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Research Article

Effects of New Plant Growth Regulators on Growth and Quality in Potato

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Abstract: This experiment aimed to explore the effects of new plant growth regulators on the growth and quality of potato, we conduct potato tubers with different concentrations of the regulators and cultivated in the seedling pot, with water as the control treatment. The results showed that sorbic amide (5%), sorbic amide quaternary ammonium salt (5%), Cinnamamide (5%), betaine Cinnamamide (5%), naphthalene dicarboxamide (5%), betaine naphthalenedicarboxamide (5%) these 6 new regulators have good activity in improving and enhancing the content of chlorophyll, soluble protein, soluble sugar and free amino acids with 400 times dilution and 800 times dilution on potato seedling. At the same time, we compared the changes of the physiological indexes in different periods. As can be seen from the experiment, these 6 compounds have a strong role in promoting growth and improving the quality of the potato so that they can be called plant growth regulators.

Keywords: Physiological and biochemical indexes, plant growth regulator, potato

INTRODUCTION

Plant Growth Regulators (PGRs) as part of large categories of pesticides is distinctly different from pesticidal action. The main role of growth regulator is to change the growth of a plant such as stimulate the growth of the plant or have a selective effect on some parts only (Zhao *et al*., 2007; Zhang *et al*., 2013; MiraArpe *et al*., 2013; Mayank Anand *et al*., 2013; Somayeh *et al*., 2012). Many new PGR compounds have been developed and tested on different plants with variable results due to varied environments and practices. In order to research and development of new plant growth regulator, we applied for series of plant growth regulator patents (CN: 103694129A, 103641781A, 103724265A, 103719082A, 103719081A, 103694128A). This series of patent substances have obvious advantages in seed germination, rooting activity and improving the appearance and intrinsic quality of wheat, cucumber, etc. in the previous research work. Potatoes are one of the main crops of our country, there are reports of the effect on growth, yield and quality of potato with original plant growth regulator, nutrient solution and mixed fertilizer (Chang, 2011; Wang and Xiao, 2009; Ingrid *et al*., 2006; Gong *et al*., 2008; Gong *et al*., 2010). Therefore, the purpose of this study was to investigate the effect of these new PGRs used as Seed soaking and foliar sprays on potato plants for agronomic characteristics and quality.

MATERIALS AND METHODS

Plant material and growth conditions: Pot experiment was conducted in 2013 in Qingdao Agricultural University (36.30°N, 120.36°E), Shandong Province, in northwest China. The seedling pot were PP products (150×132×110 cm), nursery substrates were: brown soil, the organic matter was 8.50 g/kg and pH of the soil was 6.70. Adopted the 6 compounds (5% water formulation) making 7 treatments:

- CK (Control)
- Treatment 1 (sorbic amide diluent 400 and 800 times)
- Treatment 2 (sorbic amide quaternary ammonium salt diluent 400 and 800 times)
- Treatment 3 (Cinnamamide diluent 400 and 800 times)
- Treatment 4 (betaine Cinnamamide diluent 400 and 800 times)
- Treatment 5 (naphthalene dicarboxamide diluent 400 and 800 times)
- Treatment 6 (betaine naphthalenedicarboxamide diluent 400 and 800 times)

Soaking seeds with the above treatments respectively. Every pot sow 2 potato tubers. During the growth of potato, spraying the above treatments on the leaf respectively in 30 days. Other measures comply with the local cultivation.

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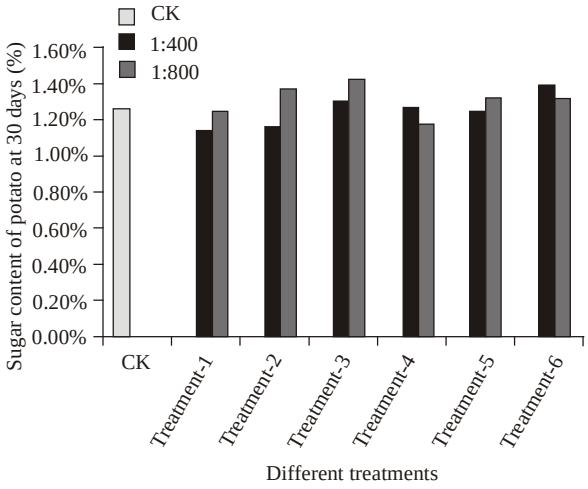

Fig. 1: The effects of different treatments on soluble sugar content of potato at 30 days

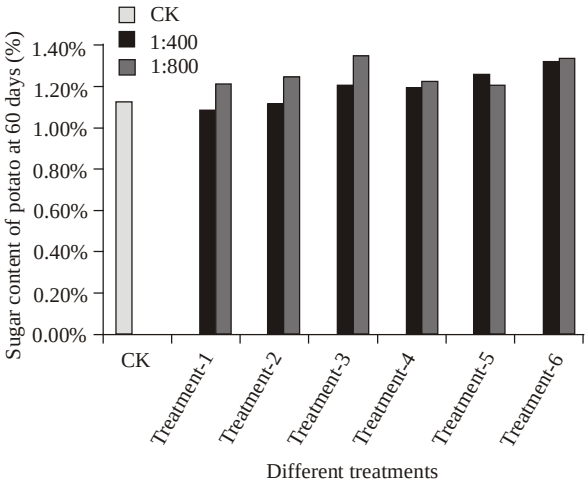

Fig. 2: The effects of different treatments on soluble sugar content of potato at 60 days

At growing and harvest season each plot were randomly selected the leaves of potato, mixed into a repeat sealed plastic bags, each treatment three quarters, three repeat, immediately after sealing (into the ice box) back to the laboratory for measurement. Leaves washed with deionized water, cotton drying, the leaves along the main vein cut into two parts, removing the main vein and the remaining leaves for physiological parameters were measured. Determination of chlorophyll with acetone extraction method, soluble protein content determined by Coomassie blue staining, free amino acids determined by ninhydrin colorimetric method, sugar content determined by anthrone reagent method, starch content determined by colorimetric method (Cao *et al*., 2007; Cang and Zhao, 2000).

Statistical analysis: All graphics and data were obtained and analyzed through EXCEL.

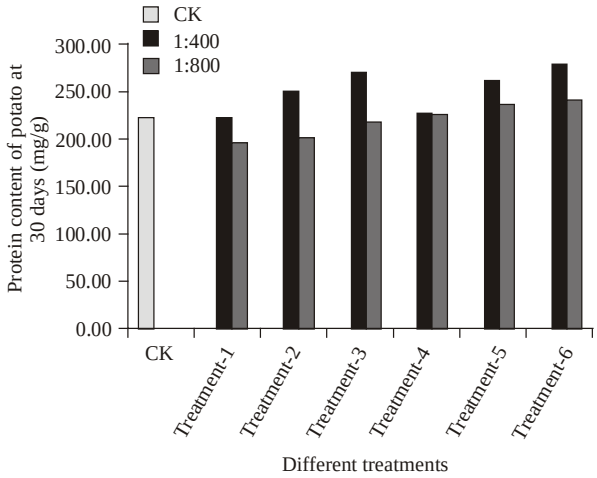

Fig. 3: The effects of different treatments on soluble protein content of potato at 30 days

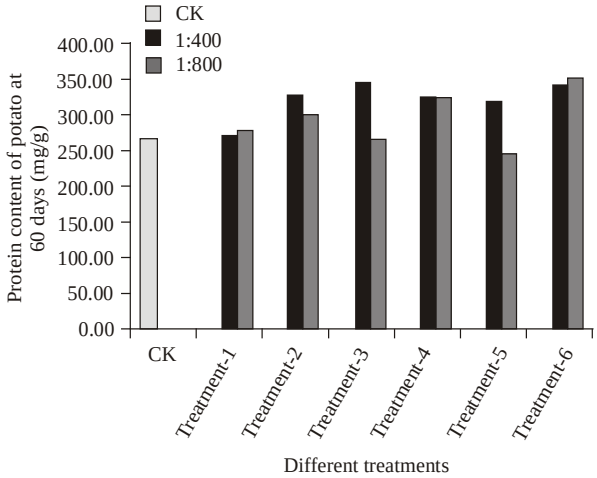

Fig. 4: The effects of different treatments on soluble protein content of potato at 60 days

RESULTS AND DISCUSSION

Effects of different treatments on the content of sugar in the leaves of potting potato at different grow period: Figure 1 and 2 showed that either 30 or 60 days treatment with novel plant growth regulators had differences in sugar content compared to control treatment at any concentrations tested. In these results showed at 60 days, there is a slight increase of sugar content of 800 times dilution. Potato plants show significant changes in sugar content in response to different treatments. These results suggest that in the growth in potato plants following treatments are related to a change in sugar content, but about its mechanism has not study.

Effects of different treatments on the content of soluble protein in the leaves of potting potato at different grow period: Figure 3 and 4 listed the effects

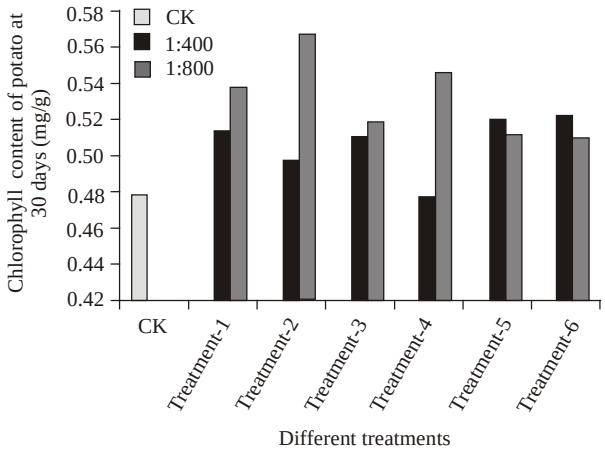

Fig. 5: The effects of different treatments on chlorophyll content of potato at 30 days

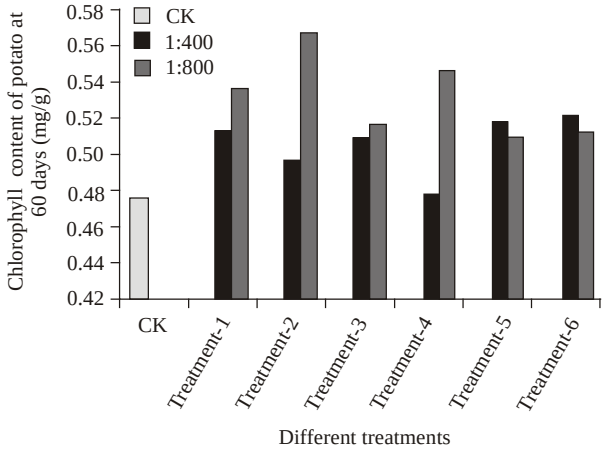

Fig. 6: The effects of different treatments on chlorophyll content of potato at 60 days

of different treatments on the content of soluble protein in the leaves of potting potato at different grow period, we can see that potato plants subjected to new compounds showed a regular: higher protein content at 60 than 30 days and 800 times dilution higher than 400 times dilution. In all treatments treatment-3 has the highest protein content at 800 times dilution. There are different promoting effects with all treatments at different times.

Effects of different treatments on the content of chlorophyll in the leaves of potting potato at different grow period: In Fig. 5 and 6, results listed were effects of different treatments on the content of chlorophyll in the leaves of potting potato at different grow period. With the growth of potato, the content of chlorophyll in the leaves increased. And in all treatments appear that the chlorophyll content were higher at 800 times dilution than at 400 times dilution except treatment 5 and 6. At the same time, it can be

(a) (b)

Fig. 7: The potato seedlings of different treatments, (a) treatment-3, (b) treatment-4

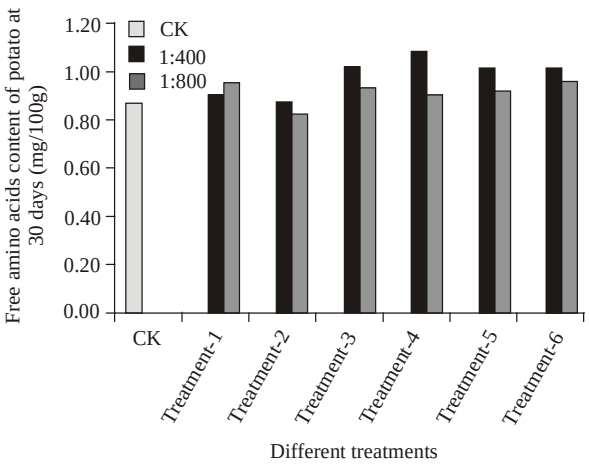

Fig. 8: The effects of different treatments on free amino acids content of potato in 30 days

seen from Fig. 7 that the potting seedlings showed different growth status with different concentrations of tested compounds.

Accompanied part of the potato seedlings. Figure 7a was potato treated with treatment-3 (from left to right be CK, 10, 50, 400 and 800 times dilution, respectively). Figure 7b was potato treated with treatment-4 (from left to right be CK, 50, 400 and 800 times dilution, respectively).

Effects of different treatments on the content of free amino acids in the leaves of potting potato at different grow period: As showed in Fig. 8 and 9, it is clearly that at 30 days the content of free amino acids in the leaves in lower than at 60 days and there are many negative promotion at 30 while at 60 days the trend is decrease. The 400 times of treatment-3 has 24% higher promotion rate than CK on free amino acids and the 800 times of it has 15% higher promotion rate than CK.

Effects of different treatments on the content of soluble protein in the ripe fruit of potting potato at harvest time: At mature period of potato, the protein content of ripe fruit was determined (data listed in Fig. 10). Effects of different treatments showed the same regular those 800 times dilution have higher promotion rate than 400 times dilution. Treatment 3 and

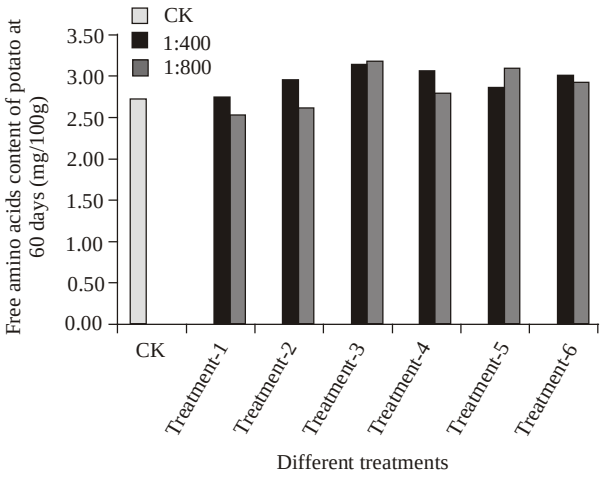

Fig. 9: The effects of different treatment on free amino acids content of potato in 60 days

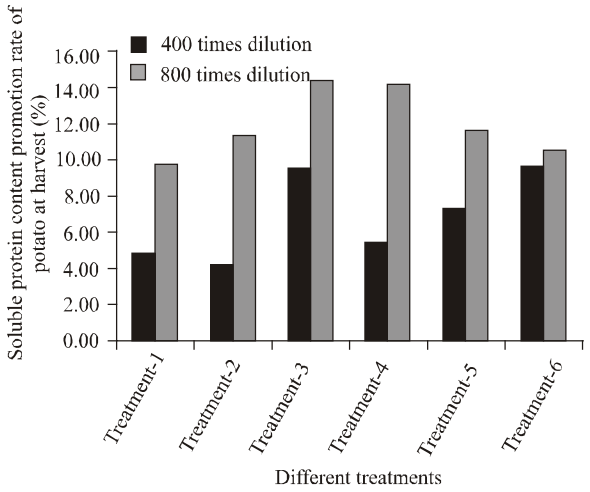

Fig. 10: The effects of different treatments on soluble protein content in the ripe potato at harvest time

4 at 800 times has the highest promotion rate. In all treatments there was all positive promotion on protein content of potato.

CONCLUSION

Plant growth regulator, as a large categories of pesticides, play an important role in the agricultural of increasing production, improving the quality of plants (Xu *et al*., 2013; Ren *et al*., 2007). In this study, new compounds using in water-based formulations to check the activity of growth and quality of potato.

The results of this experiment showed that under the condition of this experiment, when the dilution time was 800, the potato quality (content of protein, sugar, free amino acids, chlorophyll) gradually improved. And the results obtained compared these indicators at different harvest time. Therefore, under this experimental condition, taking quality and growth state into consideration, the best dilution times was 800. Due to the use of plant growth regulators is associated with many factors such as environmental temperature, dose, crop etc. So the conclusion of this test is only suitable for potting potato plants. As for the other areas, other season, other crops the best dose of plant growth regulator application have yet to be further studied.

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