

MusaCare® CP



**The Power
Inside and Outside**



Ceradis® Crop Protection
Green Innovations

MusaCare® CP is a mineral organic product that combines the strength of the potassium phosphonate and the copper sulfate pentahydrate to be used in the production of bananas and optimized for aerial spraying.

Its unique combination of components allows it to act as an elicitor of the plant natural defense response against Black Sigatoka (*Pseudocercospora fijiensis*) as well as to promote plant growth. It is a great tool in agriculture for integrated crop management that increase yield in a safe and sustainable way.

Composition of MusaCare® CP

Component	g/Kg
Potassium Phosphonate	519
Copper Sulfate Pentahydrate	102
Aditives	c.s.p. 1.0 kg
Total	1000

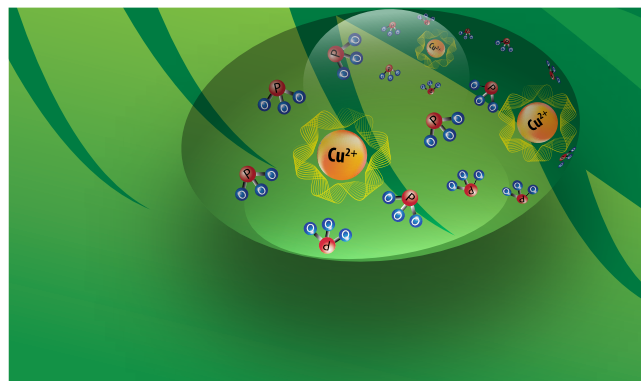
MusaCare® CP has a unique and patented formulation, developed by **Ceradis Crop Protection B.V.** in conjunction with Wageningen University and Research Centre (WUR) in the Netherlands. The patent safeguards the technology to include the element copper in combination with the phosphonate.



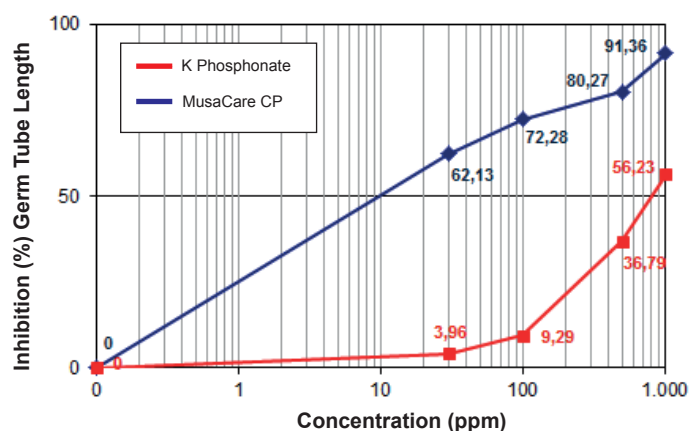
MusaCare® CP components are active ingredients with low risk of resistance according to the Fungicide Resistance Action Committee (FRAC). Therefore, the use of **MusaCare® CP**, in alternation or as a partner, is an excellent tool to reduce the likelihood of increased loss of sensitivity of the site-specific fungicides.

MusaCare® CP has been developed with the farmers in mind, boosting a high rain fastness, a slow release of the copper from its matrix, and a highly mobile phosphonate inside the plant to trigger plant defense responses and promote plant growth.

Phosphonates have fungicidal activity which is demonstrated through the germ tube length inhibition of ascospores of *Pseudocercospora fijiensis* grown in water :agar plates ammended with different concentration of the a.i. However, the presence of copper in **MusaCare® CP**, enhances the inhibition of the ascospores' growth.



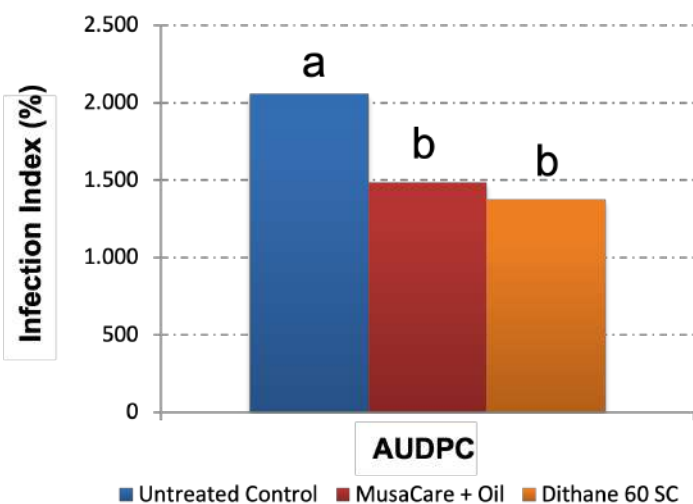
Copper is protected by the organic matrix and the phosphonate enters freely inside the plant to trigger plant defense responses.



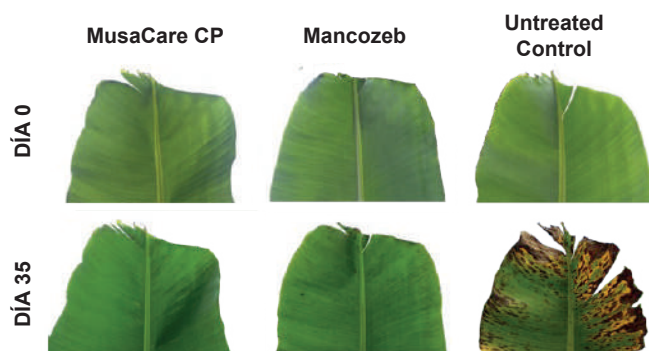
Inhibition of germ tube length of ascospores of *Pseudocercospora fijiensis* grown in water:agar with different concentrations of a.i. Study performed by CIB, Colombia, 2015.

Single-leaf tests and small-plot evaluations performed in Guatemala, Costa Rica, Colombia and Ecuador, by independent researchers, have demonstrated the biological efficacy of **MusaCare® CP**. Its performance does not differ statistically from other protectant fungicides commonly used in the banana industry such as chlorothalonil and mancozeb. Results of some studies are shared as examples, but more information can be provided on request.

Additional studies were conducted to determine the effect of mineral oil on **MusaCare® CP** efficacy at different rates, as well as to compare when it is applied in water, especially for the Guatemalan market.

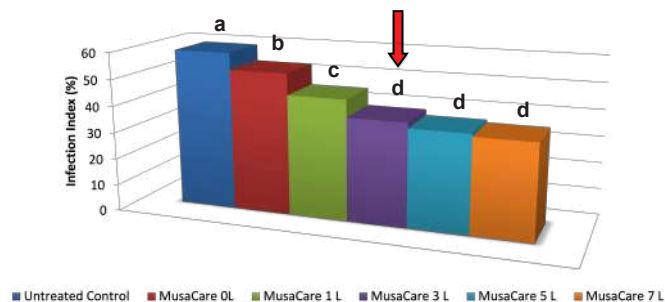


Infection Index (% AUDPC) in a small-plot test carried out by STAA in Costa Rica, 2019. Twelve applications every 6-7 days..



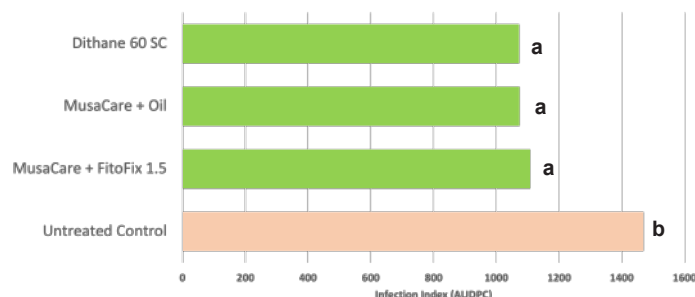
Small-plot trial conducted by A. Parra, Colombia, 2020. Leaf #1 at start of trial.

Under Costa Rican conditions, the mixture of **MusaCare® CP** with mineral oil improves its biological efficacy; however, oil rates above 3.0 L/ha does not have a positive impact on its performance.



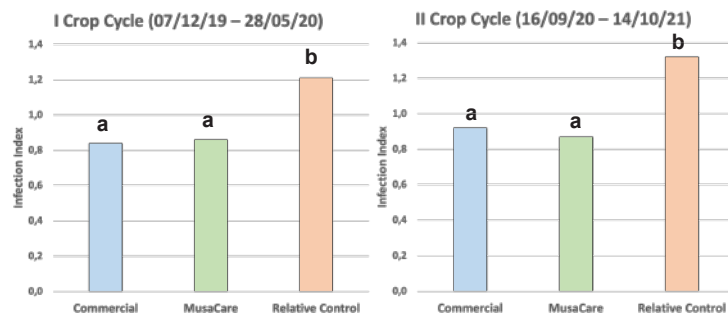
Effect of mineral oil rates on the biological efficacy of **MusaCare® CP** in a small-plot trial. Study conducted by STAA, Costa Rica, 2016.

However, under the conditions of the southern coast of Guatemala, the oil does not play a role as important as it does in Costa Rica where the oil makes a difference in its biological efficacy. Nevertheless, an adjuvant such as FitoFix® is required to stabilize **MusaCare® CP** when applied in water only.



Infection Index (% AUDPC) in a small-plot test carried out by E. Orozco in Guatemala, 2020, to compare the biological efficacy of **MusaCare® CP** applied in water and in oil:water emulsion.

A two-year experiment was established in Costa Rica to validate the effect of **MusaCare® CP** in a commercial program where one protectant cycle was replaced once a month. The program was based on the rotation of all modes of action available (DMI's, amines, SDHI's, anilinopyrimidines, benzimidazoles, guanidines, n-phenyl carbamates and mancozeb). Site-specific fungicides were always mixed with mancozeb, and number of cycles and intervals followed FRAC and label recommendations. The program alternated one site-specific + protectant mixture and one protectant (mancozeb). A "relative control" was established, where oil:water emulsion was sprayed when mancozeb and **MusaCare® CP** was applied in the corresponding fourth cycle. This "relative control" allows



Infection Index in a "semi-com plot" test arrangement carried out by Monreri in Costa Rica, 2019-2021, to determine the contribution of **MusaCare® CP** in an integrated management program.



us to disregard that neither the commercial program nor the oil is enough to replace the contribution of the protectant fungicide (mancozeb or MusaCare®) in the fourth cycle.

As the Infection Indexes showed in both crop cycles, no significant differences were observed between the commercial control and the treatment where **MusaCare® CP** replaced one cycle of mancozeb, which indicates that the inclusion of this product in the program does not affect the control of the disease. On the other hand, “the relative control” showed higher levels of infection than the other two treatments which confirms the contribution of the fungicide included in the fourth cycle. Neither the other fungicides in the program nor the oil alone were capable of replacing the effect of the protectant fungicide in the cycle.

Multiple semmicomercial experiences have been done with **MusaCare® CP** in Latin America and the Philippines with success. In one of the last semicommercial experiments in Ecuador, **MusaCare® CP** was compared to the commercial control. Leaves (position #1) were tagged on the day of the application, and evaluated 112 days after, finding no significant differences in the severity of the disease. **MusaCare® CP** is used used commercially in Guatemala, Costa Rica, Colombia and Ecuador.



Banana leaves evaluated 112 days after the application of treatments using aerial spraying in a commercial banana plantation, Guayas, Ecuador, 2021.

From the regulatory point of view, the phosphonates (EPA - Federal Register, 40 CFR 180.1240) and the coppers (EPA – Federal Register, 40 CFR 180.1021) are exempt of import tolerances for the US market. However, the EU market has established import tolerances (MRL, Maximum

Residue Limits) for the different crops. Since fosetyl-al, disodium and potassium phosphonates are converted into phosphonic acid inside the plant, a shared MRL between fosetyl-al and these two phosphonates has been set. The current reference values for these products are reported as “fosetyl sum”, which includes the fraction for fosetyl-al and for the phosphonic acid and its salts (EU Regulation 2019/552, valid since April 25th, 2019). The MRL for fosetyl-sum for bananas is 2.0 ppm. On the other hand, the MRL for copper is described in the EC Regulation No. 149/2008 and indicates that its value for bananas is 20.0 ppm.

Although our commercial recommendation for bananas is to spray one cycle every four weeks, some users were interested in learning about residues if continuous applications are scheduled. Therefore, a study was established to determine the residues on banana fruit exposed up to three consecutive applications. None of the analysis performed showed residues above the current MRL for the EU, despite the consecutive applications (data not shown). It is clear, that residues increase with the number of applications in the case of phosphonic acid and salts but did not affect copper. The number of applications did not have an effect on the copper content, since it is mainly determined by the plant uptake and not by the copper content of our products

Field evaluations have demonstrated the biological efficacy of **MusaCare® CP** in the integrated disease management of Black Sigatoka. We recommend to include it in rotation once a month, and can be used solo or in mixture with site-specific fungicides. For detailed information on compatibility and mixture procedure, contact Ceradis Crop Protection B.V. or our local distributor.

The recommended rate of **MusaCare® CP** is **1.0 kg/ha**, if mixed with site-specific fungicides, rate can be adjusted to **0.75 kg/ha** with no effect on its biological performance. Mixture with **3.0 L/ha** of mineral oil is recommended to enhanced its biological activity, higher rates of oil do not improve its performance. Mixtures with protectant fungicides do not have any additional value; therefore, Ceradis Crop Protection B.V. does not suggest its use.

Exclusive Distributor in The Philippines



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