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Effects of hormone seed soaking and substrate cultivation on the growth of blueberry

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Abstract.: Blueberry seeds have low germination rates, which is difficult to germinate under natural conditions. In this experiment, the optimum treatment of blueberry seed germination was explored using different hormones, different concentrations of the same hormone and different treatment durations. The results showed that blueberry seeds reach the highest germination rate and the shortest germination period when 500 mg/L GA3 treatment for 48 h. We found that the substrate ratio of perlite + grass carbon (ratio 1:1) is most suitable for blueberry seed germination and seedling growth.

Introduction

Blueberry (*Vaccinium* spp.) is a berry of family Vacciniaceae, genus Vaccinium. Blueberry fruit is delicious, low-sugar, low-fat, and rich in anthocyanins. It has significant anti-oxidant capacity so that it is good for improving eyesight, preventing nerve aging and cancer. Blueberry fruit is suitable for both fresh and processed foods, which is of high value[1-4].

In recent years, fresh and processed blueberries products are expensive, and that of developed countries such as Europe and the United States have fallen short of demand. For this reason, the cultivation area of the Netherlands, Canada, and Australia has rapidly expanded and it has begun to take shape. However, the blueberry breeding work[5] is relatively backward, and there are few blueberry varieties with independent intellectual property rights. Observations and experiments have shown that germination of blueberry seeds takes a long time, and the average germination time is about 30 d. So far, there are few reports to study the optimal sprouting treatment on blueberry seeds using different hormone treatment. In our experiment, Blueberry seeds were treated with different hormone for different duration or different concentrations. Moreover, the blueberry sprouts after germination treatment were cultivated with rice husk, perlite, and a mixture of peat and vegetal respectively in 1:1 ratio to investigate the process and performance of soilless cultivation of blueberry seedlings. Our research found effective ways for blueberry seed propagation, provided more blueberry crossbreeding experience and technical support for blueberry development in China.

Materials and methods

Experimental Materials:

Naturally air-dried seeds of blueberry cv. 'Oneal'.

Experimental steps:

Germination treatment with different hormones

Four groups of seeds were soaked in solutions of gibberellin (GA3: 50 mg/L) (treatment 1), polyethylene glycol (PEG: 30%) (treatment 2), indole acetic acid (IAA: 50 mg/L) (treatment 3), 2,4-D (10 mg/L) [6] (treatment 4) as treatment groups, and distilled water treatment was used as a control. Each group was set for three time levels: 6 h, 12 h, 24 h [7], a total of fifteen treatments. We set three replicates per treatment and 30 seeds per treatment. After the immersion treatments were completed, the seeds were placed in a 75 mm diameter petri dish covered with moist filter paper and

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placed in a light incubator for germination. The culture conditions were: 25±2 ℃ temperature, 12 h light time per day, 2000 lx light intensity. Kept filter paper moist. Observed blueberry seed germination every day and made a record.

Germination treatment with different GA3 concentrations

The different concentrations of GA3 were set for 50 mg/L, 200 mg/L, and 500 mg/L, respectively. Distilled water was used as the control. The treatment time was set to 12 h, 24 h, and 48 h, respectively. Made three repetitions. The culture conditions were the same as above (Experimental steps 1.2).

Different substrates for seedling growth

The blue-green seedlings with the same growth were transplanted into the different substrates (perlite + peat, rice husk + peat). Each treatment was set with five replicates, one for each replicate. Completely random design, a total of 10 experimental units. We cultured and observed the growth of blueberry seedlings in different nutrient substrates. After transplanted into different substrates on October 11, 2017, the seedlings was recorded on growth situation in three separate measurements: November 9, 2017, November 23, 2017, and January 2, 2018.

At the same time, the blueberry seeds that have not been germinated are sown directly in the substrate for 100 seeds per treatment. The substrate ratios were: perlite + moss + grass carbon (ratio 1:1:2), perlite + grass carbon (ratio 1:1), sand + grass carbon (ratio 1:1), sand + moss + grass carbon (Ratio 1:1:2).

Results and analysis

Blueberry seeds germination rate under different hormones treatment

Table 1 Blueberry seeds germination rate under different hormones treatment (%)

treatment	6h	12h	24h
1	3.33	0	6.67
2	0	6.67	3.33
3	3.33	6.67	3.33
4	3.33	0	3.33
Distilled water	6.67	0	6.67

When treatment time was 6 h, the distilled water group had the highest germination rate; when treatment time was 12 h, the germination rate of the seeds treated with PEG and IAA was the highest; when treatment time was 24 h, the GA3 and distilled water group had the highest germination rate. Overall, the germination rate of seeds treated with IAA increased significantly, while GA3 and 2, 4-D treatment did not significantly increase the seed germination rate. PEG treatment had little effect on the seed germination rate.

The Germination Rate of Blueberry Seeds Under GA3 Treatment

Table 2 Germination rate of blueberry seeds under different concentrations of GA3 (%)

GA_3 concentrations （mg/L）	Soaking time（h）		
	12	24	48
50	0	0	0
200	0	2.22	8.89
500	3.33	5.56	14.44

With the increased of GA3 concentration, the germination rate of seeds increased significantly, and with the increased of processing time, the germination rate of blueberry seeds also increased significantly. Whether the germination rate will increase or not with the concentration and processing time continued to increase yet to be studied.

Time for blueberry seeds to germinate under different GA3 concentrations

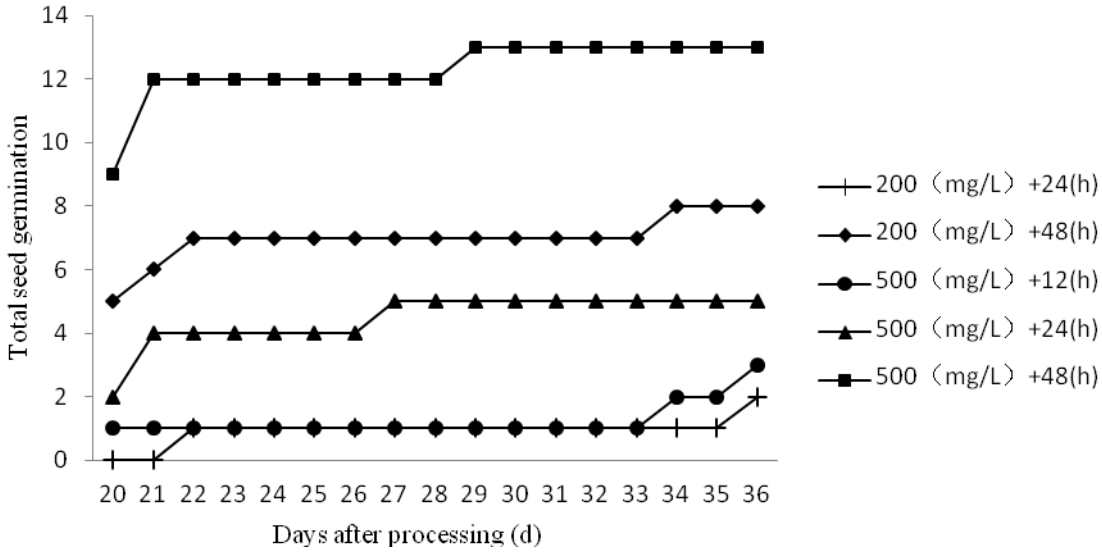

Fig.1 Germination duration of blueberry seeds treated with different concentrations of GA3

Blueberry seeds germinated for a long time. Without any treatment, the average germination time was 25-35 d. After GA3 treatment, the germination time was significantly shortened. After treatment with 200 mg/L GA3, the germination duration of blueberry seeds was reduced. However, the effect was not obvious. They were maintained between 20 and 35 d. When the 500 mg/L GA3 treatment of blueberry seeds, the germination time of the blueberry seeds was significantly shortened at the treatment time of 24 h and 48 h, and it only took 20-27 d and 20-21d, the germination can be completed. It can be seen that treatment with 500 mg/L GA3 had a significant effect on shortening the germination time of blueberry seeds.

Blueberry seedling growth in different substrates

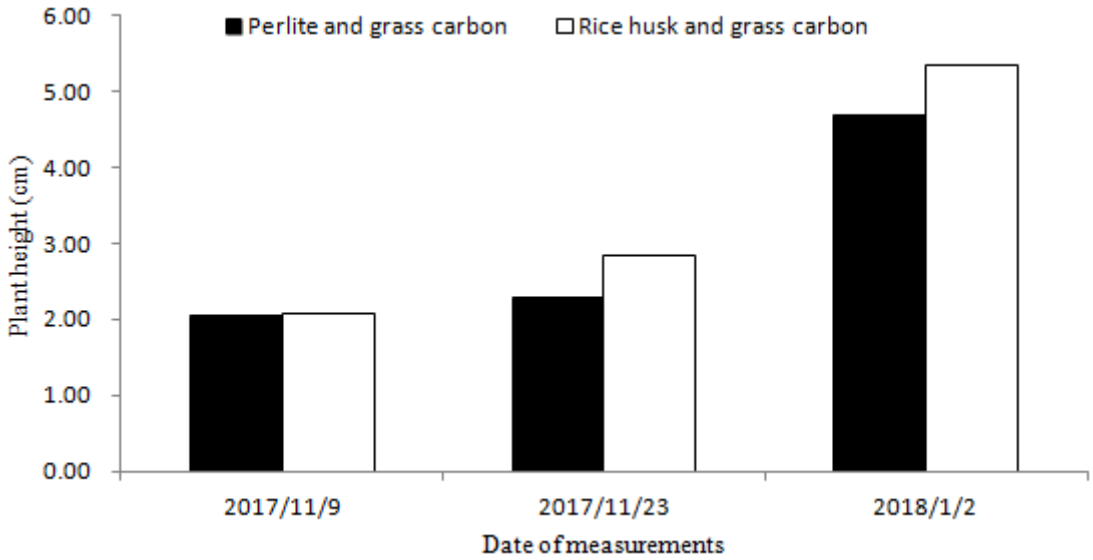

Fig 2 Growth of blueberry seedlings in different substrates

Fig. 3 Growth of blueberry seedlings in perlite plus grass carbon

Fig.4 Growth of blueberry seedlings in rice husk and grass carbon

Seedlings of bluegrass with the same growth had little tendency to grow in the substrate of perlite plus grass carbon and in the substrate of rice husk plus grass carbon. The growth of rice husk plus grass carbon was slightly stronger than that of perlite and grass carbon, and that of blueberry seedlings. The growth rate of plant height in pearlite plus grass carbon at the initial stage of transplanting was somewhat lower, but at the later stage, the growth rate was
basically the same in both substrates.

Seen from the number of branches, the number of branches of rice hull and grass carbon (2.13) was also higher than the number of branches of perlite plus grass carbon (1.88). It can be seen that the growth of blueberry seedlings in the substrate of rice hull and grass carbon was better. From the physical properties of the soil, it can be seen that the total porosity (69.89%) of rice husk and grass carbon was larger, the soil was looser, the water permeability was better, and the water storage was weaker.

In summary, rice husk plus grass carbon, perlite plus grass carbon were suitable for the growth of blueberry seedlings, rice husk and grass carbon were more suitable.

Survival of Blueberry Seeds in Different Substrate Proportions

Table 3 Survival Rate of Blueberry Seeds in Different Proportions (%)

D after sowing	33 d	37 d	44 d	53 d
Grass Carbon + Perlite + Moss	4	3	3	4
Grass carbon + sand	3	2	1	1
Grass Carbon + Moss + Sand	3	3	3	1
Grass Carbon + Perlite	5	7	7	7

The germination rate of blueberry seeds in different substrates was significantly different. The substrate ratio of perlite and stalk carbon was most suitable for blueberry seed germination and seedling growth, while the rest of the substrate ratios not only had lower germination rates but also had different levels of blueberry seedlings. The circumstances of death. In these four substrate ratios, perlite + grass carbon was the most ideal substrate for the growth and development of blueberry seeds.

Conclusions

According to the experimental results, IAA with a concentration of 50 mg/L could significantly increase the concentration of 50 mg/L GA3, 50 mg/L IAA, 10 mg/L 2,4-D, and 30% PEG seed. Increase the germination rate of the seeds. This is different from the performance of grape seeds[6]. It may be because grape seed and blueberry seed have different structures, so their performance under the same agent treatment was not the same.

When the processing time was different from the drug concentration, the optimum treatment time and treatment concentration of the drug could be selected. From the experiment, it can be seen that the optimal treatment time of GA3 was 48 h, and the optimal treatment concentration was 500 mg/L. With the processing time, the highest germination rate of blueberry seeds, and the earliest germination

time and the shortest interval between the start and end of germination, was the ideal method for blueberry seed germination. We speculate that when the concentration of GA3 continued to increase, the germination rate of seeds would continue to increase, and this remains to be studied. Similar experimental results with Liu Xiao et al.'s study on artificial hybridization of blueberry and seedling cultivation techniques[7]. However, the results of the study of the effects of GA on blueberry seed germination in other studies[8-9] are quite different. It may be because the blueberry seed varieties we used are different, resulting in different experimental results. At the same time, the germination rate was significantly different from that of Zhang Huawei et al.[10] in promoting the seed germination of bilberry. This may be due to the low germination rate caused by the stratification treatment after we did not do pharmaceutical treatment.

By comparing the germination and survival of blueberry seeds in different substrate ratios, it was found that perlite + grass carbon (ratio 1:1) is the most suitable substrate for germination and growth of blueberry seeds. This method is easy to use and inexpensive, and can be extended to the germination of hybrid seeds after cross-breeding in the field.

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