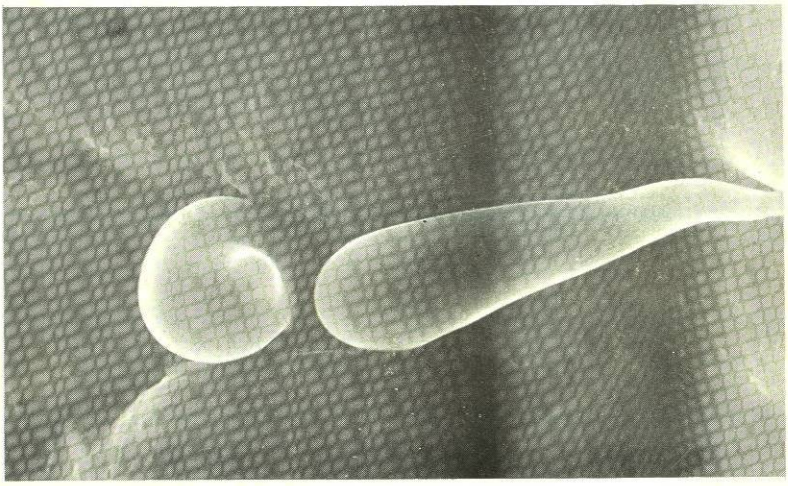
MORPHOPHYSIOLOGICAL TRAITS IN CROP IMPROVEMENT: CASE STUDY - SORGHUM

RATIKANTA MAITI



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CONTENTS

ABOUT THE BOOK

Understanding the process of a plant development morpho-physiological traits in any crop, depends largely on the knowledge of its individual components, namely seeds, seedlings, stems and reproductive meristem. Total productivity is dependent on expression of these plant components which work in harmony. The behavior of these individual components under a variety of environmental conditions is directly reflected in the total productivity of the crop and can be measured quantitatively.

The role of the plant physiologists is to study the vast array of complex functions operating in plant. It is an essential pre-requisite in a crop improvement research program to understand the growth and development of different organs and their constraints under different environments. These factors are considered to determine the structure and thesis of the present book. Although literature is available regarding the growth and development of sorghum, no one book details all these aspects in a concise manner. The main objective of writing this book is to present information of original research by the author and an extensive review of the literature on the subject in each chapter. I have attempted to make each chapter independent; however, there are some repetitions in several chapters. The book is divided into nine chapters.

Chapter 1 is an introductory chapter outlining the sorghum crop, its origin and domestication, the areas under cultivation, its yield potentials and constraints, as well as the research needs.

Chapter 2 deals with morpho-physiological characteristics of seeds. The emphasis has been to show seed morphology related to physical characteristics of seeds and ultimately to the development of seedlings. Factors relating to seed viability,grain germinability and grain weathering are also discussed.

Chapter 3 is concerned with the facets of seedling development the evaluation of seedling vigor and stand establishment traits. Problems of seedling emergence through crusted soil and methodology of seedling resistance and traits related to multiple resistance are also discussed.

Chapter 4 deals with morphology, structure, growth and development of leaf and stem. Distribution of dry matter in different plants organs under different environments is also discussed in this chapter.

Chapter 5 deals with panicle growth and development and its limitation under different climatic conditions. The grain growth pattern, the effect of weather on growth stages and relationship among growth stages and panicle components are also discussed in this chapter.

Chapter 6 discusses the morphology and development of root both in the field and under simulated conditions. As the growth and development of crop is largely influenced by climatic conditions, a general account of crop environments and its effect on sorghum growth and development is discussed in Chapter 7. This includes (1) the general aspects of micro-environments (2) plant responses to physical environments; (3) a review of the effects of water stress on plant function and (4) integrating soil-water-crop environments.

Chapter 8 deals with the mineral nutrition of sorghum and it representas a direct contribution by R.B. Clark, from the University of Nebraska.

Chapter 9 draws inferences of screening techniques for several resistance traits discussed in previous chapters, the research imperatives and evaluates multistress resistance for dryland sorghum crop improvement. It outlines a plan for development of multistress-resistance traits and plant type concepts in sorghum.

This book gives special emphasis to look for genetic variability in morphophysiological traits in sorghum and discusses its possible utilization in crop improvement with special reference to unfavorable conditions. Very few attempts are made in this directions on any other crops.

I believe this book will serve as a guide to students, extension workers and also researchers in sorghum crop productivity. I have attempted to use sorghum crop as a basis for synthesis of the growth and development of other cereals crops. The work done of this crop could be used as a guide for the study of other cereal crops.

R.K. Maiti

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INTRODUCTION

THE SORGHUM CROP

Sorghum is a major source of food for millions of people in the semiarid tropics. In tropical areas sorghum grain is important as food and as livestock feed. The stem and foliage are used as a green crop, hay silage and pasturage. The stems are also used as fuel and building material. In temperate areas, it is a major source of cattle feed except in China, where it is primarily used for food (House, 1980).

Sorghum is used in the preparation of different types of food, and an unleavened bread is the most common food made from sorghum flour. Sometimes the dough is fermented before the bread is prepared, and the grain is boiled to make a porridge or gruel. It is also used in the preparation of biscuits. Beer is prepared from sorghum grain in many parts of Africa. Besides these products, popped and sweet sorghum which are parched, are also eaten (House, 1980).

The demand for sorghum as a staple food has been growing in recent years. Though sorghum is known for its versatile use, hardness, dependability, stability of yield and adaptability over a wide range of cultures and climates, the adverse edapho-climatic conditions prevailing in the sorghum growing areas of the world limit the crop's production (Swindale, 1980). The crop is often grown on poor soils by farmers who have little resources for control of moisture, the purchase of fertilizers, insecticides and other inputs. Therefore, there is a need for the development of cultivars more adaptable to the adverse climatic conditions of the SAT world (semiarid tropics, Figure 1.1).

ORIGINS AND DOMESTICATION OF SORGHUM

Nothing is known about when *Sorghum bicolor* was first brought into cultivation, but Murdock (1959) stated that, along with several West African Crops, it was domesticated some 7000 years ago. It might have reached India not earlier than 1500 BC and China by AD 900. Cultivated sorghums were first introduced to the Americas and Australia about 100 years ago (Peacock, 1984). Sorghum is distributed in wild forms in Africa and other countries. Mann *et al.* (1983) reviewed this subject. In sorghum, domestication is initiated by allelic changes at only two loci resulting from different selection pressures following the innovation of harvesting techniques. Wild sorghum disperse their seeds by the breakage of nodes (due to the absence of an abscission zone along the rachis, panicle or at spikelet nodes) with the subsequent scattering of the seeds. The essential step adopted in domestication was the harvest of the whole inflorescence, and the