Effect of Indole Butyric Acid Concentrations on Rooting of Green and Soft Wood Cuttings of Mahaleb SL-64

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The effect of various rates of indole butyric acid (IBA) on rooting, callusing, number of roots per cutting, length of roots per cutting, number of cuttings remaining active, part forming of roots, number of cuttings usable for producing the plant and root quality of green and soft-wood cuttings obtained from Mahaleb SL-64 was investigated. The cuttings were planted in mist unit, filled with perlite and placed in a high plastic tunnel. The green cuttings were separated into two parts, the bottom and upper cuttings, in June and July of 1995. According to trial results, the highest rooting ratio was found from the green cuttings obtained in June. The hormone concentration 2000 ppm at the upper cuttings and 4000 ppm at the bottom cuttings was seen to be more effectual on the rooting. In the upper and bottom cuttings collected in June the average rooting ratio was obtained to be 85.33 and 84.17% respectively. Also, for other characteristics examined, the green cuttings are superior.

Key Words: Mahaleb SL-64, Cutting, Rooting, IBA concentration.

INTRODUCTION

The rootstocks used for young fruit tree production are basely separated into two groups as seedling and clone rootstocks according to multiplication methods[1, 2]. Generative rootstocks are propagated from seed; on the other hand, vegetative rootstocks are formed from a piece which is completely the same genotype as mother plant. Thus, in many countries all fruit propagated over the world, the clone rootstocks do not show any main variation, except for mutations[2]. The cuttings have usually been used for multiplication of clone rootstocks by a majority. The clone rootstock of SL-64 selected from Mahaleb was often preferred for cherries[1]. The green cuttings of this rootstock can be casily rooted under a mist system[3, 4].

In general, the green cuttings are rooted better than the hard-wood cuttings in many fruit species but the green and the soft-wood cuttings require much more

care than the hard-wood cuttings during the rooting[5]. It is reported that the highest rootings are obtained from the cuttings taken from bottom part of shoot, in majority species. On the contrary the upper cuttings of *P. avium*, *P. cerasus* and *P. mahaleb* species showed a better rooting. The bottom cuttings taken from soft-wood shoots of Stockton Morello and Montmorency sour cherry varieties rooted in the ratios of 30% and 10% respectively. On the other hand, in the upper cuttings of the same varieties, 77 and 90% rooting were obtained, respectively[6]. The highest rooting ratios were recorded from green cuttings of rootstocks, taken in middle of June, such as GM 9, GM 61/1 and GM 79 in a study carried out by Wolfrom (1989).

The types of green cutting (bottom, middle, upper cutting etc.) seem to be an important factor in the multiplication of Mahaleb SL-64. Some researches reported that the rooting ratio in the cuttings decreases when the shoots are divided into three pieces such as bottom, middle and upper. From these pieces, Mahaleb upper cuttings root better than bottom and middle cuttings. It is also suggested that the shoots must be separated into parts in the propagation of Mahaleb SL-64[3, 6, 7]. In a study, 12–15 cm tall green cuttings of Can and Myrobalan plum varieties were used under mist propagation[8]. The daytime temperatures of mist propagation system (21–27°C) and the night temperatures of the system (15–20°C) were satisfactory for rooting of the cuttings of most species[2, 5, 6, 9]. In order to enhance the rooting of stem cuttings of most species, several hormones such as indole-3-butyric acid (IBA), naphthalene-acetic acid (NAA) and indole-3-acetic acid (IAA) are used[10]. In the research carried out by Kosina[11] the green cuttings of Mahaleb SL-64 and Colt rootstocks taken in the middle of June were treated with 4000 and 10,000 ppm dose of IBA and then cuttings were placed for rooting under mist in a plastic tunnel. This research showed that the green cuttings of Mahaleb SL-64 were found better than Colt. Mackawiak[12] tested the green, soft-wood and hard-wood cuttings of F12/1, Colt and SL-64 rootstocks, but could not obtain successful results. On the other hand, Colt rootstock showed 50% of rooting in a different study[13]. In an investigation carried out by Konarli[14], 52 and 23% of rooting ratios were obtained from the green cuttings of Mahaleb SL-64 and Mazzard F12/1 treated with 4000 ppm dose of IBA respectively. Konarli and Philippe[15] reported that the cuttings taken later then middle July decrease the percentage of rooting.

The objective of this study was to investigate the rooting reactions of green and soft-wood cuttings of rootstocks of Mahaleb SL-64 under mist propagation system.

EXPERIMENTAL

In this study the green and soft-wood cuttings of Mahaleb SL-64 were used. The cuttings of Mahaleb SL-64 were obtained from the clonal rootstock garden of Tokat Nursery Station. Mahaleb SL-64 rootstocks were pruned deeply in the

pruning season of 1994–1995. Cuttings were obtained from new shoots sprouted after pruning. Perlit was used as rooting medium and indolebutyric acid (IBA) was applied to stimulate rooting of cuttings. The investigation was carried out at mist system of Agricultural Faculty of Gaziosmanpasa University in 1995.

Method

The experimental layout was a random parcel design with three repetitions of 10 cuttings per plot. 0, 2000, 4000 and 6000 ppm of IBA were used and the time of cutting taking was June and July. Two types (bottom and upper cutting) of green cuttings were used; a total of 480 cuttings were taken for green cuttings experiment. In the experiment done with soft-wood cuttings, 0, 2000, 3000 ppm of IBA were used for the soft wood cutting experiments; two cutting types (bottom and upper) were used. A total of 180 cuttings were taken only in September for the experiment.

The cuttings were prepared at a height of at least 20 cm from bottom of shoots[8, 16–18]. In the treatment with hormone, about 2 cm from bottom part of cutting were dipped into indolebutyric acid solution for 5 s. After planting, a light irrigation was applied immediately. Then, they were irrigated as required. Both the cutting groups were planted with spaces of 10 × 10 cm in rows. The cuttings were placed for about six weeks under mist and then they were uprooted from rooting medium. In the valuing of the results, the following observations and criteria were taken into account.

Callusing ratio (%): With calculated as percentage of the cutting taken from callus tissue in the edge surfaces cut of cuttings at the bottom part were determined.

Rooting ratio (%): The root numbers of cuttings were calculated as percentage.

Average number of roots: The number of roots of each cutting was counted and then the average of the results was calculated numerically.

Average length of roots (mm): The lengths of four roots chosen at random on each cutting were determined and then the average length was calculated based on these values.

Useable (practical) cutting ratio in plant production (%): The cuttings having two or more roots were counted as quality cuttings and then the results were calculated as percentage.

Active cutting ratio (%): The callused and rooted cuttings were counted and then the results were determined as percentage. Duncan's multiple comparison test was used for statistical analysis of values.

Root quality (1–5 point): By using the scale in Table-1 based on the average number of roots and the average length of roots, root quality was graded from 1 to 5. Cutting quality was also categorised according to the evaluation points given in Table-2.

TABLE-1
ROOT NUMBER AND ROOT LENGTH (mm) POINTS

Average number of roots	Points	Average length of root	Points
1–3	1	1.0–30.0	1
4–6	2	30.1–40.0	2
7–9	3	40.1–50.0	3
10–12	4	50.1–60.0	4
13 and >	5	60.1 and >	5

TABLE-2
THE POINTS OF ROOT QUALITY CATEGORIES

Root quality	Points
Low	0.1–1.9
Middle	2.0–2.9
Good	3.0–4.9
Very good	5.0 and >

RESULTS AND DISCUSSIONS

Green Cuttings

The values concerned with callusing, rooting, root number per cutting, length of roots, number of cuttings remaining active, percentage of cutting usable for plant production and root quality in the green cuttings of June and July are shown in Tables 3–9.

While the highest rooting in the upper cutting of June was obtained from 2000 and 4000 ppm of IBA with 93%, the highest (93%) rooting in the bottom cuttings of June was obtained from 4000 and 6000 ppm of IBA. When the cuttings were taken in July, the rootings of upper cutting and bottom cutting were highest, in 2000 ppm of IBA with 60 per cent and in 4000 ppm of IBA with 33 per cent respectively. Also, the time of cutting taken affected the average rooting ratios, with 85% in June cuttings and 35% in July cuttings. The average rooting for cuttings types was 65% in upper cuttings and 55% in bottom cuttings (Table-3).

The highest callusing of the upper and bottom cuttings of June were obtained from control (0 ppm) with 26 and 33%, respectively. When cutting taking time was considered, the callusing was 12.92% in June cuttings and 0.83% in July cuttings. The cutting type was not found statistically significant on the callusing ratios as shown in Table-4.

TABLE-3
THE VARIATION ACCORDING TO THE TIME OF CUTTING TAKE, CUTTING TYPE AND IBA DOSES OF ROOTING (%) IN THE GREEN CUTTINGS

The time of cutting take	Upper cutting				Bottom cutting				Average				Average
	2000	4000	6000	Cont.	2000	4000	6000	Cont.	2000	4000	6000	Cont.	
June	93.3	93.3	90.0	66.6	90.0	93.3	93.3	60.0	91.6a	93.3a	91.6a	63.3b	85.0a
July	60.0	40.0	36.6	40.0	30.0	33.3	23.3	23.3	45.0c	36.6c	30.0c	31.6c	35.8b
Average	76.6	66.6	63.3	53.3	60.0	63.3	58.3	41.6					
June	85.83				84.17				68.3a	65.0a	60.8a	47.5b	60.41
July	44.17				27.50								
Average	65.00a				55.83b								

TABLE-4
THE VARIATION ACCORDING TO THE TIME OF CUTTING TAKE, CUTTING TYPE AND IBA DOSES OF CALLUSING (%) IN THE GREEN CUTTINGS

The time of cutting take	Upper cutting				Bottom cutting				Average				Average
	2000	4000	6000	Cont.	2000	4000	6000	Cont.	2000	4000	6000	Cont.	
June	6.6	6.6	6.6	26.6	10.0	6.6	6.6	33.3	8.3b	6.6b	6.6b	30.0a	12.92a
July	0.0	0.0	0.0	3.3	3.3	0.0	0.0	0.0	1.6b	0.0b	0.0b	1.6b	0.83b
Average													
June	11.67				14.17				5.0b	3.3b	3.3b	15.8a	6.87
July	0.83				0.83								
Average	6.25				7.50								

While the highest root number in upper cuttings of June was obtained from 4000 ppm of IBA with 11.57, 2000 ppm of IBA with 12.96 gave the best result for rooting. Besides the highest (21.63) root number in upper cuttings of July was obtained from 6000 ppm of IBA, the highest (11.30) root number in bottom cuttings was determined in 4000 ppm of IBA (Table-5).

The average root length was about 88.44 mm in June cuttings and 40.45 mm in July cuttings (Table-6). The active cutting ratios were determined as 95% in June cuttings, 39% in July cuttings for the time of cutting take. The cutting types were not found statistically significant on the active cutting ratio as shown in Table-7.

While the highest (93%) percentage of cuttings useable for plant production in upper cuttings of June was obtained from 2000 and 4000 ppm of IBA, the same percentage (93%) in the bottom cuttings was determined from 6000 ppm of IBA. The cutting types were not found statistically significant for useable cutting ratio at plant production (Table-8).

TABLE-5
THE VARIATION ACCORDING TO THE TIME OF CUTTING TAKE, CUTTING TYPE AND IBA DOSES OF THE AVERAGE ROOT NUMBER IN THE GREEN CUTTINGS

The time of cutting take	Upper cutting				Bottom cutting				Average				Average
	2000	4000	6000	Cont.	2000	4000	6000	Cont.	2000	4000	6000	Cont.	
June	11.2	11.5	11.0	6.3	12.9	10.3	9.8	6.6	12.0ab	10.9abc	10.4abc	6.4cd	9.98
July	8.8	16.8	21.6	4.4	8.3	11.3	8.2	4.0	8.5bc	4.0a	14.9a	3.2d	10.20
Average	10.0	14.1	16.3	4.4	10.6	10.8	9.0	5.3					
June	10.03				9.93								
July	12.44				7.97				10.3a	12.5a	12.6a	4.8b	10.09
Average	11.23a				8.95b								

TABLE-6
THE VARIATION ACCORDING TO THE TIME OF CUTTING TAKE, CUTTING TYPE AND IBA DOSES OF THE AVERAGE ROOT LENGTH (MM) IN THE GREEN CUTTINGS

The time of cutting take	Upper cutting				Bottom cutting				Average				Average
	2000	4000	6000	Cont.	2000	4000	6000	Cont.	2000	4000	6000	Cont.	
June	74.1	76.4	89.3	71.2	11.0.8	93.0	103.9	88.5	90.00	84.70	94.60	79.10	88.44a
July	50.1	47.8	52.2	32.9	38.0	33.6	28.0	40.6	44.10	40.70	40.10	36.80	44.45b
Average	62.1	62.1	70.8	52.1	74.9	63.3	66.0	64.6					
June	77.79a				97.86a								
July	45.81b				35.11b				67.05	62.74	67.40	58.01	64.44
Average	61.80				66.48								

TABLE-7
THE VARIATION ACCORDING TO THE TIME OF CUTTING TAKE, CUTTING TYPE AND IBA DOSES OF ACTIVE CUTTING RATIO (%) IN THE GREEN CUTTINGS

The time of cutting take	Upper cutting				Bottom cutting				Average				Average
	2000	4000	6000	Cont.	2000	4000	6000	Cont.	2000	4000	6000	Cont.	
June	96.6	93.3	93.3	93.3	93.3	96.6	100.0	93.3	95.0	95.0	96.6	03.3	95.00a
July	60.0	40.0	36.6	43.3	33.3	33.3	33.3	33.3	46.6	36.6	30.0	33.3	39.17b
Average	78.3	66.6	65.0	68.3	63.3	65.0	66.6	63.3					
June	94.17a				96.83a								
July	45.00a				28.33c				70.8	65.8	63.3	63.3	67.08
Average	69.58				62.08								

TABLE-8
THE VARIATION ACCORDING TO THE TIME OF CUTTING TAKE, CUTTING TYPE AND IBA DOSES OF PRACTICAL CUTTING RATIO AT PLANT PRODUCTION (%) IN THE GREEN CUTTINGS

The time of cutting take	Upper cutting				Bottom cutting				Average				Average
	2000	4000	6000	Cont.	2000	4000	6000	Cont.	2000	4000	6000	Cont.	
June	93.3	93.3	83.3	50.0	90.0	86.6	93.3	56.6	91.6	90.0	88.3	53.30	80.83a
July	33.3	33.3	33.3	0.0	16.6	16.6	13.3	3.3	25.0	25.0	23.3	1.67	18.75b
Average	63.3	63.3	58.3	25.0	53.3	51.6	53.3	30.0					
June	80.00				81.67				58.3a	57.5a	58.8a	27.5b	49.79
July	25.00				12.50								
Average	52.50a				47.08								

TABLE-9
THE VARIATION ACCORDING TO THE TIME OF CUTTING TAKE, CUTTING TYPE AND IBA DOSES OF ROOT QUALITY (POINT) IN THE GREEN CUTTINGS

The time of cutting take	Upper cutting				Bottom cutting				Average				Average
	2000	4000	6000	Cont.	2000	4000	6000	Cont.	2000	4000	6000	Cont.	
June	7.64	4.46	3.94	3.22	4.57	4.00	4.46	3.68	6.10	4.18	4.19	3.45	4.48a
July	3.11	3.32	4.00	1.67	2.46	2.59	2.00	2.08	2.79	2.96	3.00	1.88	2.66b
Average	5.38	3.84	3.97	2.44	3.52	3.29	3.23	2.88					
June	4.79				4.18				4.45	3.57	3.59	2.66	3.57
July	3.03				2.28								
Average	3.91				3.23								

The highest root quality in the June cuttings (7.64 point) was determined for upper cutting with 2000 ppm of IBA. The best root quality of bottom cutting was 4.57 (from 2000 ppm). In July cuttings, the best root quality was 4.0 in upper cutting and 2.59 in bottom cutting.

Soft-Wood Cuttings

The values obtained in September are given in Table-10. The highest rooting was obtained from 3000 ppm of IBA with 28%. The average rooting values were 21% in bottom cuttings and 18% in upper cuttings. The average root number was found 1.97 in the upper cuttings and 1.77 in the bottom cuttings. The average root lengths were determined about 2.78 mm in the upper cuttings and 3.14 mm in the bottom cuttings as given in Table-10.

TABLE-10
THC VALUES OBTAINED FROM SOFT-WOOD CUTTINGS OF SEPTEMBER FOR SOME CRITERIA

Hormone doses → / Cutting types ↓	2000	3000	Control	Average
		Rooting (%)*		
Upper cutting	23.33	26.67	6.67	18.89
Bottom cutting	26.67	30.00	6.67	21.11
Average	25.00a	28.33a	6.67b	
		Callusing (%)		
Upper cutting	40.00	46.67	50.00	45.56
Bottom cutting	63.33	56.67	36.67	52.22
Average	51.67	51.67	43.33	
		Root number		
Upper cutting	2.33	2.58	1.00	1.97
Bottom cutting	1.75	2.22	2.49	1.77
Average	2.04	2.40	1.17	
		Root length (mm)		
Upper cutting	3.10	3.43	1.80	2.78
Bottom cutting	3.53	3.40	2.49	3.14
Average	3.32	3.42	2.15	
		Active cutting ratio (%)		
Upper cutting	63.33	60.00	56.67	60.00
Bottom cutting	90.00	86.67	43.33	73.33
Average	76.67	73.33	50.00	

*Values with different letters are statistically significant at the 1% probability level according to the Duncan's multiple range test.

The highest rooting in the green cuttings of Mahaleb SL-64 was obtained from the upper and bottom cuttings of June. The rooting in July cuttings was slightly higher than in June cuttings (Table-3). The best rooting in the green cuttings of temperate-zone fruit species are obtained from early taken cuttings. Generally, the leaves on cuttings affected rooting positively[6, 8-11, 16, 17, 20]. Strydom determined that the leafy cuttings rooted better than the unleafy cuttings in Marianna 2624 plum cultivar. Yilmaz[19], Ryugo, Harada and Nakayama stated that the buds had positive effect on rooting of cuttings. According to Mendilcioğlu[6], the highest rootings were obtained from the green cuttings take in June and July for sweet cherry, sour cherry and plums. On the other hand, Konarli[3] found that June cuttings rooted better than July cuttings, the time of cutting taken in Mahaleb SL-64 rootstock was imported on rooting[3]. The highest rooting values for soft-wood cuttings taken in September were obtained in the bottom cuttings with 3000 ppm IBA (Table-10).

Although the rooting ratio was low in July cuttings, the root number of the upper and bottom cuttings of this month was found higher than others. The average root number were, also similar in the upper cuttings of both months. IBA doses was also found significant which is in agreement with the report carried out by Sharma and Aier[17]. On the other hand, the root number of upper cuttings of September (soft-wood cuttings) was found higher than the bottom cuttings.

Although the highest root lengths of green cuttings were obtained from June cuttings, the bottom of soft-wood cuttings gave the highest root length (Table-6). June cuttings showed higher active cutting ratio in comparison to July cuttings as given in Table-7. Sharma and Aier[17], Howard and Ridout[20] reported that the planning season of cuttings and IBA concentrations was important for rooting and active cutting ratio. June cuttings were also found superior according to July cuttings for usable cutting ratio at plant production.

In conclusion, the cuttings of Mahaleb SL-64 should be taken and planted in June in order to get best rooting and quality rootstock. 2000 ppm of IBA in June upper cuttings and 4000 ppm of IBA in the bottom cuttings are the best concentrations for the rooting.

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