



Dr. Ralf-Udo Ehlers was leading a research team at the University of Kiel in the 1990s, seeking to find a way to successfully culture insect pathogenic nematodes in a bioreactor. Like many of his colleagues, he recognized the potential value of EPNs as biocontrol agents if only a cost-effective process for producing them could be found. As a result of the success of his efforts, he and two colleagues, Dr. Arne Peters and Mr. Tillmann Frank, founded e-nema GmbH in 1997 to commercialize the results of their scientific work and contribute to making plant protection more environmentally friendly. e-nema is unique in that it has focused exclusively on producing and commercializing EPNs from its beginning. Initially located in a small facility with just two bioreactors of 500 liters near the University of Kiel, today e-nema is a successful medium sized company with bioreactors ranging from three to 60,000 liters in capacity.

Where do EPNs fit in the overall biocontrol market – are they part of the macro-organism sector?

They are macro-organisms. EU registration authorities developing 1107/2009 wanted to classify nematodes as micro-organisms

Interview with Dr. Ralf-Udo Ehlers, e-nema (Germany)

and include them into the registration process because of the presence of their bacterial symbionts. An initiative of all EPN researchers in Europe (COST Action 819) together with the EPA (USA) managed to persuade them to take EPN out again. All macrobials carry symbionts. Microbiomes are everywhere. Consequently, they would have ended up regulating insects and mites as well, which would have completely exaggerated related risks. It was a wise decision to exclude EPN from the PPP regulation, as it left us with a lot of flexibility quickly responding to upcoming pests and enabled us to build our business. Would EPN have had to be registered like micro-organisms, e-nema GmbH would not exist. No family start-up can afford costs related with registration.

How do you see the EPN market today and what portions of it are growing the fastest?

The current global biocontrol market for macro-organisms is valued at between US\$450 million and US\$600 million with EPNs representing about 7.5% to 10% of this total. The EPN market is growing at about 11% per year with the largest opportunity for growth coming from use in arable crops.

Most EPNs come from either Heterorhabdus or Steinernema genera. Has the potential for EPNs been adequately explored?

The potential is much larger than currently exploited. EPNs are still mainly used in niche markets. But with the phasing out of neonicotinoids and other insecticides, the need for effective control measure, particularly in cryptic environments, will grow. EPN efficacy

already outcompetes many of the soil insecticides and there are many more targets in horticulture and arable crops.

Are there new developments in delivery systems for EPNs? Could this approach help to expand the market?

Application technology is crucial to secure the success of EPNs and can help to overcome limitations caused by limited resistance of EPNs to environmental extremes. Nematodes stop moving at relative humidity below 99% and die when exposed for longer to lower values. Hence, EPNs need to be applied to moist soil, otherwise they desiccate and die. In many crops, irrigation systems can supply appropriate amounts of water for EPNs application and nematodes can be fed into these systems for delivery through the drip or overhead irrigation. When used on the plant canopy, the environment needs to be moist for approximately 3-4 hours, which is no problem in greenhouses, but in outside environments this limits the market potential. For successful control in outdoor environments special application technology is required to minimize the application density and the amount of water. For control of the corn rootworm we have developed a special application technology mounted on the seed machine. We inject nematodes into the furrow during seeding with a minimum of water and thus are able to offer EPNs at the same price of granular chemicals. The technology is cheap and easy to adapt. A genetically improved strain with prolonged persistence and enhanced virulence against the Rootworm provides better control results than currently applied chemical prod-

ucts. Adapted application technology and improved genetics thus play a major role in making EPN a success story.

Production methods for EPNs has been at the core of e-nema success.

Do the special handling requirements for juvenile nematodes make it more challenging for distribution to handle these products?

Production in liquid culture is currently done in volumes of up to 50 cubic meter and will be further up-scaled in the near future. Exploitation of economies of scale come to a limit. What increases the product costs is process duration of up to 14 days and failures due to technical or biological problems. EPNs need cooling during transportation. Logistics can be organized, but also significantly contribute to product costs when shipments go overseas. Within the USA or Europe products reach the producer usually within a day. Requirements for logistics limit the application of EPNs products to countries with well-developed infrastructure. Among the microbial products EPNs are easy to handle. Compared to synthetic PPPs the effort is much higher.

Successful use of EPNs by the end user requires training and technical advice. How does e-nema approach this?

Yes, without a profound training our distributors would not be successful in the market. We have produced detailed instructions for application and provide video clips on YouTube to support the correct application of EPN products.

Market access is often a limiting factor for many biopesticide technologies

with many new technologies emerging from small start-up companies that lack a strong distribution network. Is this an important factor for the EPN producers as well?

Or do you feel most EPN companies have successfully established a good distribution network and market access for their products?

Our 'competitive partners' in the market are BASF and Koppert. Both dispose of a well-developed distribution network. Still there are many other potential distributors in the market, which are a partner of our SME. e-nema is THE nematode company. Apart from contract production of microbial biocontrol agents, our core business are EPNs. We have eight senior scientists working with us out of 50 employees. Our knowledge in EPN is supported by 30 years of research in EPN biology, production, storage and formulation, safety, distribution, application technology and breeding. We are innovative, concentrating on a continuous improvement of our EPN technology. That qualifies us as the largest producer and most competent partner in EPN.

There has been substantial merger and acquisition activity in the biocontrol sector overall, but few of these have involved companies focused on EPNs.

Why do you believe there has not been as much M&A activity in the EPN sector?

Although BASF has taken over Becker Underwood with its successful EPN program, I agree that EPNs seem to be less attractive for take-overs. EPNs were the smallest share of this deal. I guess that most offers we received were motivated by the possibility to get access to our biotechnological production facilities. We are an independent player in the market of service providers. Many companies have identified us as competent partners to produce and further improve their microbial biocontrol products. It would not be wise to join with a single player in such a situation. We make a good living from our business and we hope to be able to continue supplying environmentally friendly and effective biological control products composing of nematodes, bacteria, fungi and yeasts to our partners and the agricultural sector in the future. It is fun to work in biocontrol.