

## Efficiency of Treatment of Maize Seed by Active Phosphoric Acid Solution

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**Abstract** Active phosphoric acid solution was made and applied to maize seed, and then the activity of peroxidase was inhibited by 54.7 % and respiration rate decreased by 19 % at germination, therefore, nutrient of germplasm is retained for a long time, the growth of maize become excellent and eventually, the maize yield increased by 110 %.

**Key words** maize, active phosphoric acid solution, peroxidase

### Introduction

Phosphorus is a nutrient element that is necessary for forming of ATP, nucleotide, nucleic acid and phosphorus lipid.

Phosphorus becomes active in plant and facilitates the tillering, root growth, flowering and maturation [2].

Characteristic symptoms of phosphorus lack are that the growth of young plant is slow and to appear dark green color, deformed leaves and leaf spots [3, 4].

Supplementary symptoms of phosphorus lack are that stems are thin, many leaves don't exist, old leaves are died quickly, a course of growth is slow and leaf color is purple with dark green.[1]

We have studied to produce active phosphoric acid solution and investigate growth, yield characteristics and economic efficiency when active phosphoric acid solution is applied to maize seed.

### 1. Production and Analysis Methods of Active Phosphoric Acid Solution

#### 1.1. Production of active phosphoric acid solution

First,  $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$  24mg,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  18mg,  $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$  2.5mg are diluted with a liter of 0.2%  $\text{H}_3\text{PO}_4$  solution.(Solution I )

Next, 2 kg of  $\text{CaSO}_4$  dried with 10% water content are put in 4 liter water, then after 24 hours, the supernatant liquid from complex solution is mixed with solution I 20 mL and use it as undiluted liquid.

#### 1.2. Analysis method of active phosphoric acid solution

Phosphorus absorption quality of maize seed is measured by auto analysis tool ("EPARD") and activity of peroxidase by Gwayakol method, respiration rate by Warbourg method.

And water absorption capacity of root is measured by the method that calculates the titration concentration of methylen blue in salt water with different concentration and osmotic pressure of the certain solution.

## 2. Results

### 2.1. Physiological changes of maize seeds treated with active phosphoric acid solution

Change of phosphorus content in maize seed in active phosphorus solution treatment is seen in table 1.

Table 1. Change of phosphorus content in maize seed by phosphoric acid solution treatment

Group	Phosphorus content in solution/(mg·L <sup>-1</sup> )	Phosphorus content in solution after 1 hour seed soaking/(mg·L <sup>-1</sup> )	Phosphorus content absorbed per 1kg seed/mg	Compare /%
Control Test 1 (Group treated with 0.3% active phosphoric acid solution)	0.01	0.01	7 000	100
Test 2 (Group treated with 0.3% active phosphoric acid solution after 10% germination)	3 091	2 367	7 724	110.3
	3 024	2 258	7 766	110.9

Cultivar: "Huasong 1", Soaking time:5h, treatment time:1h, treatment temperature:20~25°C.

As shown in table 1, phosphorus content of maize seed according to active phosphoric acid solution treatment is 7 766mg in test 2 and is 7 724mg in test 1.

Effects of peroxidase activity of maize seed according to active phosphoric acid treatment are as follows (table 2).

Table 2. Effects of peroxidase activity of maize seed according to active phosphoric acid treatment

Group	Peroxidase activity /(mg·g <sup>-1</sup> ·h <sup>-1</sup> )	Difference	Rate /%
Control	26.7±2.1	—	100
Treatment	14.6±1.6	12.7	54.7

Cultivar: "Huasong 1", active phosphoric acid solution treatment density: 0.3%

The decrease of peroxidase activity by active phosphoric acid solution treatment for maize seed is related that iron existed in active unit is blocked by phosphoric acid and don't attend oxidation-reduction process.

There are cytochrome oxidation enzymes except peroxidase in enzymes that

include iron in active unit among the respiration enzymes of crops and it shows that active phosphoric acid solution treatment inhibits peroxidase activity specially.

Effect on respiration of maize leaf by active phosphoric acid solution treatment was investigated (table 3).

Table 3. Effect on respiration of maize leaf by active phosphoric acid solution treatment

Group	Respiration intensity (CO <sub>2</sub> ) /(μL·g <sup>-1</sup> ·10min <sup>-1</sup> )	Difference	Rate /%
Control	109.96	—	100
Treatment	89.08	20.88	81.0

Table 3 means that Share of peroxidase in whole respiration of maize leaf is about 19% If maize seed is treated with active phosphoric acid solution, it shows that stored sugariness is usefully used in other metabolism because activity of peroxidase is inhibited.

Effects on water absorption of maize roots by active phosphoric acid solution treatment are as follows (table 4).

Table 4. Effects on water absorption of maize roots by active phosphoric acid solution treatment

Group	Water absorption capacity/MPa	Difference	Rate/%
Control	-2.33	—	100
Treatment	-4.02	-1.69	172.5

Laboratory condition: it is same as table 2, survey: 5 leaves

As shown in table 4, water absorption capacity enhances as 172.5% by increasing 1.69Mpa in active phosphoric acid solution treatment than control. This means that absorption of water and nutrients is enhanced due to increasement of solution density of root cell by active phosphoric acid solution.

## 2.2. Variation of growth and yield of maize in active phosphoric acid solution treatment

In the active phosphoric acid treatment for maize seed, capacity of germination is as high as 3.3 % and rate of germination 3.6% and germination is equal than Control, and leaf color is clear green than Control with the naked eye.

Growth changes of maize by the active phosphoric acid solution treatment are as follows (table 5).

Table 5. Maize growth by the active phosphoric acid solution treatment

Group	Height /cm	Leaf umber /leaf	Thickness /cm	Leaf size per a plant/(cm <sup>2</sup> · plant <sup>-1</sup> )	Average leaf length/cm	Average leaf width/cm
Control	167.5	16.3	7.5	5 161.4	59.7	7.8
Treatment	181.0	16.7	8.5	5 968.9	64.1	8.2

Cultivar: "Huasong 1", the active phosphoric acid solution treatment density: 0.3% , treatment time:1 hour.

As shown in table 5, in control, the end of leaf is dried, but didn't appear in the active phosphoric acid solution, living leaf number is more emerged 1 leaf and root length, root number and air root number of maize is more emerged than Control.

After treating maize by the active phosphoric acid solution, nitrogen, phosphorus and potassium content in root, leaf and stem are as follows.(table 6)

Table 6. Content changes of nitrogen , phosphorus and potassium in root, leaf and stem of maize(%)

Elements	Root		Stem		Leaf	
	Control	Treatment	Control	Treatment	Control	Treatment
Phosphorus	0.19	0.23	0.41	0.43	0.19	0.23
Nitrogen	1.71	1.76	1.40	1.47	1.47	1.51
Potassium	1.00	1.12	1.56	1.75	1.29	1.36

As shown in table 6, phosphorus content of root and leaf of maize is more enhanced 0.04% in root, 0.02% in stem, 0.04% in leaf, nitrogen content respectively 0.05, 0.06, 0.04%; potassium content 0.12, 0.09, and 0.07%.

This shows that 0.3 % active phosphoric acid solution increases phosphorus content of root, stem and leaf of maize.

Yield components and yield changes of maize by the active phosphoric acid treatment are as follows (table 7).

Table 7. Yield components and yield changes of maize by the active phosphoric acid solution treatment

Group	Ear length /cm	Grain number filling with seed per ear /number	1 000 grain Mass/g	Average yield per kg/ha <sup>-1</sup>	Yield rate /%
Control	16,3	387.4	301.4	8 460	100
Treatment	19.2	401.6	331.6	9 330	110.3

Laboratory condition: it is same as table 5,  $LSD_{0.05}=412.5\text{kg}$ ,  $LSD_{0.01}=586.7\text{kg}$ .

As you can see in table 7, in the active phosphoric acid solution treatment group, ear length is 2.9cm longer , and grain number filling with seed per ear is more 14.2 grains, 1 000 grain mass is more 30.2g heavier therefore, the yield of maize is 110.3%, 870kg /ha is more increased.

Also, starch content is more enhanced as 2.6%, whole starch content is more enhanced as 0.7%, therefore, quality of maize grain is promoted.

## Conclusion

The maize seeds soaking in 20 or 25°C water for 5 or 10 hours were treated with 0.3% active phosphoric acid solution for 1 hour and then gives affirmative effects on physiological indices and yield, and yield per ha was increased by 110%.

## References

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