



Grandevo[®] Bioinsecticide - Regulatory Status in the EU and Biological Characterization

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Forward-Looking Statements



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MBI's Agricultural Product Portfolio

smart.
natural.
solutions.

GRANDEVO[®] BIOSIDECTICIDE

- Broad spectrum control of sucking, chewing and sponging insects and mites without harming pollinators. Reduces fecundity and kills key pest species such as *Drosophila suzukii*, *Diaphorina citri*, thrips, aphids, scales and mites. Based upon *Chromobacterium subtsugae* strain PRAA4-T¹

VENERATE[™] BIOSIDECTICIDE

- Protects crops from a broad range of harmful pests including *Diaphorina citri*, scales, thrips, aphids, mites, soil pests, various weevils and several key lepidopteran pests.
- Based upon *Burkholderia rinojensis* strain A396.

REGALIA[®] BIOFUNGICIDE

- Extract of *Reynoutria sachalinensis* acts as a plant defense activator to provide fungicide and bactericide activity plus proven plant health benefits.

MAJESTENE[™] BIOREMATICIDE

- Broad spectrum nematocide with application in-furrow, drench, drip irrigation or as a seed treatment on a wide variety of crops.
- Based upon *Burkholderia rinojensis* strain A396.

HAVEN[™] ANTI-TRANSPIRANT

- Unique biostimulant that reduces water loss, reflects heat to reduce crop stress and increase yield, reduces bitter pit in apples



 **GRANDEVO**[®]
BIOINSECTICIDE

Chromobacterium subtsugae strain PRAA-T¹



- New species of bacteria, *Chromobacterium subtsugae* isolated from US forest soil by the USDA-ARS
 - Dead bacteria plus cell-associated compounds
 - MBI patents on *Diabrotica*, nematodes, others pending, including protein actives
- Rapid cessation of feeding & reproduction of many sucking insects, mites and flies and acts as a slow acting stomach poison
- First EPA registration 2013, Mexico 2016
- DF and WDG formulations with 30% a.i.



Grandevo - *C. subtsugae* (MBI-203)



- US EPA Label
- Re-entry interval (REI) of 4 hours
- Zero-day pre-harvest interval
- Exempt from tolerances
- NOP compliant/OMRI listed for use on organic production



Some Key Insect Targets in the EU

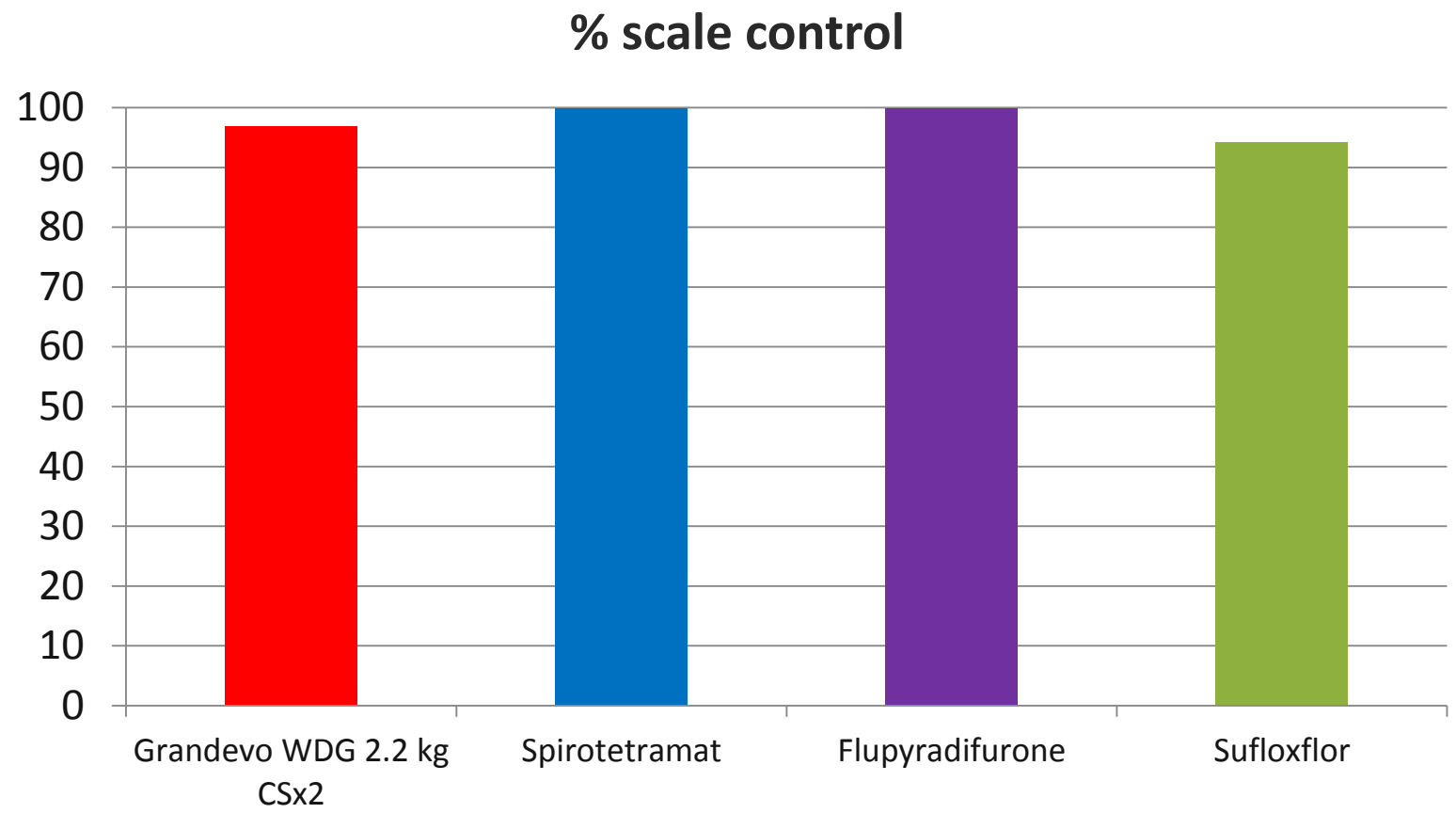


Grandevo
1-3 KG/HA

Whiteflies	<i>Trialeurodes, Bemisia on protected and field Solanaceous and cucurbits</i> <i>Frankliniella occidentalis on protected Solanaceous</i>		
Thrips			
Mealybugs	<i>Pseudococcus spp.</i>	Leafrollers	<i>Lobesia botrana</i>
Twospotted spider mite	<i>Tetranychus urticae</i>	Rust mites	<i>Eryiophidae spp.</i>
San Jose scale	<i>Quadraspidiotis perniciosus</i>	Rosy apple aphid	<i>Dysaphis plantaginea</i>
Spotted wing drosophila	<i>Drosophila suzukii</i>	Armyworms	<i>Spodoptera spp.</i>



San Jose Scale, *Quadraspidiotis perniciosus*, Control on Peaches in a High Pressure Orchard

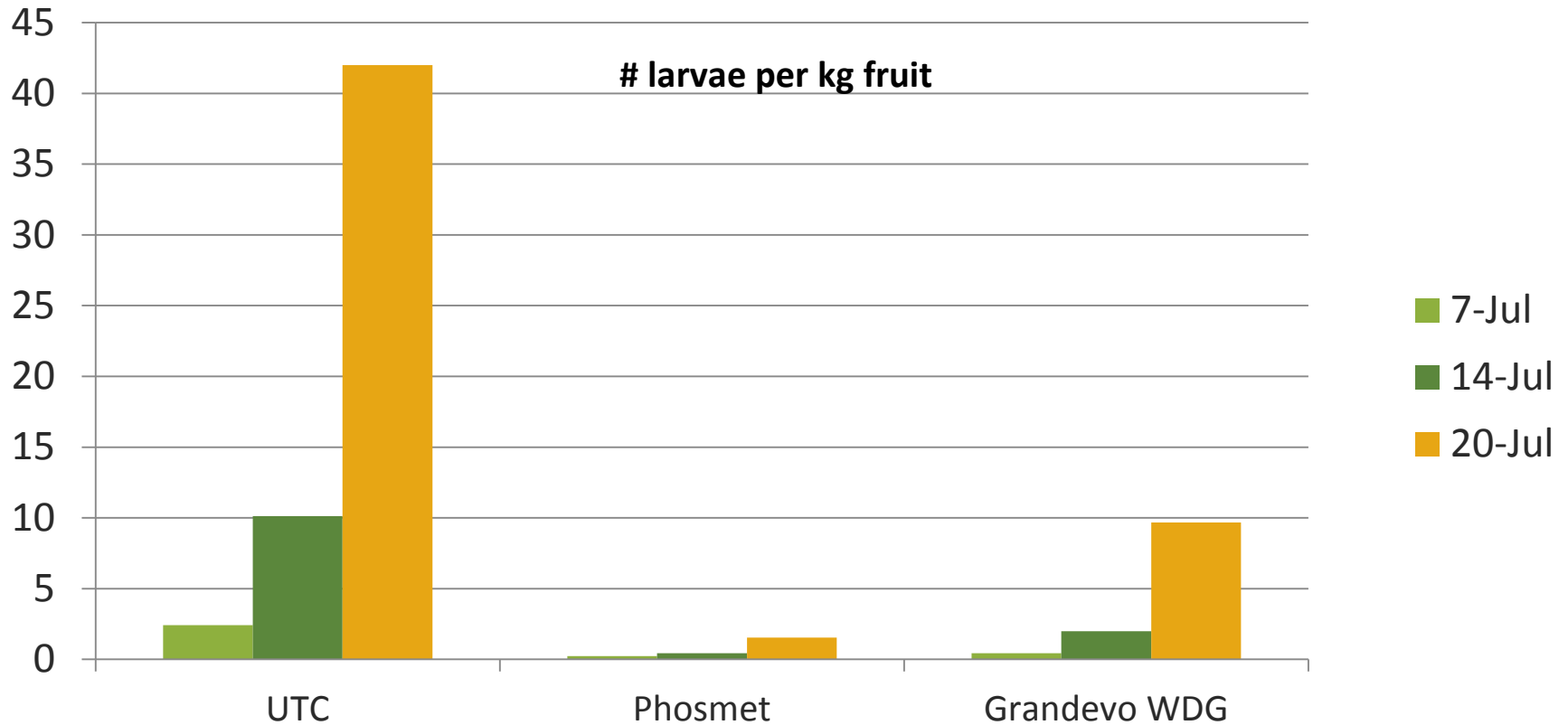


Dr. Anne Nielsen, Rutgers, Bridgeton, NJ. Season total of crawlers/5 cm tape in UTC = 657. Flupyradifurone application included LI-700. No adjuvant included with Grandevo application.

Control of Spotted Wing Drosophila, *Drosophila suzukii*, on Tart Cherry



Dr. J. Wise, Michigan State U.

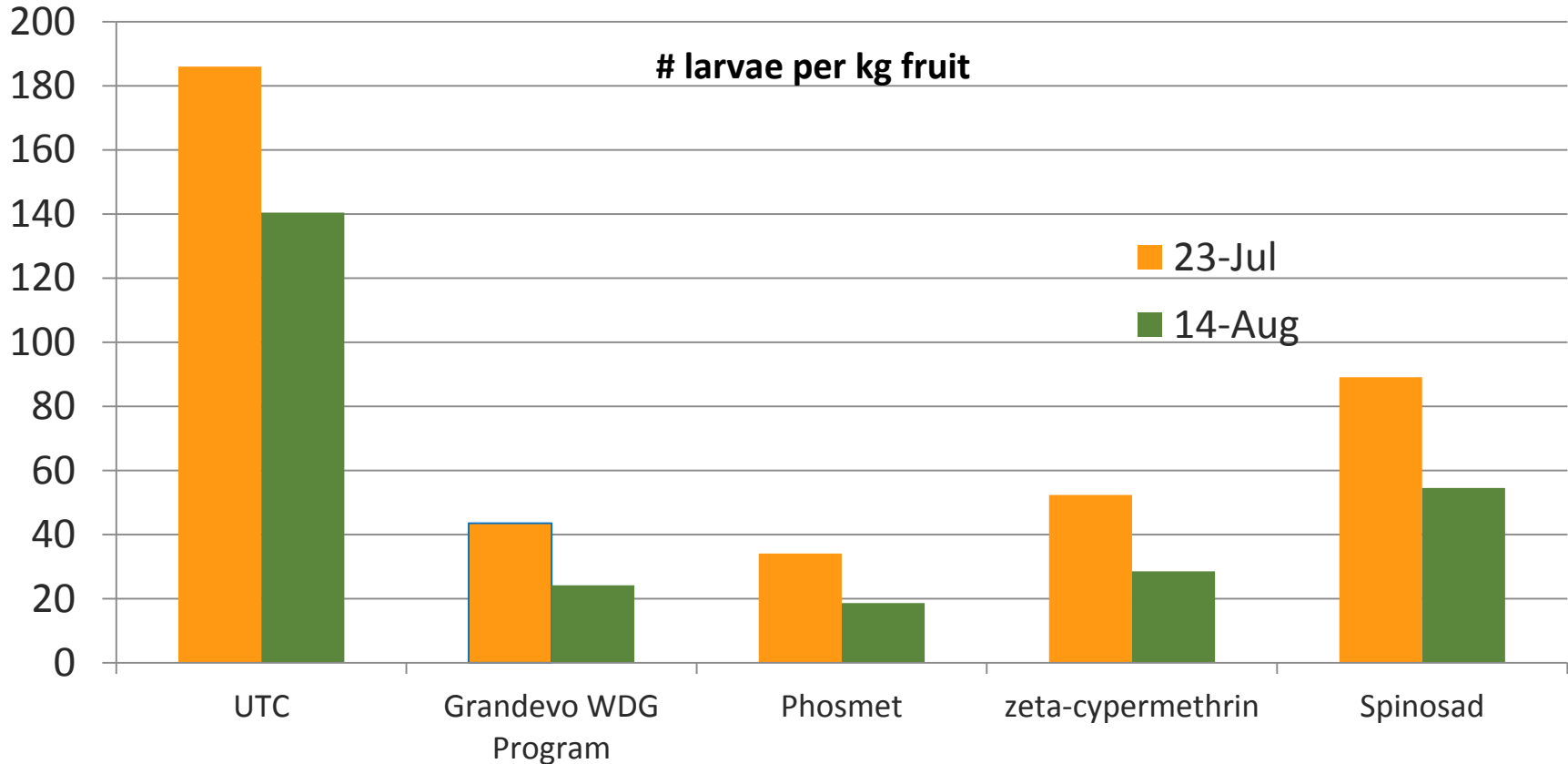


Applications made on 24-June and 1, 8 and 15-July.

Phosmet (Imidan) applied at 2.3 kg/acre, Grandevo WDG applied at 3.3 kg/acre. All applications included an adjuvant.

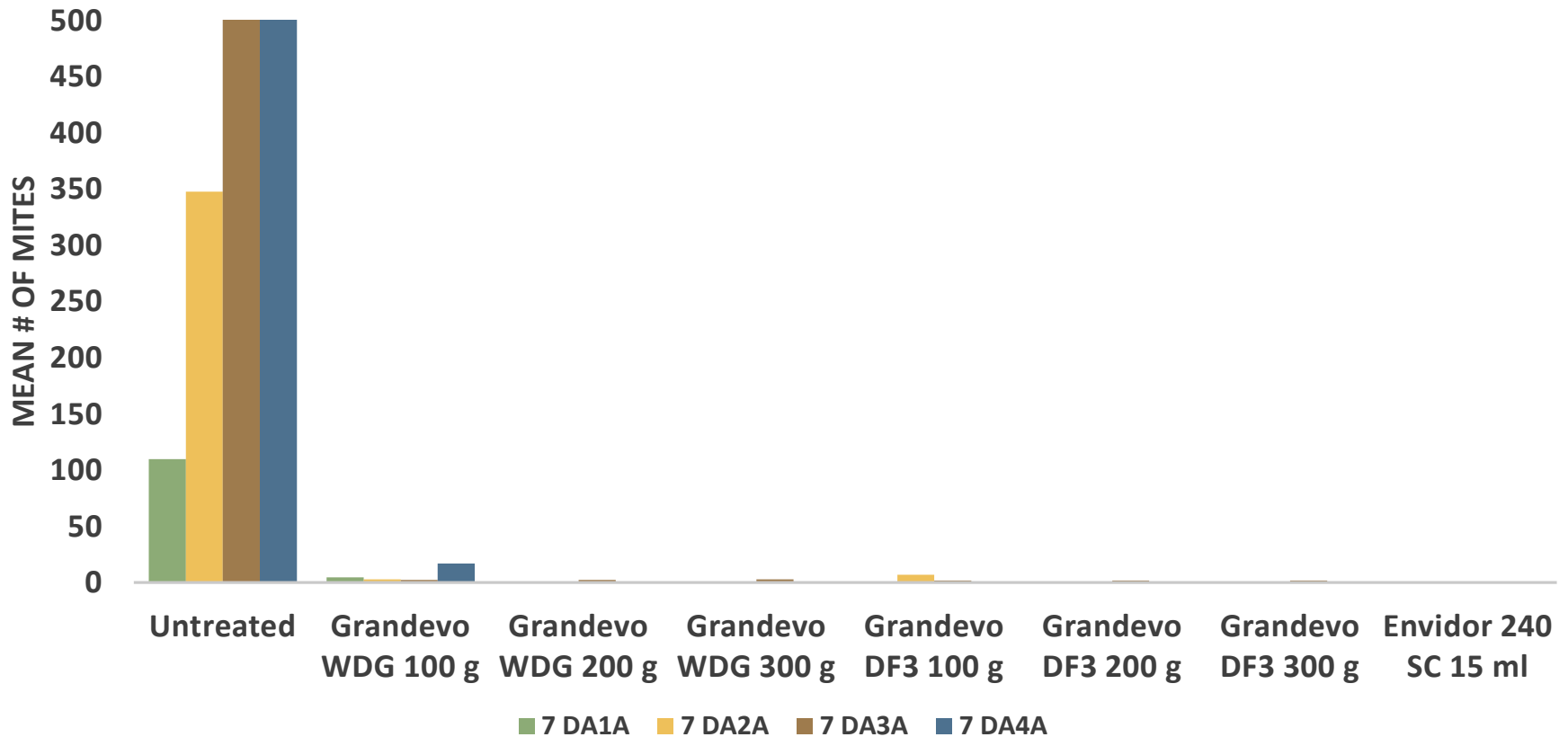
Control of Spotted Wing Drosophila on Blueberry

Dr. J. Wise, Michigan State U.



Six applications - Phosmet (Imidan) @ 1.5 kg/ha, zeta-cypermethrin (Mustang Maxx) @ 292 ml/ha, spinosad (Entrust) @ 438 ml/ha. Grandevo program consisted of GVO WDG @ 3 kg/ha f/b phosmet @ 1.5 kg f/b zeta-cypermethrin @ 292 ml f/b spinetoram (Delegate) @ 438 ml f/b cyantraniliprole (Exirel) @ 730 ml f/b GVO @ 3.3 kg/ha. All applications included an adjuvant.

Efficacy of Grandevo Formulations on Citrus Rust Mite in South Africa



Mean # Mite = per 10 fruit

Grandevo TGAI Mammalian Toxicity

Test	Species	Dose Tested	Results
Acute oral toxicity	Rat	>5000 mg/kg	Non-toxic Category IV
Acute dermal toxicity	Rat	>5050 mg/kg	Non-toxic Category IV
Primary dermal irritation	Rabbit	0.5 ml undiluted product for 4 hours	Slight irritant Category IV
Primary eye irritation	Rabbit	0.1 ml undiluted product for 24 hours	Minimal irritant Category IV
Acute inhalation toxicity	Rat	>2.37 mg/L aerosol for 4 hours	Non-toxic Category IV
Skin sensitization	Guinea pig	0.4 ml undiluted test substance (given once per week for 3 weeks, followed by a 2 week period before challenge)	Not sensitizing
Acute intravenous toxicity / pathogenicity	Rat	3.1×10^6 cfu/ml	Non-toxic, non-pathogenic

Grandevo TGA1 Non-target Toxicity



Test	Species	Dose Tested	Results
Avian oral toxicity	Northern Bobwhite quail	4 X 10 ¹¹ cfu/kg body weight for 5 days	No mortality or overt signs of toxicity or pathogenicity
30-day freshwater fish toxicity/pathogenicity	Fathead minnow	Aqueous and dietary multi-dose study	No effects at highest dose tested, LC50>2060 mg/L
48-hour acute toxicity	<i>Daphnia magna</i>	1.9 – 60 mg/L	<u>48-hour EC50 = 11 mg/L</u>
Non-target insect testing	Green Lacewing	700 – 70,000 ppm	No evidence of pathogenicity Dietary LC50 > 70,000 ppm

Grandevo TGAI Non-target Toxicity - *Apis mellifera* L.



Test	Species	Dose Tested	Results
Honey bee contact study (adult)	<i>A. mellifera</i> L.	>25 µg per bee	No observable abnormalities in treated bees
Tier II honey bee larval study	<i>A. mellifera</i> L.	>100 µg per bee	No observable effects, no mortality
Acute oral honey bee larval	<i>A. mellifera</i> L.	7.5 mg per bee	Mortality from exposure was low and not different from the control mortality. 11 mg per bee is considered practically non-toxic by EPA
Whole hive honey bee study	<i>A. mellifera</i> L.	3.3 kg/ha Two applications	Enclosed hoop-house study with Grandevo-treated flowering buckwheat demonstrated short-term repellency but no effect compared to untreated hives

Grandevo - EU Regulatory Status



November 14, 2014 - Initial Submission with Ctgb

July 17, 2015 – Admissibility completed as a biopesticide

Since July 2015 - generating new information and studies requested by Ctgb, new EU guidelines on additional bee studies, dossier will be updated and submitted to EFSA Q1 2018

EFSA conclusion end of 2018/early 2019

Product authorization early 2020

- Five years after an initial registration we are still in the very early stages of exploiting the bioactivity of *Chromobacterium subtsugae*
- Continued manufacturing process and formulation improvements should yield additional products for new market segments including seed treatments and as a nematicide
- Expand international registrations in Europe, Asia, Oceania and LATAM

