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# *In Vitro* Effects of Gibberellic Acid on Morphogenesis of Potato Explant

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## ABSTRACT

The effect of three treatments of Gibberellic acid (GA3) - 0.100 mg $L^{-1}$, 0.248 mg $L^{-1}$ and 0.500 mg $L^{-1}$ and a control 0 mg $L^{-1}$ was studied on the morphogenesis of explants of potato (*Solanum tuberosum* L.) cv. Desiree. Data were recorded for root length (cm), roots plantlet$^{-1}$, days to root initiation, plantlet height (cm) and leaves plantlet$^{-1}$. The dosage of 0.248 mg $l^{-1}$ of $GA_3$ boosted all the characters over control and other treatments. This dosage could be used as standard dose for micro propagation of potato.

**Key Words:** Gilleberellic acid; Morphogenesis; Potato

## INTRODUCTION

Potato (*Solanum tuberosum* L.) is a major world food crop, belongs to family Solanaceae. It is vegetatively grown crop and almost no dish is complete without it. The produce in Pakistan is far below than in developed countries. One of the reasons is low quality of seed. Pakistan meets only 4% of its seed requirements and rest rely on low quality and infected seed.

Plant tissue culture especially micropropagation, nowadays used as standard methodology for production of disease free (virus free) seed potatoes. *In vitro* plants are grown on defined medium and growth of explant is dependant upon the right combination of growth regulators. The medium on which the plant cells or organ are cultured is known as culture or nutrient medium. The nutrient medium contains inorganic salts, trace elements, certain vitamins, a carbon source (generally sucrose) and, where needed growth regulators (Rahbar, 1996). The control of plant growth and differentiation through the use of chemical substances is a modern development.

The recent advancement in tissue culture and the flexibility of organ development in potato allows for alternative methods of propagation through *in vitro* techniques. In many countries these techniques have boosted first multiplication steps in seed production programs by using *in vitro* plantlets, microtubers (Bizarri & Ranalli, 1995) or minitubers (Hussey & Stacey, 1981).

A number of substances are now known that have a relatively broad spectrum effects such as Gibberellic acid ($GA_3$), whose primary morphological effects are associated with cell enlargement and cell division, because it is a very potent hormone, whose morphological effects are associated with cell enlargement and cell division. GAs stimulated development of nodal cutting on MS but at high concentrations it produced narrow and elongated shoots (Novak *et al*., 1980) depending on genotypes. Since $GA_3$ regulates growth, application of very low concentrations can have a profound effect. The purpose of this project is to record *in vitro* effect of different concentrations of $GA_3$ on morphogenesis of potato explant.

## MATERIALS AND METHODS

The experiment was conducted at tissue culture laboratory, Potato Research Centre (PRC) Abbottabad during the year 2002.

**Plant material.** Plant material consists of a widely cultivated variety of potato "Desiree".

**Nutrient medium.** The growth and differentiation of explant is dependant primarily on the culture medium. Murashige and Skoog medium "MS" (Hartmann & Kester, 1968) with different concentrations of $GA_3$ were used in this experiment.

**Gibberellic acid treatments.** Four treatments of Gibberellic acid (GA3) were administered in this experiment- T1 (0 mg $l^{-1}$), T2 (0.1 mg $l^{-1}$), T3 (0.248 mg $l^{-1}$) and T4 (0.5 mg $l^{-1}$). Each treatment had three replications.

**Parameters for study.** All the observations were completed after 30 days of culturing except number of days to root initiation. For each treatment three observations were recorded on number of days to root initiation, plantlet height (cm), number of leaves plantlet$^{-1}$, root length (cm) and number of roots plantlet$^{-1}$. For the comparison of means LSD test was applied.

## RESULTS AND DISCUSSION

*In vitro* effects of different concentrations of Gibberellic Acid ($GA_3$) on morphogenesis of potato explants were studied.

**Number of days to root initiation.** Statistical calculations show that T1 and T2 are non-significantly different from T4, while T3 is significantly different from T1, T2 and T4. Control took 7.33 days to root initiation as compared to other treatments. Dosage of 0.248 mg $L^{-1}$ $GA_3$ concentration decreased days to root initiation (4.667) by > 36%, followed by T2 and T4, which is > 18% as compared to control. The early initiation of roots directly affects shoot growth, root length and latter on leaves plantlet$^{-1}$.

**Plantlet height.** The effect of all treatments on plantlet height is significantly different from each other. The plantlet having 9.133 cm height was produced with the dosage of 0.248 mg $L^{-1}$ $GA_3$, which is > 86% higher as compared to control. Two treatments T4 and T2 also increased the plantlet height by > 61 and 44%, respectively. It indicates that a moderate dose of $GA_3$ is effective for shoot growth. The present results are in agreement with earlier observation of Al-momani *et al*. (1999). Novak *et al.* (1980) reported that when the medium is normally supplemented with $GA_3$, with low concentrations of other growth regulators like KIN, BA and Indole Acetic Acid may be beneficial to shoot growth and multiple shoot formation. Simko (1990) reported variability in root growth was generally higher than in shoot growth. Webb *et al*. (1983) reported that the addition of hormones and GA to the MS medium enhanced shoots.

**Number of leaves plantlet$^{-1}$.** All the treatments are significantly different from each other for number of leaves plantlet$^{-1}$. All the concentrations of $GA_3$ increased the number of leaves plantlet$^{-1}$ as compared to control. The concentration in treatment 3 produced the highest number of leaves plantlet$^{-1}$ (7.333), which is > double than control. Treatment 4 also increased leaves > 90%, however this increase was only > 30%. It is clear that the medium dosage of 0.248 mg $L^{-1}$ is ideal for increase in number of leaves plantlet$^{-1}$; however other concentrations also can not be ignored. Al-momani *et al*. (1999) found similar response at a dosage of 3 mg $L^{-1}$ $GA_3$.

**Root length.** Three treatments (T4, T2 & T1) are significantly different from T3, while T4 and T2 are non-significantly different from each other. The average length of root in T3 was 3.670 cm, showing an increase of > 49% as compared to control. Both the concentrations in T4 and T2 also increased the root length by > 26% as compared to T1. Increase in root length is significant for plant stand, water and nutrient uptake in all crops. Webb *et al*. (1983) reported that the addition of hormones and GA to the MS medium, enhanced shoot regeneration and the shoots obtained were easily rooted.

**Table I. *In vitro* effect of concentrations of $GA_3$ on morphogenesis of potato explants**

| Parameters | T1 | T2 | T3 | T4 | LSD |
|---|---|---|---|---|---|
| Days to roots initiation | 7.33 A | 6.00 B | 4.667 C | 6.33 AB | 1.331 |
| Plantlet height (cm) | 4.9 D | 7.07 C | 9.13 A | 7.93 B | 0.515 |
| Leaves plantlet$^{-1}$ | 3.33 B | 4.33 B | 7.33 A | 6.33 A | 1.087 |
| Root length (cm) | 2.45 C | 3.037B | 3.67 A | 3.09 B | 0.425 |
| Roots plantlet$^{-1}$ | 2.33 C | 3.33 BC | 5.67 A | 4.00 B | 1.331 |

$T_1$ = 0 mg $L^{-1}$ (control), $T_2$ = 0.1 mg $L^{-1}$, $T_3$ = 0.248 mg $L^{-1}$, $T_4$ = 0.5 mg $L^{-1}$

**Number of roots plantlet$^{-1}$.** All treatments affected number of roots plantlet$^{-1}$. The controlled treatment produced 2.333 roots on average, which is the lowest. The treatment number 3 with 0.248 mg $L^{-1}$ $GA_3$ > doubled the roots plantlet$^{-1}$ (5.667) as compared to control (2.333). Treatments 2 and 4 also increased number of roots plantlet$^{-1}$. Increase in number of roots is beneficial in case of low soil moisture and nutrients especially in hilly and hard soils.

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