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Effect of rooting hormones in propagation of dahlia (*Dahlia variabilis* L.) through stem cutting

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Abstract
A study on the impact of auxins (IBA and NAA) on two cultivars of dahlia (*Dahlia variabilis* L.) was conducted at Department of Floriculture and Landscape Architecture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), during the year 2019-20. The study revealed that among the two cultivars (Kenya Blue and Kenya Yellow) experimented, the highest rooting percentage was recorded in the cultivar Kenya Blue (62.46%) which was significantly higher than the rest one. Similar tendency of superiority was observed for survival percentage, number of roots per cutting and root length, wherein the cultivar Kenya Blue took the least number of days for root initiation (18.11 days). As for the different concentration of auxins used, IBA at the rate of 1000 ppm resulted in the maximum rooting percentage (69.82%) as compared to the rest of the treatments. Similar tendency of superiority was observed for number of roots per cutting and root length, wherein IBA at the rate of 250 ppm + NAA at the rate of 250 ppm took the least number of days for root initiation (17.21 days). The highest survival percentage was recorded with treatment of NAA at the rate of 500 ppm (63.96%) followed by NAA at the rate of 1000 ppm (56.39%).

Keywords: dahlia, cultivar, auxin, IBA, NAA, rooting percentage, root length

Introduction
Dahlia (*Dahlia variabilis* L.) belongs to the family Asteraceae and has originated in mountainous areas of Mexico and Central America. The Dahlia flowers have great variations in shape, size, colour, prolific growing habit and easy to cultivate. Dahlias are good for garden display, exhibition, plantings for edging or for growing in beds. Dahlia plants reproduce sexually by seed and vegetatively through tuberous roots. The most widely used methods for its propagation are via cuttings or tuberous root division, however, the most commonly used is the commercial form by cuttings. The main advantages of propagation by cuttings are the relative simplicity of the operations, the low unit cost of production, and the ease with which plants will reestablish themselves. Therefore, this method of propagation is highly practical and economically important. (Wei-June Lu, 1958) [10]. Exogenous application of auxin enhances the rooting efficiency and quality of stem cuttings, while indole-3 butyric acid (IBA) and naphthalene acetic acid (NAA) and its derivative naphthalene acetamide (NAd) are the materials in most common use for rooting of cuttings. The promoting effect of IBA on rooting is mainly due to its conversion to IAA in plant tissue (Epstein and Lavee, 1984) [2]. Auxins like IBA, IAA and naphthalene acetic acid NAA were found to promote rooting in Virginia creeper (Taleb *et al.*, 2012) [9]. Hence the present study was designed to investigate the response of auxin (IBA and NAA) applied on stem cuttings of two cultivar of dahlia, for root induction.

Material and Method
The experiment was carried out at Horticultural Research cum Instructional Farm, Department of Floriculture and Landscape Architecture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), during 2019-20, to study the effect of rooting hormones in propagation of dahlia (*dahlia variabilis* l.) through stem cutting. In the experiment, 8-9 cm long stem cuttings of two dahlia cultivar *viz*. Kenya Blue and Kenya Yellow were treated with two auxins, namely, IBA and NAA, each at 250, 500 and 1000 ppm individually and their combinations each at 125, 250 and 500 ppm, along with control (distilled water), were used. The experiment was laid out in Factorial Completely Randomized Design, with three replications. The basal portion of cuttings was dipped in the respective auxins for a few seconds while the Control was dipped in distilled water. Treated cuttings were planted in planted in portrays having 9×11 cells. Cells of portray were filled well with an equal amount of coco peat sand and vermiculite. Single cutting was planted in a single cell of portray. Temperature was maintained at 18-25 °C, and relative humidity at 80-85% within the mist chamber.

The rooting substrate was treated with 0.2% Bavistin to control fungal infection. Observations were recorded on different root characteristics of the cuttings at 50 days from planting. The cuttings were picked randomly and days from planting to formation of root initials were treated as days required for root initiation. Rooting percentage was determined by counting the number of rooted cuttings per replication and dividing this by the total number of cuttings per replication. For number of roots per cutting, all the roots originating from the cuttings were counted and the total number of roots was divided by the total number of rooted cuttings. All roots produced per replication were collected and their length was measured; the sum of the length was divided by the total number of cuttings to calculate average root length and data obtained from the study was analyzed statistically.

Result and Discussions

Days required for root initiation

Application of auxins improved the rooting efficiency of dahlia cuttings over the control and cultivar Kenya Blue were found to be better than Kenya Yellow for root attributes (Table 1 and Fig. 1). Auxin treatment significantly reduced time-to rooting and early rooting was recorded with IBA @ 250 ppm + NAA @ 250 (17.21 days), at par with treatment application of NAA @ 500 ppm (17.83 days) and IBA @ 500 ppm + NAA @ 500 ppm (17.98 days) over the control (24.66 days). With regards to dahlia cultivar, Kenya Blue resulted in earliest rooting (18.11 days) compared to the Kenya Yellow (21.81 days). Interaction between auxins cultivars were found to be non-significant and minimum days (15.99 days) for rooting were recorded in interaction of mutants of Kenya Blue with IBA @ 250 ppm + NAA @ 250 ppm. It has been reported that auxin existence is necessary for induction of the root starter cells (Hartmann *et al.*, 2002) [4]. The decrease in time taken to root initiation may be attributed to the fact that application of exogenous growth regulators might have supplemented endogenous auxin levels and brought about certain anatomical and physiological changes in the cuttings leading to early root initiation. Similar findings have been reported Bharathy *et al*. (2004) [1] in carnation.

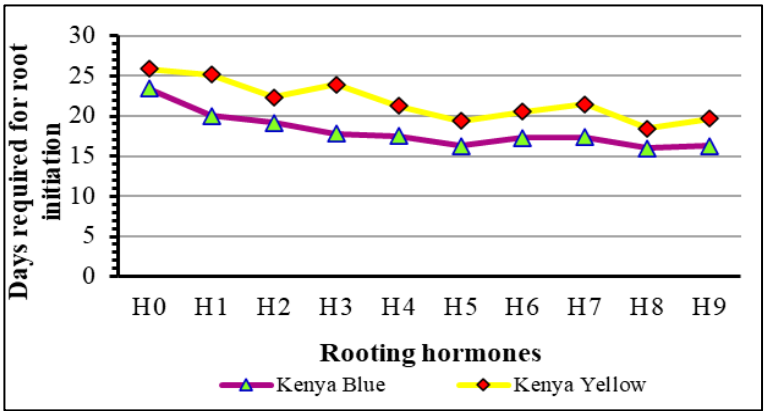

Fig 1: Effect of rooting hormones on days required for root initiation in dahlia cultivar

Table 1: Effect of rooting hormones on days required for root initiation in dahlia cultivars

Cultivar / Rooting Hormones	Days required for root initiation		
	Kenya Blue	Kenya Yellow	Mean
Control	23.40	25.91	24.66
IBA @ 250 ppm	20.03	25.14	22.58
IBA @ 500 ppm	19.17	22.38	20.77
IBA @ 1000 ppm	17.79	23.90	20.85
NAA @ 250 ppm	17.54	21.24	19.39
NAA @ 500 ppm	16.28	19.39	17.83
NAA @ 1000 ppm	17.32	20.53	18.92
IBA @ 125 ppm + NAA @ 125 ppm	17.34	21.47	19.40
IBA @ 250 ppm + NAA @ 250 ppm	15.99	18.44	17.21
IBA @ 500 ppm + NAA @ 500 ppm	16.29	19.68	17.98
Mean	18.11	21.81	
	CD at 5%	S.Em±	
Rooting hormone	1.142	0.400	
Cultivar	0.511	0.179	
Rooting hormone × Cultivar	NS	0.565	

Rooting percentage

Data presented in Table 2 and Fig. 2 showed that rooting percentage was significantly affected by auxin and different cultivar. high rate of rooting (69.82%) was recorded in IBA @ 1000 ppm, at par with NAA @ 500 ppm (69.03%), whereas, control resulted lowest rooting percentage (36.02%) followed by IBA @ 125 ppm + NAA @ 125 ppm (58.03%). As respect to cultivars, Kenya Blue resulted significantly higher percentage of rooting (62.46%) over Kenya Yellow (61.37%). Interaction between NAA @ 500 ppm and Kenya Blue recorded significantly highest rooting percentage (73.85%), at par with treatment combination of IBA @ 500 ppm + NAA @ 500 ppm and Kenya Blue i.e. 72.15%. However, lowest rooting percentage (32.03%) recorded in Kenya Blue in control. The rooting hormones increases the overall percentage of rooting, facilitate initiation of adventitious roots and enhance the number and quality of adventitious roots (Dirr and Heuser, 2006) [2]. Similar result found by Prince *et al*. (2017) [7] and Kumar *et al*. (2014) [5] in carnation.

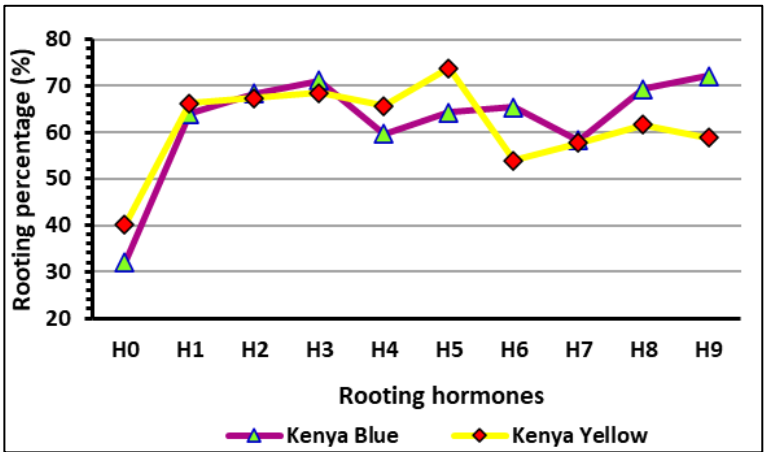

Fig 2: Effect of rooting hormones on rooting percentage in dahlia mutant

Table 2: Effect of rooting hormones on rooting percentage in dahlia cultivars

Rooting Hormones \ Cultivar	Rooting percentage (%)		
	Kenya Blue	Kenya Yellow	Mean
Control	32.03	40.01	36.02
IBA @ 250 ppm	63.93	66.20	65.07
IBA @ 500 ppm	68.37	67.37	67.87
IBA @ 1000 ppm	71.16	68.47	69.82
NAA @ 250 ppm	59.70	65.64	62.67
NAA @ 500 ppm	64.22	73.85	69.03
NAA @ 1000 ppm	65.37	53.94	59.66
IBA @ 125 ppm + NAA @ 125 ppm	58.29	57.77	58.03
IBA @ 250 ppm + NAA @ 250 ppm	69.38	61.65	65.51
IBA @ 500 ppm + NAA @ 500 ppm	72.15	58.78	65.46
Mean	62.46	61.37	
	CD at 5%	S.Em±	
Rooting hormone	1.374	0.481	
Cultivar	0.615	0.215	
Rooting hormone × Cultivar	1.943	0.680	

Number of roots per cutting

There was a significant effect of auxins and cultivars on number of roots per cutting (Table 3 and Fig. 3). Maximum number of roots per cutting (22.74) was recorded in plants treated with IBA @ 1000 ppm and NAA @ 500 ppm, at par with IBA @ 500 ppm (22.67). Among the cultivar, Kenya Blue gave significantly maximum number of roots cutting^{-1} (20.33) compared to the Kenya Yellow (16.76). Interaction effect also showed significant results in respect to number of roots per cutting and the maximum number of roots per cutting (26.12) observed in interaction of NAA @ 500 ppm and Kenya Blue, at par with IBA @ 1000 ppm treatment in same Kenya Blue (25.13). Minimum number of roots per cutting (8.94) recorded in controlled plants of Kenya Blue. The more number of roots obtained with the application of growth chemicals clearly reflects that they not only initiate rooting but also help in subsequent rapid growth of roots in numerical strength. The effect of auxins has been reported to enhance rooting through the translocation of carbohydrates and other nutrients to the rooting zone (Middleton, 1980) [6].

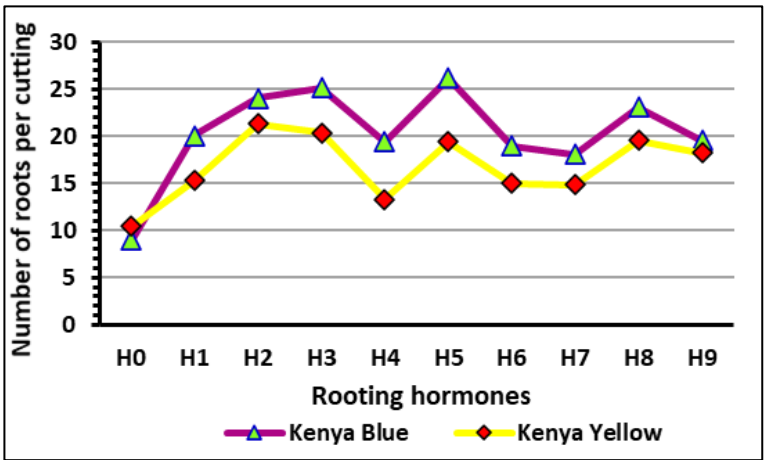

Fig 3: Effect of rooting hormones on number of roots per cutting in dahlia cultivar

Table 3: Effect of rooting hormones on number of roots per cutting in dahlia cultivars

Cultivar / Rooting Hormones	Number of roots per cutting		
	Kenya Blue	Kenya Yellow	Mean
Control	8.94	10.44	9.69
IBA @ 250 ppm	20.02	15.25	17.64
IBA @ 500 ppm	24.03	21.32	22.67
IBA @ 1000 ppm	25.13	20.35	22.74
NAA @ 250 ppm	19.39	13.26	16.32
NAA @ 500 ppm	26.12	19.36	22.74
NAA @ 1000 ppm	18.93	14.99	16.96
IBA @ 125 ppm + NAA @ 125 ppm	18.08	14.84	16.46
IBA @ 250 ppm + NAA @ 250 ppm	23.09	19.53	21.31
IBA @ 500 ppm + NAA @ 500 ppm	19.56	18.22	18.89
Mean	20.33	16.76	
	CD at 5%	S.Em±	
Rooting hormone	0.766	0.268	
Cultivar	0.342	0.120	
Rooting hormone × Cultivar	1.083	0.379	

Root length

The data (Table 4 and Fig. 4) clearly indicated that different doses of rooting hormones, dahlia cultivar and their interactions significantly influenced root length. Longest root length (5.57 cm) was observed in treated with IBA @ 500 ppm at par with IBA @ 1000 ppm (5.56 cm), whereas, poorest root length (2.53 cm) were significantly recorded in untreated plants. As respect to dahlia cultivars, Kenya Blue resulted significantly longer root length (4.16 cm) over Kenya Yellow (3.96 cm). Kenya Blue treated with dose IBA @ 500 ppm recorded significantly longest root length (6.16 cm) at par with interaction of treatment dose IBA @ 1000 ppm with same dahlia cultivar (5.86 cm), whereas, untreated plants of Kenya Yellow noted lowest (2.15 cm) root length. There was increase in root length with treatment of higher doses of IBA, similar results found in hardwood cuttings of hibiscus and mussaenda pink when treated with the IBA reported by Shiva and Nair 2009.

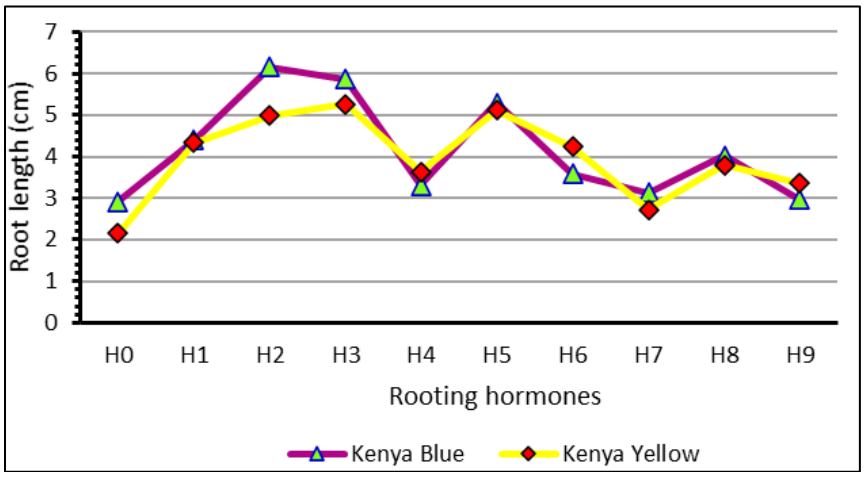

Fig 4: Effect of rooting hormones on root length in dahlia cultivars

Table 4: Effect of rooting hormones on root length in dahlia cultivars

Cultivar / Rooting Hormones	Root length (cm)		
	Kenya Blue	Kenya Yellow	Mean
Control	2.91	2.15	2.53
IBA @ 250 ppm	4.40	4.34	4.37
IBA @ 500 ppm	6.16	4.98	5.57
IBA @ 1000 ppm	5.86	5.26	5.56
NAA @ 250 ppm	3.31	3.64	3.47
NAA @ 500 ppm	5.29	5.11	5.20
NAA @ 1000 ppm	3.58	4.24	3.91
IBA @ 125 ppm + NAA @ 125 ppm	3.13	2.73	2.93
IBA @ 250 ppm + NAA @ 250 ppm	4.02	3.79	3.90
IBA @ 500 ppm + NAA @ 500 ppm	2.96	3.35	3.15
Mean	4.16	3.96	
	CD at 5%	S.Em±	
Rooting hormone	0.236	0.083	
Cultivar	0.106	0.037	
Rooting hormone × Cultivar	0.334	0.117	

Conclusion

From the above, it can be concluded that auxin and cultivars significantly affected rooting parameters in dahlia cuttings. Kenya Blue is better than Kenya Yellow in all studied parameters. IBA was found more efficient in rooting percentage, number of roots per cutting and root length whereas earliest rooting recorded in combination of both IBA and NAA.

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