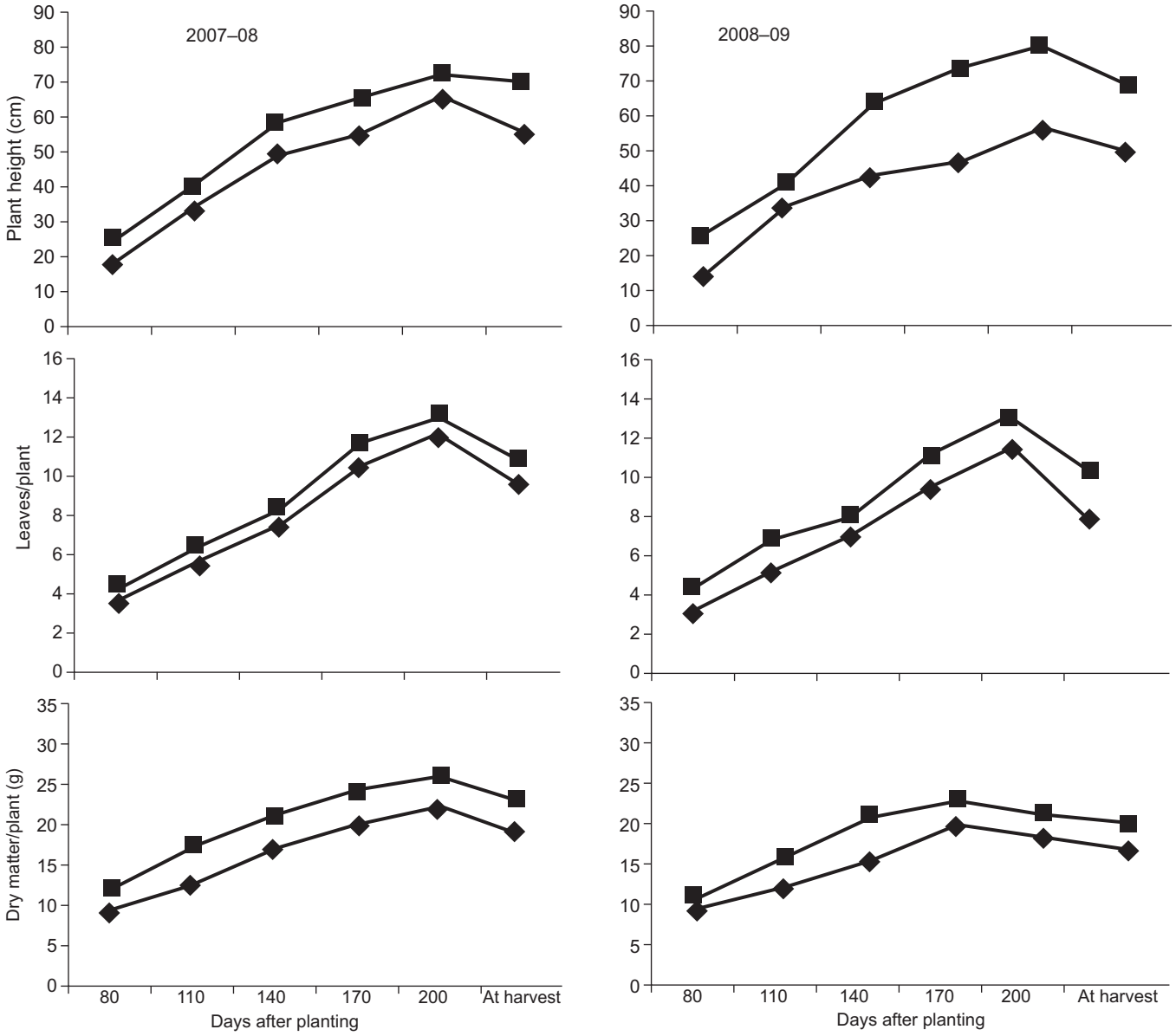


Fig 3 Periodic plant height, number of leaves and dry matter accumulation as influenced by different FYM levels

Significant periodic increase in the plant height, number of leaves and dry matter accumulation/plant was recorded due to FYM treatments (Fig 3). The increased availability of plant nutrients with farmyard manure application over a period of time due to slow release of nutrients might have resulted in better crop growth in terms of plant, number of leaves and dry matter accumulation. Application of 45 tonnes/ha farmyard manure produced significantly more number of mother, primary, secondary and total rhizomes/plant compared to 30 tonnes/ha during both the years of observation. The highest weight of mother, primary, secondary and total rhizomes/plant were recorded with 45 tonnes/ha farmyard manure. When FYM was applied @ 45 tonnes/ha farmyard manure resulted in significant increase in fresh, dry and processed rhizome yield compared to 30 tonnes/ha farmyard manure treatment during both the years (Table 2). The increase in rhizome yield due to farmyard manure application might be due to enhancement in number and weight of rhizomes/plant. The oil and curcumin content were also increased when FYM was applied @ 45 tonnes/ha but the difference was not significant (Table 2).

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