Press release

AMOEBA : A year of field trials that confirms AXPERA's strategic positioning

Chassieu (France), November 23, 2023 - 17h45 - AMOÉBA (FR0011051598 – ALMIB) an industrial biotech in pre-commercialization* specialised in the treatment of microbiological risk, developing a biocontrol agent for the crop treatment in agriculture that has obtained a marketing authorization in the United States and a biological biocide that has also obtained a marketing authorisation in the United States for use in closed cooling systems, today announces the publication of its 2023 trial results.

With more than **140 field trials** completed or ongoing in Europe, the United States, Brazil, Costa Rica and Asia, the winter 2022 / summer 2023 trial campaign confirms the results of the 2022 season and allows the commercial strategy and target markets to be refined in preparation for the launch of AXPERA biofungicide.

In this pre-marketing context, the main objectives of these trials carried out by independent external service providers on small plots of land in accordance with BPE ("Bonnes Pratiques d'Expérimentation" - Good Experimentation Practices) were:

- **To generate efficacy data for future product registration dossiers** in Europe, Brazil and California.
- To **determine a positioning strategy for AXPERA** by conducting trials involving a combination or alternating application with other conventional and organic fungicides.
- To **evaluate the company's formulations on new target crops** in order to broaden our knowledge of the spectrum of activity of our amoeba lysate-based biofungicide.

Two main formulations were tested, depending on the crops: a *Suspension Concentrate* (SC), which should be the formulation selected for registration of the formulated product, and an *Oil Dispersion* (OD), which is more appropriate for certain crops.

1 - Target markets for primary registrations

The trials carried out this year have enabled us to confirm the application rates for future marketing authorisation applications and to position AXPERA in combination or alternatively in organic or conventional farming programs:

Vegetable crops (mildew and powdery mildew	2.5 - 3.75 litres per hectare treated (l/ha) alone or in combination with copper or sulphur
Vines (mildew and powdery mildew)	2.5 (l/ha) - 1.25 l/ha in combination with copper and sulphur

Vegetable crops

A major campaign of 45 trials was carried out in 2023 in Europe and California, confirming the efficacy of AXPERA on its own or as part of a grower programme against powdery mildew and downy mildew on vegetable crops.

Industrial tomatoes

For industrial tomatoes, grown in open fields and intended for manufacturing, disease pressure was high in Italy, with a devastating late blight attack. Flooding and hail for three weeks at the end of August in Veneto (Italy) had not been favourable to the development of industrial tomatoes, having a considerable impact on yield. As the effectiveness results varied widely, it is difficult to draw conclusions about the strategy to adopt: trials will therefore be conducted in 2024.

In France, with similar climatic conditions in the south-west, the strategy implemented by Amoéba was to combine or alternate AXPERA at 2.5l/ha with sulphur or copper. This programme made it possible to halve the dose of sulphur or copper applied, while maintaining similar efficacy to the references.

This strategy offers better protection than AXPERA on its own, which is insufficiently effective in the case of heavy downy mildew attacks, with an average efficacy of 62%.

In addition, trials carried out on tomato powdery mildew in glasshouses have shown that AXPERA provides efficacy ranging from 50% to 98%, depending on infestation conditions. These remarkable results for a biocontrol product have led us to continue our trials on this disease.

Melon

This year's conditions have resulted in significant downy mildew pressure on field-grown melon in the Poitou-Charentes region. In these conditions, the AXPERA product applied on its own showed an average efficacy of 30% in the case of heavy attacks.

However, the results observed when AXPERA is combined with copper are very satisfying: this programme (by reducing copper by 60% of its initial dose) offers equivalent efficacy to copper applied on its own, i.e. around 70% efficacy on average.

These observations allow Amoéba to confirm the positioning of AXPERA as a complement to copper, which contributes directly to reducing the treatment frequency index (IFT) for melons.

Greenhouse crops

Against powdery mildew in glasshouse crops (cucumber and squash), very good results were measured during this third year of trials in Italy, Spain and France.

Although it sometimes lagged behind the sulphur reference, the product nevertheless appeared to be systematically more effective than the reference biocontrol products, with an average efficacy of 60% on cucumbers.

The strategy of combining AXPERA with sulphur, aiming to replace 4 out of a total of 6 applications with our product, provides equivalent efficacy to that of sulphur applied alone and at full dose.

Vine

This year, viticulture was severely impacted by a climatic incident in the Bordeaux region (France) and the Piedmont region (Italy), resulting in heavy attacks of downy mildew and a late arrival of powdery mildew on bunches (90% of vines affected in Gironde).

In these conditions, the strategy adopted for the 2023 trials was to protect the vines during the flowering period (a sensitive stage for mildew contamination) with conventional pesticides and to position AXPERA in local conventional programmes (Champagne, Gironde, South-East, Burgundy, Italy).

Despite the use of conventional products, these programmes have not provided sufficient protection for the bunches, and yield losses have been deplored. Given the climatic conditions in Europe, it is impossible to draw any conclusions about the effectiveness of AXPERA in this year's trials.

Only one trial carried out in the Friuli-Venezia Giulia region (Italy) showed promising results, with efficacy similar to the chemical reference programme, incorporating 4 applications of AXPERA in the same programme. In this way, Amoéba's biofungicide is helping to reduce the use of conventional plant protection products.

With regard to powdery mildew on vines, AXPERA was found to be highly effective when applied alone, with efficacy levels ranging from 50 to 90% depending on the level of attack.

The development of AXPERA on mildew and powdery mildew will continue in 2024.

2 - Secondary markets: aromatic herbs and arboriculture

Basil

Cut basil is by far the most important crop on the European herbs market. For several years now, basil mildew has been causing problems for growers in the production basins of France and Italy. Basil requires intense irrigation to keep the plant growing, which encourages the development and heavy contamination of downy mildew in open fields. Varietal resistance is one of the pillars for fighting downy mildew in basil, in addition to conventional phytosanitary products, which are becoming increasingly limited or even withdrawn from the market.

In 2023, Amoéba conducted 4 trials on downy mildew of basil in Italy in the Parma region, the Italian basil production basin. The AXPERA product was evaluated on two different varieties of basil, one tolerant and one susceptible to mildew.

Using the product alone on the susceptible variety was not sufficiently effective to control the pathogen. However, when AXPERA was applied to a tolerant variety, we observed efficacy ranging from 10% to 82%.

Given this gap in efficacy, it is necessary to continue our studies on this target in order to position the product accordingly and increase our knowledge of the subject.

The evaluation will therefore be continued in 2024 with a larger number of GHP trials.

Apple

This year, climatic conditions in the north of France and in Italy, characterised by long periods of heatwave, did not allow sufficient development of apple scab in susceptible orchards, making evaluation more difficult.

Four trials carried out in France and Italy on lightly contaminated apple trees have, however, demonstrated the product's strong activity, similar to copper at the highest dose tested.

These results will be confirmed in the longer term in situations of more severe infestation, in this important market where there are currently no natural solutions.

3 - New targets and potential new markets

This year again, Amoéba has conducted trials on new crops and diseases in order to broaden our knowledge of the AXPERA product and its spectrum of activity.

Vine

In addition to the mildew and powdery mildew trials, two trials were carried out on Black Rot, Guignardia bidwellii, in vines in the Bordeaux region (France) at the request of winegrowers. The particular climatic conditions were favourable to the development of the pathogen, with attack rates sometimes reaching 70% on untreated bunches. In this exceptional context, AXPERA's efficacy on this target is judged to be insufficient. The tests will not be continued in 2024.

Strawberry

Two trials carried out in France on Botrytis in strawberries concluded that AXPERA was poorly effective against this target, with an average efficacy of 15% on fruit.

However, two other trials carried out on powdery mildew in strawberries in France on susceptible varieties showed an average efficacy of 62% for the product alone at 2.5 l/ha, equivalent to one of the organic references on the market.

This promising result for this new target offers new development opportunities for the strawberry market in France, Spain and Italy. Numerous trials on strawberry powdery mildew will be included in the 2024 campaign.

Sugar beet

In the year 2023, two trials on cercosporiosis of sugar beet were set up in the Nord de France, a European sugar beet production basin. Climatic conditions made it difficult to assess AXPERA's efficacy, and trials on this target will continue in 2024.

As copper hydroxide has been the subject of an annual exemption for several years now to control the risk of cercosporiosis and powdery mildew on industrial sugar beet, AXPERA could be used to replace copper or in combination to reduce the number of its applications.

Banana

Two trials were carried out in the second half of 2023 in Costa Rica and Guadeloupe.

The first trial, in Costa Rica, was carried out during a highly rainy period, representative of the harshest conditions, on a highly contaminated trial. The programme involving one application per week (for a total of 12) showed that the two formulations (AXP12 and AXP13) were highly effective, with efficacy ranging from 70 to 80% depending on the dose. This efficacy, which is lower than the best contact chemical fungicide, mancozeb (94%), is nevertheless equivalent to the most effective biocontrol product recently introduced to the market, Tea Tree essential oil, at 70%.

The second trial in Guadeloupe (French West Indies) was carried out using a different application programme, with one application every two weeks (rather than weekly) for a total of 6 applications, under average disease pressure. The AXP12 and AXP13 formulations were as effective (50%) as the natural reference used locally, sulphur.

Banned in Europe a few years ago, mancozeb and chlorothalonil are still widely used on banana as a complement to unisite fungicides, which are highly effective because of their systemic and curative properties, but are subject to high risks of resistance and therefore require partners (in combination or alternately) to maintain their effectiveness over the medium term.

All the trials carried out over the last two years show that AXPERA is effective enough to fulfil this partner role in an anti-resistance strategy.

4. Conclusion

Despite widespread climatic incidents which made it difficult to assess effectiveness due to yield losses, the 2022 - 2023 campaign led Amoéba to the following conclusions:

- The positioning of AXPERA in programmes in combination with or alternating with conventional or organic copper/sulphur products seems more than appropriate to gradually lead to a reduction in the use of phytosanitary products.
- AXPERA has shown real potential for controlling powdery mildew on a wide range of crops (vines, vegetables, strawberries, etc.).
- Downy mildew being a more virulent disease and difficult to control, particularly with organic products, makes it necessary to position AXPERA more precisely in farmers' programmes.
- New targets have been characterised, with real opportunities for cercosporiosis of beet and downy mildew of basil.

- AXPERA has also confirmed its potential to combat black spot on bananas (Sigatoka) and to become a key fungicide in annual treatment programmes, replacing the chemical contact fungicides still in use.

"This particularly complex year for field trials has enabled us to refine our objectives for the 2023-2024 campaign, in order to position AXPERA as closely as possible to farmers' expectations. Throughout the year, we have identified very promising targets, confirmed our knowledge from previous years and developed effective programmes. AXPERA is clearly emerging as a partner for conventional products and a support for organic products, and we are very enthusiastic about offering a high-potential solution to help meet European pesticide reduction targets. As early as next year, we will be conducting trials on new minor-use targets to expand our knowledge of this innovative product, which is expected to be launched on the market in 2025," says Annabelle GILGEN, biocontrol technical development manager at Amoéba.

About AMOÉBA:

Amoéba's ambition is to become a major player in the treatment of microbiological risk in the water, plant protection and health sectors. Based on the natural properties of the amoeba *Willaertia magna* C2c Maky, our biological solution is a viable alternative to the chemical products widely used in the industry today. Amoeba is currently focused on the closed system industrial cooling tower market in the United States estimated at €200 million (1) and on the global biocontrol market for plant protection estimated at €3 billion (2), out of a global market for chemical fungicides estimated at €21 billion (3). The commercialization of the associated biocides and phytosanitary products is subject to local regulatory approvals.

**At the end of 2022, Amoeba obtained approval of its active substance for biocidal use in closed cooling system and for biocontrol use in the United States. The substance has also been recommended for biocontrol use in Europe by the Austrian authority in the same year. The company is currently in a pre-commercialization phase for biocidal and plant protection applications and is expected to market its products by 2025. Founded in 2010 and based in Chassieu (Lyon, France), Amoéba is listed on Euronext Growth. The Company is a member of the BPI Excellence network and is eligible for the PEA-PME scheme. For more information, please visit www.amoeba-nature.com.*

(1): Amoéba data

(2): IBMA data

(3): Amoeba data

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