

Effects of calcium and magnesium on potato tuber yield, quality and disease incidence in Inner Mongolia of China

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Abstract

Potato is a predominant crop in Inner Mongolia, which plays an important role on guaranteeing country food security and local economic development. The potato yield increase in past twenty years was greatly attributed to the NPK chemical fertilizer application. However, calcium and magnesium fertilizer were not paid enough attention. Polyhalite, a new 4-in-1 fertilizer proved being positive effect on yield and quality of many crops, contains Ca and Mg. In this study, the absorption of calcium and magnesium by potato plants were observed, the effect of Polyhalite on potato was investigated, and its application method was explored as well.

Experimental design

Exp.1

The local popular cultivar, Kexin No.1 was used as experimental material. Altogether 300 kg N ha⁻¹ and 180 kg P₂O₅ ha⁻¹ were applied during sowing, drip irrigation was used in the trail. The experiment was laid out in a complete randomized block design with three replicates. Plot dimension was 20 by 5 m and plots were separated by a 1-m wide guarding row. Plant density was 42000 seedlings ha⁻¹ with 90 cm of row distance. Three treatments were included in Exp.1, which were (T1) 300 kg ha⁻¹ K₂O as K₂SO₄; (T2) 300 kg ha⁻¹ K₂O as K₂SO₄ plus 90 kg ha⁻¹ MgO as MgSO₄; (T3) 300 kg ha⁻¹ K₂O as K₂SO₄ plus 225kg ha⁻¹ CaO as Ca(NO₃)₂. The fertilizer of all treatments are applied as basal dressing. The amount of K₂O in treatments is based on previous study in our research group under local condition. The amount of K₂O are equal for all treatment.

Exp.2.

Four treatments are set as (T1) 1500 kg ha⁻¹ polyhalite plus 90 kg ha⁻¹ K₂O as K₂SO₄; (T2) 300 kg ha⁻¹ K₂O as K₂SO₄; (T3) 300 kg ha⁻¹ K₂O as K₂SO₄, 90 kg ha⁻¹ MgO as MgSO₄ and 225kg ha⁻¹ CaO as Ca(NO₃)₂; (T4) 469 kg ha⁻¹ polyhalite plus 234 kg ha⁻¹ K₂O as K₂SO₄. Complete randomized block design with three replicates was also used in Exp.2, and the cultivar and other field managements were as in Exp.1

Results and discussion

The results showed supplied 469 kg ha⁻¹ polyhalite plus 469 kg ha⁻¹ K₂SO₄ resulted in the highest yield, arriving at 50 727 kg ha⁻¹. The higher tuber yield is mainly attributed to its more tuber number per seedling and its highest dry matter accumulation of whole developmental stage.

The suitable fertilization combination of polyhalite+K₂SO₄ is not only beneficial for yield formation but has positive effect on tuber quality. Starch accumulation in potato tuber is significantly higher in 1/2 polyhalite + 1/2 K₂SO₄ treatment than other

treatments. Moreover, both calcium and magnesium could decrease the incidence of common scab. The treatment polyhalite combined 50% K_2SO_4 , exhibited the lowest disease incidence.

Absorption, accumulation as well as requirement of calcium and magnesium was investigated in this study. The Ca concentration in tuber is much lower than leaf, stem and root, and not affected by fertilization treatment, however leaf Ca concentration response to fertilizer greatly, which increase with the increasing of fertilizer amount. Opposite to Ca, Mg was mainly accumulated in tuber, which increase with Mg-contained fertilizer application.

The two elements had higher concentration in leaf and tuber in 1/2 polyhalite + 1/2 K_2SO_4 fertilization combination treatment, especially at the middle and later developmental stages.

Summary

1/2 polyhalite + 1/2 K_2SO_4 fertilization combination has significant effect on potato yield promotion, starch content increase and the elimination of common scab in local climate and soil condition.

The absorption and requirement characteristics were also investigated and cleared, which provided a guideline for further scientific use of calcium and magnesium fertilizer.