

Development and commercial testing of the yeast *Metschnikowia fructicola* for the control of pre and postharvest diseases

Mordechai Keren-zur¹, Michael Lazare¹, Alice Khusid¹, Amir Bercovitz¹, Mordechai Rebhun¹, Lea Cohen², Batia Weiss², Avinoam Daus², Ozgur Akgun Karabulut³, Himmet Tezcan³, Samir Droby²

¹Minrav Infrastructures-The Biological Division, Jerusalem 91291

²Department of Postharvest Science, ARO, The Volcani Center, P.O. Bo 6, Bet Dagan 50250, Israel,

³Department of Plant Protection, Faculty of Agriculture, Uludag University, 16384 Gorukle-Bursa, Turkey.



Introduction

Chemical pesticides are widely used for the prevention of fungal decay of fruit and vegetables. Public concern about consumer exposure to toxic residues has led to the search for safer alternatives. A large number of antagonistic organisms have been identified in research laboratories, yet only few made it to the marketplace as biological products. The yeast *Metschnikowia fructicola* Kurtzman and Droby sp. nov. (1) was isolated from the surface of table grapes in Israel. Over a period of three years, the product (temporarily named "Shemer") was tested on Citrus (pilot packinghouse tests), table and wine grapes and strawberries. More than 30 commercial field tests in Israel, Turkey, Italy, US, South-Africa were conducted with "Shemer"

Objectives

- Develop industrial processes for the production of a stable product based on viable *Metschnikowia Fructicola* cells.
- Demonstrate efficacy in controlling pre- and postharvest decay under commercial conditions.
- Expand the utility of the product to different crops and to field applications.

Materials and methods

- "Shemer" is produced by submerged fermentation of the yeast *Metschnikowia fructicola* followed by formulation with inerts into dry water dispersible granules.
- Citrus: All experiments were conducted in pilot packing line which simulates all operations of a commercial packinghouse. The layout of the packing line include: wash with plain water, drying under fans blowing warm air, drenching with the yeast cell suspension, air-drying under warm blowers, sorting, waxing and packing.
- Strawberry: Test were conducted in commercial fields in Turkey and Israel. Each treatment consisted of 4 replications and each replication was 8 m length. The application of the biological and chemical treatments were performed at weekly intervals starting at the first flowering cycle of strawberries. (total of 6 - 10 applications). For the storage experiments, fruit were picked before the application of the treatments, stored at 1°C for 3 days followed by 2 days at 20°C.
- Wine and table grapes: Tests were conducted in commercial vineyards. Each treatment consisted of 6-8 plots of 5m each. Fruit from each plot (3-5kg) was stored at 0°C for a period of 35 days followed by storage at 20°C for 10 days. Fruit from the non treated plots and exposed to SO₂ releasing pads was used as standard chemical control.

Results

Product Description

- "Shemer (temp. name) : is based on a natural, non-antibiotic-producing strain of yeast.
- Effective against wide range of postharvest pathogens including: *Penicillium digitatum* and *P. italicum* (citrus), *P. expansum* (pome and stone fruits) *Botrytis cinerea*, *Rhizopus stolonifer* (grapes and strawberries), *Aspergillus niger* (grapes), mainly by competition for nutrients and space.
- A water dispersible granule (WDG) formulation - applied by spraying using conventional application equipment.
- Shelf life - over a year (see below).
- Non-toxic to mammals in Acute toxicological Studies.
- Non-toxic to beneficial insects.

Product stability under accelerated conditions

No loss in viability was observed following 3 months storage at 30°C, corresponding to 1 year under recommended storage conditions. (Rate of loss at room temperature is at least 3 times slower than at 30°C)

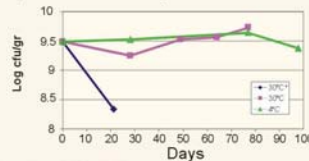


Fig. 1. Stability of "Shemer" under accelerated storage conditions. Viability in terms of CFU was assessed periodically* before packaging.

"Shemer" for the control of molds on citrus

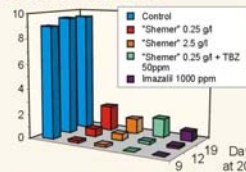


Fig. 2. Control of *Penicillium digitatum* on Grapefruit by "Shemer" treatments

Each treatment consisted of 10 boxes, each containing 36 fruit. Fruit was stored for 2 weeks at 10°C followed by one weeks at 20°C.

"Shemer" for the control of gray mold on strawberry

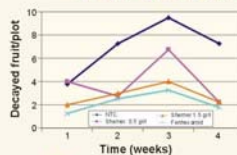


Fig. 3a. Control of *Botrytis cinerea* on strawberry in the field *Izlik, Turkey

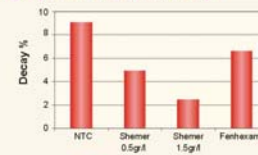


Fig.3b. Control of postharvest rots of strawberry *Izlik, Turkey

"Shemer" for the control of bunch rots in grapes

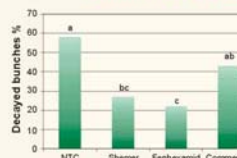


Fig. 4a. Control of gray mold in grapes in the field *Izlik, Turkey

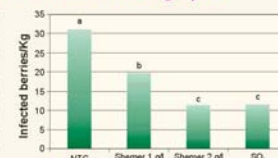


Fig. 4b. Control of gray mold in grapes under cold storage conditions Lachish, Israel. (cv Thompson) Single application, 2 days before harvest.

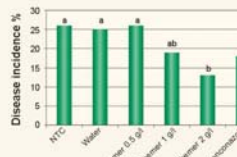


Fig. 5a. Control of *Aspergillus* rot in the vineyard. *Netta farms, Israel. Three applications (10 days interval) from veraison on.

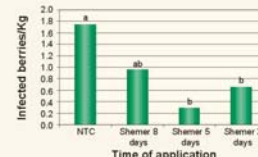


Fig. 5b. Control of *Aspergillus* rot at shelf life condition (14 d 20°C). *Kfar-Truman, Israel.

"Shemer" for the control of Rhizopus rot

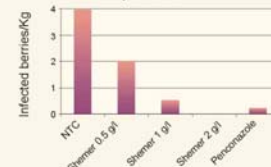


Fig. 6. Control of *Rhizopus* rot on table grapes (cv. Thompson) at Shelf condition (12 d 20°C).

Zichron-Yaakov, Israel. 3 biweekly applications of "Shemer" from veraison on.

Conclusions

- "Shemer" is stable for commercial distribution purposes.
- "Shemer" was effective in preventing green mold (*P. digitatum*) on grapefruit.
- "Shemer" was effective in preventing Gray mold on strawberries in the field and at storage.
- "Shemer" was effective in preventing Gray mold on grapes in the vineyard and at storage.
- "Shemer" was effective in preventing *Aspergillus* bunch rot on grapes in the vineyard and at storage.
- "Shemer" was effective in preventing *Rhizopus* rot in stored table grapes.
- "Shemer" shows effective control activity in a wide spectrum of crop/ fungal rot combinations under commercial conditions.

Reference

(1) Kurtzman, C.P. and Droby, S. 2001. *Metschnikowia fructicola*, a new Ascosporic yeast with potential for biocontrol of postharvest fruit rots. System Appl. Microbiol. 24: 395-399.