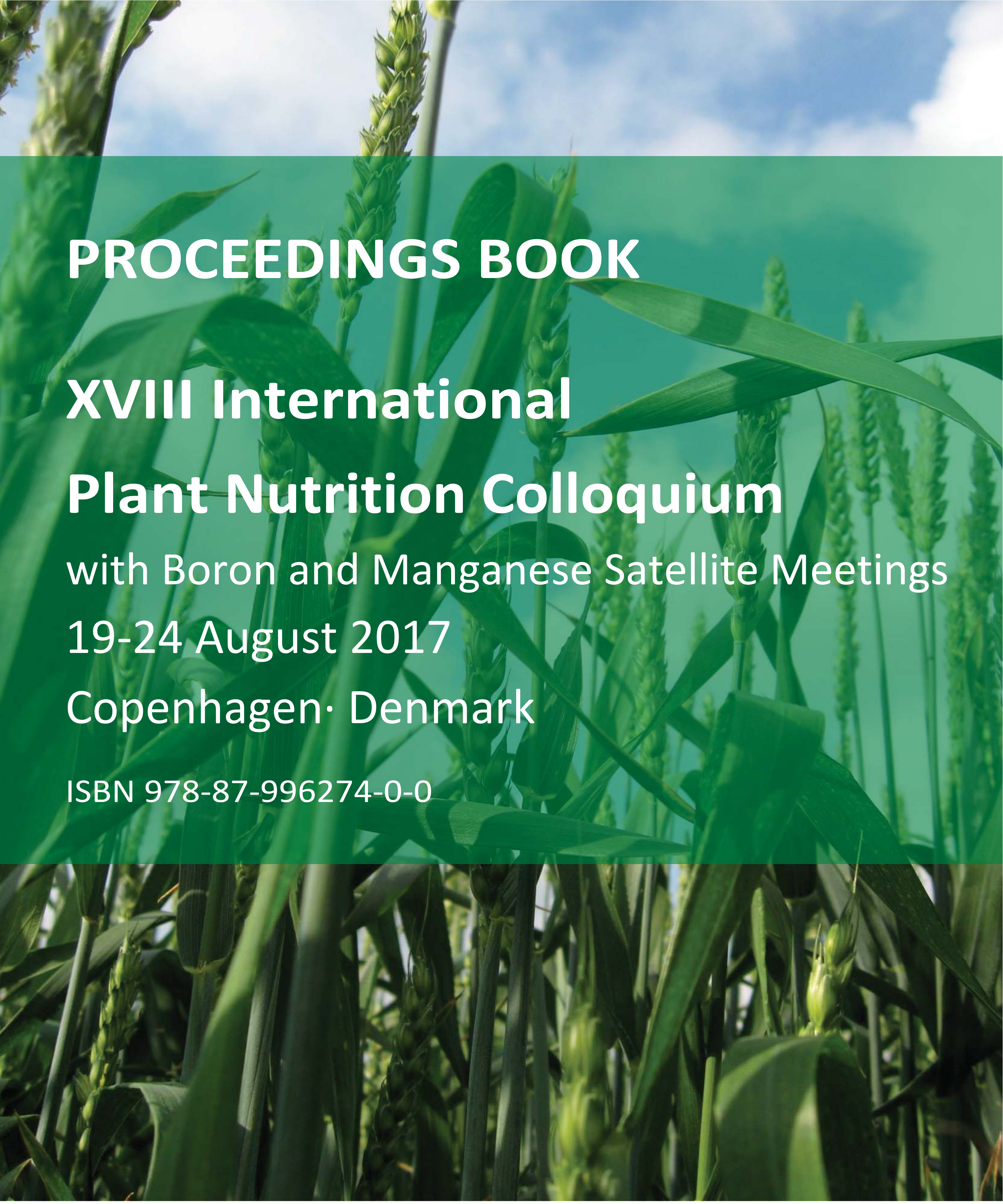

# PROCEEDINGS BOOK

# XVIII International Plant Nutrition Colloquium

with Boron and Manganese Satellite Meetings

19-24 August 2017

Copenhagen· Denmark

ISBN 978-87-996274-0-0

UNIVERSITY OF COPENHAGEN
FACULTY OF SCIENCE

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**How to cite this e-Book:**

*The full reference to this e-book should be:*

Proceedings Book of the XVIII International Plant Nutrition Colloquium with Boron and Manganese Satellite Meetings (2017). University of Copenhagen, Denmark. ISBN 978-87-996274-0-0

*Example reference:*

Husted S, Schmidt SB, Pedas PR, Jensen PE, Laursen KH and Schjoerring JK (2017) Effective strategies to diagnose and correct manganese deficiency in cereals. *In:* Proceedings Book of the XVIII International Plant Nutrition Colloquium with Boron and Manganese Satellite Meetings (A Carstensen, KH Laursen and JK Schjoerring, eds), pp 943-944. University of Copenhagen, Denmark. ISBN 978-87-996274-0-0. Retrieved from: www.ipnc2017.org.



ISBN 978-87-996274-0-0 (e-book)

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Published by Department of Plant and Environmental Sciences, University of Copenhagen, Bülowsvej 17, DK-1870 Frederiksberg (http://plen.ku.dk/english/).

# Comparing polyhalite and KCl in alfalfa fertilization

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## INTRODUCTION

Supplying nutrients in balanced and adequate levels is a key factor for alfalfa production and is essential to maintain high quality and efficient yields. Potassium fertilization is essential for alfalfa production and is the most common nutrient input for this crop in the high weathered, low-fertile and acids soils of the tropical region (Bernardi et al., 2013).

The minerals commonly explored as sources of K are sylvite (KCl), sylvinite (KCl + NaCl), and carnallite ($KMg_2Cl_3.6H_2O$). Potassium chloride potash (58 to 62% of $K_2O$) is the most potash fertilizer used in Brazil accounting for over 95% of the market. However, there are other minerals composed of sulfates that may be considered of economic interest owing to their potassium content and easy solubilization, e.g., langbeinite, kainite, and polyhalite (Prud'homme and Krukowski, 2006). Polyhalite ($K_2MgCa_2(SO_4)_4.2H_2O$) is a mineral of natural occurrence with large existing deposits and has potential to be a multi-nutrient (ratio of 11.7%-K, 19%-S, 3.6%-Mg, and 12.1%-Ca) fertilizer for forage crop production.

However, little information is available for the response of alfalfa to polyhalite. Acid, low-fertile, high-weathered soils typically benefit from the addition of K, Ca, Mg, and S fertilizers, and polyhalite may provide a slow-release fertilizer source of these nutrients (Barbarick, 1991). The objective of this study was to evaluate the effect of doses and sources of application of potassium fertilizer on the alfalfa dry matter yield, quality, and nutritional status.

## METHODS

The green house experiment was conducted at Embrapa Pecuária Sudeste, in Sao Carlos (22°01' S and 47°54' W; 856 m above sea level), State of Sao Paulo, Brazil. Alfalfa (*Medicago sativa*) was grown in pots with 3 kg completed with soil samples taken at a 0-0.2 m deep layer of a Typic Hapludox. Soil presented the following chemical properties: $pHCaCl_2$ = 5.2, organic matter = 24 g/dm$^3$, $P_{resine}$ = 2 mg/dm$^3$, K = 1.6 mmol$_c$/dm$^3$, Ca = 19 mmol$_c$/dm$^3$, Mg = 8 mmol$_c$/dm$^3$, CEC = 52 mmol$_c$/dm$^3$, basis saturation = 55%; S-$SO_4$ = 12 mg/dm$^3$, B = 0,37 mg/dm$^3$, Cu = 6,3 mg/dm$^3$, Fe = 13 mg/dm$^3$, Mn = 1,5 mg/dm$^3$, Zn = 0,5 mg/dm$^3$; and the physical characteristics: 265 g/kg of sand, 198 g/kg of silt and 537 g/kg of clay. Pots were uniformly limed (until V = 80%) before planting and fertilized at planting with 458 mg/kg of $P_2O_5$, and 25 mg/kg of FTE-BR12 (1.8% of B, 0.8% Cu, 3% Fe, 2% Mn, 0.1% Mo, 9% Zn).

Treatments comprised two K sources: polyhalite and KCl (60% $K_2O$), five ratios (polyhalite:KCl) and four $K_2O$ levels (0, 50, 10 e 200 kg/ ha) combined in a 7x3x+1 fractionated factorial design with 4 replications, in a total of 88 experimental units. The treatments were: i) Control (no K, S, Mg or Ca); ii) KCl 100%; iii) KCl 87,5% + Polyhalite 12,5%; iv) KCl 50% + Polyhalite 50%; v) KCl 12,5% + Polyhalite 87,5%; vi) Polyhalite 100%; vii) KCl 100% + gypsum (12,5%; viii) KCl 100% + gypsum 50%.

Alfalfa shoot was sampled at the beginning of flowering. A total of 6 cuts were evaluated. Measurements carried out were: dry matter yield, % of leaves, leaf area, quality analysis (crude protein, digestibility) and foliar diagnosis (N, P, K, Ca, Mg, S, Cu, Fe, Mn and Zn).

## RESULTS AND DISCUSSION

Alfalfa responded positively to the application of both K and S. Polyhalite was an effective source of both K and S as measured by alfafa yield and nutrient uptake; and it´s better than KCl alone or plus gupsum. Polyhalite and KCl mixture significantly out yielded the control, the highest polyhalite concentration improved alfalfa performance. KCl with gypsum did not get the same performance. Given its relatively low K uptake on control, it is likely that availability of K might have been a limiting factor to alfalfa yield. Based on K and S uptake, there may some synergy between the nutrients in polyhalite that enhances alfalfa performance (Table 1).

**Table 1. Alfafa dry matter yield (g per pot), leaf area (cm²), K and S concentration on shoot (g/kg) due K source and dosis.**

| Dosis | KCl 100% | KCl 87.5% + Polyh 12.5% | KCl 50% + Polyh 50% | KCl 12.5% + Polyh 87.5% | Polyh 100% | KCl 100% + gypsum 12.5% | KCl 100% + gypsum 50% |
|---|---|---|---|---|---|---|---|
| **($K_2O$ kg/ha)** | | | | **Dry matter yield (g pr pot)** | | | |
| **0** | 28.2 | 28.2 | 28.2 | 28.2 | 28.2 | 28.2 | 28.2 |
| **50** | 45.7 | 52.0 | 54.2 | 57.7 | 61.1 | 36.4 | 48.4 |
| **100** | 56.9 | 55.1 | 77.1 | 53.0 | 72.3 | 55.2 | 57.4 |
| **200** | 48.6 | 64.1 | 63.7 | 68.1 | 82.0 | 62.1 | 65.4 |
| | | | | **Leaf area (cm²)** | | | |
| **0** | 2406.3 | 2406.3 | 2406.3 | 2406.3 | 2406.3 | 2406.3 | 2406.3 |
| **50** | 2805.0 | 3153.8 | 3159.9 | 3181.3 | 3811.5 | 2060.3 | 2651.3 |
| **100** | 3616.8 | 3227.7 | 3333.1 | 2644.1 | 2813.1 | 3212.6 | 2636.9 |
| **200** | 3323.1 | 3098.5 | 3631.1 | 2654.0 | 3702.3 | 2976.1 | 4081.1 |
| | | | | **K (g/kg)** | | | |
| **0** | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| **50** | 11.3 | 8.2 | 9.9 | 7.2 | 5.3 | 9.2 | 10.1 |
| **100** | 10.9 | 11.5 | 10.2 | 13.4 | 9.9 | 10.2 | 11.3 |
| **200** | 15.0 | 13.2 | 13.4 | 16.2 | 15.1 | 13.0 | 7.2 |
| | | | | **S (g/kg)** | | | |
| **0** | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 |
| **50** | 1.64 | 1.37 | 1.68 | 1.56 | 1.30 | 1.30 | 1.69 |
| **100** | 1.35 | 1.45 | 1.69 | 1.59 | 1.71 | 1.47 | 1.48 |
| **200** | 0.97 | 1.52 | 1.70 | 1.94 | 1.94 | 1.58 | 1.25 |

## CONCLUSIONS

This study demonstrated that polyhalite is an alternative source of K and S and can meet the nutritional requirements of alfalfa for healthy growth and production.

## ACKNOWLEDGEMENTS

To the International Potash Institute - IPI, for the financial support for this research.

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