15 Remote Sensing Estimation of Crop Biophysical Characteristics at Various Scales

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CONTENTS

15.1 INTRODUCTION

Remote sensing has provided valuable insights into agronomic management over the past few decades. The use of remote sensing for determining crop physiological and phenological status has its roots in the pioneering work by William Allen, Harold Gausman, and Joseph Woolley [1–3], who provided much of the basic theory relating morphological characteristics of crop plants to their optical properties. These pioneering works have led to the understanding of how leaf reflectance changes in response to leaf thickness, species, canopy shape, leaf age, nutrient status, and water status. Leaf chlorophyll content and its absorption in the visible spectrum provide the basis for utilizing reflectance as a tool either with broadband radiometers typical of current satellite systems or hyperspectral sensors that measure reflectance at narrowbands. The basic understanding of leaf reflectance has led to the development of various vegetation indices (VIs) that have been extended to crop canopies and have been used to quantify various agronomic parameters (e.g., leaf area, crop cover, biomass, crop type, nutrient status, and yield). These tools are still being developed as we learn more about how to use the information contained in reflectances from a range of different sensors.

A summary of the progress in applying remote sensing to agriculture was recently published in a collection of articles in *Photogrammetric Engineering and Remote Sensing* (volume 69) [4–8]. Other recent reviews of the application of remote sensing methods to crops were developed by Hatfield et al. [9,10]. These articles provide a summary of the multispectral and hyperspectral remote sensing efforts in more detail and the reader is referred to these articles for a more thorough understanding.

This chapter contains a summary of experiences and advances made in the last 10 years in understanding how remote sensing at a close range and at satellite level can be used to quantitatively assess crop biophysical characteristics (BPCs). In what follows, the performance of VIs in estimating crop