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PREVIEW

Murtadha, Hussain M.

EFFECTS OF NITRATE/AMMONIUM RATIO, NITROGEN SOURCE,
TEMPERATURE, RELATIVE HUMIDITY, AND LIGHT INTENSITY ON GROWTH
AND CALCIUM UPTAKE, TRANSLOCATION, AND ACCUMULATION IN
SORGHUM (SORGHUM BICOLOR (L.) MOENCH)

The University of Nebraska - Lincoln

PH.D. 1986

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PREVIEW

EFFECTS OF NITRATE/AMMONIUM RATIO, NITROGEN SOURCE,
TEMPERATURE, RELATIVE HUMIDITY, AND LIGHT INTENSITY ON
GROWTH AND CALCIUM UPTAKE, TRANSLOCATION, AND ACCUMULATION
IN SORGHUM (Sorghum bicolor (L.) Moench).

by

Hussain M. Murtadha

A DISSERTATION

Presented to the Faculty of
the Graduate College in the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Doctor of Philosophy

Major: Agronomy

Under the Supervision of Professor Jerry W. Maranville

Lincoln, Nebraska

May, 1986

TITLE

EFFECTS OF NITRATE/AMMONIUM RATIO, NITROGEN SOURCE, TEMPERATURE,
RELATIVE HUMIDITY, AND LIGHT INTENSITY ON GROWTH AND CALCIUM UPTAKE,
TRANSLOCATION, AND ACCUMULATION IN SORGHUM.

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EFFECTS OF NITRATE/AMMONIUM RATIO, NITROGEN SOURCE,
TEMPERATURE, RELATIVE HUMIDITY, AND LIGHT INTENSITY ON
GROWTH AND CALCIUM UPTAKE, TRANSLOCATION, AND ACCUMULATION
IN SORGHUM (Sorghum bicolor (L.) Moench).

Hussain M. Murtadha, Ph.D.

University of Nebraska, 1986

Advisor: J. W. Maranville

Information about calcium utilization in sorghum is limited. Five sets of experiments were conducted to study the effects of (1) different $\text{NO}_3^-/\text{NH}_4^+$ ratios and N sources, (2) different temperature and relative humidity regimes, and (3) different light intensity regimes in combinations with different Ca levels on plant growth and the uptake, translocation, and accumulation of Ca in sorghum.

Parameters used to measure the effects of treatments on 'Redlan' and 'Martin' plants were Ca deficiency symptoms, Ca uptake and distribution, Ca distribution within leaves, dry matter yields, total dry matter produced per total Ca absorbed (CaE1) or per Ca concentration (CaU1) or per total N absorbed (NE1), N/Ca ratios, shoot/root dry matter ratios, solution pH, and plant concentrations of Mg, P, S, Cl, Mn, Fe, Cu, and Zn.

Plants grown in solution with a higher proportion of NH_4^+ than NO_3^- , high temperature regime, or 60% relative humidity in combination with low solution Ca developed Ca deficiency symptoms. Calcium deficiency symptoms were characterized by young leaves curling and the edges becoming

serrated. Marginal necrosis appeared only at the later and more severe stages of deficiency. Solution pH increased with increasing NO_3^- supply. Calcium concentrations in the plant parts increased as the amount of NO_3^- or Ca^{2+} in the solutions increased.

Dry matter yields increased as $\text{NO}_3^-/\text{NH}_4^+$ ratios increased and was more pronounced with higher Ca in solution. Plants grown in $\text{Ca}(\text{NO}_3)_2$ solutions generally had the highest Ca concentrations and dry matter yields followed by plants grown with urea, NH_4NO_3 , and $(\text{NH}_4)_2\text{SO}_4$, respectively. Nondeficient plants had low N/Ca, CaE1, and CaU1 values. Higher NE1 values were also associated with nondeficient plants. Lower leaves had higher Ca concentrations than upper leaves reflecting Ca immobility. Calcium concentrations in each leaf increased from the base to the tip.

Plants grown under a relatively lower temperature regime produced more dry matter. Highest dry matter yields were produced in plants grown at 30% relative humidity, and the minimum yields when grown at 60% humidity. Dry matter yields, number of tillers, and shoot/root values increased with increased light intensity.

TO MY PARENTS

PREVIEW

ACKNOWLEDGMENTS

I would like to express my appreciation and sincere thanks to my major advisor Dr. Jerry W. Maranville for his support, encouragement, and excellent guidance throughout this study and writing this manuscript.

Special thanks and appreciations are also expressed to Dr. Ralph B. Clark for his guidance, helpful ideas in planning this study, serving as a major advisor during the absence of Dr. Maranville, and serving on the reading committee. Deep appreciation is also extended to Dr. Robert C. Sorensen for his wise advice and serving on the reading committee.

I also wish to thank Dr. Max D. Clegg and Dr. Ralph E. Neild who served on the supervisory committee and shared their experience and time.

A note of thanks and gratitude to the University of Nebraska-Lincoln for the use of the greenhouse and laboratory facilities; also to all of my friends in the Agronomy department who helped during the course of this study.

Finally, I would like to express my sincere gratitude to all members of my family for their help, patience, understanding, and encouragement throughout this task.

Hussain M. Murtadha

1986

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**Growth and Calcium Uptake, Translocation,
and Accumulation in Sorghum**

**1. Effects of Nitrate/Ammonium Ratios and
Nitrogen Sources.**

PREVIEW

ABSTRACT

Information about $\text{NO}_3^-/\text{NH}_4^+$ ratios and different N sources effects on Ca uptake and distribution is limited in sorghum (Sorghum bicolor (L.) Moench). The sorghum genotypes "Redlan" and "Martain" were grown in a greenhouse with 300 mg N L⁻¹ (21.45 mM) at $\text{NO}_3^-/\text{NH}_4^+$ ratios of [300/0, 250/50, 200/100, and 150/150] in combination with 50 (12.48 mM) and 100 (24.96 mM) mg Ca L⁻¹. Plants grown with high proportions of NH_4^+ developed Ca deficiency symptoms within 21 days after being put in treatment solutions. Nitrogen sources used were $\text{Ca}(\text{NO}_3)_2$, NH_4NO_3 , $(\text{NH}_4)_2\text{SO}_4$, and urea at 300 mg N L⁻¹ (21.45 mM) in combination with 50 and 100 mg Ca L⁻¹.

Symptoms of Ca deficiency were visible on young leaves of plants grown with high proportions of NH_4^+ . Leaves tended to curl toward the inside and the edges became serrated. Severe necrosis of leaf margins appeared at the later stage of the deficiency. Roots of deficient plants were abnormal, short, and the root tips were dark brown. The pH of solutions were higher with NO_3^- and lower with higher proportions of NH_4^+ .

Results showed that Ca concentrations in plant parts or in the whole plant increased as the proportion of NO_3^- increased, and decreased with higher proportions of NH_4^+ in the treatment solutions. Higher Ca^{2+} uptake associated