



NUTRAGE
Consiglio Nazionale delle Ricerche



Metabolomic approach based on NMR spectroscopy to explore the nutraceutical and sensorial profile of tomato fruits produced by Effective Micro-organisms

NUTRAGE: Nutrizione, Alimentazione ed Invecchiamento Attivo
I convegno 16 -17 maggio 2024 - Area della Ricerca di Palermo

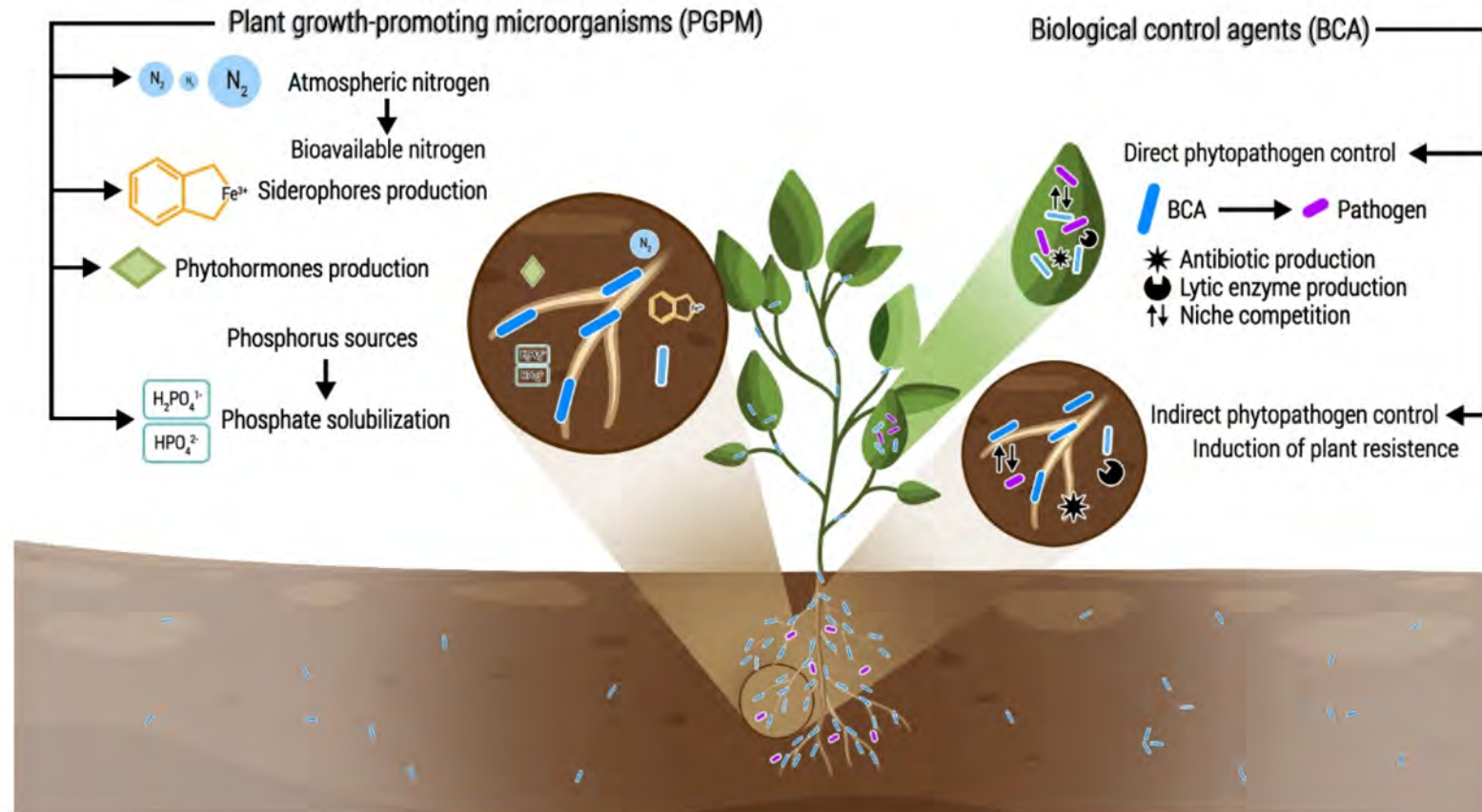
Annabella Tramice





Beneficial and Effective Micro-organisms for a sustainable agriculture and environment

- Effective Microorganisms (EM[®]) is a mixed culture made from a combination of **photosynthetic bacteria, lactic acid bacteria, yeasts, and actinomycetes**, that can be applied as inoculants to increase the microbial diversity of the soil ecosystem.
- How effective microorganisms work? EM[®] promote beneficial microbes and suppress undesirable ones, thus supporting the ecological balance and counteracting the spread of harmful microorganisms.





Two typical tomato varieties of the Campania region, San Marzano and Corbarino were analyzed:



Corbarino tomatoes cultivations were from:

- ❖ Corbara sud
- ❖ Corbara Tramonti
- ❖ Agerola
- ❖ **Nocera Superiore with**



San Marzano tomatoes cultivations were:

- ❖ "antico" variety, traditional cultivation
- ❖ "antico" variety, cultivation without pesticides
- ❖ **"antico" variety with**



From lyophilized whole fruits were made extracts in:

- ✓ CHCl_3
- ✓ $\text{EtOH:H}_2\text{O}$



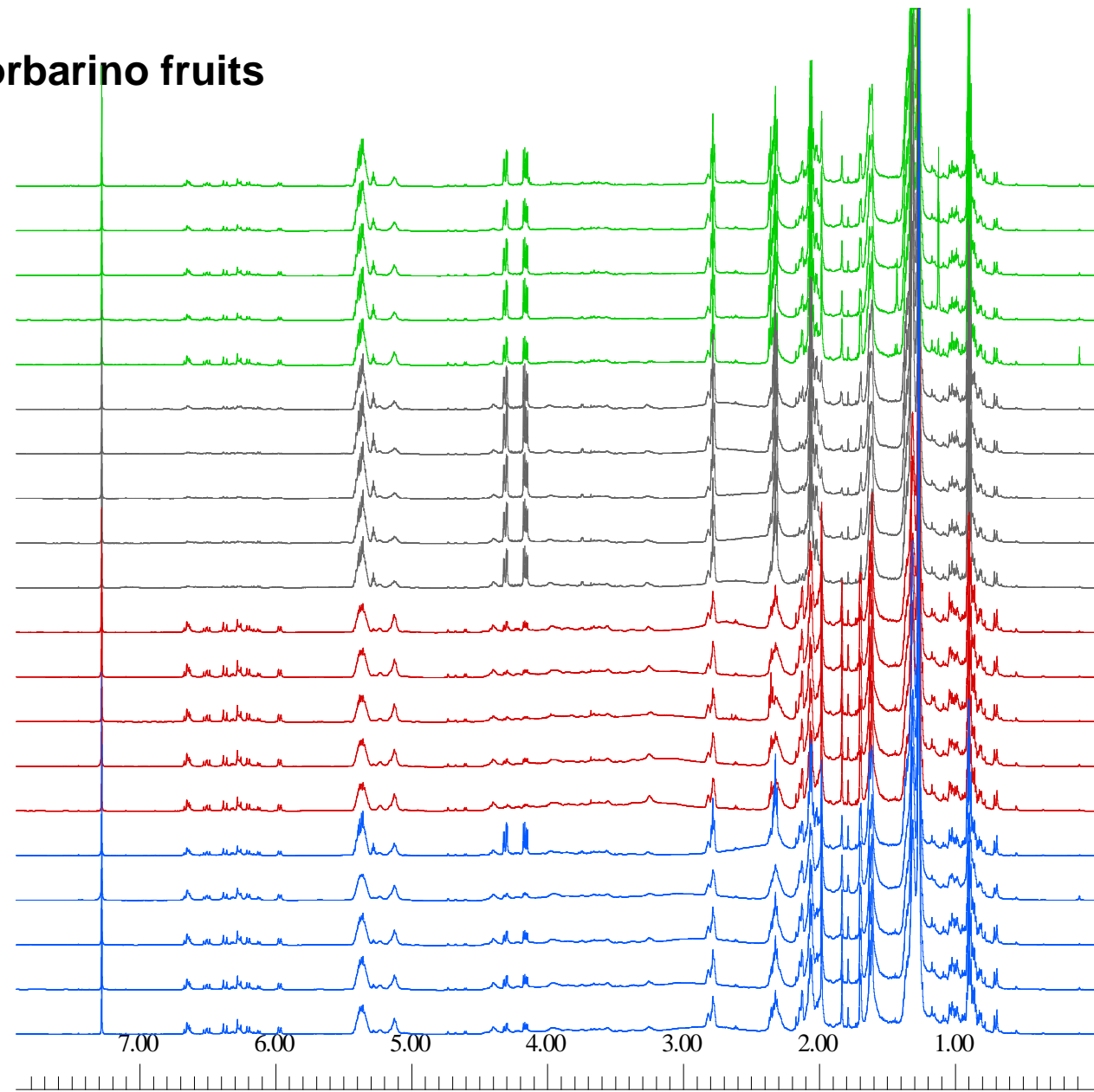
Metabolomic analysis of apolar extracts of Corbarino and San Marzano tomato fruits from different cultivars by using NMR spectroscopy coupled with multivariate statistical analysis.

¹H-NMR spectra of corbarino fruits

- Corbarino from Corbara sud
- Corbarino from Corbara Tramonti
- Corbarino from Nocera Superiore with EM
- Corbarino from Agerola

Molecular class :

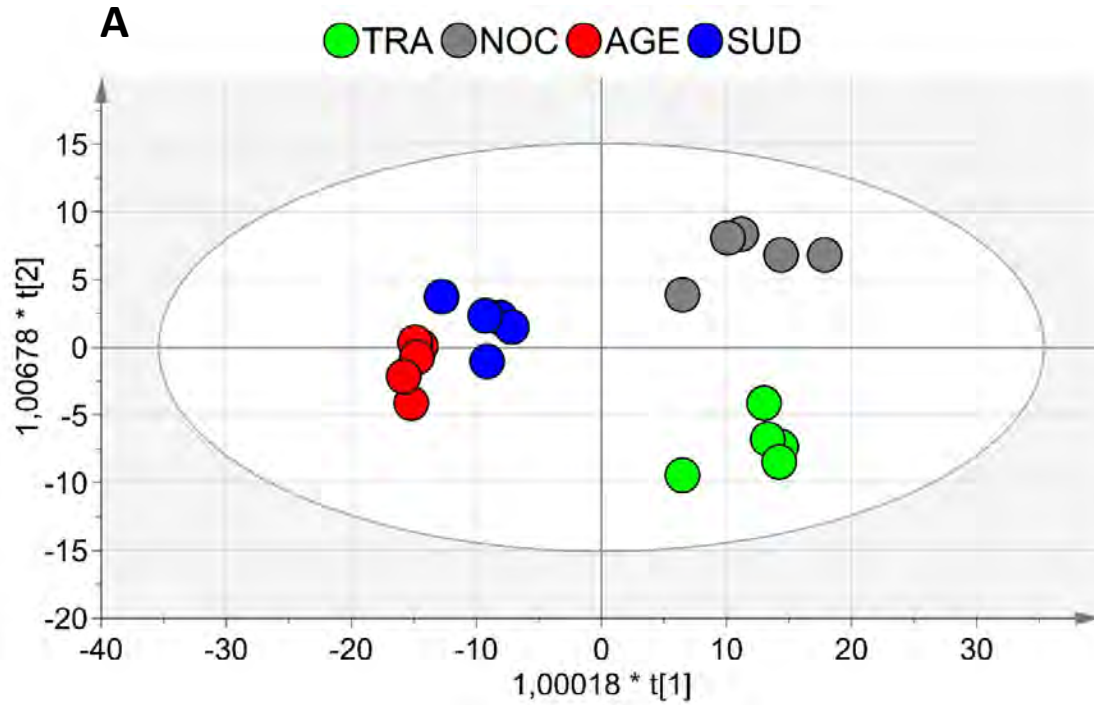
- CAROTENOIDS: β -carotene, lycopene, lycopene 1,2 epoxide,
- PHOSPHOLIPIDS: phosphatidylcholine, phosphatidyl-ethanolamine, phosphatidyl-inositol
- FATTY ACIDS: oleic, linoleic, linolenic, SFA (palmitic, stearic acids)
- PHYTOSTEROLS: sitosterol, campesterol, stigmasterol
- VITAMINS: tocoferols



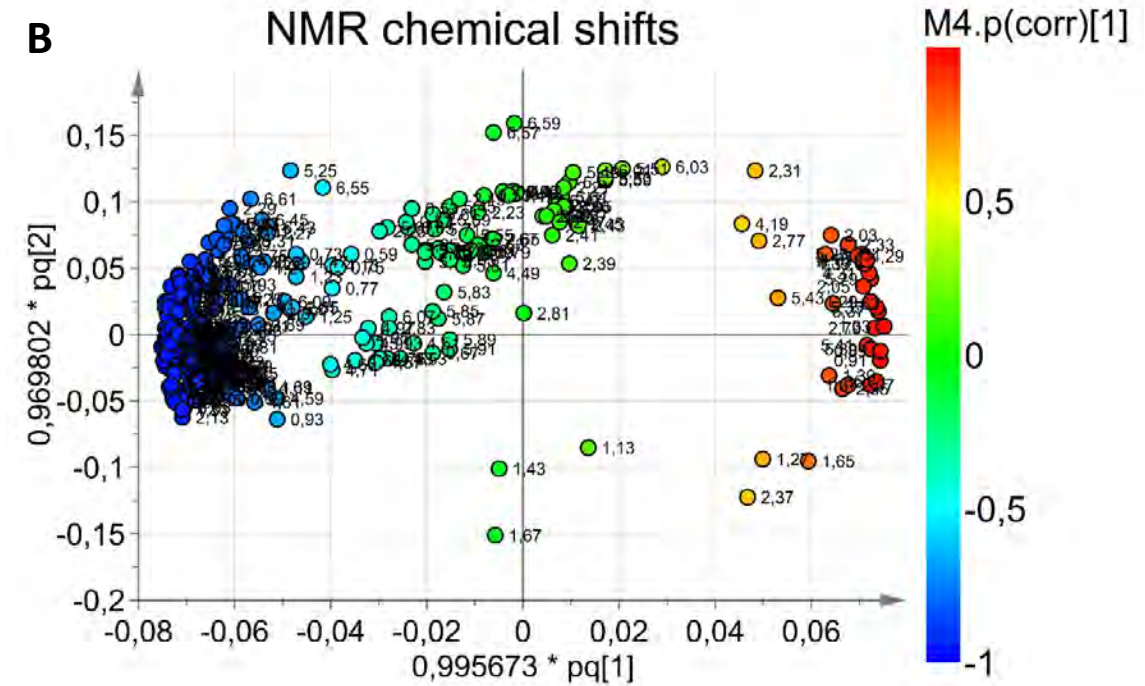


Multivariate statistical analysis of corbarino apolar extracts OPLS-DA model

OPLS-DA scores plot-samples projection



OPLS-DA loadings plot- signals projections



For **Corbara sud** and **Agerola** cultivars, discriminating class molecules are: carotenoids, phytosterols

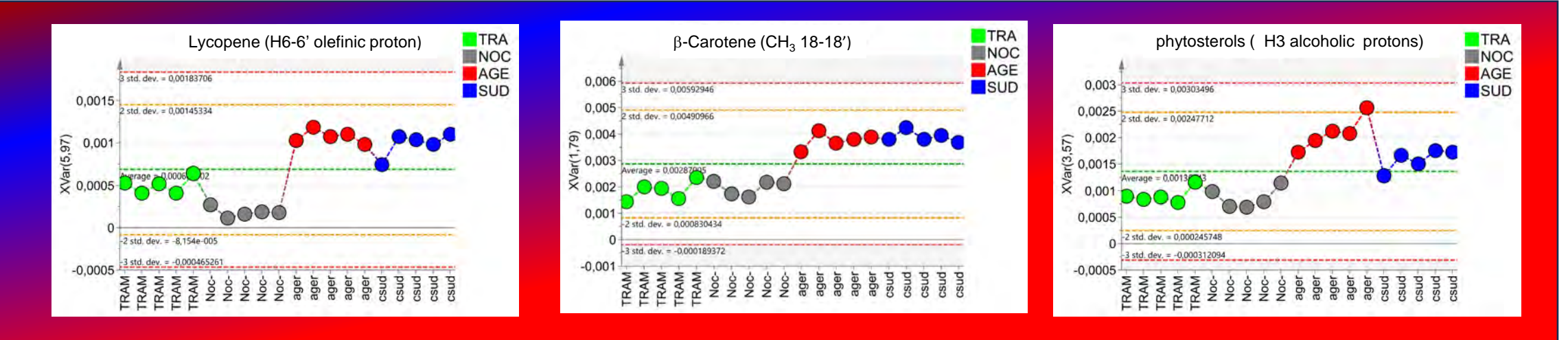
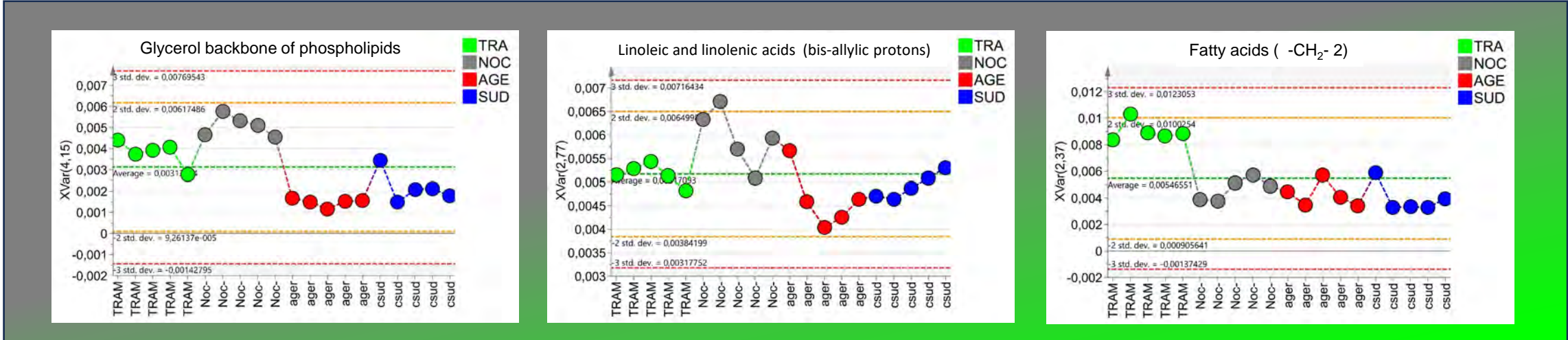
For **Nocera with EM** cultivars, discriminating class molecules are: phospholipids and unsaturated fatty acids (in particular linoleic and linolenic acids)

For **Tramonti** cultivar, discriminating molecules are : oleic, SFA

We elaborated a statistical model with 3 predictive and 2 orthogonal components and parameters $R^2 = 0.84$ and $Q^2 = 0.47$, CV-ANOVA test p value = 0,0079 (significant at 0,05 level).



Normalized bin variations of discriminant molecules from corbarino fruits

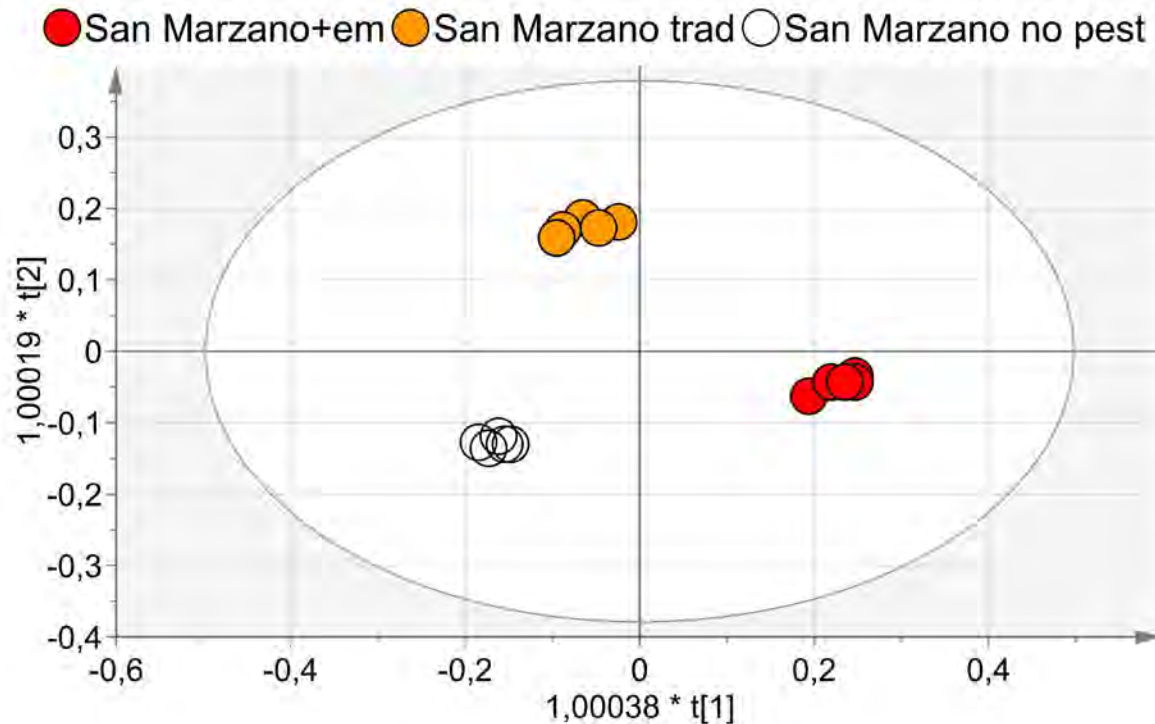




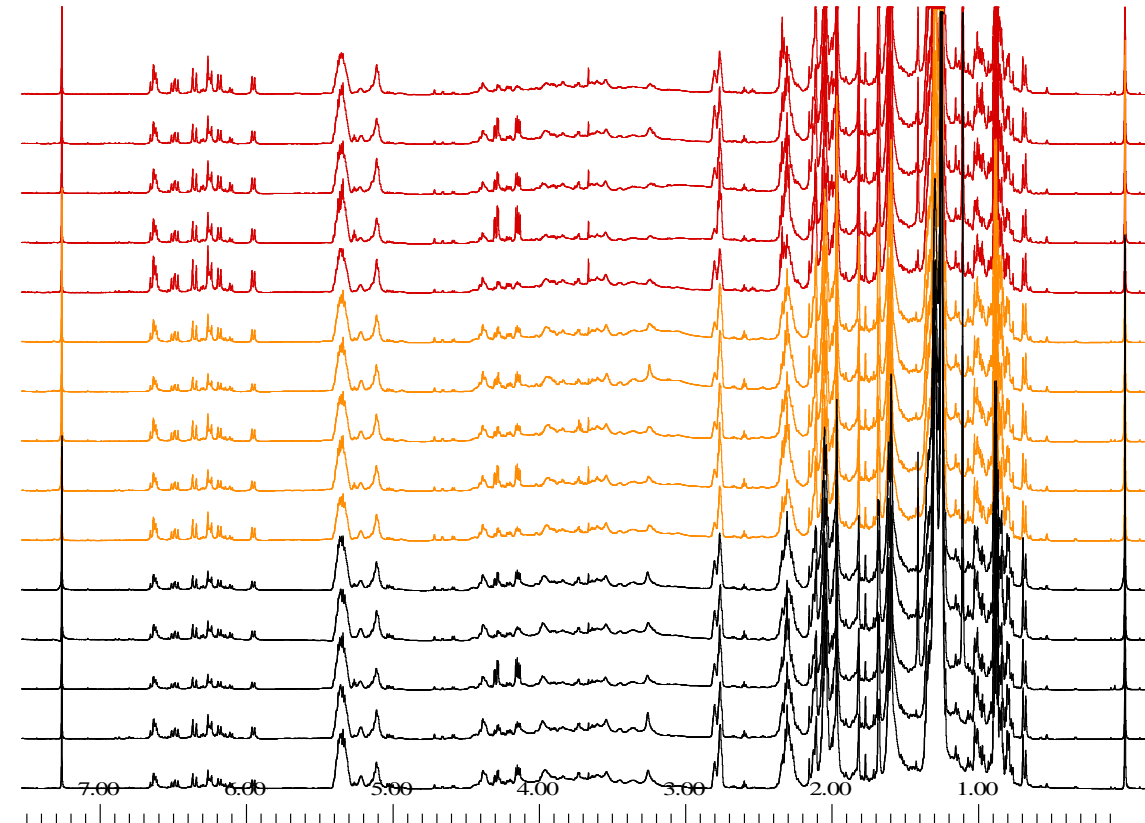
Multivariate statistical analysis of San Marzano apolar extracts OPLS-DA model

- **San Marzano « antico » with EM**
- **San Marzano « antico » traditional**
- **San Marzano « antico » without pesticides**

OPLS-DA scores plot-samples projection



¹H-NMR spectra



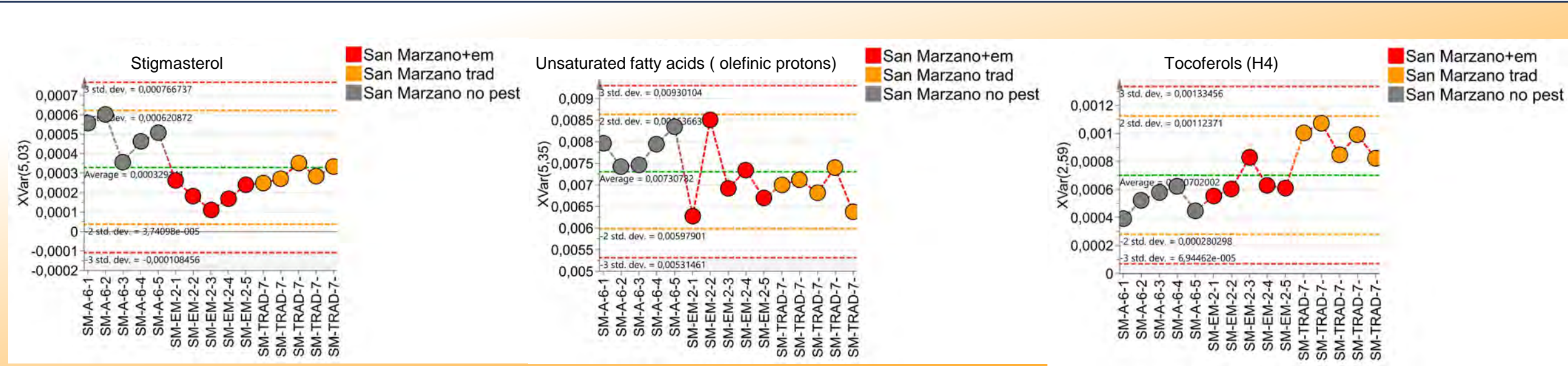
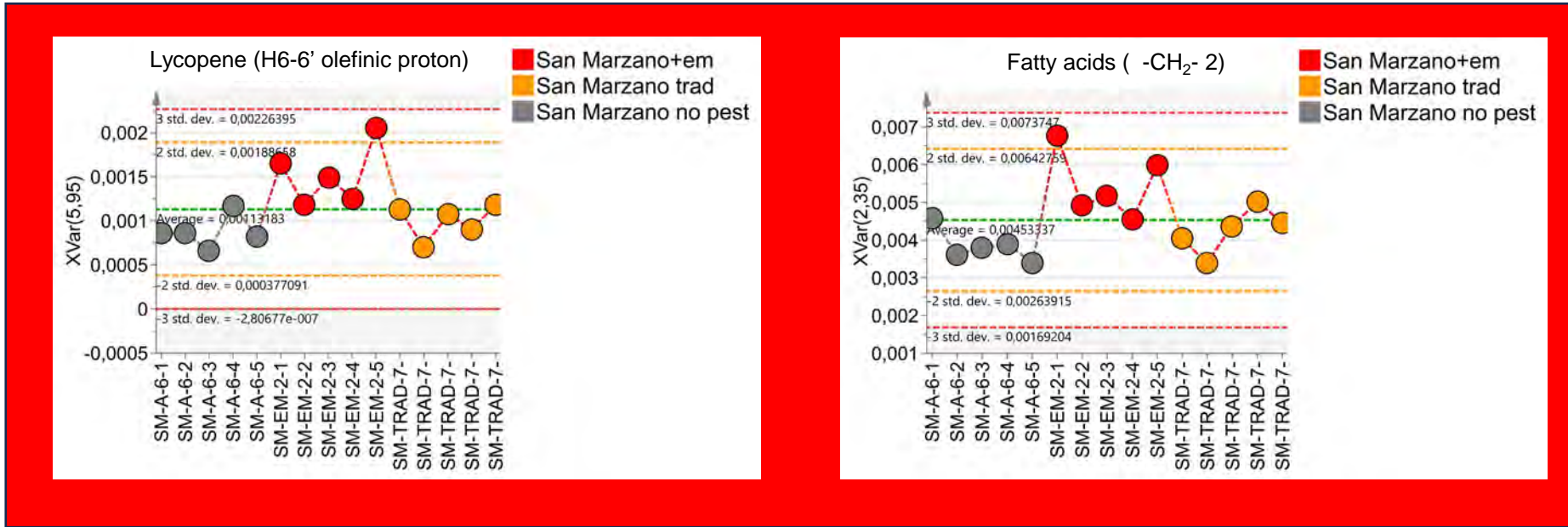
For **San Marzano « antico » with EM** cultivar, discriminating class molecules are: carotenoids, fatty acids

For **San Marzano « antico » traditional** cultivar, discriminating class molecules are : phytosterols, tocoferols

For San Marzano « antico » without pesticides cultivar, discriminating class molecules are unsaturated fatty acids




Normalized bin variations of discriminant molecules from San Marzano fruits

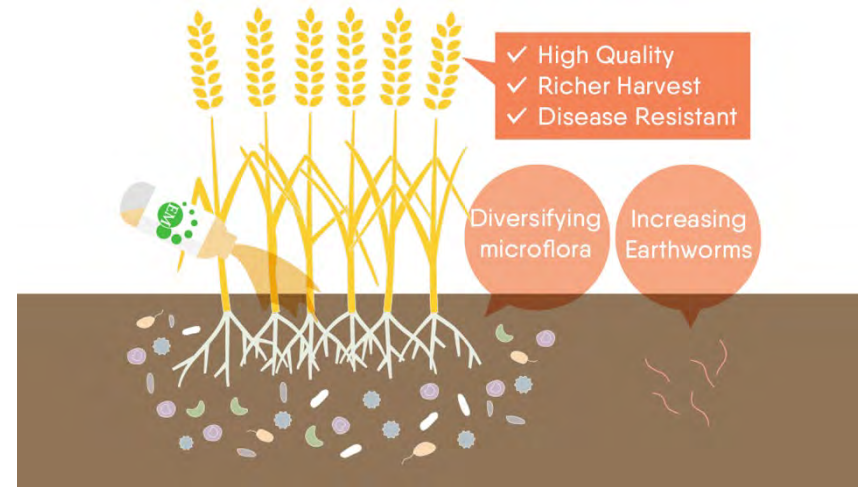




In conclusion:

For the first time, using a metabolomic NMR-based approach, the nutraceutical profile of apolar extract of Corbarino and San Marzano fruits produced by Effective Micro-organisms has been characterized :

➤  inoculants modulate the tomato crops quality:

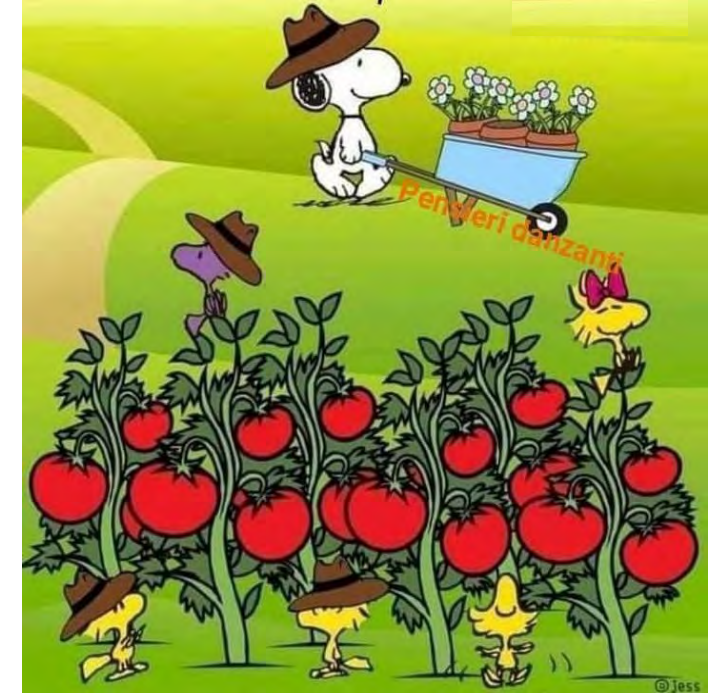


- Corbarino fruits biomarkers are: phospholipids and linolenic-linoleic acids
- San Marzano fruits biomarkers are: lycopene and fatty acids (oleic, palmitic)



The ICB-GROUP

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Thanks for the attention

