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Effect of girdling on leaf tissue analysis of mango (*Mangifera indica* L.) cv. Alphonso

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Abstract
A field experiment was conducted at AES, NAU, Paria and RHRS, ACHF, NAU, Navsari in randomized block design with factorial concept comprising four treatments of girdling width *viz.*, 0.75 cm (W_1), 1.00 cm (W_2), 1.25 cm (W_3) and 1.50 cm (W_4) and three treatments of girdling time *i.e.* 15th July (T_1), 15th August (T_2) and 15th September (T_3) of girdling time as along with control. The treatments were replicated thrice. Results of present investigation revealed the girdling during 15th July (T_1) and girdled with 1.50 cm width (W_4) were proved beneficial for improving carbohydrate content (%), C: N ratio in leaf tissues.

Keywords: gridling, leaf, tissue, mango

Introduction
India has a rich wealth of mango germplasm with more than 1000 mango varieties grown throughout the length and breadth of the country. However, only about 21 of them are commercially cultivated in different mango growing regions (Yadav, 1997) [9]. Among them, Alphonso top the list and is grown along the West coast of Gujarat, Maharashtra, Goa and Karnataka, which is acclaimed as one of the best Indian mango varieties. It enjoys virtual dominance both in domestic as well as in international markets due to its typical sugar-acid blend, attractive colour and shape, pleasant aroma, highly appreciable flavour, taste and distinctly having long keeping quality. Under changing WTO regime, this variety has recently attracted the attention of APEDA, New Delhi and efforts are on to have international registration for 'Alphonso' mango for IPR norms under geographical indication. Although, most of the quality merits are confirmed on this variety, it has some serious inherited physiological disorders such as, alternate bearing habit, and excessive/heavy fruit drop at different stages of fruit growth, rendering this variety as poorest yielder (2.5 to 3.5 tons/ha). While, the average productivity among 21 commercially grown varieties in the country is over 7.10 t/ha.

Orchardists have practiced the use of girdling and related techniques in horticulture since last few decades in order to increase the fruit production. The culture of fruit trees is geared toward production of a high-value crop, reduce fruit drop integrating quantity and quality. This is achieving by various techniques; including breeding, nutrition, pest control and bio-regulators as well as direct manipulations of the plant itself. Direct plant manipulations leading to the desired yield consist of two kinds of horticultural techniques. Removal of certain tree organs (e.g. training, pruning, fruit thinning) and interference with translocation between major tree organs (e.g. girdling, ringing, scoring, branch bending, which modifies auxin distribution, may be included in this second category). Fruit trees might be viewed as a system of sinks and sources (leaves, reproductive organs and roots) interconnected via vascular organs (trunk, branches and scaffold roots). Girdling is basically an intervention in the phloem transport between canopy and roots, in an attempt to manipulate the distribution of photosynthate, mineral nutrients and plant bio-regulators (Goren *et al.*, 2004) [2].

Materials and methods
A field experiment was conducted at AES, NAU, Paria and RHRS, ACHF, NAU, Navsari in randomized block design with factorial concept comprising four treatments of girdling width *viz.*, 0.75 cm (W_1), 1.00 cm (W_2), 1.25 cm (W_3) and 1.50 cm (W_4) and three treatments of girdling time *i.e.* 15th July (T_1), 15th August (T_2) and 15th September (T_3) of girdling time as along with control. The treatments were replicated thrice. Girdling practiced mainly on secondary branches (50-60%) of the plants. Selected healthy plants having five or more than five secondary branches. Use of sharp pruning saw and small scale measurement tape for management of proper width of girdled portion. Girdling was done very carefully without damage of xylem tissue, only cut were made between peel and xylem. After girdling, applied the copper oxychloride 50 % WP paste on girdled portion for protection of girdled portion.

Table 1: Effect of time and width of girdling on carbohydrate content (%) at 15th October and 15th January in mango leaves cv. Alphonso

Treatments	Carbohydrate content (%)		
	15th July	15th October	15th January
Width of Girdling (W)			
W_1	12.417	13.25	15.26
W_2	12.705	13.40	15.90
W_3	12.745	13.57	16.11
W_4	12.701	13.73	16.60
S.Em.±	0.215	0.21	0.21
C.D. at 5%	NS	NS	0.61
Time of Girdling (T)			
T_1	12.906	14.13	16.84
T_2	12.339	13.03	15.62
T_3	12.681	13.30	15.43
S.Em.±	0.187	0.18	0.18
C.D. at 5%	NS	0.52	0.53
Interaction effect (W x T)			
S.Em.±	0.373	0.368	0.37

C.D. at 5%	NS	NS	NS
CV%	7.23	6.72	5.74
Treated *vs* Control			
Treated Mean	12.642	13.491	15.96
Control	12.685	13.297	14.77
S.Em.±	0.388	0.38	0.38
C.D. at 5%	NS	NS	0.78

Table 2: Effect of time and width of girdling on carbohydrate content (%) at 15th January in mango leaves cv. Alphonso

Treatments	C: N ratio at 15th January		
	Paria	Navsari	Pooled
Width of Girdling (W)			
W_1 – 0.75cm	12.07	11.65	11.86
W_2 – 1.00cm	12.13	11.97	12.05
W_3 – 1.25cm	11.84	11.91	11.88
W_4 – 1.50cm	12.59	12.69	12.64
S.Em.±	0.39	0.27	0.24
C.D. at 5%	NS	NS	NS
Time of Girdling (T)			
T_1 – 15th July	13.20	12.59	12.89
T_2 – 15th August	11.70	11.81	11.75
T_3 – 15th September	11.57	11.77	11.67
S.Em.±	0.34	0.24	0.20
C.D. at 5%	0.99	0.70	0.59
Interaction effect (W x T)			
S.Em.±	0.68	0.48	0.41
C.D. at 5%	NS	NS	NS
CV%	9.72	6.89	8.47
Treated *vs* Control			
Treated Mean	12.16	12.05	12.11
Control	11.08	11.49	11.28
S.Em.±	0.711	0.49	0.43
C.D. at 5%	NS	NS	NS

Results and Discussion

Among the carbohydrates content (%) in leaves during 15th October and 15th January were found significant effect in 1.50 cm girdling width (W_4) treatment. This might be due to more stress by girdling or blocking (complete ringing) of translocation of photosynthates (sugar and starch) from leaves to roots by making restriction of bark ringing in the trunk (Hossain, 2006) [3]. In which girdling interrupts the phloem pathway and hence large amount of carbohydrates produced by photosynthesis accumulated in vegetative organs above the girdled which leads to increased in carbohydrates percentages in leaf tissue (Onguso *et al.,* 2004) [5]. Similar trends were observed by Eltom *et al*., (2014) [1]. in grape and Mostafa and Saleh (2006) [4]. and Rivas *et al*. (2007) [7]. in citrus.

The data pertaining on C: N ratio in leaves were significantly maximum in 1.50 cm girdling width (W_4) treatment and minimum C: N ratio in leaves obtained in 0.75 cm girdling width (W_1) treatment. This might be due to girdling treatments continuously increased carbohydrates after girdling but there was failed to any significant in nitrogen (%) in leaves which decreased in leaf tissues. Which leads to increased C: N ratio in leaves in same treatment during 15th January. Similar trend was observed by Mostafa and Saleh (2006) [4]. in citrus.

Among different girdling time, 15th July of girdling time (T_1) treatment gave the significantly maximum carbohydrate (%) during 15th October and 15th January and C: N ratio in 15th January than later girdling treatments *i.e.* T_2 (15th August) and T_3 (15th September). This might be due earlier girdling increased accumulation of carbohydrates above girdled portion. Onguso *et al.,* (2004) [5]. stated that girdling blocked the translocation of sucrose from leaves to roots through phloem bundles. Schneider, (1969) and Plaut and Reinhold, (1967) [6]. also revealed that the block decreased starch content in root system and accumulated of sucrose in the leaves. The block decreased starch content in root system and accumulated of carbohydrates in the leaves. Due to that higher carbohydrates content increased C: N ratio in leaves in the same treatment. The similar confiding by Mostafa and Saleh (2006) [4]. in citrus.

Referances

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