International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 12, 2018, pp.-6445-6448.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

DETERMINATION OF SUITABLE CUTTING SIZE FOR ROOTING OF PEAR CUTTINGS *CV.* PATHARNAKH

NAVPREET KAUR AND AMARJEET KAUR*
Department of Horticulture(Agriculture), Khalsa College, Guru Nanak Dev University, Amritsar, 143001 India
*Corresponding Author: Email- dr.amarjitkaur30@gmail.com

Received: June 17, 2018; Revised: June 22, 2018; Accepted: June 23, 2018; Published: June 30, 2018

Abstract: In the present investigation entitled Determination of suitable cutting size for rooting of pear *cv.* Patharnakh conducted at the nursery of Department of Horticulture, Khalsa College, Amritsar during 2017-2018 an attempt was made to propagate the pear cv. Patharnakh through stem cuttings without any rooting hormonal treatments. The cuttings were selected with three different lengths, *viz.* 20 cm (L_1), 30 cm (L_2), 40 cm (L_3), and 50 cm (L_4) and three types (T_1) apical, (T_2) sub-apical and (T_3) basal. The cuttings were planted in the nursery and observed for days to first sprouting, sprouting and survival percentage, rooting percentage, number of roots, and their fresh and dry weight on 90 days after planting. It is clear from the results that the treatment T_3 and L_4 proved to be the best in terms of minimum days to first sprouting (25.33), maximum sprouting percentage (61.66%), survival percentage (87.67%), rooting percentage (86.66%), number of roots per cutting (5.00), root length (10.50 cm), maximum fresh weight (0.69 g) and dry weight (0.55g) respectively .

Keywords: Pear, Cuttings, Apical, Basal, Sub-apical, Patharnakh, Survival, Rooting, Sprouting

Citation: Navpreet Kaur and Amarjeet Kaur (2018) Determination of Suitable Cutting Size for Rooting of Pear Cuttings *cv.* Patharnakh. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 12, pp.- 6445-6448.

Introduction

Pear is one of the most ancient of cultivated temperate fruit crop in India. The pear spp. belongs to the genus Pyrus, family *Rosaceae* and sub family *Maloideae* [1]. It is undoubtedly one of the most ubiquitous of all the fruits and ranks 2nd next only to apple in the deciduous fruits of the world [2]. The Greek poet 'Homer' giving an insight on early fruit culture praised "Pears as one of the gift of God" [3]. The cultivars of pear mainly belong to three groups, European (*Pyrus communis*), Asian or Oriental pear (*Pyrus pyrifolia*) and their hybrids [4]. The Asian pear Pyrus pyrifolia (BurmNakai) originated in China, where its cultivation dates back to 2500 – 3000 years[5]. Pear is less winter hardy due to which it can be grown in a wide range of climatic conditions, even in the warmer climates of subtropical regions. It can grow under wider temperature conditions ranging from minus 26°C when dormant to as high as 45°C during growth period [2]. Pear fruit is said to be consumed in diets because of low calorific value. It has high nutritional value with reasonable amounts of vitamins A, B, B_2, C and minerals like Na, K, P, Ca, Mg and Fe[6]. It has a lot of fibre which give excellent results in the treatment of constipation, intestine inflammation and reduces the cholesterol in body and there by protects from various heart diseases. It also cures kidney stones and cystitis [7]. Its juice is sometimes used as the first juice introduced to infants [8]. Due to the presence of grit cells in pear fruits regular consumption of it offers protection against colon cancer. It contains a large amount of vitamin C and dietary fibre. Moreover, pear wood is the most preferred material for manufacturing of high quality wood wind instruments, furniture and for making the curved blocks for woodcuts [9]. Pear fruit is eaten fresh and in the form of juice, jam, jelly and in the dried form. Its leaves are used for smoking in Europe when there was no tobacco. Pear is propagated vegetatively [10]. Although Patharnakh pear is propagated through grafting but hard wood cuttings are also used for propagation. The cuttings are prepared during December from juvenile shoots and are kept for callusing for about a month and are planted in the nursery. There is a shortage of true to type planting material of pear. Various factors such as size of cuttings and age of tree affects the rooting of cuttings in pear [11]. Keeping these factors in view the present investigation was therefore carried out to standardize the size of cuttings of pear *cv.* Patharnakh.

Materials and Methods

The present investigation "Determination of suitable cutting size for rooting of pear *cv.* Patharnakh" was carried out in the nursery of Department of Horticulture, Khalsa College, Amritsar during the year 2017-2018.The cuttings were taken from healthy uniform sized branches of pear *cv.* Patharnakh, growing in the nursery of Department of Horticulture, Khalsa College, Amritsar. To determine the optimum length and position of the cuttings for vegetative propagation, a large number of cuttings were collected from 3.5 years old mother plants. After removal of the side branches and leaves the cuttings were made into 20 cm (L_1), 30 cm (L_2), 40 cm (L_3), 50 cm (L_4), T_1 apical, T_2 sub – apical and T_3 basal based on the length the cuttings were graded into small medium and large. The cuttings were planted on the 15 cm high nursery beds of size of 10 x 1 m. The beds were prepared by incorporating a mixture of sand, soil and farmyard manure. While planting about 2/3rd length of the cutting were buried in the soil, leaving 1/3rd part exposed to the environment. The cuttings were planted 20 cm apart with row to row distance of 30 cm. The various observations regarding sprouting percentage, survival percentage, root, shoot and leaf formation were recorded. Field observations were statistically analysed by factorial Randomized Block Design.

Results and Discussion

Days to first sprouting (days)

It is evident from the data that cutting type and the length of pear cuttings significantly affected the days to first sprouting up to a certain limit. The cuttings of length 50 cm (L_4) recorded minimum number of days (30.11) for first sprouting followed by L_3 and L_2 with33.67 and 35.11. Maximum (49.11) days were taken by the cuttings of length L_1 respectively. Among the type of cuttings basal cuttings (T_3) recorded the minimum days (32.00) with the maximum (45.08) in T_1(apical) type of cuttings. Significant interactions between the length and type of cuttings were observed during the analysis of data.

Minimum days to first sprouting (25.33) were recorded in L_4T_3 while the maximum days (51.33) were recorded in L_1T_1. Earliness in sprouting might be due to the fact that there was better utilization of stored carbohydrates, nitrogen and other factors in larger cuttings as compared to smaller cuttings due to higher adventitious ability of juvenile characters. Early sprouting of basal cuttings might be due to the fact that there is a variation in sprouting with respect to age and physiological condition of the mother plant [12].

Table-1 Effect of cutting type and cutting length on number of days to first sprouting of pear cuttings *cv.* Patharnakh

Days to first sprout					
	Cutting length (cm)				
Cutting type	L1	L2	L3	L4	Mean
T1 – Apical	51.33	47.33	44.67	37.00	45.08
T2 -Sub-apical	49.00	29.67	29.00	28.00	33.91
T3- Basal	47.00	28.33	27.33	25.33	32.00
Mean	49.11	35.11	33.67	30.11	
	T	L	TL		
CD (p = 0.05)	1.38	1.59	2.76		

Sprouting percentage (%)

The maximum percentage of sprouting (52.11%) was observed in L_3 while the least (42.22%) was recorded in L_1. Significant interactions between the length and type of cuttings were observed during the analysis of data. Minimum sprouting (26.66%) were recorded in L_1T_2while the maximum (61.66%) was recorded in L_1T_2. It might be due to higher adventitious ability of juvenile characters of larger cuttings as compared to smaller ones which have tender tissues with unsaturated latex and the higher content of metabolites like tannin, lignin etc which adversely lead to better sprouting. Kathiravan, *et al*., (2009) [13] observed that the stem cuttings with 40 cm length and 2.5 to 3.0 cm thickness was found to be very suitable for quicker regeneration. Similar findings were reported by Kaur and Kaur (2016) [14] in pomegranate *cv.* Ganesh. The present results are in consonance with the findings of Tewfik [15] who found that the basal cuttings were better than median and apical ones with respect to survival percentage in nemaguard peach rootstock.

Table-2 Effect of cutting type and length on the sprouting (%) of pear *cv.* Patharnakh

Sprouting (%)					
	Cutting length (cm)				
Cutting type	L1	L2	L3	L4	Mean
T1- Apical	40.00	43.33	54.00	52.66	47.50
T2-Sub-apical	26.66	33.00	40.66	38.33	34.66
T3-Basal	60.00	58.00	61.66	61.33	60.25
Mean	42.22	44.77	52.11	50.77	
	T	L	TL		
CD (p = 0.05)	NS	1.25	NS		

Survival percentage (%)

Among the different lengths the highest survival (80.44%) was recorded in L_4 followed by L_3 and L_2 with 75.22 and 46.55 percent while the lowest survival percentage (30.33 %) was recorded from L_1. Regarding the type of cuttings basal cuttings (T_3) recorded the maximum survival percentage (69.25%) with the minimum (47.33%) in T_1 (apical).According to data significant interactions between the length and type of cuttings were observed regarding survival percentage. Minimum survival percentage (25.00%) were recorded in L_1T_1 while the maximum (87.67%) was recorded in L_4T_3. It is presumed that the medium sized cuttings might have got sufficient food material and hormones leading to more survival. According to [16] hormones have shown to regulate different aspects of growth and development of plant in terms of cell division, elongation and differentiation which leads to formation of great quantity of roots and shoots making great plant and higher plant survival [17] . Henning, (2003) [18] observed that the cuttings of this length are highly amenable for vegetative propagation. Mehta, *et al*., (2016) [19] also stated the maximum survival with cutting size of 25 cm in quince pear. Brar and Khehra, (2017) [20] also reported the same in peach with cutting length of 24 cm. These findings are in agreement with the research work of Thota, *et al*., (2012) [21] on fig propagation *cv.* Poona fig with highest survival (85.25) in basal cutting. Devi, *et al*., (2016) [22] concluded that the hardwood basal cuttings of phalsa showed the highest growth, shoot development characters and percent survival of (63.66 %). The research findings of Kaur and Kaur (2016) [14] in Jatropha and Rafael (2006) [23] reported the same in fig.

Table-3 Effect of cutting type and length on the survival (%) of pear cuttings *cv.* Patharnakh

Stem cutting	Survival percentage %				
	Cutting length (cm)				
	L1	L2	L3	L4	Mean
T1 – Apical	25.00	27.00	64.33	73.00	47.33
T2 – Sub-apical	31.00	44.66	75.00	80.66	57.83
T3 – Basal	35.00	68.00	86.33	87.67	69.25
Mean	30.33	46.55	75.22	80.44	
	T	L	TL		
CD (p= 0.05)	0.90	1.04	1.80		

Rooting percentage (%)

Highest rooting (79.77%) was gained from L_4 followed by L_3, and L_2 with 72.88 and 46.11 percent while the least (42.22%) was in L_1. The basal cuttings generated roots ranging from 67.33 percent which were maximum and the lowest rooting percentage (46.83) was with apical cuttings respectively. Significant interactions between the length and type of cuttings were observed regarding rooting percentage. Maximum rooting percentage (86.66%) were recorded in L_4T_3while the minimum (25.00%) was recorded in L_1T_1. Poor rooting was observed with reduction in size of cuttings. Due to inadequate supply of nutrients in shorter cuttings resulted in poor performance in rooting. Hegde (1996) [24] expressed that this might be due to higher adventitious ability of juvenile characters of larger cutting compared to smaller cuttings which are having tender tissues, with unsaturated latex and the higher content of metabolites like tannin, lignin etc. which adversely interfere with sprouting and root development. Tewfik (2002) [15] reported that the basal cuttings of nemaguard peach rootstock were better than median and apical ones with respect to rooting percentage. The results are in conformity with Koyuncu and Senel 2003) [25] in rooting of black mulberry hardwood cuttings and Dick, *et al*., (2006) [26] in rooting potential of cherry. Reddy, *et al*., (2008) [27] also reported the same in the rooting of hardwood and semi hardwood cuttings of fig. The present results also conform the findings of Kathiravan, *et al*., (2009) [13] in Jatropha.

Table-4 Effect of cutting type and length on the rooting (%) of pear cuttings *cv.* Patharnakh

Rooting (%)					
	Cutting length (cm)				
Cutting type	L1	L2	L3	L4	Mean
T1 – Apical	25.00	26.00	63.66	72.66	46.83
T2 – Sub-apical	29.66	44.66	75.00	80.00	57.33
T3-Basal	35.00	67.66	80.00	86.66	67.33
Mean	29.88	46.11	72.88	79.77	
	T	L	TL		
CD (p = 0.05)	1.55	1.79	3.10		

Number of roots per cutting

Among the length of cuttings, the highest number of primary roots (4.44) were recorded in L_4 followed by L_3 and L_2 with (3.55) and (2.66) roots respectively. It was observed that L_1 had minimum number of roots (1.66) per cutting. It has also been found that basal cuttings produced more roots (3.50) as compared to sub-apical and apical cuttings which registered 3.08 and 2.66 roots respectively. Significant interactions between the length and type of cuttings were observed regarding number of roots per cutting. Maximum roots (5.00) were recorded in L_4T_3 while the minimum (1.33) was recorded in L_1T_1. The poor performance of small grade cuttings is also attributed to the reason that the cuttings are still under maturity and might be devoid of sufficient food material for induction of roots. These findings are in agreement with the research work of [27] in fig and [28] in peach. The results are also similar to Rafael, (2006) [23] and Adelson (2009) [29] in olive, and Kaur and Kaur (2016) [14] in pomegranate *cv.* Ganesh.

Table-5 Effect of cutting type and length on number of roots per cutting of pear *cv.* Patharnakh

Root per cutting					
	Cutting length (cm)				
Cutting type	L1	L2	L3	L4	Mean
T1- Apical	1.33	2.33	3.00	4.00	2.66
T2- Sub-apical	1.66	3.00	3.33	4.33	3.08
T3- Basal	2.00	2.66	4.33	5.00	3.50
Mean	1.66	2.66	3.55	4.44	
	T	L	TL		
CD (p = 0.05)	NS	1.25	NS		

Root length (cm)

Significantly maximum root length (10.22cm) was recorded with L_4 followed by L_3 and L_2 with root length of 9.16 and 8.66cm followed by the least (2.96 cm) in L_1. On the other hand basal cuttings (T_3) generated roots with length of 8.16 cm and least with7.80 cm in apical cuttings. According to analysis of data regarding root length significant interactions between the length and type of cuttings were observed with maximum root length (10.50 cm) were recorded in L_4T_3 while the minimum (2.00 cm) was recorded in L_1T_2. Small sized cuttings showed poor results for root length as compared to medium and longer sized cuttings. A reduction in root length was observed with reduction in cutting size due to inadequate supply of nutrients and leaching of nutrients in shorter cuttings resulted in poor performance in rooting. Endogenous auxin and its oxidation enzyme peroxidase is involved in both root initiation and root elongation. [24] expressed that this might be due to higher adventitious ability of juvenile characters of larger cutting compared to smaller cuttings which are having tender tissues, with unsaturated latex and the higher content of metabolites like tannin, lignin etc. which adversely interfere with root development. Sharma, (1999) [17] observed maximum rooting, root number and root length in semi-hardwood and hardwood basal cuttings of pomegranate. Present analysis is in accordance with Singh, *et al*., (2009) [30] in pomegranate, Al Samaraee, (2010) [31] in LawsoniainermisL. and Owais, (2010) [32] in pomegranate.

Table-6 Effect of cutting type and length on root length (cm) of pear cuttings *cv.* Patharnakh

Root length (cm)					
	Cutting length (cm)				
	L1	L2	L3	L4	Mean
T1 – Apical	2.23	8.83	9.83	10.33	7.80
T2 – Sub-apical	2.00	8.66	8.66	9.83	7.29
T3 – Basal	4.66	8.50	9.00	10.50	8.16
Mean	2.96	8.66	9.16	10.22	
	T	L	TL		
CD (p=0.05)	NS	NS	1.19		

Fresh weight of roots (g)

The apical cuttings produced lower fresh weight of roots (0.35 g) as compared to basal cuttings (0.86 g) which was the maximum. Results of these findings are confirmed by De oliveira *et al*., (2003) [33] in peach, Koyuncu and Senel, (2003) [25] in black mulberry. The poor performance of small grade cuttings is also attributed to the reason that the cuttings are still under maturity and might be devoid of sufficient food material for induction of roots. Also, the shoots formed have reserve carbohydrates which start producing auxins which moves downward thereby accumulating in the lower portion of the cuttings.

Table-7 Effect of cutting type and length on the fresh weight (g) of roots of pear cuttings *cv.* Patharnakh

Fresh weight of roots (g)					
	Cutting length (cm)				
Cutting type	L1	L2	L3	L4	Mean
T1- Apical	0.17	0.30	0.40	0.53	0.35
T2- Sub – apical	0.63	0.70	0.80	0.68	0.70
T3- Basal	0.77	0.83	0.87	0.96	0.86
Mean	0.52	0.61	0.69	0.72	
	T	L	TL		
CD (p = 0.05)	NS	NS	NS		

When the concentration reaches a threshold value, endogenous auxins at the extreme basal and start getting metabolized and signal the process of root initiation leading to good weight of roots Kochhar *et al*., (2005) [34].

Dry weight of roots (g)

The maximum dry weight (0.55g) was recorded in L_4 followed by L_3 and L_2 with 0.47g and 0.41 g of dry weight. These treatments were at par with each other. Interaction between the length and type of cuttings regarding dry weight of roots were found to be non-significant. The present results are in accordance with findings of Devi, *et al*., (2016) [22] in fig *cv.* Poona. Increase in dry weight of roots might be due to the fact that the increase in the root number and length of roots resulted in higher accumulation of dry matter. Results are in agreement with the findings of Kathiravan, *et al*., (2009) [13] in Jatropha and Tewfik (2002) [15] in nemaguard peach rootstock.

Table-8 Effect of cutting type and length on dry weight (g) of roots of pear *cv.* Patharnakh

Dry weight of root (g)					
	Cutting length (cm)				
Cutting type	L1	L2	L3	L4	Mean
T1 – Apical	0.07	0.13	0.23	0.36	0.20
T2 – Sub – apical	0.46	0.50	0.53	0.54	0.51
T3 – Basal	0.59	0.60	0.66	0.74	0.65
Mean	0.37	0.41	0.47	0.55	
		T	L	TL	
CD (p=0.05)		NS	NS	NS	

Conclusion

The present study concluded that the macro propagation of pear *cv.* Patharnakh basal stem cuttings with length 50 cm was found to be the most efficacious in generating higher survival encouraging rooting parameters and invigorating the shoots leading to good shoot number, diameter, fresh and dry weight of shoots. It also aided to the good leaf production. Hence this study implies that the basal stem cuttings develop uniform plant stock for successful pear cultivation in one planting season.

Application of research: This research is applicable where cultivation of pea is commercial basis to get good yield of quality.

Research Category: Horticulture

Abbreviations: T- Treatment; L- Length; *cv.*- Cultivar; cm- centimetres ; g- grams; %- Percentage; CD- Critical difference.

Acknowledgement / Funding: Author thankful to Khalsa College, Guru Nanak Dev University, Amritsar, 143001 India

***Principle Investigator or Chairperson of research: Dr Amarjeet Kaur**
University: Guru Nanak Dev University, Amritsar, 143001 India
Research project name or number: MSc Thesis

Author Contributions: All author equally contributed

Author statement: All authors read, reviewed, agree and approved the final manuscript

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

References

[1] Dhillon W.S. (2013) Narendra publishing house, New Delhi-110006(India).
[2] Chadha K.L. (2001) ICAR, New Delhi.

[3] Ayn U.Q., Beigh M.A., Mir M.A. and Parveen S. (2014) Environment science ISSN- 2249-555X.
[4] Rehman H.U., Gill M.S., Sidhu G.S. and Dhaliwal S. (2014) *J. of Exp Bio and Agri. Sci.,* 2,188-96.
[5] Singh G., Hussain S. and Bashir D. (2016) *An Int Quart J of life Sci.*,11, 1171-77.
[6] Baniwal P. and Hathan B.S. (2017) *Asian J of chem*., 29, 805-809.
[7] Silva G.J., Souza T.M., Barbieri R.L. and de oliveira A.C. (2014) Adv inAgri:8.
[8] Vadivel V. and Janardhanan K. (2005) *Pl food Hum Nutr*., 2, 69-75.
[9] Mohammad M.U., Kamba A.S., Abubakar L. and Bagna E.A. (2010) *African J of F Sci and Tech*., 1, 76-81.
[10] Gill P.P.S. and Singh N.P. (2014) *The Asian J of Hort*., 9, 301-04.
[11] Tworkoski T. and Takeda F. (2007 *Sci Hort*.,115,98-100.
[12] Chandramouli H. (2001) *M.Sc (Agri) Thesis, Univ of Agri Sci, Bangalore*
[13] Kathiravan M., Ponnuswamy A.S. and Vanitha C. (2009) *Nat Pro Rad* 8, 162-66.
[14] Kaur S. and Kaur A. (2016) *Biol Forum.,* 8,203-06.
[15] Tewfik A.A. (2002) *Effect of IBA Acta Hort*., 592, 169-75.
[16] Davis P.J. (1996) *Kluwer Dordrecht.*
[17] Sharma S. (1999) M.Sc. Thesis GNDU Amritsar.
[18] Henning R. (2003) *Project Zambia, Mazabuka* 13, 37.
[19] Mehta N.S., Bhatt S.S., Kumar J., Kotiyal A. and Dimri D.C. (2016) *Hort Flora Res Spec*., 5,242-45.
[20] Brar J.S. and Khehra S. (2017) *Int J of curr microbiol and App Sci*., 8, 1449-53.
[21] Thota S., Madhavi K. and Vani V.S. (2012) *Int J of Trop Agri*., 32, 89-94.
[22] Devi J., Bakshi P., Wali V.K., Kour K. and Sharma N. (2016) *The Bioscan*, 11, 535-37.
[23] Rafael E. (2006) *Cienc.Agrotec*, 30,1021-26.
[24] Hegde S.S. (1996) *M.Sc. (Agri) Thesis submitted to Univ of Agri Sci, Bangalore.*
[25] Koyuncu F. and Senel E. (2003) *J of fruit and ornament plant Res*.,11,53-57.
[26] Dick McP J. and Leakey R.R.B. (2006) *J of Hort Sci and Biotech*, 81, 296-302.
[27] Reddy R.K.V., Reddy C.P. and Goud P.V. (2008) *Indian J Agric Res* 42, 75-78.
[28] Shukla H.S., Tripathi V.K., Awasthi A.K. (2010) *Int J of Appl Agri Res* 5, 467.
[29] Adelson F.D. (2009) *Cienc. Agrotech*., 33, 79-85
[30] Singh B., Singh S. and Singh G. (2009) *Acta Hort.,* 890.
[31] Al Samaraee S.M.S. (2010) *J Agri Sci*., 23,73-79.
[32] Owais S.J. (2010) *Pak J of Bio Sci.,*13, 51-58.
[33] De oliveira A.P., Nienow A.Y., Calvete A. and De oliveira E. (2003) *Rev Bras Frutic*., 25,282-85.
[34] Kochhar S., Kochhar V.K., Singh S.P., Katiyar R.S. and Pushpangadan P. (2005) *Curr Sci*., 89, 936-39.