

# Sophorolipid as Novel Adjuvant Technology



The agricultural market is under increasing pressure as consumers prefer food containing lower, or no amounts of residual chemicals, but at the same time growers need to prevent the development of pathogens and pests resistant to active ingredients. Regulators demand less agrochemical input, so the efficiency of agrochemicals has to be improved. Surfactants provide a versatile solution.

Well-known in the agrochemical market, surfactants are used in formulations and as tank-mix adjuvants. The benefits of surfactants are important in plant protection products from pesticide formulation to storage, tank-mix dilution, spraying, targeting and finally acting on the pest. In water-based formulations one of the main tasks of surfactants, also called adjuvants, is to decrease surface tension. This results in better wetting of e.g. surfaces of to be dispersed particles of actives. In oil-based formulations, emulsification properties of surfactants ensure higher stability and lower droplet size. In tank-mix dilutions for all kinds of formulations, surfactants prolong the physical stability as they reduce the interfacial tension between water and the dispersed active ingredients. Targeted delivery

is the main purpose of surfactants during spraying, which enhances efficacy and decreases the active amount needed. Targeted delivery is achieved by: 1) reducing driftable particles, 2) enhancing adhesion and retention of spray droplets on the plant, 3) improving uptake and penetration of active ingredients, and 4) increasing rain fastness.

Accordingly, the agrochemical market is increasingly demands innovative additives that are more sustainable. As a consequence, rising regulatory pressure lead to the termination of using some surfactants which came with an unfavorable toxicological profile. Evonik, being one of the world's leading specialty chemicals companies, pursues a high ambition to develop novel, benign solutions which meet or even surpass the market requirements.

New adjuvants that comply with eco-toxicological, safety and sustainability criteria provide solutions to support the plant protection industry. Sophorolipids represent a new class of biosurfactants that offer several improved benefits and comply with eco-toxicological, safety and sustainability criteria.



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BREAK-THRU®SF 420 is a novel sophorolipid-based surfactant manufactured by natural fermentation of rapeseed oil and sugar - a vegetable, non-genetically modified feedstock which is sourced in Europe (Figure 1). The yeast strain used is also a natural microorganism - *Starmerella bombicola*. It is also interesting to note that the low temperature fermentation process consumes relatively low energy. Furthermore, no harmful process auxiliaries are being used and no harmful by-products are generated.

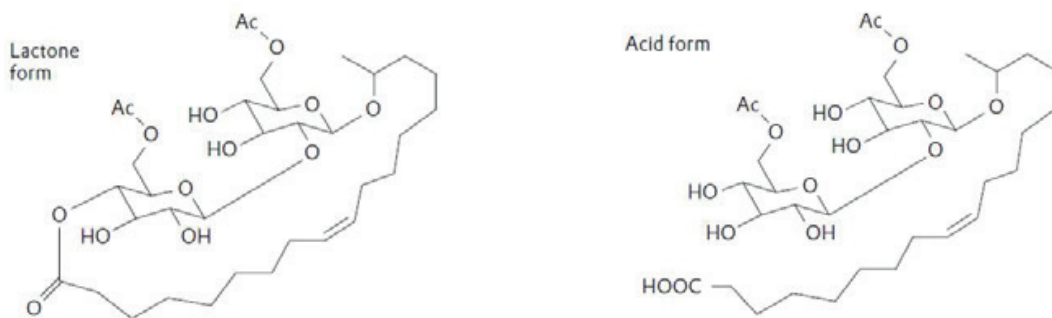


Figure 1. The sophorolipid adjuvant comprises a lactonic uncharged molecule in combination with a charged, open molecule

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From laboratory development to applied technology, greenhouse trials and field trials: Evonik is permanently conducting broad ranges of scientific analysis and test methods to lead and stay ahead of the technological advancements. One important test to analyze the capabilities of surfactants is a surface tension test which is used to verify and confirm wetting and dispersing capabilities.

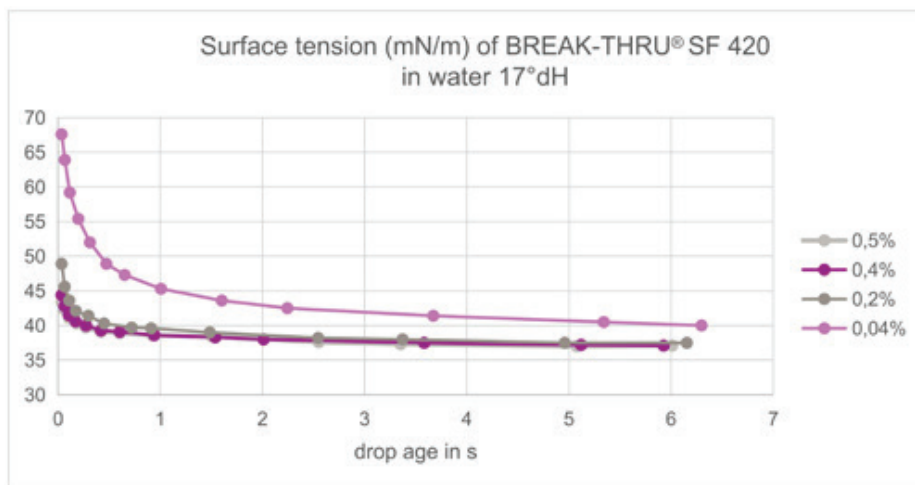


Figure 2. In the discipline to reduce surface tension, the sophorolipid adjuvant delivers excellent wetting and dispersing performance

Due to the special chemical structure (Figure 4), BREAK-THRU®SF 420 is an excellent dispersant for metal hydroxides like  $\text{Cu}(\text{OH})_2$  in water which makes it an excellent option for suspension concentrate (SC) formulations. The lower surface tension as illustrated in Figure 2, leads to excellent spreading and thus to a more even distribution of, for example, copper spray solution on the foliage, improving the control of fungicides. Furthermore BREAK-THRU® SF420 also increases insecticide performance (Figure 5) and enhances the activity, the speed of action and the duration of effectiveness of herbicides.

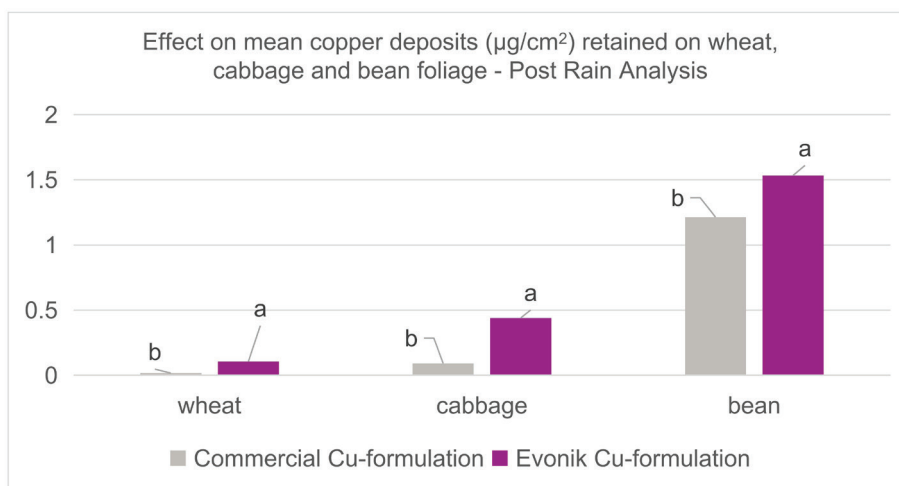
The ability of BREAK-THRU®SF 420 to disperse metal cations can be also applied for nutrient suspension concentrate (SC).

**Table 1**  
Evonik Cu-formulation; Copper hydroxide 383 SC

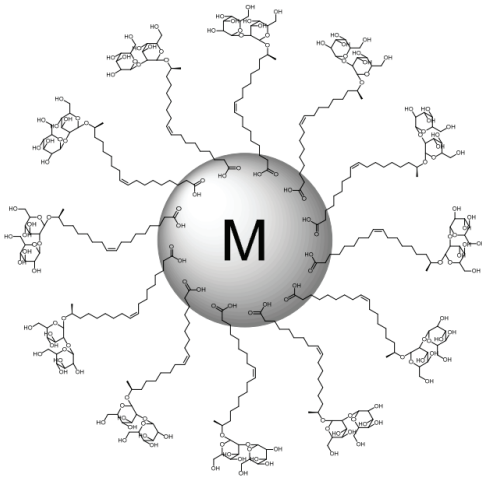
g/L	Ingredient	Function
383.0	Copper Hydroxide	Active Ingredient
75.0	BREAK-THRU® SF 420	Dispersing and Wetting Agent
3.0	BREAK-THRU® AF 9903	Antifoam
3.3	NaOH (20% solution)	Neutralization
2.5	Xanthan gum	Thickener
50	Propylene Glycol	Antifreeze
q.s.	Water	Solvent

This multifunctional biosurfactant performs very well as a water soluble, low foaming tank-mix surfactant by reducing the surface tension of water to  $< 38 \text{ mN/m}$  (Figure 2). Accordingly, due to the novel mode of action BREAK-THRU®SF 420 provides excellent adhesion. As proven in a post rain analysis, it delivers significantly higher retention on very difficult to wet species such as wheat: As it dries, a film is formed from the gel layer created by a hydration effect of rainwater and the sophorolipid.

Therefore, a more even distribution of spray solution on the foliage is achieved, resulting in superior rainfastness (Figure 3).

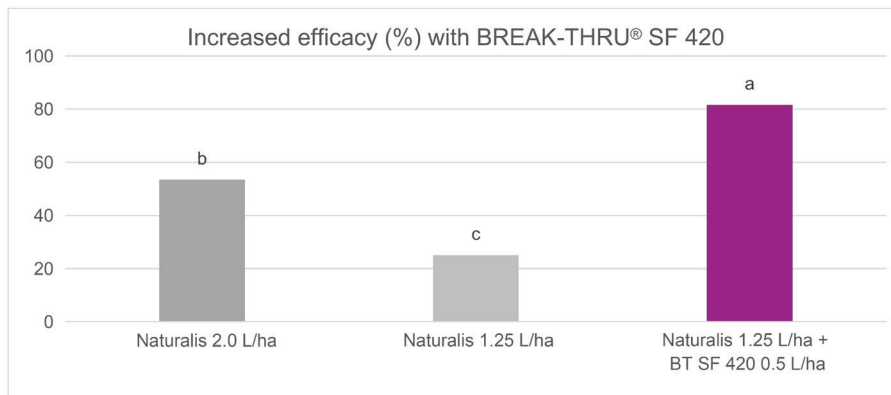


**Figure 3.** Copper deposit ( $\mu\text{g}/\text{cm}^2$ ) retained on wheat, cabbage and bean foliage



**Figure 4.** Dispersing of metal(hydr)oxides / carbonates. Taken from: Delbeke et al., Green Chem. Volume 18, (2016), pages 76 - 104

The combined ability to disperse copper evenly, and to provide copper deposition and retention on very difficult and difficult to wet species, make BREAK-THRU®SF 420 a state-of-the-art adjuvant in comparison to existing commercial Cu-formulations.



**Figure 5.** Efficacy of Naturalis® and BREAK-THRU® SF 420 against whiteflies in tomato

In addition to its outstanding performance BREAK-THRU®SF 420 provides stability across a wide pH range, and is regarded in general as a benign product, which is also readily biodegradable (> 99 % after 28 days) according to OECD 301 C).

BREAK-THRU®SF 420 has been approved by the German Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL) for use as tank-mix adjuvant for herbicides and fungicides for the German agricultural market.

To conclude, all the features of sustainable multifunctional surfactants innovated by Evonik help increase the biological efficacy of agrochemicals, which has been confirmed in many field applications around the globe.



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22-ev-ag-biosurfactant-brochure 12/2022