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PAPER ON TUBER FORMATION IN POTATO (*SOLANUM TUBEROSUM*)

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Abstract

Plant Growth Regulators played an essential role in root and shoot growth in potato plants. They are considered as a key element for vegetative propagation. In the present study, the experiment was evaluated for recording the effect of two type of growth hormones such as Gibberellin acid ($GA_{4/7}$) and Abscisic acid (ABA) using in vitro cultured single-node cuttings. The four treatments were used in this experiments such as 0.1:0.1($GA_{4/7}$:ABA), 0.3:0.3 ($GA_{4/7}$:ABA), 1:1 ($GA_{4/7}$:ABA) and 0:0 ($GA_{4/7}$:ABA). The medium consist of 0.1:0.1($GA_{4/7}$:ABA), 0.3:0.3 ($GA_{4/7}$:ABA), 1:1 ($GA_{4/7}$:ABA) and 0:0 ($GA_{4/7}$:ABA). Significant difference was found in among all treatments in case of root and shoot growth. The highest number root was found in Opperdoezer ronde in 0:0 ($GA_{4/7}$:ABA) followed by 1:1 ($GA_{4/7}$:ABA) (Agria), whereas the lowest number was observed in 0.3:0.3 ($GA_{4/7}$:ABA) (Agria). Agria and opperdoezer ronde showed mostly larger roots in 1:1 ($GA_{4/7}$:ABA). It was indicated that higher concentration of giberellin acid as well as abscisic acid has great effect on root development of potato. On the other hand, the lowest root number in both genotypes was observed in 0.1:0.1 ($GA_{4/7}$:ABA). It showed that low concentration of giberellins acid and abscisic acid hamper the root growth. The root number of genotype opperdoezer has increased gradually in all treatments. Particularly, shoot was only found in 0:0 ($GA_{4/7}$:ABA) (Agria). So, the average performance of Opperdoeze ronde was better than Agria. Our results indicated that higher concentration of giberellins and abscisic acid has great roles in root developmet rather than shoot in both genotypes.

Keywords: Potato, Gibberellin acid ($GA_{4/7}$) and Abscisic acid (ABA)

1.Introduction

Potato (*Solanum tuberosum*) is the most important food-security crop throughout the world, as it is an important part of the diet of most countries. The position of potato, non-cereal food crop known as the king of vegetables, is number one in the world and ranked as the world's 4th most important food crop after rice, wheat and maize, with production achieving a record 376.83 million tons in 2016. It has the ability to produce more food per unit area and time as well and also has high nutritional value to keep overloading population (Roy et al. 2017). It has high values of carbohydrates (16%), protein (2%), minerals (1%), dietary fibres (0.6%) as well as a good source of vitamin C and antioxidants (FAOSTAT, 2014). The Agria potato cultivar is a mid-season to late variety with rapid development. It is a relatively new cultivar (1986), selected to be especially suited for baking and frying. Usually, Agria potatoes are resilient low maintenance plants (Ref: Potato 'Agria'). The Opperdoezer Ronde (ODR) cultivar is an early-season variety with rapid development. ODR potatoes are resilient enough to grow under relatively low temperatures. ODR potatoes can only be cultivated near the Dutch city of Opperdoes, because the sabulous clay soil is responsible for their characteristic taste (Ref: Over Opperdoezer Ronde). But unlike with other important food crops, potato farmers heavily rely on the plant's vegetative propagation to produce yields.

Solanum tuberosum plants can form tubers on underground specialised stems (stolons). This complex process is affected by many external and internal factors like cultivar, temperature, hormones and nutrient availability. It was already established that tuber and stolon formation is optimal in vitro when the plants are cultured on a high sucrose medium (Xu et al. 1998).

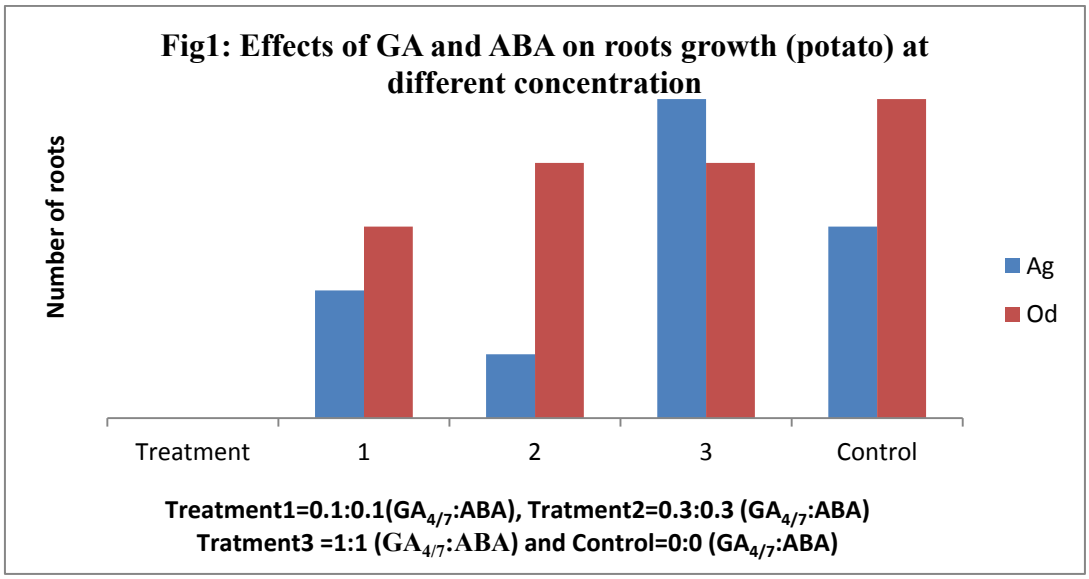
Conducting with a new Agriculture technology, a lot of experiments have been done to promote tuber formation using plant growth regulators such as cytokinins in vitro. This ways of propagation can provide potato virus free under certain condition (lijiana et al. 2012).

Gibberellin acid ($GA_{4/7}$) increase stem organ elongation that helps initiation, growth and branching of potato stolon. Higher concentration of $GA_{4/7}$ enhances stolon initiation. Abscisic acid (ABA) has also a major contribution to stolon growth. Gibberellin acid ($GA_{4/7}$) as well as abscisic acid have contribution on number root and shoot formation in potato growth. The hypothesis of this experiment was to observe the effect of $GA_{4/7}$: ABA on root and shoot growth of potato at different concentration and observed the performance of two genotypes.

2. Material & Methods

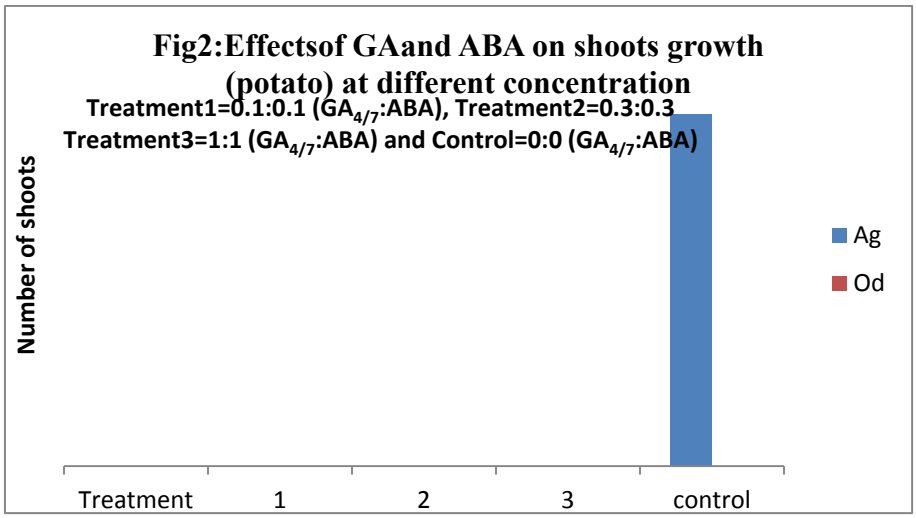
The experiment was carried out at the Forum of Wageningen University in practical room P826 and under flow cabinets (Latitude: N51^{o} 59' 5.7484". Longitude: E5^{o} 39'50.9796"). In the experiment potato plants were used. The experiment was done under light conditions at 20°C. Pre in-vitro cultivated potato plants were used for this experiment with ten plants per pot.

The experiment had as factor the ratio of Gibberellin acid ($GA_{4/7}$) and Abscisic acid (ABA). The ratio of Gibberellin acid ($GA_{4/7}$) and Abscisic acid that were used are: 0.1:0.1($GA_{4/7}$: ABA), 0.3:0.3 ($GA_{4/7}$: ABA), 1:1 ($GA_{4/7}$: ABA) and 0:0 ($GA_{4/7}$: ABA). The concentration of each Gibberellin acid and Abscisic acid used in the media was 1 mg/L. For the experiment the following medium was used: 1.2 g/L MS medium with low N levels, sucrose 4.4 g/L MS salts and agar 8 g/L. Where the medium pH is adjusted to around 5.8 and standard 9 cm petri dishes were used. Under a flow cabinet a cutting of a potato was used with one axillary bud and a piece of stem on both sides with leaflets. Of each plants circa 12 cuttings could be made. The axillary buds that were used had not sprouted yet. In each petri dish five to ten cuttings were placed and of each treatment four petri dishes were used, so 20 to 40 cutting per treatment. On the first day the medium was prepared and on the second day the potato plants were cut and transplanted to their medium with hormone treatment. The measurement took place at tenth day, this means the plants were also 10 days old. The measurements were done at the same day of the harvest. The plants were separated from the media and the number of shoot was counted per plant. Then the number root was counted for each plant. From where the number of shoot and root could be measured. There was no statistical analysis done, because two replications were used in our experiment.



3. Results and discussion

The highest number root was found in Opperdoezer ronde in control followed by treament3 (Agria), whereas the lowest number was observed treatment2 (Agria). Agria and opperdoezer ronde showed mostly larger roots in treatment3 (Fig1). It indicated that higher concentration of giberellin acid as well as abscisic acid has great effect on root development of potato. Another experiment showed that $GA_{4/7}$ has played an important role in tuber formation. Another report also showed that ABA enhanced tuberization in combined with $GA_{4/7}$ (Xu, X., van Lammeren, et al. 1998). On the other hand, the lowest root number in both genotypes was observed in tratment1. It showed that low concentration of giberellins acid and abscisic acid hamper the root growth. Similarly, in another experiment Krelle & Libbert (1969) indicated that abscisic acid in combination with grbberellin acid retarded the growth of rooting of bean stems, but bud growth was inhibited by abscisic acid. The root number of genotype opperdoezer has increased gradually in all treatments. So, the average performance of Opperdoeze ronde was better than Agria. Basically shoot was only found in control (Agria). A similar result was found by Thorpe & Meier (1973) on bean callus. They observed that the initiation of shoot retarded due to gibberellic acid as well as abscisic acid.



4. Conclusion

The performance of the high concentration $GA_{4/7}$:ABA was better in root growth except control. It indicated that $GA_{4/7}$:ABA enhanced root growth of potato. On the other hand, shoot was not found any treatment. Only shoot was observed in control as control contained auxin.Over all performance of Opperdoeze ronde was much better than Agria at all treatment.

5. References

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