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Studies on the Vegetative Propagation of Korean Ginseng (*Panax ginseng* C. A. Meyer)

Ⅱ. Effects of Synthetic Auxins on the Rooting and the Root Growth after Rooting from Ginseng Stem Cutting.

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高麗人蔘의 營養繁殖에 관한 硏究

第 2 報 合成 Auxin의 處理가 人蔘莖挿穗의 發根 및 發根後 根의 生長에 미치는 影響

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ABSTRACT

To define the effects of synthetic auxins on rooting from the ginseng stem cutting and the root growth in diameter after the rooting of the cuttings, stem cuttings with palmate leaves obtained from seedlings and 2-year old ginseng plants were planted in rooting media treated with solutions of the synthetic auxins. All the roots induced from the cuttings were adventitious fibrous roots at first, but a few adventitious roots of the cutting were thickened in diameter to over 2 to 3mm at 120 days after cutting and the rest of them disappeared. IBA was the most effective auxin for rooting and root growth in diameter after rooting from the cuttings. The shape of the roots that thickened in diameter could be divided into two types. Both types of thickened roots were fully lignified at 120 days after cutting and those thickened roots did not dry up or die by July of the next year, however no rhyzomes or shoot primodia were induced from them.

INTRODUCTION

Since M.K. Grushvtchkaya[1] et al of the CCCP discovered the initiation of callus and adventitious roots from the cut surface of a ginseng stem cutting without the treatment of any plant growth hormone, J.Jo[2)3)] defined that rooting from the cut surface of a ginseng stem cutting was significantly stimulated by NAA and a mixture of sand and leaf compost was an excellent media for good rooting as well as for root growth after rooting but all the roots formed from the cutting were adventitious roots. With adventitious roots, successive plant growth in the next year is impossible because the adventitious roots can not lay up the nutrients necessary for the ginseng plant winter over and rhizomes cannot be induced from them. In a provious study on the effects of the NAA on the rooting of ginseng stem cuttings J.Jo found that a few of the adventitious roots thickened to a diameter of over 3.0mm and that the rest of them disappeared when the leaflets of the ginseng stem cuttings were dropped in autumn.

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The present study was conducted to define the effects of synthetic auxins on rooting from the ginseng stem cutting and the root growth in diameter after the rooting of the cuttings.

MATERIALS AND METHODS

The stem cuttings were taken from ginseng seedling grown for 70 to 80 days when stem length was about 5cm and the leaflets were fully expanded. Stem and petiole cuttings were also taken from 2-year old ginseng plants which were grown for 70 to 80 days after transplanting the ginseng seedlings. The rooting medium used in this cutting experiment was a mixture of field soil, leaf compost and sand in a ratio of 6:3:1, and the containers were small plastic pot, 10cm in diameter and 10cm in height. The stem cuttings taken from seedlings were 3cm in length with 3 seedling leaflets, and the stem and the petiole cuttings from 2-year old ginseng plants were 5cm in length with 2 palmate leaves and 4cm in length with one palmate leaf respectively. The cuttings were planted in the rooting medium at a depth of 2cm and irrigated with a solution of auxins. The kinds of auxins and their concentrations treated in this experiment were NAA 0.5, NAA 1.0, NAA 2.0, IBA 0.5, IBA 1.0, IBA 2.0 and 2.4-D 1.0ml/l. After irrigation, the upper parts of cuttings were covered with a transferant polyethylene film cap to depress transpiration from the leaflets. The rooting percentage and root growth after rooting were observed 120 days after the planting of the cuttings.

RESULTS AND DISCUSSION

In the previous studies on the vegetative propagation of Korean ginseng I[3] found that naphthalene acetic acid had an excellent effect on the rooting of the stem cuttings as well as the leaf petiole cuttings of the ginseng plants and that all the roots formed from the cuttings were adventitious roots. This experiment was conducted to define the most effective auxin and its concentration for the rooting of ginseng stem cuttings and petiole cuttings and the root growth after rooting of the cuttings.

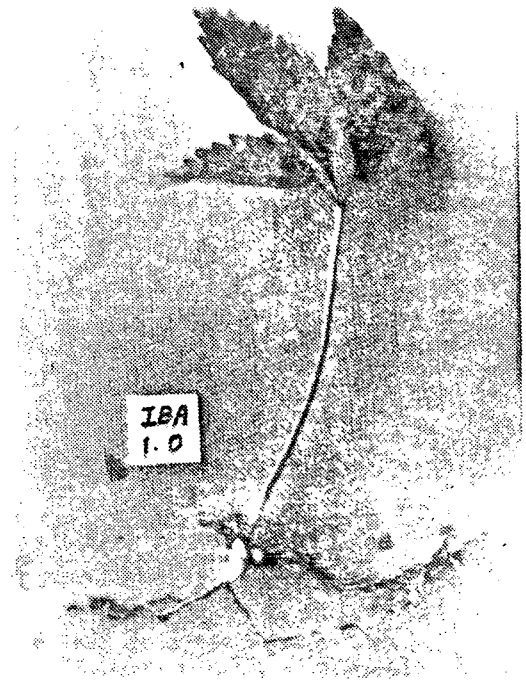

Plate 1. A few adventitious roots induced from the ginseng stem cutting thickened to a diameter of over 3.0mm and were fully lignified at 120 days after planting. Those thickened roots did not dry up or die by July of next year, however no shoot primodia were induced from them.

In this experiment, all the roots induced from the cuttings were adventitious fibrous roots at first, but a few adventitious roots of some cuttings were thickened in diameter to over 2 or 3mm at 120 days after cutting and their tissues were lignified, but the rest of the adventitious roots disappeared.. Indole butylic acid(IBA) was more effective than NAA or 2.4-D for rooting the ginseng stem cuttings or petiole cuttings and for root thickening after rooting. When 0.5 to 2.0 ppm IBA solutions were used to irrigate the cutting media after planting the cuttings, 80 to 85% of the cuttings showed root thickening of over 2.0mm and 38 to 67% of cuttings showed root thickening of over 3.0mm in diameter. In this experiment, treatment of 2.0 ppm IBA

Table 1. Percentage of the cuttings forming roots that thickened to a diameter of over 2.0mm and 3.0mm at 120 days after cutting

Diameter of roots	NAA(ml/ℓ) 0.5	1.0	2.0	IBA(ml/ℓ) 0.5	1.0	2.0	2.4-D(ml/ℓ) 1.0	Control
Over 2.0mm	68	77	70	83	80	85	76	66
Over 3.0mm	24	15	19	38	43	67	18	16

Table 2. Number of roots that thickened to a diameter of over 2.0mm at 120 days after cutting

Age of stock plants	NAA(ml/ℓ) 0.5	1.0	2.0	IBA(ml/ℓ) 0.5	1.0	2.0	2.4-D(ml/ℓ) 1.0	Control
Seedling	3.43	2.86	3.60	3.13	3.27	3.27	3.65	3.55
2 year-old	3.00	3.89	4.11	5.06	5.17	5.64	4.22	4.25
Average	3.27	3.44	3.52	4.10	4.22	4.46		
Mean of level		3.41			4.26		3.85	3.84

Table 3. Average diameter of the roots that thickened to a diameter of over 2.0mm at 120 days after after cutting

Age of stock plants	NAA(ml/ℓ) 0.5	1.0	2.0	IBA(ml/ℓ) 0.5	1.0	2.0	2.4-D(ml/ℓ) 1.0	Control
Seedling	3.26	2.40	2.82	2.94	3.11	3.22	2.70	2.90
2 year-old	2.33	2.72	2.61	3.46	2.85	3.86	2.38	2.71
Average	2.80	2.56	2.72	3.20	2.98	3.59		
Mean of level		2.69			3.26		2.54	2.82

Table 4. Average weight of roots that thickened to a diameter of over 2.0mm at 120 days after cutting

Age of stock plants	NAA(ml/ℓ) 0.5	11.0	2.0	IBA(ml/ℓ) 0.5	1.0	2.0	2.4-D(ml/ℓ) 1.0	Control
Seedling	0.083	0.089	0.057	0.081	0.121	0.109	0.106	0.068
2 year-old	0.078	0.091	0.164	0.177	0.146	0.198	0.140	0.121
Average	0.081	0.090	0.112	0.145	0.136	0.164		
Mean of level		0.094			0.148		0.123	0.095

was the most effective for rooting and root growth after rooting.

When seedlings were used as stock plants for the cuttings, there were no significant differences in the number of roots thickened in diameter over 2.0mm among the different treatments of auxins and their concentration, and the number of roots that thickened to a diameter of over 2.0mm was 3.35 on the average. However, when 2-year old ginseng plants were used as the stock plants, the number of roots that thickened in diameter showed significant differences among the different treatments of auxins. The number of thickened roots from the cutting treated with IBA was about 5.3 and from those treated with NAA was about 3.7 on the average.

The average diameter of the thickened roots from the cuttings treated with an IBA solution was 3.26mm, a significant increased compared with those of the control group.

But, there was no difference in the diameter of the thickened roots of the cuttings treated with NAA and 2.4-D compared with those of the control group. The fresh weight of the thickened roots from

the cuttings treated with IBA was 0.148 gr. per cutting on the average, which was singnficantly heavier than those treated with NAA, 2.4-D or the control group.

When ginseng seedlings were used as the stock plants for the cuttings, a treatment of 1.0mm IBA solution was more effective for root thickening growth after rooting than a treatment of 0.5 or even 2.0 ppm IBA solution. However, when 2-year old ginseng plants were used as the stock plants, a treatment of 2.0 ppm IBA solution was significantly more effective in increasing root weight when compared with lower levels of IBA and NAA or the 2.4-D treatment.

The shape of the roots that thickened in diameter could be divided into two types. One was small, round-shaped roots having long thin lignified root at the distal portion of the small round root with 4 to 5 small, round-shaped roots making a cluster around the basal portion of stem cuttings where the callus was induced just before rooting. The other was normal seedling root-like shape. Both type of thickened roots were fully lignified at 120 days after cutting. In October, the leaflets of the cutting were shed but the thickened roots of the cuttings did not dry up or die by July of the next year, however no rhizomes were formed on the thickened roots of stem cuttings, until May of the next year. Grushvtchkaya[1] and Jo[3] had reported that the roots formed from stem cuttings were adventitious roots and that rhizomes were not induced. However in this experiment, a few of the adventitious roots induced from the cuttings were thickened in diameter and lignified without forming rhizomes or new shoot primodia. The fact that the lignified thickened roots which formed on the ginseng cutting survived until July of the next year suggests the possibility of the vegetative propagation of ginseng by stem or petiole cutting, but the problem to be solved is to define how to induce the rhizomes and new shoot primodia from the thickened roots from the cuttings.

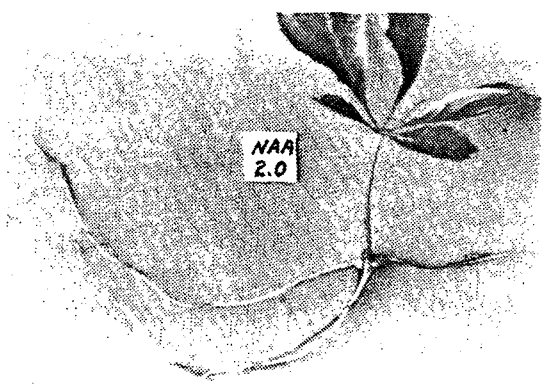

Plate 2. Small, round-shaped roots having long thin lignified tail were formed from the leaf *petiol cutting of 2-Year old ginseng plant.* Small round-shaped roots made a cluster around the basal portion of the cutting where the callus were induced just before rooting

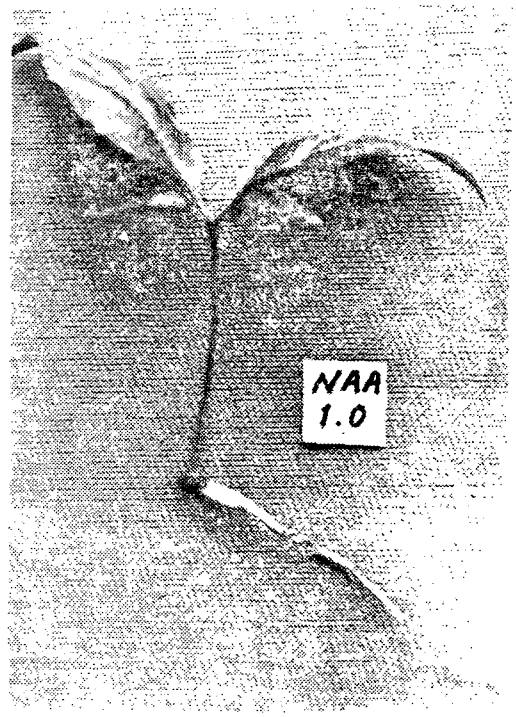

Plate 3. Seedling root-shaped root of about 5cm long and 3.5mm in diameter was formed the stem cutting of 2-Year old ginseng plant at 120 day after planting

摘　　要

본 實驗은 人蔘莖의 挿木時 發根 및 發根後 根의 肥大生長에 미치는 合成 Auxin의 效果를 究明하고저

苗蔘 및 2年生 人蔘의 莖挿後 NAA, IBA를 각각 0.5, 1.0 및 2.0 ppM 그리고 2.4-D는 1.0ppM을 處理하였다. 莖挿後 發根된 根은 初期에는 모두 半透明의 수염 뿌리였으나 莖挿 120일 後에 調査하였던바 이들 수염 뿌리中 3~4개는 肥大하여 本質化되었고, 나머지는 없어졌다. IBA가 發根 및 發根後의 根肥大 生長에 가장 效果的이었던바 IBA 2.0 ppM 處理區에서는 85%의 挿穗가 2.0㎜ 以上의 肥大根을 形成하였으며 67%의 挿穗는 3.0㎜ 以上의 肥大根을 形成하였다. 이들 本質化된 肥大根은 種子根과 類似한 形態를 보이는 것과 callus 모양의 求形根 3~4개가 서로 癒着된 두 가지의 形態였으며 翌年 7月까지도 根은 乾燥되거나 죽지 않았던 反面 腦頭도 形成되지 않았다.

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