Studies on effect of IBA concentrations and planting times on propagation of rose (*Rosa hybrid* Vill.) through semi-hardwood cuttings

ABSTRACT

The conventional method of rose propagation involves budding on one year old field established rootstock plants. For multiplication of plants, cutting is the simplest way of propagation of desirable rose varieties. There are relatively few varieties that develop roots, so exogenous application of growth promoters is essential. In order to study the effects of different concentrations of IBA (0, 500, 1000 and 1500 ppm) on rooting of different varieties (English Holiday, Eiffel Tower, Don Don, Confetti and Iceberg) of rose, during planting times viz., February, July, October and December. It was found that 500 ppm IBA resulted in maximum number of roots (15.66), number of leaves (22.33), the percentage of survival (50%), shoot length (13.23 cm), fresh weight of roots (4.80 g) and stem (5.93 g), dry weight of roots (4.36 g) and stem (4.33 g) and took minimum days (13.00) for leaf bud initiation,whereas,themaximum root length (7.80 cm) was found in 1000 ppm IBA and control treatment had the lowest effect on the different traits of rooting in rose cutting. Among different varieties, Eiffel Tower was found to be best in terms of different traits, whereas, variety English Holiday and Confetti didn't respond to any of the planting times and treatments. Cuttings planted in February showed the highest effect on their evaluated traits with a significant difference with those planted in July and October, whereas in December planting time, zero survival rateswas observed.

Key words: IBA, Planting time, Propagation, Rose, Semi-hardwood cuttings

Introduction

Rose belongs to the family Rosaceae, genus *Rosa*, ranks first among the top ten cut flowers. It is called 'Queen of Flowers' (Muhammad *et al* 1996) having its value in landscape gardening, as an ornamental plant, medicinal plant, food and wide range of adaptability to habitats (Winther*et al* 2005). Propagation of roses by stem cuttings is the most common and easy method among various vegetative methods (Anderson and Woods, 1999). Various factors like growth media, moisture, age, season, nutrient status and portion of the branch used affect the growth rate and establishment of cuttings.Different plant processes like growth (e.g. root growth, ageing and promotion of stem elongation etc.) and development (e.g. rooting of cutting, flowering, prevention or colour enhancement of fruit etc.) are influenced by the use of different plant growth regulators (Hobbie, 1998).The root development speed in cuttings depends on the type of cuttings, the rooting medium and concentration of hormones used.IBA is very much helpful in promoting root-initiation as well as adventitious root production in different types of cutting (Waisel*et al* 1991).The adventitious roots which appear from callus first are the main roots for cuttings. Callus formed on the cuttings after

planting contains a high amount of auxins (Hartman *et al* 2002). Rooting ability of different types of cutting depend on the hereditary factors in the stem cells and other factors include the total carbohydrate reservoir within the cuttings, leaves and buds on the cuttings, auxin level, stem location, stage of plant growth and type of tissue in the cutting (Rosier *et al* 2006). In the North Indian conditions, T- budding is done in December-March and plants become saleable in October–November, almost after two year of planting the rootstock. This method is laborious and expensive as plants need to be taken care for two years and lot of space is required for their propagation. Development of plant cuttings is the easy way of propagation of required varieties. Therefore the present investigations had been done to study the propagation of rose varieties through semi-hardwood cuttings.

MATERIALS AND METHODS

The present studies were carried out at Landscape Nursery, Punjab Agricultural University, Ludhiana during the year 2015-2016. The semi hardwood cuttings of pencil thickness of rose cultivars viz., English Holiday, Eiffel Tower, Don Don, Confetti and Iceberg will be planted in different planting time i.e. February, July, October and December and treated with 0, 500,1000 and1500 ppm IBA for rooting in sand in polycarbonate house. The cuttings were prepared by giving slant cut on the upper end and a straight cut on lower end to distinguish both ends while planting. The experiment was laid in FactorialCompletely Randomized Design (FCRD) and arrangement with three replicates of each treatment. Different observation were recorded as root length (cm), shoot length (cm), number of roots/ cutting, number of leaves, fresh weight of roots (g), dry weight of roots (g), fresh weight of stem (g), dry weight of stem (g), number of days taken to bud emergence and survival percentage/mortality recorded at two months interval.

RESULTS AND DISCUSSION

The perusal of data presented in Table 1 indicated significant differences between the four treatments with respect to root length. Maximum root length i.e. 3.41 cm was observed, when the cuttings were dipped in IBA 1000 ppm solution, which was significantly more than the other treatments, whereas, the lowest root length (0.35 cm) was observed in the control. Among different planting time, the maximum root length (3.30 cm) was observed when the cuttings were planted

during February and minimum i.e. 0.21 cm was observed during July. Variety Eiffel Tower showed maximum root length i.e. 2.50 cm as compare to variety Iceberg and Don Don that showed 1.84 cm and 0.85 cm root length, respectively. The interaction between treatments x varieties x planting time were significant. Among interaction maximum root length i.e. 7.80 cm was found when the cuttings of Eiffel Tower variety were dipped in IBA 500 ppm during February. Root length was maximum in IBA @ 1000 ppm that may be due to the fact that IBA helps in mobilization of reserve food materials, elongation of meristematic cells and differentiation of cambial initials into root primordial (Younis and Riaz, 2005). Similar finding has been observed by Dawa*et al* (2017) and Yeshiwas*et al* (2015) in Rose. Maximum root length was recorded in variety Eiffel Tower and minimum in Don Don. Differences in root length among varieties may be attributed to genetic compositions and carbohydrate content of cuttings. The cuttings of Eiffel Tower might have higher amount of internal stored carbohydrates and other root promoting factors as compared to other two varieties, which resulted in the maximum root length. Planting time had significant effect on root length. The cutting planted during February showed the maximum root length. It may be associated with the adequate heat and radiation for propagation in February. Similar results were reported by Khajehpour*et al* (2014) in Rose. They observed that the spring season showed the highest effect on their evaluated traits with significant differences with those planted in winter.

The treatment of cuttings with growth regulator i.e. IBA had significant effect on shoot length (Table 1). The mean shoot length was maximum (5.12 cm)in IBA 500 ppm and minimum (0.99 cm) in the control. Among different varieties, maximum shoot length was observed in Eiffel Tower (4.71 cm), followed by Iceberg (2.93 cm) and Don Don (1.47 cm). Among different planting time, maximum shoot length i.e. 5.52 cm was found when the cuttings were planted during February followed by October (2.66 cm) and July (0.66 cm). The interaction with respect to shoot length was significant among the varieties, planting time and treatments. Maximum shoot length (13.23 cm) was observed when Eiffel Tower variety cuttings were dipped in IBA @ 500 ppm and planted during February month. Maximum shoot length was found when the cuttings were treated with IBA 500 ppm and planted during February. Similar results have been reported by Abbas *et al* (2006) in *Rosa damascena* and *R. centifolia*, when the cuttings were planted during spring season and treated with

IBA 500 ppm. The increase in shoot length with IBA application may be due to the better utilization of carbohydrates, nitrogen and other nutrients, which are important for growth.

The treatment of different varieties of rose cuttings with different conc. of IBA planted during four different planting times had significant effect on number of roots per cutting (Table 1). The mean number of roots was maximum in IBA 500 ppm (4.74) and minimum in control (0.33), irrespective of the varieties and planting times. The difference among varieties was significant, however, the maximum was in Eiffel Tower (3.69), followed by Ice berg (1.91) and Don Don (0.80). Among different planting time, maximum number of roots (4.12) was observed during February.

Susaj*et al* (2012) reported that maximum rooting percentage and maximum number of roots was recorded by using IBA 500 ppm for both cultivars i.e. ChristopherColombus and VayVicend. Similar results were reported by Akhtar *et al* (2015) in *Rosa centifoilia*. Higher conc. of IBA inhibited the root formation by promoting higher level of degradative metabolites (Baker and Wetzstein, 2004). Haq*et al* (2009) reported inhibitory effect of higher concentration of IBA on root growth. February planting time resulted in maximum number of roots in present investigation. Ibrahim *et al* (1991) used 500 and 1000 ppm of IBA and reported that the cutting taken in March from plant resulted in better rooting than those in late summer and early autumn.

The treatment of cuttings with growth regulators had a significant effect on fresh weight of roots per cutting(Table 2). The mean fresh weight of root was the maximum in IBA 500 ppm (2.36 g) and minimum in the control (0.56 g), irrespective of the varieties and planting time. The difference among varieties was significant, however, the maximum was observed in Eiffel Tower (2.37 g), followed by Iceberg (1.65) and Don Don (0.48), irrespective of the IBA treatment and planting time. The interaction between treatments × planting time x varieties, $T_2 \times P_1 \times V_1$ exhibited significant effects on fresh weight of root. The interaction effect of IBA treatments x planting time x varieties, $T_2 \times P_1 \times V_1$ recorded maximum fresh weight (4.80 g) in Eiffel Tower variety treated with IBA 500 ppm and planted during February. The minimum dry weight of shoot was recorded in $T_1 \times P_2 \times V_2$ i.e. when cuttings of Don Don variety were treated with tap water and planted during July.

Due to production of more number and healthier roots in cuttings treated with IBA 500 ppm, the absorption of water and nutrients from medium was more resulting in enhanced growth adding to

increased weight of roots. Renuka and Sekhar in 2014 recorded maximum fresh weight of roots in cutting of carnation treated with 200 ppm of IBA. Fresh weight of root of olive was influenced by planting time as more fresh weight was recorded in spring than in winter (Khajehpour*et al* 2014).

The observation regarding the effect of treatments i.e. IBA and planting time on dry weight of roots of rose varieties (Table 2). Among three varieties, four treatments and three planting time, the difference was significant and variety Eiffel Tower showed maximum (1.81 g) dry weight of roots followed by Iceberg and Don Don. Among different IBA treatment, 500 ppm showed maximum (1.96 g) dry weight of roots as compared to the control (0.36 g). Among interaction, maximum (4.36 g) dry weight of roots was observed in Eiffel Tower variety planted during February and dipped in IBA 500 ppm. All treatments were significantly better than the control with respect to dry weight of roots.

Khajehpour*et al* (2014) reported that cuttings rooted in spring season had the highest root dry weight, which can be related to hot environment and transpiration of the leaves and resulted in increase in mineral content in the plant part particularly in the leaves.

The perusal of data presented in Table 2 showed the significant effect of treatments, planting time and varieties on the fresh weight of shoot. Maximum fresh weight of shoot (3.21 g) was obtained in T_2 i.e. 500 ppm 0f IBA significantly higher over all other treatments. Whereas, the minimum dry weight (1.10 g) was recorded in T_1i.e. when plants were treated with tap water. As regard the effect of planting time, maximum fresh weight (3.51 g) was recorded in P_1, when the cuttings were planted during February and found to be significantly better with respect of two planting time. However, the minimum dry weight (0.98 g) was recorded in P_2 i.e. when cuttings were planted during July. The interaction between treatment×planting time × varieties exhibited significant effect on fresh weight of shoot. The interaction effect of IBA treatments x planting time x varieties recorded maximum fresh weight (5.93 g) of shoot was recorded in $T_2 \times P_1 \times V_1$, when the cuttings of Eiffel Tower variety were treated with IBA 500 ppm and planted during February. As mentioned earlier the best results in most of the parameters were observed when the cuttings were treated with IBA 500 ppm during February. This may be due to favourable temperature (about 35 ^{0}C) prevailed in the propagation house that increases the growth and development so that low conc. of hormone was enough for good growth of

cutting. This shows that for good effect of IBA, temperature of green house also plays important role. Thus the maximum fresh weight of shoot was recorded in 500 ppm of IBA. This finding is in agreement with finding of Taghvaei*et al* (2012).

The perusal of data presented in Table 2 indicated the significant effect of treatment, planting time and varieties on shoot dry weight. The maximum dry weight (2.54 g) was obtained in T_2 i.e. 500 ppm of IBA and found to be significantly higher over all other treatments. As regards the effect of planting time, the maximum dry weight (2.42 g) was recorded in P_1 i.e. when cuttings were planted during February and found to be significant with respect of two planting time. However, the minimum dry weight (0.55 g) was recorded in P_2 i.e. when cuttings were planted during July. The interaction between treatments × planting time x varieties exhibited significant effects on dry weight of shoot. The interaction effect of IBA treatments x planting time x varieties recorded maximum dry weight (4.33 g) of shoot in$T_2 \times P_1 \times V_1$i.e. when cuttings of Eiffel Tower variety were treated with IBA 500 ppm and planted during February. These results of dry weight increase in shoots are in close conformity with the work of Akhatr*et al* (2015), reports that 450 ppm IBA was effective for producing maximum shoot length, shoot dry weight, number of roots and root dry weight.

The treatment of cuttings with IBA had significant effect on number of leaves per cutting (Table 3). The mean number of leaves was maximum in IBA 500 ppm (9.00) and minimum in the control (1.55), which was at par with IBA 1500 ppm, irrespective of the varieties and planting time. The difference were significant among the varieties with maximum in Eiffel Tower (7.06), followed by Iceberg (4.02) and Don Don (2.30), irrespective of IBA treatment and planting times. Among the planting time, the maximum number of leaves (8.77) was found in the cuttings planted during February. Among the interaction, maximum number of leaves (22.33) was observed when the cuttings of Eiffel Tower variety were treated with IBA 500 ppm and planted during the month of February. More is the number of roots; more will be the number of shoots and hence more will be the leaves. It has been reported that morphogenesis is the main function of cytokinin (Muller and Leyser, 2011). As one of the main well known function of roots is synthesis of cytokinin and therefore more leaves were correlated with more number of roots. Increase in leaf number may be due the positive effect of IBA 500 ppm on inducing vigorous root system thus, enabling cuttings to absorb more nutrients and more

number of leaves as observed by Stancato et al (2003). The present findings are in confirmation with the earlier finding of Singh (2000) who reported that in *Bougainvillea peruviana* cv. Shubra, the treatment of cuttings with IBA (500 ppm) resulted in maximum number of shoots per cutting (1.37).

Number of days taken to leaf bud emergence was significantly affected with IBA application, different varieties and planting times (Table 3). Minimum number of days (14.40) taken to leaf bud emergence was observed, when the cuttings were dipped in 500 ppm of IBA, indicating effectiveness of low concentration of IBA on leaf bud emergence, whereas maximum days (23.07) was found in control. Similar results were reported by Hussain and Khan (2004). Eiffel Tower showed early leaf bud emergence (18.38 days) followed by Don Don and Iceberg. When cuttings were planted during February, minimum days were taken for leaf bud emergence and maximum during July planting time. However among interaction, results obtained were non-significant.

Among different planting time, maximum survival percentage i.e. 23.61 % was observed when cuttings were planted during February and minimum i.e. 8.6 % were observed during July (Table 3). The difference among varieties had significant effect and maximum survival was found in variety Eiffel Tower i.e. 23.33 % whereas, minimum i.e. 11.38 % was found in variety Don Don.

Among different treatments, maximum survival percentage i.e. 30.00 % was observed when cuttings were dipped in IBA 500ppm solution, whereas, minimum survival i.e. 7.77 % was observed in the control. The interaction between treatments × planting time × varieties exhibited non-significant effect on survival percentage. Among the interaction, maximum survival 50 % was found when cutting of Eiffel Tower were dipped in solution of IBA 500 ppm during February. Renuka and Sekhar (2014) studied the effect of IBA and NAA on rooting of carnation (*Dianthus caryophyllus* L.) cuttings of cv. Dona. Singh (2000) reported in *Bougainvillea peruviana* cv. Shubra, the treatment of cuttings with IBA (500ppm) resulted in significantly more establishment of plant (51.67%) than all the other treatments, irrespective of duration (12,24 h) of treatment and method of planting.

Conclusion

The results of this study showed that the application of IBA hormone using semi-hardwood stem cuttings significantly affect the rooting capacity and shoot characters of rose cuttings. Among tested IBA concentrations, stem cuttings that received 500 ppm IBA showed better rooting capacity

and shoot system under February, planting time, whereas, maximum root length was recorded in IBA 1000 ppm. Cuttings treated with tap water showed the least root and shoot performance. Eiffel Tower, variety showed the best results among all the varieties. Among four planting time, February month reported to be best in all the traits.

Table 1: Effect of IBA treatments and planting times on root length, shoot length and number of roots/cutting in different varieties of rose.

IBA Treatments / Planting Time		Root length (cm)				Shoot length (cm)				No. of roots/ cuttings			
		T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
P_1	V_1	1.36	5.06	7.80	2.63	2.16	13.23	11.23	5.83	0.66	15.66	3.33	2.66
	V_2	0.00	3.60	5.50	1.16	1.33	4.04	5.36	2.36	0.00	4.66	3.00	2.00
	V_3	0.66	4.06	6.00	1.80	2.00	8.26	6.80	3.46	0.66	10.00	3.66	2.00
P_2	V_1	0.16	0.80	1.30	0.30	0.40	2.20	1.00	0.66	0.33	2.33	1.66	0.66
	V_2	0.00	0.00	0.00	0.00	0.00	0.76	0.40	0.16	0.00	0.00	0.00	0.00
	V_3	0.00	0.00	0.00	0.00	0.00	1.06	0.83	0.50	0.00	0.00	0.00	0.00
P_3	V_1	0.56	3.33	5.20	1.46	1.73	8.03	6.63	3.43	1.33	6.66	7.00	2.00
	V_2	0.00	0.00	0.00	0.00	0.50	1.20	0.70	0.63	0.00	0.00	0.00	0.00
	V_3	0.40	3.13	4.90	1.20	0.80	7.33	2.80	1.36	0.33	3.33	1.66	1.00
Mean T		0.35^d	2.22^b	3.41^a	0.95^c	0.99^d	5.12^a	3.97^b	2.06^c	0.37^d	4.74^a	2.25^b	1.18^c
Mean V		$V_1=2.5^a$	$V_2=0.85^c$	$V_3=1.84^b$		$V_1=4.71^a$	$V_2=1.47^c$	$V_3=2.93^b$		$V_1=3.69^a$	$V_2=0.80^c$	$V_3=1.91^b$	
Mean P		$P_1=3.30^a$	$P_2=0.21^c$	$P_3=1.68^b$		$P_1=5.52^a$	$P_1=5.52^a$	$P_3=2.66^b$		$P_1=4.02^a$	$P_2=0.41^c$	$P_3=1.92^b$	

The different letters in each column are significantly different at $P \leq 0.05$ by Duncan's multiple range test (DMRT).

Treatments:
T_1: IBA 0 ppm (Control)
T_2: IBA 500 ppm
T_3: IBA 1000 ppm
T_4: IBA 1500 ppm

Varieties:
V_1: Eiffel Tower
V_2: Don Don**P_2:** July
V_3: Iceberg

Planting time:
P_1: February

P_3: October

Table 2: Effect of IBA treatments and planting times on fresh weight of root, dry weight of root, fresh weight of shoot and dry weight of shoot in different varieties of rose.

IBA Treatments / Planting Time		Fresh weight of roots (g)				Dry weight of roots (g)				fresh weight of shoot (g)				Dry weight of Shoot (g)			
		T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
P_1	V_1	1.80	4.80	4.10	2.50	1.23	4.36	3.26	1.70	2.20	5.93	4.26	3.10	1.56	4.33	3.30	2.36
	V_2	0.00	2.43	1.80	1.63	0.00	1.63	1.13	1.03	1.16	3.20	2.46	2.63	0.70	2.36	1.60	2.06
	V_3	0.50	4.10	3.66	1.46	0.36	3.56	3.23	1.03	1.96	4.60	3.96	2.36	1.40	4.23	3.53	1.70
P_2	V_1	0.23	1.40	1.23	0.90	0.13	0.62	0.50	0.86	0.30	3.10	2.60	1.53	1.10	2.03	1.66	1.06
	V_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.43	0.36	0.00	0.40	0.13	0.10
	V_3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.93	0.70	0.00	0.50	0.46	0.30
P_3	V_1	1.46	4.36	3.93	1.80	0.93	3.97	3.23	1.60	1.83	3.86	4.20	2.70	1.23	4.33	3.56	2.16
	V_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.03	2.2	1.56	1.10	0.50	1.43	1.06	0.46
	V_3	1.06	4.20	3.50	1.33	0.62	3.50	3.13	0.86	1.46	4.10	3.86	2.26	0.93	3.40	3.43	1.86
Mean T		0.56^{d}	2.36^{a}	2.02^{b}	1.07^{c}	0.36^{d}	1.96^{a}	1.61^{b}	0.72^{c}	1.10^{d}	3.21^{a}	2.70^{b}	1.86^{c}	0.70^{d}	2.54^{a}	2.08^{b}	1.34^{c}
Mean V		V_1 2.37^{a}	V_2 0.48^{c}	V_3 1.65^{b}		V_1 1.81^{a}	V_2 0.31^{c}	V_3 1.36^{b}		V_1 2.97^{a}	V_2 1.40^{c}	V_3 2.28^{b}		V_1 2.31^{a}	V_2 0.89^{c}	V_3 1.80^{b}	
Mean P		P_1 2.40^{a}	P_2 0.31^{c}	P_3 1.80^{b}		P_1 1.88^{a}	P_2 0.13^{c}	P_3 1.48^{b}		P_1 3.15^{a}	P_2 0.98^{c}	P_3 2.51^{b}		P_1 2.42^{a}	P_2 0.55^{c}	P_3 2.03^{b}	

The different letters in each column are significantly different at $P \leq 0.05$ by Duncan's multiple range test (DMRT).

Treatments:
T_1: IBA 0 ppm (Control)
T_2: IBA 500 ppm
T_3: IBA 1000 ppm
T_4: IBA 1500 ppm

Varieties:
V_1: Eiffel Tower
V_2: Don Don**P_2:** July
V_3: Iceberg

Planting time:
P_1: February

P_3: October

Table 3: Effect of IBA treatments and planting times on number of leaves, days taken to leaf bud emergence and survival percentage in different varieties of rose.

Treatments / Planting Time		Number of leaves				Days taken to leaf bud emergence				Survival percentage (%)			
		T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
P_1	V_1	6.33	22.33	13.33	7.00	21.33	13.00	15.33	19.00	20.00	50.00	30.00	26.66
	V_2	2.00	8.66	6.00	3.66	23.33	13.33	16.66	20.66	6.66	33.33	16.66	10.00
	V_3	3.00	18.00	10.00	5.00	22.33	13.66	15.66	19.33	10.00	40.00	23.33	16.66
P_2	V_1	0.66	4.06	2.00	1.00	24.33	17.00	18.66	21.32	6.66	20.00	16.66	10.00
	V_2	0.00	1.00	3.33	0.33	25.00	15.00	18.00	22.33	0.00	10.00	6.66	3.33
	V_3	0.00	2.00	0.00	0.00	23.33	16.00	17.66	20.32	0.00	13.33	10.00	6.66
P_3	V_1	1.00	17.00	8.00	2.00	21.66	13.33	16.00	19.66	16.66	43.33	20.00	20.00
	V_2	0.33	3.00	1.33	1.00	23.66	13.66	17.00	17.00	3.33	26.66	13.33	6.66
	V_3	0.66	5.00	2.00	1.00	22.66	14.66	16.32	20.33	6.66	33.33	20.22	16.66
Mean T		1.55^c	9.00^a	4.88^b	2.40^c	23.07^a	14.40^d	16.8^c	20.44^b	7.77^d	30.00^a	17.40^b	12.86^c
Mean V		$V_1=7.06^a$	$V_2=2.30^c$	$V_3=4.02^b$		$V_1=18.38^c$	$V_2=18.52^b$	$V_3=19.13^a$		$V_1=23.33^a$	$V_2=11.38^c$	$V_3=16.38^b$	
Mean P		$P_1=8.77^a$	$P_2=1.03^c$	$P_3=3.58^b$		$P_1=17.80^c$	$P2=19.91^a$	$P_3=18.32^b$		$P_1=23.61^a$	$P_2=8.6^c$	$P_3=16.38^b$	

The different letters in each column are significantly different at $P \leq 0.05$ by Duncan's multiple range test (DMRT).

Treatments:
T_1: IBA 0 ppm (Control)
T_2: IBA 500 ppm
T_3: IBA 1000 ppm
T_4: IBA 1500 ppm

Varieties:
V_1: Eiffel Tower
V_2: Don Don**P_2:** July
V_3: Iceberg

Planting time:
P_1: February
P_3: October

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