SELECTIVE INOCULATIONS USING A PRECISE COMBINED HARVESTING MACHINE

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Background

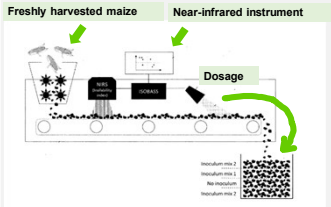
- **Problem**: Aerobic stability (AS) is a critical issue in maize silage during the feed-out phase. Poor AS leads to spoilage and economic loss. Current Practice
- **Current Practice Gap**: Pre-ensiling conditions affecting silage quality are not dynamically managed during harvest.
- **Innovation**: A patented sensor-based system integrated into a precision harvesting machine can detect key maize traits in real time and adjust the inoculant dose accordingly.
- **Objective:** Improve the silage's fermentative quality and aerobic stability by tailoring heterofermentative inoculant application based on crop variability.

Aims

- Evaluate the effect of different doses of *Lentilactobacillus buchneri* (standard vs. decupled vs. control) on:
  - Fermentative profile
  - Aerobic stability (AS)
  - Overall silage quality index (QI)
- Demonstrate that real-time inoculation adjustment during harvest enhances silage preservation.

Materials and Methods

Patented algorithm: Based on the quality of the freshly harvested maize, the inoculation range is between 0.8 and 1.5 times the regular dosage.



The freshly harvested maize (FHM) is analyzed using a Near-infrared instrument to ascertain the "quality index." Based on this value, the computer determines whether to inoculate and selects the most suitable dosage accordingly.

Inoculants & Treatments
•Used *Lentilactobacillus buchneri* (KWS LACTOSTABILITY, strain CCM 1819)
•**3 treatments**:
- **C** (Control): water only;
- **SD** (Standard Dose): 2.02 × 10^5 CFU/g;
- **DD** (Decupled Dose): 2.02 × 10^6 CFU/g.

Field setup
Maize sown in a checkerboard pattern in one field (April 6, 2023)
- **3 hybrids**:
  1. KWS Simpatico (FAO 200)
  2. KWS Adaptico (FAO 300)
  3. KWS Inteligens (FAO 400)
- Harvested **on August 4, 2023**, Veneto, Italy

Subplot 3 Hybrid 2	Subplot 4 Hybrid 1
Subplot 2 Hybrid 3	Subplot 5 Hybrid 2
Subplot 1 Hybrid 1	Subplot 6 Hybrid 3

Silage Preparation
Ensiled as buckets: 10 L, 3 replicates

Measurements
Chemical Analysis after 60 days, and Aerobic Stability Test:
AS = Time (h) silage stays within 2°C of room temperature

Results

- Harvested maize differs in dry matter (DM, %) and content for the three inoculants (28.3b, 28.2b, and 30.3a—P < 0.0001—for SD, DD, and C, respectively);
- Water-soluble carbohydrates (WSC, % DM) did not differ among the treatments (7.04, 7.03, and 7.81 for SD, DD, and C, respectively);
- The DM density (146 Kg DM/m3) did not differ in the three theses but did not satisfy the recommended threshold of 240 Kg DM/m^3 to limit the porosity at 0.40;
- The observed porosity was 0.57b, 0.56b, and 0.59a (P = 0.001) for SD, DD, and C, respectively, exposing the silage to aerobic deterioration risk..

	QI (0-100)	pH	Ammonia (NH4/N, %)	Mannitol (% DM)	Ethanol (% DM)	Lactic ac. (% DM)	Acetic ac. (% DM)	Propionic ac. (% DM)	Butiryc ac. (% DM)
C	42.1b	3.87	6.12	0.21b	0.93a	4.24b	1.90	0.82	0.08
SD	56.4a	3.84	6.38	0.50a	0.64b	5.25a	1.97	0.82	0.08
DD	52.1a	3.85	6.28	0.63a	0.62b	4.79a	1.86	0.83	0.08
P	<0.0001	0.053	0.393	0.001	<0.0001	<0.0001	0.664	0.964	0.134

Table 1: The quality index (QI), and the maize silage's fermentative profile underwent three inoculations. C = pure water, SD = standard dose; DD = decupled dose. Within the constituent letters indicate differences in means with P = 0.05. C= control, SD = standard dose; DD = decupled dose

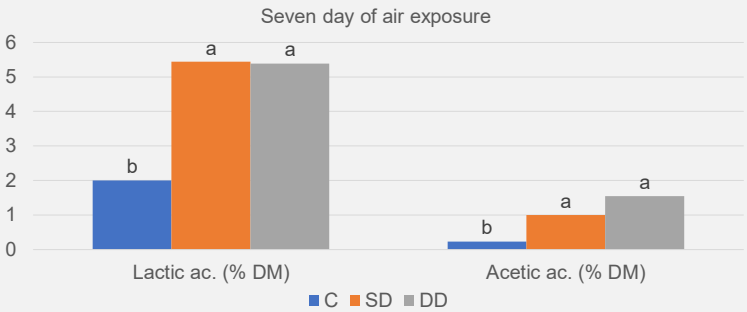


Figure 1: Lactic and acetic acid contents of silage after 7 days of aerobic exposure. C= control, SD = standard dose; DD = decupled dose

Aerobic Stability (Survival Time in hours):
•**Control:** 48.8h
•**SD:** 82.4h
•**DD: 274h** (↑↑) → P < 0.0001

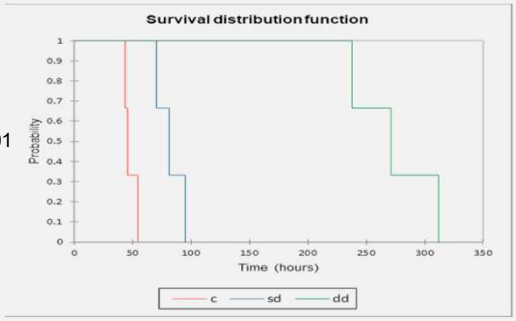


Figure 2:: Kaplan-Meier survival curve for aerobic stability. C= control, SD = standard dose; DD = decupled dose

Conclusions

- Precision inoculation improves fermentation and extends aerobic stability;
- Standard dose already meets typical farm requirements;
- Higher dose offers more stability but at a higher cost → Not economical;
- Future work should fine-tune dosage strategies for optimal cost-benefit balance.