Dear reader

Biologicals are still a long way from the mainstream! Although organic crop protection agents and biostimulants are now on everyone’s lips and are being widely discussed, they account for only a few percent of crop protection treatments worldwide. And just why is that? On the one hand, there are still certain gaps in biological control agents when it comes to covering all crop protection issues but, on the other hand, solutions which have only recently become available have not been implemented for long enough. Intelligent biological crop protection requires a systemic perspective and not least of all expert knowledge that still needs to be brought to the crop producers!

The Andermatt Biocontrol Group is constantly developing new solutions (such as Loopovir) and introducing them to crop producers via their own subsidiaries or their distributors. It is now also represented in Germany (Biofa AG) and in Kenya (Madumbi East Africa Ltd) through its own subsidiaries.

We are convinced that our commitment is making an important contribution to sustainable agriculture and with this we are continuing to pursue our major goal of developing meaningful biological alternatives and making them available to producers – so that they can produce healthy foods in a healthy environment.

We hope you enjoy reading these articles from the Andermatt Biocontrol Group.

Daniel Zingg  
CEO
From the customer's wishes to market launch and beyond

The development of a microbial pesticide involves many individual steps. A close cooperation with our partners is an absolute must in this mission. This is the only way to achieve a sustainable solution quickly and in a targeted manner.

1 At the start, we are faced with a problem that lacks a solution: Pests or fungal diseases can cause devastating crop failures. In close collaboration with our partners, we try to identify which problems farmers are most concerned with and the solutions that they most urgently need. This information can help us to assess which problems are the most significant and where best to invest our development and registration efforts.

2 The research begins: Possible solutions are first discussed in interdisciplinary project teams. If the initial situation looks promising, the research and development department then starts a feasibility study. If all goes well, a first test product can be produced and evaluated in the lab; at this stage research institutions are often involved.

3 Life in the field: The formulated product must then be proven for the first time in a field trial: Can it withstand UV radiation? Does the product adhere well to leaves? In collaboration with our partners, it is then evaluated to determine whether its effectiveness meets our requirements. In addition, we also discuss the desired formulation and type of packaging with our customers to suit their needs. This ensures that the greatest possible practicality can be achieved.

4 New regulations come into play: Just as with a drug, a crop protection agent needs to be approved so that only safe and qualitative products reach the marketplace. For this purpose, data and information for assessing risks is compiled in a registration dossier. Exchanging information with the authorities prior to submission of the dossier helps with the planning of the studies.

5 The heart of the dossier: The indications, application time-points and waiting times between the last application and the harvest are important components of the dossier and are summarised, so that corresponding studies can be generated. Since our customers are best at knowing their needs on the ground, interaction with them is absolutely essential for acquiring above information.

6 Generation of data: The majority of the data for the registration dossier is collected from external, qualified laboratories who have a great deal of experience and know-how about microbial products. This includes the molecular biological identification of the microorganism, studies to exclude human toxicity, ecotoxicological assays to ensure safety for non-target organisms, residue studies on the harvested products, studies on environmental persistence, microbial contaminant testing and storage stability, efficacy studies, and relevant basic research as stated in the dossier.

7 Compilation of the dossier: The dossier is compiled according to the latest guidelines of the authorities and ultimately contains up to fourteen files that are submitted to the registering authority.

8 Evaluation of the dossier: In most countries, approval of crop protection products occurs in two steps, i.e., the registration of the active substance and the subsequent approval of the formulated product. The authorities then evaluate the completeness and content of the documents. Through constant interaction with the authorities and rapid handling of any subsequent issues and requests, we always strive to push forward this evaluation process. Although this process is very time-consuming, it only serves to make the pleasure of receiving a new approval all the more gratifying!

9 Only a correctly applied product can work properly. Together with our distributors and customers, we develop suitable application strategies so that they are then able to bring about the best possible results. We discuss miscibility with other products, or the positioning of an application within an integrated crop protection strategy.

10 Further development can only be ensured by the user: A close collaboration with early users during product development is very important to us. Their pioneering efforts can sometimes lead to new applications being discovered, meaning that other growers can also profit from this experience.

11 We stay on the ball: If our customers determine that they need further uses/indications we can then extend the authorisation, and in some cases additional post-registration data will be submitted. In addition, authorisations of active substances and products often have to be reassessed after a certain period of time. The costs and duration of the approval process can often prevent the market development of many useful biological products for niche markets and cultures. But here, too, we stay firmly on the ball, by seeking discussions with the authorities and looking to find customer-oriented solutions for the future.

From the customer's wishes to market launch and beyond
Biofungicides on the rise

Great progress has been made in the development of new biofungicides and strategies for managing fungal diseases. Their advantageous profiles in terms of absence of residues and anti-resistance management make biofungicides a welcome option in conventional cultivation.

For a long time, the traditional biofungicides copper and sulphur enjoyed almost exclusive use. In recent years, however, various alternatives have meandered their way into biological and conventional crop protection strategies. The drivers for this development are the growing organic market, the search for alternatives to the controversial active ingredients sulphur and copper, but also the advantageous profiles of biological fungicides with regard to residues and resistance.

Plant strengtheners

The term plant strengther is fraught with difficulties both from an agronomic and a regulatory perspective. No harmonisation exists with regard to their regulatory handling in different countries. In Germany, there is a separate list for strengtheners, but in other countries the products listed are often neither classified as fertilizers nor, in the absence of dosiers, as crop protection agents. Under the term plant strengthener much is advertised and claimed. From substances with a good partial effect to those whose contents and effects have only been poorly studied.

Elicitors

Several plant strengtheners and specifically developed plant protection products contain elicitors (see box). Andermatt Biocontrol has registered the product FytoSave with the active ingredient COS-OGA for the Swiss market. The induction of defence mechanisms before a first fungal attack is of decisive importance here. As a result, preventive and regular treatments are required every 7 to 14 days so that the induced defences can be maintained at a high enough level. FytoSave is used as a complementary component of a fungicide strategy against downy and powdery mildew in vines, cucumbers and tomatoes. Its application becomes particularly attractive when the efficacy of other fungicides can be increased and their application rates be reduced.

Classic and novel contact fungicides

In addition to copper and sulphur, sulphaoryl clay earth and fennel oil, in particular, have been used for some years now and are playing an increasingly important role. Potassium bicarbonate was the next fungicidal active ingredient subject to approval. And for the combat of powdery mildew, Prev-AM (orange oil, not FiBL-listed in Switzerland) has also become available recently. Interesting for IPM-strategies are also the secondary effects on downy mildew and botrytis. Common to all of these agents is their ability to act as a contact fungicide without any systemic effects. This means that biofungicide strategies must be adapted according to the weather. The treatment intervals are timed according to predicted infection states, wash-off and leaf growth. In climate zones with high precipitation, this leads to more intensive treatment strategies. However, for many users the advantages provided by the favourable user and environmental toxicity, the lack of residues on crops, and the reduced risk of developing resistance far outweigh any such disadvantages.

Today, Vitisin (potassium bicarbonate) and Curario (lime sulphur) are two crop protection products for orchards which can be curatively applied to germinating fungal spores right up until a few hours after an infection event.

Microbiological products

For a number of years biological botryticides have been the subject of intensive research. The first products with microbiologically active ingredients, such as Aureobasidium pullulans, Bacillus amyloliquefaciens and Gliocladium catenulatum, have been approved. Further microorganism products shall follow (see also article page 9). The effect under central European conditions often lies within the partially effective range. Nevertheless, such new solutions may prove to be important in light of the already identified and sometimes major resistance problem associated with chemical agents, especially in berry production.

The biological control of plant pathogens is currently widely possible. However, in practice, the individual solutions must be better packaged into concepts, whereby not only the right sequence and combination of biofungicides lead to success, but are in addition complemented by better crop management, by breeding of more robust varieties, as well as closer monitoring and precision farming.

Biological fungicides with registration in Switzerland – an overview

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Active Ingredient</th>
<th>Category</th>
<th>Targeted diseases</th>
<th>Residue freea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wettatable sulphur Stutis</td>
<td>Sulphur 80%</td>
<td>Inorganic</td>
<td>Powdery mildew, apple scab</td>
<td>+</td>
</tr>
<tr>
<td>Azone</td>
<td>Copper hydroxide, -sulphate</td>
<td>Inorganic</td>
<td>Downy mildew, apple scab</td>
<td>+</td>
</tr>
<tr>
<td>Fenicur</td>
<td>Fennel oil</td>
<td>Plant oil</td>
<td>Powdery mildew</td>
<td>+</td>
</tr>
<tr>
<td>Vitisin</td>
<td>Potassium bicarbonate</td>
<td>Inorganic</td>
<td>Powdery mildew, apple scab</td>
<td>+</td>
</tr>
<tr>
<td>Prev-AM®</td>
<td>Orange oil</td>
<td>Plant oil</td>
<td>Powdery mildew, downy mildew, botrytis</td>
<td>+</td>
</tr>
<tr>
<td>Curatio</td>
<td>Lime sulphur</td>
<td>Inorganic</td>
<td>Apple scab</td>
<td>+</td>
</tr>
<tr>
<td>Myco-Sin</td>
<td>Azotobacter</td>
<td>Inorganic</td>
<td>Powdery mildew, downy mildew, apple scab</td>
<td>+</td>
</tr>
<tr>
<td>Amyla-X</td>
<td>Bacillus amyloliquefaciens</td>
<td>Microorganism (bacterial)</td>
<td>Botrytis, downy mildew</td>
<td>+</td>
</tr>
<tr>
<td>Prestop</td>
<td>Gliocladium catenulatum</td>
<td>Microorganism (fungus)</td>
<td>Botrytis, soil-borne diseases</td>
<td>+</td>
</tr>
<tr>
<td>Botector</td>
<td>Aureobasidium pullulans</td>
<td>Microorganism (fungus)</td>
<td>Botrytis</td>
<td>+</td>
</tr>
<tr>
<td>BiospenProtect</td>
<td>Aureobasidium pullulans</td>
<td>Microorganism (fungus)</td>
<td>Fire blight, postharvest diseases</td>
<td>+</td>
</tr>
<tr>
<td>FytoSave</td>
<td>COS-OGA</td>
<td>Bacterium</td>
<td>Powdery mildew, downy mildew</td>
<td>+</td>
</tr>
<tr>
<td>Alginurea</td>
<td>Potassium phosphate</td>
<td>Inorganic</td>
<td>Downy mildew</td>
<td>+</td>
</tr>
<tr>
<td>Conturs</td>
<td>Coniothyrium minitans</td>
<td>Microorganism (fungus)</td>
<td>Sciarina</td>
<td>+</td>
</tr>
</tbody>
</table>

1 Refer to label for registered uses
2 According to the Swiss Federal Legislation
3 Not on the FiBL list of organic production
4 Not listed as EU legislation of organic production

How does resistance induction work?

Plants have the ability to defend themselves against infection by bacteria, fungi or viruses. The plant recognizes invading pathogens via elicitors. Elicitors are plant-own (endogenous) components or components of pathogens (exogenous), which are recognized by receptors in the plant cells, trigger a signalling cascade and the reactions required for defense. This mechanism is also referred to as induced resistance.

Martin Günter
Andermatt Biocontrol
From spray plan to strategy
Crop protection strategies are not set in stone, and must be continuously adapted to the prevailing circumstances. The use of crop protection agents alone is often not sufficient. Integrated crop protection concepts involving preventive and indirect measures are now in demand.

Active ingredients are disappearing from the market
In recent years, many active ingredients have not been re-registered due to their unfavourable toxicological profiles. Not all of them could be substituted easily. Often it is suppos-
edly "small" products, such as the active ingredient cyroma-
zine, which have caused voids in spray plans. As a result of this, the strategy against tomato leafminers was one-sidedly geared towards the active ingredient spinosad (Spintor). The result was a reduction in effectiveness due to the development of resistance.

Active ingredients have a reduced effect
White fly and thrips are two major pests in vegetable, berry and ornamental plant cultivation. There are currently no pesticides with strong effects against either of these. As such thrips in strawberries are not just simply thrips, but are in fact two species, namely Frankliniella intonsa and Frankliniella occidentalis. Conventional active ingredients are effective against one of these species, but not the other.

Important building blocks of greenhouse strategies

| Varieties selection: Choose fungi-tolerant varieties |
| Hygiene: Complete harvesting and removal of plant material |
| Climate control and irrigation: Fungus prevention and creation of optimal conditions for beneficial insects and insect pathogenic fungi |
| Beneficial insects: Preventive use on the entire area and targeted releases in infested foci |
| Pesticides: Targeted use of crop protection agents compatible with beneficial insects (Organic or IPM) |

New pests are appearing
Tuta absoluta, Drosophila suzukii, Nezara viridula, Halyomorpha halys: a short list of the current newcomers. In particular, the last two species, which belong to the mirid family, have taken a firm hold the preceding, rather warm years. Both pests can only be effectively reduced at this time using agents that have a significant adverse effect on beneficial insects. The use of such agents leads to an interruption of beneficial insect application and this in turn leads to a potential increase in pests that are difficult to control with pesticides (see above).

Strategies instead of individual direct measures
In order to circumvent these vicious circles with good fore-
sight, it is important to establish sustainable concepts and not to counteract any deficiencies that may materialise with isolated emergency measures (see box). These concepts should not just contain a spray plan, but should also include strategies that incorporate and sometimes even revolutionise production systems and cultivation measures.

Increased storability of produce with T-77
Botrytis spp. are one of the most significant post-harvest fungal diseases worldwide on vegetables and fruits. The control of Botrytis is not only important to increase marketable yield at harvest, but also to prevent harvested fruit and vegetables from rotting in storage.

Consumer preferences drive supermarkets to only sell unblemished produce. Having extended shelf life is there-
fore a key factor when evaluating suppliers of fresh produce. Crops can be infected throughout the growing period pref-
ably through wounds caused by e.g. pruning, hail, herbicides, senescing plant parts or insect feeding. Botrytis is also known for quickly developing resistance to commonly used synthetic fungicides. The use of different modes of action is crucial for a sustainable Botrytis control program.

Mode of action of T-77
Conventional fungicides target the pathogen preventatively, through inhibition of germination, or curatively, by the break-
down of fungal metabolism. In contrast, T-77 (Trichoderma atroviride 77B) colonizes the wounds and prevents the pathogen from entering the plant. Once the wound is colonized, T-77 can persist for as long as the wound is susceptible for infection. Furthermore, the strain used in T-77 is an extremely power-
ful mycoparasite, meaning that it feeds on certain pathogenic fungi and destroys them.

Versatile use in individual spray programs
Over the past years, multiple field trials on various crops have shown the value of T-77 not only for at-harvest reduction of Botrytis, but also for a significant decrease in infected fruit after simulated storage at cool and ambient temperatures. T-77 can be applied in a spray program with biological or chemical fungicides. Due to its zero pre-harvest interval, T-77 can be applied up to the date of harvest when many chemical fungi-
cides cannot be used anymore. The mode of action of T-77 is also efficacious when fungicide resistant Botrytis strains are present, making T-77 an ideal tool for resistance management, especially in conventional spray programs.

Trial conducted on greenhouse strawberry in Italy, 2018
Botrytis, but also for a significant decrease in infected fruit.

T-77 improves marketability of strawberries
Efficacy on controlling Botrytis after 7 days of cold storage compared to untreated control. T-77 at lowest (250 g/ha) and highest label rate (750 g/ha) both improved marketability compared to biological reference at highest label rate.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Marketability</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-77 high rate</td>
<td>86% (a)</td>
</tr>
<tr>
<td>T-77 low rate</td>
<td>50% (b)</td>
</tr>
<tr>
<td>Biological reference</td>
<td>40% (b)</td>
</tr>
</tbody>
</table>

Notes: 
(a) Significant improvement of marketability compared to untreated control (t-test p< 0.05) 
(b) Significant improvement of marketability compared to highest label rate (t-test p< 0.05)
Is the customer king? He is our partner!

In June 2018, the production, research and technical staff of Andermatt Biocontrol visited Vogt Obstbau Ltd in Remigen. During the multifaceted factory visit, it turned out that the success stories of the two companies were closely intertwined for quite some time.

Christian Vogt manages the family company Vogt Obstbau Ltd as its third-generation owner. He and his father Erwin Vogt switched their fruit production company to organic production in 1996. In the years during this switchover, numerous experiments were conducted in the apple orchards of Vogt Obstbau Ltd using new biological crop protection products from Andermatt Biocontrol. The codling moth was already very well controlled using Madex. At the time, however, no satisfactory biological solutions were available for other significant pests and diseases that reduced yields and quality, such as apple scab or the rosy apple aphid.

Building field experience in tandem

In cooperation with the staff of Andermatt Biocontrol, including Daniel Zingg, Christian Vogt carried out trials and has always been very active, conscientious and persistent in developing the optimal implementation strategy. He understood that wherever the results turned out to be inferior, the problem was not due to the product, but rather due to external circumstances. With his practical knowledge, his steadfastness and persistence, he actively supported Andermatt Biocontrol in determining the optimal application time points and intervals.

Based on tests performed by Vogt Obstbau Ltd among others, Andermatt Biocontrol was able to approve NeemAzal-T/S in 1995 against rosy apple aphid and Myco-Sin at the end of 1996 against apple scab. In the same year, Andermatt Biocontrol received its first authorisation for a mating disruption product against codling moth. Field trials at Vogt Obstbau were carried out beforehand, and other currently established mating disruption dispensers were also tested on the farm.

Foundations for further development

Through his experience gained by providing experimental support, Christian Vogt had already acquired extensive knowledge about the application of the new biological crop protection products before their launch. This enabled Vogt Obstbau Ltd to be a step ahead in organic apple production and to produce above-average quality.

Both companies are still benefiting today from more than 20 years of cooperation. The significant foundations for a healthy Vogt Obstbau Ltd and a healthy Andermatt Biocontrol were established during this time. This made it possible to make targeted investments in further developments throughout Switzerland and internationally and to press ahead with sustainable and residue-free food production.

Visitors from Andermatt Biocontrol listened closely to what Christian Vogt had to say about the early days. The exchange with Christian Vogt illustrated to our staff who our customers are, what happens to the products when they leave our buildings, and how important flawless product quality and partnership-based cooperation with our customers are. As a thank you for his inspiring contributions, Christian Vogt was handed a special bottle of Madex which had been signed by all of us at Andermatt Biocontrol Group.

Franz Bollhalder
Andermatt Biocontrol

More than a one-sided customer-supplier relationship:
With the common goal of promoting sustainable apple production, the two companies have been working as partners for more than 20 years
"Spaghetti" dispenser versus aerosol sprayer

With regard to mating disruption, the switchover to the new time-saving application methods using aerosol sprayers is causing a great deal of excitement. However, given the existing cultivation and plot structures in Switzerland, this step must be carefully considered and must always be implemented correctly.

Over the past 20 years, mating disruption has become an indispensable method for controlling the most important moth species. Major pests, such as the codling moth and the grapevine moth, can be controlled either without or with a reduced number of insecticide applications. In particular, mating disruption is also a helpful component for resistance management and reducing residues. Andermatt Biocontrol has been a driving force behind mating disruption techniques ever since its introduction onto the Swiss market. This has led to many years of experience being acquired from the work with Isonet and Isomate dispensers produced by Shin-Etsu. In 2018, the Isomate CM-Mister, an aerosol spray system against codling moth in pomefruit made by Shin-Etsu has been approved in Switzerland.

"Spaghetti" dispenser (Isonet, Isomate)
The dispensers are made of a permeable polymer that diffuses pheromones into the environment throughout the entire growing season. If the dispensers (500 to 1000 per hectare) are distributed correctly over the entire plot prior to the emergence of the moths, a uniform pheromone cloud can be formed over the plot, which protects the crop from the respective moth species.

With viticulture specific dispensers a new innovation is planned. Over the next two to three years, Andermatt Biocontrol will launch the conventional Isonet spaghetti dispenser made from biodegradable plastic, in Switzerland. The individual dispensers will no longer contain wires and will be completely degradable by soil microorganisms.

Aerosol sprayer (Isomate CM-Mister)
The pheromone cloud needed to ensure mating disruption is sprayed over two to three spraying stations per hectare. The spray modules are programmed in such a way that pheromone is released at regular intervals during the flight phase of the respective moth pests. Since last season, these aerosol sprayer systems have been approved for pomefruit production on large plots (larger than 15 hectares). This application procedure is also being considered for vineyards. However, there are still questions regarding its effectiveness against the first grapevine moth generation. This is because at this time of year, namely from the end of April till early May, hardly any foliage is present on the vines. This foliage normally helps to maintain the nebulized pheromones at a sufficiently high concentration, evenly distributed throughout the crop.

Finally, it is crucial that a uniform pheromone coverage is ensured over the entire area to be protected. This is basically best achieved using a conventional dispenser system with a high number of point sources for pheromone diffusion. The new labour-saving process using the aerosol sprayers might represent a new and interesting option for appropriate plot structures and large-scale application.

<table>
<thead>
<tr>
<th>Minimal area</th>
<th>Pheromone coverage: Area/plot</th>
<th>Spectrum of target organisms</th>
<th>Phytotoxicity</th>
<th>Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hectare isolated or 5 hectare within a cultivated area</td>
<td>Complete. Covers all generations and flight activity of pest moths.</td>
<td>All types of pest moths in vineyards and orchards as single or combined dispensers</td>
<td>None</td>
<td>Dispensers must be collected and disposed of biodegradable dispenser (from about 2000 used in winegrowing)</td>
</tr>
<tr>
<td>15 hectare or at least 5 to 10 hectare within the mating disrupted surrounding area</td>
<td>Optimal because of the large number of point sources (dispenser 5), including border coverage</td>
<td>Complete. Covers all generations and flight activity of pest moths.</td>
<td>Burns on fruits and leaves are possible near the aerosol sprayers</td>
<td>Empty aluminium bottles and electronic spray heads (batteries)</td>
</tr>
<tr>
<td>aerosol sprayers per hectare and border hanging with standard dispenser: 1-2 work</td>
<td>Complete. Covers all generations and flight activity of pest moths.</td>
<td>Restriction to individual species and combinations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Aerosol spray systems

<table>
<thead>
<tr>
<th>Minimal area</th>
<th>Pheromone coverage: Area/plot</th>
<th>Spectrum of target organisms</th>
<th>Phytotoxicity</th>
<th>Waste</th>
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<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aerosol sprayer</th>
<th>Spaghetti dispenser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerosol sprayer</td>
<td>Spaghetti dispenser</td>
</tr>
</tbody>
</table>

Constant pheromone release throughout the season

Proven dispenser quality: Isonet and Isomate dispensers show regular and sufficient release of pheromone and coverage up to the end of the growing season.
Programme for the sustainable production of healthy tomatoes

In terms of tonnage, tomato is the most important fruiting vegetable on the planet. However, there are many challenges that growers face. The programme developed by Andermatt Biocontrol aims to assist growers worldwide to produce a healthy, tasty crop.

Tomatoes are the most widely grown vegetable with a world-wide production of 277 million tonnes per year, with a CAGR of the production area of 3.1 percent over the last 10 years. Tomatoes are cultivated from tropical climates up to plateaus in the Andes, in temperate greenhouses and even in Antarctica. As varied as the production systems are, as varied are the difficulties that growers face. However, many of the diseases that affect tomatoes are distributed globally and hinder the full potential of production. Besides providing specific solutions for pests such as *Tuta absoluta*, our global portfolio also features versatile solutions for ubiquitous pests and diseases like whiteflies, fusarium wilt, or botrytis. Independent of the problem, it is important for us, not only to provide products, but to offer integrated solutions accompanied by competent technical support.

Felix Dubach
Andermatt Biocontrol

Biofa Ltd, new member of the Andermatt Group

Andermatt Biocontrol has acquired a majority stake in Biofa in Germany. Thanks to this strategic investment, we are strengthening our presence in the German market and expanding our portfolio with important biological fungicides and biocides.

The partnership between Andermatt Biocontrol and Biofa started with the mutual distribution of products in the early 1990s. The strategic reorientation of Biofa started in the year 2000, with the withdrawal of the founding family, and culminated in its transformation into today’s most successful supplier of biological pesticides and biocides in Germany. In 2003, Andermatt Biocontrol acquired a ten percent stake at first, and at the same time handed over the marketing of the granulosis virus products Madex and Capex for Germany exclusively to Biofa.

Biofa is headquartered in Münzingen in southern Germany within the Swabian Jura. Biofa holds more than 30 product approvals for the German and European market and additionally owns several distribution rights of various manufacturers. In 2011, the previous majority shareholder decided to withdraw from crop protection and Biofa completely. This paved the way for the takeover of the released shares by the two previous shareholders Andermatt Biocontrol and Trifolio-M GmbH.

The integration of Biofa within the Andermatt Group results in the bundling of future-oriented portfolios into the biological crop protection market. In addition to its products, Biofa also brings know-how in the field of biofungicides and biocides to the Andermatt Biocontrol Group. With the fungicides Vitisan (potassium hydrogen carbonate) and Curatio (lime sulphur) as well as the biocide InsectoSec (diatomaceous earth), Andermatt Biocontrol Group can now offer its market activities in Germany and Europe, and continue to invest in the development and registration of new products.
**Introduction of Cryptex by Madumbi East Africa to Kenya for management of the False Codling Moth**

The classification of False Codling Moth by the EU as a quarantine pest since January 2018 poses a threat to roses and capsicum production in Kenya for export to EU. With Cryptex, a viable solution will be available.

Madumbi East Africa is incorporated in Kenya (2018) as a member of the Andermatt Biocontrol Group. Madumbi East Africa will have access to the entire Andermatt Biocontrol portfolio which is made up of leading virus, bacterial and fungal solutions, recognised throughout the world. Madumbi East Africa is a joint venture with the local company Osarian, Kenya’s largest producer of quality roses. The company also provides microbial biocontrol agents (beneficial insects and mites) for the control of key pests in high value crops, mainly flowers and vegetables. The company vision is to be the lead in sustainable agriculture by focusing on direct technical sales with a distribution network across Kenya.

A first focus will be the management of false codling moth (FCM). FCM is currently the major pest of phytosanitary concern to the Kenyan authorities due to the threat its posing to the country’s Fresh Produce Export Industry. January to May 2018 there were 20 interceptions of shipments from Kenya to the EU due to presence of FCM, this contributed to 63 percent of total interceptions due to harmful organisms. The pest management has been focused on cultural and chemical control methods that have had limited success hence the need for a more holistic approach i.e. Integrated Pest Management (IPM) that includes use of biological solutions such as Cryptex.

Madumbi East Africa is in the process of getting approval for this pest.

The False codling moth is currently a huge problem in the Kenyan agriculture. The granulovirus product Cryptex is a safe and highly specific control tool for this pest.

**Sustainable Root and Soil Health Programs in Orchard Crops**

Soil and root health are essential for the production of healthy, nutrient dense food. The resulting plants are stronger, exhibiting increased pest and disease resistance. Early work in this field focused on annual crops, this has recently been expanded into orchard crops with significant success.

Root health is fairly easy to influence over the short term. Ideally one wants to start with treatments in the nursery and continue into the field with repeat applications every year throughout the life of the orchard. The biggest benefits are usually seen in the first two to three years after transplanting. The primary aim is to reduce the incidence of soil pathogens and stimulate root growth. The standard program of Madumbi Sustainable Agriculture (South Africa) involves the application of 500 gram T-Gro (Trichoderma asperellum) at planting or in the spring. This is followed by 500 millilitre RhizoVital 42 (Bacillus amyloliquefaciens) two to four weeks later and then two top up applications of T-Gro at 250 gram per hectare each, on the subsequent root flushes. In addition, AgriSil K50 (potassium silicate) is applied monthly through the main part of the growing season (spring and summer). When starting such a program on an existing orchard with high levels of pathogen pressure (e.g. Phytophthora), it may be necessary to first apply some form of curative treatment as all the above products are primarily preventative in nature and can not cure systemic infections already inside the root or stem.

Soil health is more difficult to influence and requires a more long-term approach. It is important to start with soil testing to build a picture of what the major problems in the soil are. Various soil health tests are available, which provide an indication of levels of soil fungi vs bacteria. This information is combined with normal soil fertility testing where factors such as pH, percent carbon, nutrient levels and ratios are considered. When combined, these test results give an overall picture of the soils current state, enabling one to make more focussed decisions on how the soil can be improved further. High pH soils with signs of phosphorous buildup and micronutrient deficiencies benefit greatly from applications of potassium humate and phosphorous mobilizing bacteria like RhizoVital 42. Similarly, low carbon soils, which are often bacteria dominant, benefit from applications of humates and T-Gro. This more tailored approach to soil health has resulted in significant successes and increased long-term productivity of perennial crop orchards.
**Shelf life challenges in development of bioproducts containing living organisms**

Shelf life and storage stability is a challenge to the success of microbial biocontrol products. Ongoing research at Plant Health Products (Pty) Ltd hopes to shed light on this complex issue.

Successful commercialization of microbial products depends not only on the field efficacy of the biocontrol agent, but also on the cost-effective mass production capabilities and the stability of the agent in storage to make the agent economically viable. Shelf life of a living organism is a complex issue. Strain selection and production procedures including choice of fermentation substrate, time, temperature, drying and harvesting procedures all influence the shelf life of the final product.

Formulation of the product is often paramount to the stability of a bioproduct but this must be carefully balanced with the application requirements of the end user.

At PHP, packaging is carefully selected to provide a stable environment for the product during storage and transit as well as considering the preferences of the customer. For microbes, suitable packaging generally involves durable, impermeable materials that ensure that the product is fully protected from humidity, oxidation and UV penetration. As an example, PHP has found packaging and storage temperature to be very important for the shelf life of Beauveria bassiana (Eco-Bb, Bb-Protec). Our laboratory studies on Bb-Protec have shown that with continuous exposure to elevated temperatures the product loses viability at a faster rate than at colder temperatures. Similarly, when stored in unsuitable packaging the product can quickly lose viability due to exposure to oxygen and moisture. When correctly packaged and stored Bb-Protec will maintain viability for at least twelve months (see Figure).

PHP researchers are constantly working to optimize shelf life of existing and developmental products through different methods. This is particularly important for the global commercialization of PHP products. Increased shelf life facilitates improved logistics and storage throughout the distribution channel and provides the customer with long-lasting, excellent quality product.

**Vitsan, a fungicide for combating oidiu m in vines in integrated protection programmes as well as in organic production**

Whether stand-alone or in combination, Vitsan replaces the application of three to four chemical fungicides for controlling powdery mildew. Its preventive and curative effects give it the flexibility required to be adaptable to regional protection strategies.

With about five million hectares treated against powdery mildew every year, phytosanitary protection of vines is now a highly sensitive topic in France, as much for wine lovers as it is for producers and authorities. All are anxious to protect the health of growers, consumers and the environment alike. While the use of sulphur dominates, two thirds of the hectares remain protected by products derived from conventional chemistry. Regulatory decisions have made the switch to an all-chemical approach. When tested on powdery mildew at a dose of six kilograms per hectare, Vitsan also displayed an effectiveness close to that of the reference chemical (Mephtyldinocap 350 grams per hectare). Various tests carried out since 2012 have ranked Vitsan as amongst the best biocontrol products ever assessed against powdery mildew in France. As well as being authorised for vines, Vitsan can also be used against scab and powdery mildew on pome fruits and various cucurbits. Its use for the treatment of other diseases (e.g. botrytis) and crops will soon be authorised.

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**Storage stability trends of Bb-Protec**

<table>
<thead>
<tr>
<th>Time (months)</th>
<th>Storage at recommended temperature</th>
<th>Recommended storage temperature</th>
<th>Storage at 25°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>100</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>4</td>
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</tr>
<tr>
<td>12</td>
<td>50</td>
<td>80</td>
<td>70</td>
</tr>
</tbody>
</table>

These studies are ongoing.

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**Example of Vitsan use in integrated protection, powdery mildew**

- **Frequency: diseased fruits (%):**
- **Severity: damaged fruit surface (%):**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Diseased Fruits (%)</th>
<th>Damaged Fruit Surface (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated control</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>Conventional reference</td>
<td>75</td>
<td>80</td>
</tr>
<tr>
<td>Vitsan programme</td>
<td>65</td>
<td>50</td>
</tr>
</tbody>
</table>

New biological control solutions available to the UK

Andermatt UK brings new biocontrol tools to UK growers with the completed registrations of two new biological insecticides; Delfin WG and Madex Top.

The use of biological control within UK horticulture continues to grow. Despite the uncertainties relating to “Brexit” in the agriculture and horticulture industries, the UK continues to expand its use of biocontrol with increasingly Integrated Pest Management (IPM) systems as well as the more traditional markets for biologicals in organic production. To support this demand for biocontrol tools, Andermatt UK will bring a portfolio of both in-house and third party technologies to the market.

The strength of the Andermatt UK development pipeline has been shown during a successful first year of trading which included the completed registrations of two new products for the UK market; Delfin WG and Madex Top. Both of these biological control products offer growers flexible tools to integrate into any cropping system. Delfin WG contains Bacillus thuringiensis subsp. kurstaki to control a wide range of Lepidoptera pests and is registered on a range of crops. Madex Top is the newest single strain CpGV (Cydia pomonella Granulovirus) product to be developed through the Andermatt Biocontrol research pipeline, and is applied against codling moth on top fruit. Both of these products strengthen the position of Andermatt UK as a solution provider for the top fruit industry, complementing the already registered Capex against Summer Fruit Tortrix on apple and its recent minor use label extension for cherry.

Loopovir, a new biological product for effective control of soybean looper

The soybean looper (Chrysodeixis includens) can damage a large variety of agricultural crops throughout the Americas, including its preferred host, soybean. Loopovir, based on the Chrysodeixis includens nucleopolyhedrovirus (ChinNPV), has been developed to control this destructive insect pest.

The soybean looper (Chrysodeixis includens) can be found throughout much of North and South America. Populations can be present year-round in temperate and tropical climates with annual migrations occurring into the cooler areas within its range. This destructive insect pest can feed on a wide-variety of host plants such as soybean (Glycine max - its preferred host), sweet potato, peanut, cotton, tomato and many others.

In warmer climates, the soybean looper can have up to eleven generations per year. Each female moth can lay up to 700 eggs, which will hatch three to six days after being laid. The larvae feed for two to four weeks consuming approximately three times its own body weight per day. Typically, larvae feed on foliage however during high populations levels, the larvae will occasionally feed on fruits and pods. If left unchecked, the soybean looper can cause severe defoliation, low plant vigor and yield lost across many important agricultural crops.

Loopovir, based on the Chrysodeixis includens nucleopolyhedrovirus (ChinNPV), is an effective biological control product for use against the soybean looper (see Figure). Loopovir has been developed as an alternative to the traditional chemistries for use in controlling soybean looper populations and providing damage control to affected crops. With a very specific host range targeting only the soybean looper, Loopovir is non-toxic to beneficials and can be a component in both Integrated Pest Management programs as well as organic programs.

Loopovir is produced by Sylvar Technologies Inc. Canada, a 100 percent subsidiary of Andermatt Biocontrol.
Andermatt USA, building strong foundations

Andermatt USA is focused on building strong foundations through a robust portfolio, superior product quality and operational excellence.

Andermatt do Brasil launches Phosbac 45, the first commercial phosphate solubilizer inoculant in Brazil

Phosphorus is a finite resource, global stocks of high-quality rock phosphorus may be depleted in about 100 years. Markus Ritter, CEO from Andermatt do Brasil explains how Phosbac 45 can help to increase yields, reduce costs, and contribute to a sustainable agriculture.

Are all forms of phosphorus available to the plant?
No, only inorganic forms of phosphorous are plant available. The inorganic P can be found in soils mostly as insoluble mineral complexes, which also originate from the P fertilization itself. Organic matter captures P, further reducing the availability of P to crops. The nutrient has therefore an efficiency of only 10 to 20 percent of the applied volumes of organic or synthetic P fertilizers.

How can Andermatt do Brasil provide solutions to improve phosphorus availability?
We developed over the last three years together with ABTEP Phosbac 45, as a phosphate mobilizer and solubilizer inoculant, based on Bacillus amyloliquefaciens strain FZB45. Replicated trials in potato and tomato have produced consistent results showing that Phosbac 45 improves the efficacy of applied mineral fertilizer and releases captured P.

Could you show phosphor mobilization in the field?
Soil analysis demonstrated that the amount of plant available P almost doubled after applying Phosbac 45 at rates between 200 to 400 millilitres per hectare together with half of the recommended rates of mineral P fertilizer, the same yield can be achieved as with the full rate of mineral P fertilizer on its own.

What is the relevance of Phosbac 45 to Brazilian farmers?
It is the first commercially available product of this kind in Brazil. We are proud to offer Brazilian farmers a new and valuable tool to save important amounts of mineral P fertilizer, to reduce costs and to contribute to more sustainable agricultural practices.

Gisela Brand: Markus, what is the importance of phosphorus in agriculture?
Markus Ritter: Phosphorus (P) is the second most crucial plant nutrient after nitrogen, essential for the development and growth of all organisms. It can be considered as a principal limiting factor for the growth of plants and the development of the ecosystems in general. Phosphorus is present in soils, in both organic and inorganic compounds.

In field trials, the additional application of 200 ml/ha Phosbac 45 resulted in 4,000 kg more yield per hectare than with P2O5 alone.

Russell Blair
Andermatt USA

Markus Ritter
Andermatt do Brasil

Andermatt USA remains committed to working with local specialists to develop best use recommendations for our products for both conventional and organic growers.

Helicovex adoption in the United States
As the first registered product for Andermatt USA in the United States, Helicovex (Helicoverpa armigera NPV) is being successfully adopted into multiple new markets for the control of Helicoverpa zea (corn earworm) and Heliothis virescens (tobacco budworm). Given the large geography and migratory behavior, regional pest pressure varies widely in the United States, and this variability affects IPM and resistance management programs. In the Southeastern U.S. there can be as many as seven or more generations of corn earworm per year. The number of generations decreases as the pest travels North, with approximately two generations occurring in the Northeast.

Andermatt USA is a strong supporter of university and third-party research in order to provide local growers with best use recommendations for Helicovex in both conventional and organic systems. Under the correct conditions, viruses have the potential to spread both horizontally across a field, and vertically across several generations. Providing a novel mode of action as well as horizontal and vertical transmission adds significant advantages to chemical IPM programs. Andermatt USA remains committed to working with local specialists to develop best use recommendations for our products for both conventional and organic growers.

Markus Ritter, CEO from Andermatt do Brasil explains how Phosbac 45 can help to increase yields, reduce costs, and contribute to a sustainable agriculture.