

Effects of Polyhalite application on seed yield, nutrient uptake and seed quality of winter oilseed rape

Jie Gao, Tao Ren, Jianwei Lu

College of Resources and Environment, Huazhong Agricultural University, Wuhan,
430070, China

Abstract

To investigate the effects of polyhalite application on seed yield, nutrient uptake and seed quality of winter oilseed rape (*Brassica napus* L.), two field experiments were conducted from 2016 to 2017 at Wuxue county, Hubei province, central China. The first experiment, including current fertilizer recommendation treatment (NPKB), polyhalite fertilization treatment (NP+PS), without potassium fertilizer treatment (NPB), without boron fertilizer treatment (NPK), calcium fertilizer treatment (NPKB+Ca), sulfur fertilizer treatment (NPKB+S) and magnesium fertilizer treatment (NPKB+Mg), was designed to estimate the contributions of K, Ca, S, Mg and B in polyhalite to seed yield. Another six polyhalite fertilizer application rates (0, 375, 750, 1125, 1500, 1875 kg polyhalite ha⁻¹) were set in the second experiment to determine the optimal polyhalite fertilizer application rate. The results showed that (1) in contrast to the NPKB treatment, seed yield was increased with the average of 13.1%, 40.7%, 43.6% and 29.7% for the NP+PS, NPKB+Ca, NPKB+S and NPKB+Mg treatment, respectively. On the contrary seed yield of the NPB and NPK treatment declined remarkably and the seed yield of without B fertilizer treatment was only 1.3 kg ha⁻¹, owing to low soil available B content. Polyhalite fertilization heightened shoot Ca, S and Mg content and shoot Ca, S and Mg uptake of the NP+PS treatment was 43.6 kg Ca ha⁻¹, 33.2 kg S ha⁻¹ and 10.0 kg Mg ha⁻¹, which were 39.5%, 72.6% and 32.3% higher than the NPKB treatment, respectively. Nonetheless, the yield increase rate of the NP+PS treatment was much lower than the treatments with Ca, S and Mg elemental fertilizer, which was associated with low B input of the polyhalite fertilizer. The B content of stem, pod wall and seed for the NP+PS treatment was only 6.77 mg kg⁻¹, 5.66 mg kg⁻¹ and 9.40 mg kg⁻¹, respectively, distinctly less than its B content of the NPKB treatment. Ca and Mg fertilization was beneficial to the improvement of seed oil concentration; nevertheless, B deficiency would decline seed oil concentration. Polyhalite fertilization increased seed protein concentration. Compared to the NPKB treatment, the average oil production increase rate was 2.5%, 46.7%, 48.6% and 35.6% for the NP+PS, NPKB+Ca, NPKB+S, NPKB+Mg treatment,

respectively. (2) Under the optimal N, P and B fertilizer input, polyalite fertilization enhanced seed yield and shoot nutrient uptake. With the increase of polyalite fertilizer application rate, seed yield increased prominently. Nevertheless, the high polyalite fertilizer application rate depressed seed yield. The increase ratio of aboveground K, Ca, Mg and S uptake varied with 54.5%-256.1%, 29.4%-131.6%, 16.6-80.9% and 57.8%-186.6%, respectively compared to the control treatment. Depending on the positive correlation between seed yield and polyalite fertilizer application rates, the fertilizer recommendation rate for the maximum yield and the economy fertilizer recommendation rate was 1250 kg ha⁻¹ and 653 kg ha⁻¹, respectively. Consequently, polyalite fertilization, which could supplemental K, Ca, S and Mg for winter oilseed rape, remarkably increase seed yield. However, additional B fertilizer should be applied in practice to satisfy B demand for higher seed yield.