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EFFECTS OF DEFOLIATION AND N-FERTILIZATION ON YIELD, NITROGEN UPTAKE, AND PROTEIN SYNTHESIS OF WHEAT CULTIVARS DIFFERING IN GENETIC POTENTIAL FOR PROTEIN CONTENT AND COMPOSITION

The University of Nebraska-Lincoln PH.D. 1979

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by

Maria Isabel da Silva

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

Department of Agronomy

Under the Supervision of Dr. V. A. Johnson

Lincoln, Nebraska

June, 1979

TITLE

Effects of Defoliation and N-Fertilization on Yield, Nitrogen Uptake, and Protein Synthesis of Wheat Cultivars Differing in Genetic Potential for Protein Content and Composition.

BY

Maria I. da Silva

APPROVED	DATE
V. A. Johnson (Chairman)	June 28, 1979
P. J. Mattern	June 28, 1979
M. G. Boosalis	June 28, 1979
R. A. Olson	June 28, 1979

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EFFECTS OF DEFOLIATION AND N-FERTILIZATION ON YIELD, NITROGEN UPTAKE, AND PROTEIN SYNTHESIS OF WHEAT CULTIVARS DIFFERING IN GENETIC POTENTIAL FOR PROTEIN CONTENT AND COMPOSITION

Maria Isabel da Silva
University of Nebraska, 1979

Adviser: Dr. V. A. Johnson

Three field experiments were conducted at the Agronomy Farm near Lincoln, Nebraska. The main objectives were: 1) measure grain yield and protein content of varieties differing in genetic potential for protein content and composition under different nitrogen rates and defoliation treatments and 2) measure total dry matter and nitrogen accumulation on a weekly basis after heading time.

The varieties studied Lancota, Favorit/5/Cirpiz/Jang Kwang/4/Cmn/Velvet, CI 13449/Centurk, Martonvasar 3, NB 66403//Trader Sel./Riebesel, and Lancer have inherently different genetic potential for grain yield and/or protein content. Five defoliation treatments were imposed at heading and 15 days after heading in three experiments. Rows were harvested at weekly intervals after heading time to determine nitrogen and dry matter accumulation in foliage and heads.

In Experiment 1, grain yield of 3305 kg/ha with no defoliation decreased to 2819 kg/ha with defoliation of flag

leaf plus 4th leaf at heading time. Similar results were obtained in the other experiments in which the defoliation of flag leaf plus 4th leaf at heading reduced grain yield, 1000-kernel weight and test weight more than the other defoliation treatments. The defoliation of flag leaf either at heading time or two weeks after heading significantly reduced grain yield in two of the three experiments.

Nitrogen application significantly increased average grain protein of the varieties from 15.6% with no nitrogen application to 17.4% with application of 120 kg/ha of nitrogen. Removal of flag leaf plus 4th leaf two weeks after heading resulted in the lowest grain protein (16.1%) as compared with the control plots (all leaves intact) with 17.2% in Experiment 1. However, in Experiments 2 and 3 defoliation of flag leaf plus 4th leaf at heading time had the most severe effect on grain protein.

Average lysine/protein and adjusted lysine/protein were the lowest with no defoliation. CI 13449/Centurk produced grain with the lowest protein in all experiments but the highest lysine % protein in two experiments.

Favorit/5/Cirpiz/Jang Kwang/4/Cmn/Velvet and Lancota produced significantly the highest grain yield and grain protein content among the varieties studied. The fact that both yield and protein content were high is unusual and indicates the presence of protein genes in these varieties. It was observed that the varieties which normally produce

relatively high yields of grain and high grain protein retained these characteristics despite the effects of nitrogen application and defoliation treatments.

CI 13449/Centurk reached maximum dry matter accumulation one week after heading but in Favorit/5/Cirpiz/Jang Kuang/4/Cmn/Velvet, Lancota and Lancer the maximum was reached one week later. A most pronounced weight reduction in both foliage and heads occurred from defoliation treatments performed at heading, especially when two leaves were removed.

The concentration on nitrogen in the foliage (stem plus leaves) decreased from 1.84% at heading to 0.61% at harvest in Experiment 1. Head nitrogen increased from 2.13% to 2.40% during this period. Similar results were obtained in Experiment 3.

The percent of nitrogen in the heads of varieties increased with the application of nitrogen but the increase resulting from the application of 120 kg/ha of nitrogen was not significantly different from 60 kg/ha of applied nitrogen except in the 4th sampling week.

Removal of flag leaf plus 4th leaf at heading time had a more severe effect on the concentration of nitrogen in the foliage and heads than the other defoliation treatments.

To my parents.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDIX TABLES

LIST OF FIGURES

INTRODUCTION

The causes of losses in grain yield of wheat are numerous. An important one is the loss of leaf area due to attack of diseases, insects or from physiological causes or mechanical injury. Reduction in leaf area changes the physiological processes in the plant, thus affecting important characteristics such as grain yield and grain protein.

Defoliation has been used by many investigators (Kiesselbach, 1925; Miller et al., 1948; Asana and Mani, 1950; Pauli and Laude, 1959; Hanway, 1969; and Mikesell and Paulsen, 1971) to study the contribution of different plant parts to the development of grain and consequently the grain yield. Most of the leaf contribution comes from the top two leaves that are green at the time of grain-filling. The leaves being the major sites of photosynthetic activity, appear to make an obvious contribution to the plant's grain-yielding ability. The literature provides good evidence that the flag leaf and morphological structures above it are important in the development of yield potential in cereals, of these the flag leaf is the more important. The defoliation of flag leaf and 4th leaf might be expected to have pronounced effects on assimilate supply to the grain. When plants are defoliated, the ear becomes the main source of assimilates to the grain.

Adequate nitrogen availability and proper environmental conditions after heading time are essential for rapid and efficient translocation of nitrogen from stem and leaves to the grain and for maximum grain protein. A number of experiments have been carried out to determine the optimum rate of nitrogen application to wheat varieties. Yield increases with nitrogen application are mainly due to an increase in tillering, number of kernels per head, and 1000-kernel weight. The effects of nitrogen application on yield, yield components and other agronomic traits have been studied in detail.

It is important to identify high-yielding wheat varieties that possess superior nutritive value. Efficient translocation of nitrogen from the foliage (stem plus leaves) to the grain has been offered as an explanation for varieties with high grain protein (Johnson, Mattern and Schmidt, 1967 and Youssef and Salem, 1975). Recent research indicates that protein content can be increased by breeding varieties that are high in grain protein content and also by the application of nitrogen fertilizer.

Some studies have demonstrated a negative relationship between grain yield and grain protein content (Gericke, 1930; Schlehuber and Tucker, 1959; and Haunold, Johnson and Schmidt, 1962). Now, the breeders are selecting for varieties with high grain yield and protein content. Some