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Short communication

Influence of different physiological stages of cuttings and plant bio-regulators on rooting potential of hazelnut

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Hazelnut locally known as virin belongs to family betulaceae. It. It is deciduous tree or shrub scattered over the temperate regions of northern hemisphere. Its kernels are used for food, eaten raw or in cookery. It is also used in making delicious chocolates. Hazelnut has also a habitat in high reaches of Kashmir. An ample amount of seedling trees can be seen growing in the natural habitate of high reaches of mountainous region of Kashmir. Dachigam Sanctuary of Srinagar and Karnah area in Kupwara also witnessed good variability. *Corylus Jacquemontiii* close relative of *colurna* found in Kashmir. Some promising cultivars introduced in Kashmir long back, but could not be exploited and popularized due to lack of techniques for its multiplication. Therefore in order to register the high value crop for orchard diversityan attempts were made to standardized the technique for mass multiplication.

The experiment was carried out in the Division of Pomology, SKUAST-K, Shalimar, during the years 2006-08. Different propagating materials i.e. apical (terminal), sub-apical, basal and root suckers (having old wood) collected in the month of January as dormant and in April as physiological active shoot (when active growth appears). Suckers in hazelnut emerged very close to main trunk/root, which was removed with help of garden shovel and axe. 15-20cm long shoot cuttings of both types were collected. Propagating material was treated in 2500 and 5000 ppm Iodole butyric acid by quick dip method in Last week of April and planted in trays containing sand media, coarse sand sterilized for 72 hours with formalin solution made up of formaldehyde (40%) and water in ratio of 1:8 (V/V). The cuttings were planted by laying out 2 (shoot condition) x 4(propagating material) x 2 (IBA concentrations.) factorial experiment under randomized block design having 16 treatments and 3 replications. The trays containing treated cuttings were placed under ground cellar locally created by making trench of 2x2x1.5 m where relative humidity and temperature were maintained by covering the trench with UV film fitted on wooden frames The humidity inside the cellar was maintained consistently by spraying water intermittently. The rooted cuttings were taken out from trays in August and planted in poly-bags containing equal proportion of soil, sand and FYM and placed under shade to avoid direct sunlight for hardening. Data regarding length of longest root, per cent rooted cutting, average root length, number of primary roots, root diameter, shoot length and leaf number were recorded at the time of shifting the rooted cuttings in poly bags. The diameters were recorded with Digimatic Caliper. Data were analyzed statistically for interpretation of the results.

It is obvious from the result that physiological stages of cuttings have significant effect on number of cuttings rooted, maximum cuttings rooted (3.96) in physiological active shoot. Average root length (8.36 cm), number of primary root (37.50), shoot length (13.75 cm), leaf number (4.15) and length of longest root (16.75 cm) was recorded in physiologically active cuttings in comparison to dormant cuttings, however, the root diameter was statistically at par in both types of shoots. In contrast Das *et al*. (2) reported highest percentage of cuttings rooted (83.70%) in hard wood than semi hardwood in olive. It may be due to the activeness of hormones which results higher mobilization of nutrients. Gautam and Chauhan (4) and Chesti, (1) also observed a significant interaction of hormonal concentration and planting time/ physiological stage of cuttings. Khabou and Drira (5) noted olive leafy cuttings taken in late winter performed better than collected in any other season.

Significantly maximum cuttings were rooted in suckers (5.08) followed by apical (3.58), however, sub-apical and basal cuttings rooted were statistically at par (Table 1). Similarly average root length was recorded highest (9.50 cm) in sucker which was statistically at par with basal cuttings (9.30), while as the average root length was recorded (4.60cm) in sub- apical but statistically at par with apical cuttings. Length of longest root (16.90cm) was recorded in suckers which were statistically at par with apical cuttings (15.27cm) (Table 1). Better rooting in suckers having old wood and in apical

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Table 1. Main effect of physiological stages of cuttings, type of propagating material and IBA concentrations on rooting potential and subsequent growth of hazelnut cuttings.

Treatment	Cutting rooted	No. of primary roots	Root diameter (mm)	Shoot length (cm)	Leaf number	Length of longest root (cm)	Average root length (cm)
A_1	3.96	37.50	0.90	13.75	4.15	16.75	8.36
A_2	2.83	19.50	0.88	6.55	5.85	7.80	6.08
LSD(0.05)	0.62	3.16	0.12	1.45	0.83	1.78	1.70
B_1	3.58	36.41	0.64	10.38	4.64	15.27	5.51
B_2	2.70	0.91	0.77	10.09	4.50	11.15	4.60
B_3	2.25	8.92	1.25	7.10	5.41	5.75	9.30
B_4	5.08	48.75	0.50	13.03	5.50	16.90	9.50
LSD(0.05)	0.88	4.47	0.17	2.05	1.17	2.51	2.37
C_1	4.12	22.54	0.70	10.55	5.14	14.43	8.72
C_2	2.70	33.45	0.88	9.75	4.86	16.10	5.72
LSD(0.05)	1.24	3.16	0.12	1.45	0.83	1.78	1.70

Where as: $A_{1=}$ Physiological active shoot, $A_{2=}$ Dormant shoot, $B_{1=}$ Apical (terminal) $B_{2=}$ Sub-apical $B_{3=}$ basal shoot, $B_{4=}$ Root suckers.

cuttings might be due to higher reserve food material in suckers and higher concentration of root promoting substances formed in the apical shoots which are translocated to the base of shoot and more available carbohydrates thereby aid in rooting. However, Chesti (1) noted maximum rooting in apical then sub-apical and basal cuttings.

Highest number of cutting rooted (4.12) and number of primary roots (33.45) was highest at 5000 ppm IBA, whereas length of longest root (14.43 cm) and average root length (8.72 cm) was noted in 2500 ppm IBA concentration. Further, shoot length (10.55 cm), leaf number (5.14) were superior in 2500 ppm IBA concentration but was statistically at par with each other. These findings are in conformity with earlier reports that lower concentrations of IBA exhibits a tendency towards increasing root length, while higher concentration improves root number (Gautam, 3).

Physiologically active cuttings of apical type interacted significantly for number of primary roots (59.17) and length of longest root (21.17 cm), however, the cutting rooted was significantly highest than other treatment combinations except A_2B_4 and A_1B_4 which were significantly at par to A_1 B_1 treatment combinations. Shoot length and average root length was superior in A_1B_4 than other treatment combinations. Length of longest root (21.17 cm) was registered in A_1B_1 which was significantly at par with A_1B_4.

Physiological active shoot and IBA had significant effect for cuttings rooted. The active shoot in 2500 ppm IBA recorded highest number of cutting rooted (4.83) followed by (3.41) in dormant cuttings in same IBA concentration. Highest number of primary roots (45.33), shoot length (14.62 cm), length of longest root (18.58 cm) and average root length (10.48 cm) was noted in physiological active shoot at 2500 ppm IBA concentration.

Significantly maximum cuttings rooted (4.83) were observed in apical +2500 ppm IBA concentration which was statistically at par with suckers + 5000 ppm of IBA. However number of primary roots (59.17) was registered in suckers + 2500 ppm IBA concentrations followed by (43.17) in apical shoot and 2500 ppm IBA concentration. So for as length of longest roots were concerned, maximum (20.40 cm) was noted in apical shoot at 2500 ppm IBA which was statistically at par with suckers at 2500 ppm and 5000 ppm IBA concentration. Numbers of primary roots were highest (59.17) in suckers at 5000 ppm IBA which was followed by apical shoot at 2500 ppm IBA. Shoot growth (13.10 cm) was registered in suckers at 5000 ppm which was statistically at par with suckers at 2500 ppm IBA and apical shoot at 2500 ppm IBA. No significant variations in leaf number were observed. Auxins are known to increase the cell division by increasing the level of endogenous cytokinin resulting in the induction of more number of root primodia.

Table 2. Interaction effect of physiological stage of cuttings and type of propagating material.

Treatment	Cutting rooted	No. of primary roots	Root diameter (mm)	Shoot length (cm)	Leaf number	Length of longest root (cm)	Average root length (cm)
A_1B_1	5.30	59.17	0.70	14.13	3.20	21.17	6.25
A_1B_2	3.33	31.17	0.79	15.00	3.33	16.83	4.83
A_1B_3	2.17	11.00	1.52	9.58	5.15	7.50	9.83
A_1B_4	5.00	48.70	0.61	16.28	4.95	21.50	12.53
A_2B_1	1.83	13.70	0.59	6.63	6.12	9.38	4.78
A_2B_2	2.00	8.70	0.76	5.18	6.00	5.50	4.30
A_2B_3	2.33	6.83	0.97	4.61	5.70	4.00	8.78
A_2B_4	5.17	48.83	0.39	9.78	6.00	12.30	6.50
LSD (0.05)	0.89	6.32	0.24	2.90	1.70	3.55	3.35

Table 3. Interaction effect of physiological stages of cuttings and Indole butyric acid on rooting of hazelnut.

Treatment	Cutting rooted	No. of primary roots	Root diameter (mm)	Shoot length (cm)	Leaf number	Length of longest root (cm)	Average root length (cm)
A_1C_1	4.83	45.33	0.74	14.62	4.40	18.56	10.48
A_1C_2	3.08	29.70	1.07	12.87	3.90	14.91	6.25
A_2C_1	3.41	21.75	0.66	6.48	5.88	10.28	7.00
A_2C_2	2.25	17.25	0.69	6.62	5.82	5.29	5.20
LSD (0.05)	0.88	4.47	0.17	2.05	1.17	2.51	2.37

Table 4. Interaction effect of propagating material and IBA concentrations.

Treatment	Cutting rooted	No. of primary roots	Root diameter (mm)	Shoot length (cm)	Leaf number	Length of longest root (cm)	Average root length (cm)
B_1C_1	4.83	43.10	0.51	12.13	5.10	20.40	5.98
B_1C_2	2.33	29.70	0.78	8.60	4.18	10.15	5.05
B_2C_1	3.00	21.50	0.76	9.68	4.70	11.00	4.65
B_2C_2	2.33	18.33	0.79	10.50	4.33	11.30	4.48
B_3C_1	2.70	10.33	1.14	7.43	5.33	7.00	11.29
B_3C_2	1.83	7.50	1.35	6.77	5.48	4.50	7.33
B_4C_1	6.00	38.33	0.41	12.97	5.50	19.33	12.98
B_4C_2	4.20	59.17	0.59	13.10	5.45	14.50	6.01
LSD (0.05)	1.24	6.32	0.24	2.90	1.66	3.55	3.35

Table 5. Interaction effect of physiological stages of cuttings type of propagating material and IBA concentrations.

Treatment	Cutting rooted	No. of primary roots	Root diameter (mm)	Shoot length (cm)	Leaf number	Length of longest root (cm)	Average root length (cm)
$A_1B_1C_1$	7.33	47.66	0.57	17.00	4.00	27.00	6.60
$A_1B_1C_2$	3.33	70.66	0.84	11.27	2.33	15.33	5.90
$A_1B_2C_1$	3.70	33.33	0.73	15.33	3.70	14.70	4.70
$A_1B_2C_2$	3.00	29.00	0.85	9.90	5.00	19.00	5.00
$A_1B_3C_1$	2.33	13.33	1.26	9.30	5.30	9.00	13.00
$A_1B_3C_2$	2.00	8.67	1.79	16.26	4.93	6.00	6.70
$A_1B_4C_1$	6.00	64.00	0.42	16.30	4.96	23.70	17.70
$A_1B_4C_2$	4.00	33.33	0.80	7.30	6.20	19.33	7.40
$A_2B_1C_1$	2.33	15.70	0.46	6.00	6.03	13.80	5.40
$A_2B_1C_2$	1.33	11.70	0.73	4.03	5.70	7.33	4.63
$A_2B_2C_1$	2.33	9.70	0.79	4.03	5.70	7.33	4.63
$A_2B_2C_2$	1.70	7.66	0.73	6.33	5.70	3.60	4.00
$A_2B_3C_1$	3.00	7.33	1.02	4.96	5.70	5.00	9.57
$A_2B_3C_2$	1.70	6.33	0.92	4.30	6.00	3.00	8.00
$A_2B_4C_1$	6.00	54.33	0.39	9.70	6.00	15.00	8.30
$A_2B_4C_2$	4.33	43.33	0.39	9.90	5.93	9.60	4.63
LSD (0.05)	1.76	8.94	0.34	4.10		5.02	4.74

Exogenous application of auxin hastens the process of root initiation.

Significant variation was observed in the physiological stages of cuttings, types of propagating material and Indole butyric acid. Physiological active shoot and apical part at 2500 ppm IBA concentration resulted maximum cuttings rooted (7.33), which was statistically at par with physiological active sucker at same IBA level. Number of primary roots per cutting were noted highest in physiological active and apical cuttings at 5000 ppm IBA. Shoot length and length of longest root were noted highest in physiological active + apical shoot at 2500 ppm IBA, however, leaf number was noted highest in physiological active sucker at 5000 ppm IBA concentration. However, average root length was noted highest (17.70 cm) in physiological active suckers at 2500 ppm IBA concentration.

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