

By Steve Werblow

AGE OF BIOLOGICALS

Microbials and biopesticides begin a new era



Biopesticides aren't new—*Bacillus thuringiensis* (Bt) hit the market back in 1938, and the past couple of decades have seen waves of rhizobia, other microbes, and biopesticides harnessed to aid crops.

But a couple of recent releases and a peek up the pipeline indicate that the biologicals industry is about to burst with new innovations. Those products are coming right on time for farmers faced with increasing public scrutiny of their inputs, growing resistance to existing crop protection products, shifting pest pressure, and the relentless search for yield increases.

Part of the boom is the result of billions of dollars of investment in small biotech companies over the past decade by the crop protection industry's heavy hitters and venture capitalists. Just as important, new DNA-analyzing technologies allow companies of all sizes to peer deep into the mysterious world of microbes and plants.

"It's like having the Hubble telescope," says Gwyn Beattie, plant pathology professor at Iowa State Uni-

►**Left:** Cutting-edge lab equipment provides a deep look into microbial activity, helping pinpoint useful compounds, and providing unprecedented insight into modes of action.

versity. "We knew there were stars out there, but now we can see the different stars and see the groups. We can count the abundance of these types of organisms and see which ones exist together, allowing us to correlate the organisms with the benefits."

That's revolutionized product development in the biologicals sector, helping scientists pinpoint important microbes, identify what they produce, and understand how they affect plants.

Black box. "Before, you had a microbe and it was a black box—you had to figure out what it was making," says Pam Marrone, head of Marrone Bio Innovations and founder in the 1990s of biopesticide pioneer Agra-Quest. "Now we know there's this gene cassette for this chemical. But just because the microbe has the gene doesn't mean it's always expressing it. We look for bioactivity up front, and then we look for the genetics."

With that approach, her team has analyzed 18,000 microbes for pesticidal and growth-promoting activity.

The results are products like Grandevo, which kills target insects and interferes with their reproduction much as conventional insecticides do, or Regalia, which activates crops' own defenses to ward off diseases.

At Bioconsortia, scientists use computer-driven analytical tools to identify microbial DNA that appears in successful treatments when groups of soil microbes are introduced to plants grown under stressful conditions.

"What is unique and very elegant about our process is we actually operate much more like plant breeders than microbiologists," says CEO Marcus Meadows-Smith. "We use an itera-

►**Above:** Protecting potatoes (left) starts with studying microbes that affect the crop. ►**Below:** Pam Marrone helped pioneer modern biopesticides and continues developing new ones.





tive process, growing plants over and over again under stressed conditions such as drought, nutrient, pest, or disease pressure. At each step, the whole microbiome is taken from the highest-performing plants, which have selected the best team of microbes.”

Delivery systems. Ultimately, those teams of microbes that improve nutrient-use efficiency or drought tolerance will be isolated, multiplied, and applied as a seed treatment so the plant and its microbial companions can develop together throughout the season.

“You’re putting on a very tiny input, then that microbe colonizes and continues to grow with the plant, whereas when you put on a chemical, it will give you a zone of protection, then the roots will grow out of that zone,” explains Meadows-Smith.

Bee Vectoring Technology (BVT) is also working on microbial products, starting with a fungus called *Clonostachys rosea*, with an added twist—BVT’s delivery system is also

►**Top:** Trials on tough weeds at Marrone Bio Innovations could yield reinforcements for beleaguered herbicides. ►**Above:** Biologicals have targeted insects since Bt launched in 1938.

biological. The fungus is carried by bumblebees to the flowers of blooming crops. There, it colonizes and prevents the establishment of pathogens like *Botrytis* or *Sclerotinia sclerotium*.

Using bumblebees as delivery drones boosts pollination, reduces active ingredient load to a few grams per acre, and continually refreshes the application, notes BVT CEO Ashish Malik. Bumblebees are easy to handle, he adds, and commercial bumblebee boxes are widely available.

BVT bees showed great promise in battling *Sclerotinia* head rot in a research field trial of sunflowers, notes plant pathologist Venkat Chapara at North Dakota State University’s Langdon Research and Extension Center.

Adequate fungicide coverage is hard to achieve because the crop’s

heavy heads tend to nod downward, away from the application, but bees fly right to the target, Chapara notes.

In his sunflower trial last year, Chapara saw an 8.4% increase in seed yield where BVT’s system was tested.

Chapara adds that using a tool like BVT’s *Clonostachys* to combat *Sclerotinia* in sunflowers could help reduce resistance pressure facing many groups of fungicides, which are vital to fighting the same pathogen in the area’s canola, soybeans, and pulse crops.

Test drive. With few new chemicals in the pipeline and many products desperately fending off resistance, this could be biologicals’ time to shine.

In the 1990s, a wave of biopesticides was largely upstaged by chemical superstars like strobilurins and neonicotinoids. Today, marketers of biologicals are trying to minimize hype as they position products that often operate subtly and out of view.

A new microbial seed treatment, Acceleron B-300 SAT, will be included

►**Above:** Almonds are ideal for biologicals—valuable, bedeviled by insects and pathogens, and grown by farmers with experience in integrated pest management. ►**Above left:** Insect trials test new biological modes of action.

at no extra cost on 2017 releases from DeKalb, Channel, and regional Monsanto seed brands. Its active ingredient, *Penicillium bilaiae*, introduced by The BioAg Alliance—a Monsanto/Novozymes collaboration—enhances nutrient uptake by corn roots.

Monsanto spokesman John Combest says the company’s strategy is “getting folks to experience this microbial technology and getting these microbes to work with really good, proven, conventional seed treatments.”

At Iowa State, Beattie is bullish on biologicals, but cautions growers not to expect to be dazzled. That’s especially true for products like SAT-300, which Monsanto says has provided a yield bump of 3 bushels per acre, or Indigo Agriculture’s microbial seed



►**Above:** Innovation comes from small start-ups as well as agrichemical giants, says the Biopesticide Industry Alliance’s Kevin Jones.

treatment that helps cotton withstand drought—a benefit that only becomes apparent during dry seasons.

“The benefits of many of these are going to be in specific conditions,” she notes. “It’s not a magic bullet. It’s incremental. But in a lot of situations, incremental is what we need.” ■