Foreword

When one is privileged to participate long enough in a professional capacity, certain trends may be observed in the dynamics of how challenges are met or how problems are solved. Agricultural research is no exception in view of how the plant sciences have moved forward in the past 30 years. For example, the once grand but now nearly forgotten art of whole plant physiology has given way almost completely to the more sophisticated realm of molecular biology. What once was the *American Society of Plant Physiologists'* is now the *American Society of Plant Molecular Biology*; a democratic decision to indemnify efforts to go beyond the limits of the classical science and actually begin to understand the underlying biological basis for genetic regulation of metabolic mechanisms in plants. Yet, as new technologies open windows of light on the inner workings of biological processes, one might reminisce with faint nostalgia on days long past when the artisans of plant physiology, biochemistry, analytical chemistry and other scientific disciplines ebbed and waned in prominence.

No intentional reference is made here regarding Darwinism; the plant sciences always have been extremely competitive. Technology is pivotal. Those who develop and/or implement innovative concepts typically are regarded as leaders in their respective fields. Each positive incremental step helps bring recognition and the impetus to push a scientific discipline forward with timely approaches to address relevant opportunities.

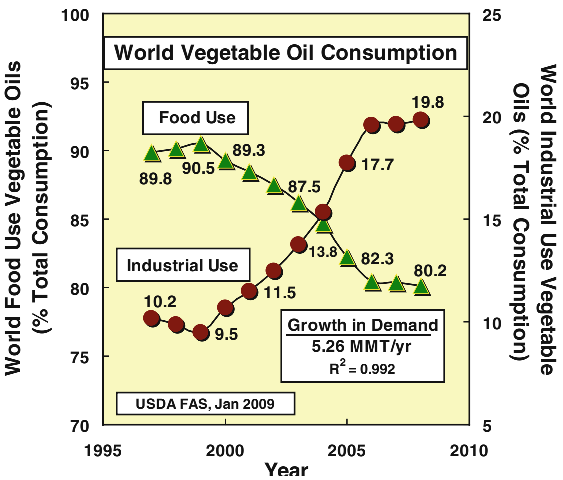
So, it might be interesting to know how those skilled in the art of statistical analysis and the field of classical plant quantitative genetics are coping with the intensifying research emphasis on biotechnology, genomics, proteomics, and the like. After all, high-throughput whole genome sequence analyses and advanced bioinformatic resources for gene discovery will soon render the characterization of haplotypes, in entire germplasm collections and among progeny of segregating breeding populations, a routine event. Will the day come when breeders are told which parents to mate for a particular objective? No doubt an interesting dialog will ensue, but by-in-large taking the mystery out of plant science should be viewed as a good thing for all the constituent professions.

Is a physician's ability impaired by the advent of new diagnostic technologies and a more effective range of pharmaceuticals? Even a NASCAR driver benefits from all of the computerized signals that monitor every aspect of a race cars performance. So, it is the same for breeding and quantitative genetics. Knowledge and skill are still needed to associate phenotypic traits with a haplotype. Ability is still required to reduce all of these ancillary tools to successful practice. Thus, the renaissance that is underway will position plant quantitative genetics to emerge with increased capacity to provide solutions to major problems and address the needs of world agriculture in a timely manner.

What are those needs with regard to oilseeds? Based on world production, USDA Foreign Agricultural Service reports show that soybean (56.0%), rapeseed (13.4%), cottonseed (10.1%), peanut (8.1%), sunflower (8.0%), and palm plus palm kernel (2.8%) are the major oilseed crops. These commodities represent essentially the entire commercial source of vegetable protein and oil. Annual world consumption of vegetable oil has averaged about 90.0% of total vegetable oil supply since 1997, leaving on average enough end-of-year stocks for about a 30-day buffer; whereas annual world use of oilseed meal has averaged about 95.7% of total supply, leaving on average a carryover equivalent to about an 11-day cushion of meal. These trends suggest that consumer demand for these products is limited only by availability, and that any natural disaster that may limit oilseed production could severely compromise the global food chain.

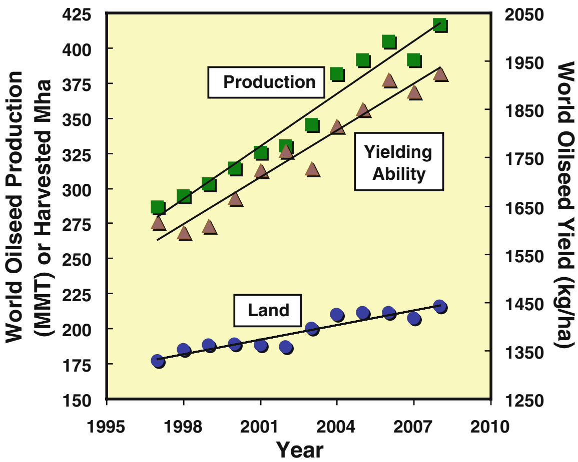
Although crushing capacity has expanded significantly in the US and abroad, the proportion crushed has averaged about 81% of total world oilseed production for decades. Considering the need to service export markets, a significant escalation of oilseed crush levels to increase the supply of meal and oil is unlikely. Hence, the greatest need that oilseed breeders face is simply to ensure a sufficient oilseed supply to meet the elastic demand for protein and oil; which on its own merit is a major contribution to alleviate world hunger.

However in recent years, a number of constraints have emerged that could mitigate efforts to increase global oilseed production for food use. The most prominent factor is renewed interest in vegetable oil as a source of biodiesel fuel. This concern recognizes that annual global vegetable oil resources could barely make a dent in the demand for energy. However, as shown in the adjacent figure, the market forces that direct food and industrial demand for



vegetable oils appear to have established a temporary equilibrium at about 80% (food):20% (industrial). Perhaps this will hold long enough for appropriate adjustments in markets for oilseed products. In addition, breeding efforts to develop varieties for commercial production of industrial oilseeds like lesquerella, cuphea and various non-food biotech innovations should help stabilize this situation.

Achieving greater genetic gain for oilseed productivity may be a lesser priority to some in the oilseed industry who subscribe to the paradigm that farmers will expand harvested area to increase the production of oilseeds. However, in view of escalating costs of oilseed production and competition for land from non-oilseed crops, the flexibility of countries to devote more agricultural resources to oilseeds remains to be seen. At this time, the rate of increase in harvested area since 1997 may be the best estimate of how much more harvested area might be available in future years. Regression analysis of these data in the figure below estimates the rate of increase at +3.45 Mha per year (R^2, 0.88). Assuming continuation of a linear trend, there might be a total of 258 Mha in global oilseed production in the year 2020, an increase of about 41 Mha over the level in 2008. One must wonder if this would be enough to make a significant difference.



Questions about future levels of harvested area place more pressure on the remaining variable in the yield equation for increased production. Regression analysis of these data in the adjacent figure estimates the rate of increase in world oilseed production at +12.5 MMT per year (R^2, 0.96). Assuming continuation of a linear trend, there might be a total of 704 MMT in global oilseed production in the year 2020, an increase of about 196 MMT over the level in 2008. Again, using simple arithmetic and assuming 258 Mha would be available to harvest, the world average oilseed yield in 2020 could be about 2.7 MT per ha (or 3.2 MT per ha if no additional land became available). Reaching that plateau would require a 40% increase in average total oilseed yield (70% without the projected increase in land) given an average global oilseed yield of 1.9 MT per ha in 2008.

In the past decade, average global oilseed yield has increased only 20%. Therefore, it appears that a great deal is riding on the development and application of oilseed biotechnology and genomics in the next decade. These technologies should enable quantum leaps in genetic progress. However, it all depends upon a renaissance in quantitative genetics and the application of those technologies now and by the next generation of public and private oilseed breeders. Perhaps, it would be wise to redouble the effort to train and deploy that future workforce now.

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