AG PROFESSIONAL

WEEDS HURT LIGHT QUALITY

Red/far red light has impact on corn and soybean's yield potential.

by Richard Keller, editor
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The quality of light detected by a field crop as it emerges and grows during the first few weeks of its life may be a yield-limiting factor, which Canadian weed scientist, Clarence Swanton, Ph.D., began researching more than five years ago.

Swanton began investigating how corn plants react to having other green plants nearby as they emerge and grow. By controlling all environmental aspects in greenhouse settings, Swanton and his graduate assistants at the University of Guelph, Ontario, measure crop plant reactions to different ratios of red and far red light reaching the plant. The far red light is basically the reflected red light and not the optimum light that comes directly from the sun. The larger the red/far red ratio the better for the crop plant to develop.

By having weeds near a crop plant, far red light is reflected to the plant from the weeds, which has major ramifications from crop emergence through the total life cycle and yield of the crop.

Swanton has concluded that "early season weed control is important not because weeds compete directly with corn for resources but because weeds change the light quality environment of developing corn seedlings.

"What we are finding consistently in our research, which we've expanded into soybeans from the initial research in corn, is that there are three things happening across these two crops. One is that we are getting a delay in the development of the plant-the rate of leaf appearance is affected. Two, we are finding that the total above ground weight of the plant is lighter. Three, we are also finding that the total biomass of the roots is lighter. These are the common responses we are seeing," Swanton said.

"Once a plant pokes out of the ground, it is sensing its external environment," Swanton added. His research indicates that allowing weeds to emerge with crops results in the crop plant reacting within hours-detecting neighboring weeds because of the light quality. This quick reaction may result in non-recoverable yield loss.

Swanton's research and conclusions are consistent with non-crop discoveries such as the findings of another scientist, Susan Dudley, Ph.D., plant ecologist at McMaster University in Hamilton, Canada.

Her research shows that Great Lakes sea rocket plants can distinguish between related plants and competitor plants. If a sea rocket detects non-sea rocket plants, it grows aggressively sprouting more roots than normal to deter the competitor, but it doesn't do this if the neighboring plants are other sea rockets. Dudley has expanded her research and found at least three other plant species that she said can recognize relatives and competitors.

Indications are that the sensing is, at least in part, related to changes in the light detected by the plants.
Swanton said, "One thing that is unique to our study is that we are trying to link to plant competition and ultimately weed management in field crops. It is a bit of a niche that we have. A lot of people have looked at the effect, but we are trying to bridge across to look at competition in a different manner."

Yield Loss and Light Ratios

All the research comes down to support that the most critical period for weed control in corn is from the three-leaf stage to the eight-leaf stage. "Yield loss is fast and it is lost forever in corn and soybeans," Swanton said.

The rule to follow in crop production based on Swanton's research is that fields need to be competition free very early. "We want the crop to come up into fairly clean conditions,

and we know that as the plant grows, providing that the field stays clean for the critical period, later emerging weeds are not part of the yield equation. They might be part of the harvestability equation, but they are not part of the yield equation," Swanton said.

Detecting the differences that Swanton and his colleagues have discovered-less total above ground weight of the plant and lighter total biomass of the roots-requires precise measurement, but those small differences can make a big difference by the end of the crop's life cycle. Visual observation in general cannot detect the differences, Swanton said.

Other aspects of Swanton's research relates to red/far red light ratios pertinent to high-density planting and a crop plant's reaction to light predisposing it to not tolerate later-season stresses.

"Why is it that some hybrids can respond to high density and some fall apart under high density, and why is it that we haven't been able to move into planting corn at higher density? You are putting a lot more corn plants in the field, and the seed isn't cheap, but the yield benefit from high density is pretty marginal. Where does the yield go when you move to high-density corn? I think the quality of the light may be part of that story," Swanton said.

As far as the stress situation, Swanton said, "Right now we are trying to explain whether this change in the plant structure [because of a low ratio of red/far red light] predisposes it to stress. So, whether you breed plants to be water tolerant or drought tolerant, we don't know how this could be affected by the light reaching the plant."

Measuring the Light

Where all this measurement of red and far red light is going to eventually lead isn't completely clear at the moment, but more and more people in agriculture realize that light quality is playing a bigger part than recognized in the past. That is why one company has already developed a red/far red hand-held measurement unit. Spectrum Technologies, Inc. is marketing the Field Scout Red/Far Red Meter.

Uses for the meter are easily identified for controlling the ratio of light reaching plants in greenhouse production and allowing golf course superintendents to adjust factors affecting the growth of grass on greens.

What isn't as straightforward yet is the use of the meter for row crops, although the meter is likely to become a handy tool for weed scientists and research agronomists.

Mike Thurow, president of Spectrum Technologies, said he can see a progressive crop consultant using the meter to learn why one hybrid performed better than another one and using that data for following year planting recommendations.

"From a practical standpoint, those consultants who are tech savvy could do some trials of different populations with different varieties and measure to see what the red/far red ratio is and how it changes. Then they could compare their notes to the yields.

"There has never been an easy-to-use hand-held meter to measure the ratio and start the journey of determining what it means," Thurow said.

The journey is also far from done by Swanton, who will be releasing more findings after the 2008 harvest.

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