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My view

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Why won't breeders do what we want? Crops that compete successfully with weeds have been on the wish list since the start of agriculture. Time and money have been spent trying to understand plant–plant interactions, but little progress has been made in designing crops with superior ability to suppress weeds. Not a single variety of any crop has been released with its principal feature being competitive ability. Reasons can be found in our fragmented understanding of plant competition and the consequent lack of a search for genetic solutions. This is seen as a consequence of limited shared understanding between plant breeders and weed scientists as well as a lack of common goals. Improving plant competitive ability, which is dependent on a range of environmental and genetic characteristics, is a complex problem and requires interdisciplinary teams and prioritization of research.

Weed scientists often suggest that the only thing breeders do that affects competitive ability is select for early vigor. They believe plant breeders will never develop competitive cultivars because they refuse to select breeding lines under weed pressure. This is true but understandable, as weeds are one among many problems plant breeders have to deal with in the selection process. Furthermore, plant competitive ability is quantitatively inherited (because it is the sum of many characteristics), and it has been difficult to select for at the same time one selects for other important, quantitatively inherited traits e.g., yield. New biotechnology tools such as marker-aided selection and the ability to duplicate genes or to combine them have enhanced the possibility to select for several quantitative traits at the same time. As weed scientists, we should not blame the breeders for lack of success but, instead, take a closer look at our own science to determine if we deliver tools that can be used for selection. The likely answer is no. In practice, breeders and weed scientists seem to be completely disconnected.

Traditionally, weed scientists have been most involved in applied descriptive and sometime even retrospective research in relation to managerial intervention. In part, this is both understandable and desirable, particularly because weed science was introduced when herbicides were developed after World War II. The primary research goal was to optimize the use of herbicides. Today, issues such as when, where, why, and how to apply herbicides still dominate the weed science. Recently, weed ecology has been introduced as the new era of weed science. Weed ecology research distances weed science from herbicides, but with few exceptions, it does little to change the descriptive approach to our science.

It is my view, that it is time to introduce a different approach to weed problems in general and crop competition in particular. Using the new tools of biotechnology and collaborating with a wide range of scientists with relevant expertise can make us more aware of the nature of complex plant features such as competitive ability.

Returning to plant competition and the question of how to close the gap between weed scientists and breeders, the first and most important answer is to learn how breeders think and try to tackle weed problems with breeding in mind. In principle, a competitive plant has features that provide increased fitness. Some of these traits are species specific or are weedy characteristics and can therefore not be manipulated for crop competitive ability. Several, however, are genetically driven and may therefore be manipulated if the right information is found through research. This information will be found if weed science research is designed to deliver tools for subsequent breeding. Some examples include:

1. *Discovery, identification and demonstration.* The aim is to identify one or several target traits and to reveal the genetic variability in the crop. From traditional competition studies, we already know that such traits can be features like relative leaf area expansion rate, early growth pattern, height, allelopathy, and so on. Laboratory, greenhouse, and field experiments must be done to isolate the parameter under study and to create a picture of how the variability is expressed in the field. Development of screening procedures and selection of indicators are important discovery steps. An approach that has been successful in *Oryza glaberrima* (African rice) is to design a growth pattern that will compete well with weeds and then work backwards from this ideotype of the crop (Bouaké, Côte d'lvoire: West Africa Rice Development Association, Annual report, 1996). This approach allows the breeders to start selection immediately because a range of desirable growth characteristics have been identified in the ideotype. However, this process selects for growth characteristics and still leaves physiological traits (e.g., nutrient acquisition capacity, nutrient efficiency, allelopathy) to be optimized.
2. *Mechanistic studies.* After the demonstration of variability, studies to reveal the underlying mechanisms must start. This is true multidisciplinary science.
3. *Interactions and managerial interventions.* The environment influences expression of genetic characteristics. Apart from geographic and climatic conditions, for agriculture, this also includes crop management practices. Understanding the interactions of different factors in the cropping system related to weed competitiveness is necessary to optimize crop competition. Changes in cultural practices will influence crop performance.
4. *Genetics.* Geneticists and plant breeders must be involved at an early research stage to identify the genes encoding for the characteristics to be improved. Breeders also need to be consulted throughout the research to identify useful indicators. This is important, because breeders will not include character that cannot be selected for.

Much of what has been mentioned is already done in weed science, but we need to do all of it and be in touch all the way through the research process. Weed scientists can learn a lot from plant pathologists and entomologists about defining a problem and creating multidisciplinary teams to solve it. I think it is our responsibility as weed scientists to take the lead. Targeting the goal of weed-suppressing crop cultivars or even weed-resistant cultivars could broaden our science as well as reduce dependence on herbicides.