

## SUPPLEMENTARY MATERIAL

### Multi-season assessment of planting-date-associated patterns in *Fusarium verticillioides* presence and fumonisin contamination in maize grains

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**Table S1.** Sowing, flowering, and harvest dates of early- and late-planted maize hybrid field trials conducted at San Antonio de Areco (INTA AER San Antonio de Areco, Buenos Aires, Argentina) across three growing seasons (GS1 = 2020–2021; GS2 = 2021–2022 for early planting and 2022–2023 for late planting; GS3 = 2023–2024).

Season	Planting type	Previous crop	Sowing date	Flowering period	Harvest date
GS1	Early	Vetch cover crop	5 Oct 20	16–20 Dec 20	Late March 21
GS2	Early	Oat for grazing	5 Oct 21	15–20 Dec 21	Early April 22
GS3	Early	Wheat/second soybean	28 Sep 23	20–27 Dec 23	Early April 24
GS2	Late	First soybean	12 Dec 20	18–23 Feb 21	Early June 21
GS2	Late	First soybean	29 Dec 22	1–10 Mar 23	Early June 23
GS3	Late	Forage oat	14 Dec 23	11–16 Feb 24	Early June 24

**Table S2.** Soil chemical properties at sowing for early- and late-planted maize hybrid field trials conducted at San Antonio de Areco (INTA AER San Antonio de Areco, Buenos Aires, Argentina) across three growing seasons (GS1 = 2020–2021; GS2 = 2021–2022 for early planting and 2022–2023 for late planting; GS3 = 2023–2024).

Season	Planting type	pH	Organic matter (%)	P Bray (mg kg <sup>-1</sup> )	N-NO <sub>3</sub> <sup>-</sup> (0–20 cm)	N-NO <sub>3</sub> <sup>-</sup> (20–40 cm)	N-NO <sub>3</sub> <sup>-</sup> (40–60 cm)
GS1	Early	5.6	3.3	16	14.8	20.2	10.1
GS1	Late	5.6	3.3	16	14.8	20.2	10.1
GS2	Early	5.7	3.59	16	19.2	15.5	7.75
GS2	Late	5.6	3.5	13.3	16.3	7.2	3.6
GS3	Early	5.7	3.19	11.5	14.1	7.6	—
GS3	Late	5.8	3.9	12	9.1	6.3	—

**Table S3.** Presence of maize hybrids in early- and late-planted trials (INTA San Antonio de Areco) across three growing seasons (GS1 = 2020–2021; GS2 = 2021–2022 for early planting and 2022–2023 for late planting; GS3 = 2023–2024). A check mark (✓) indicates participation of a hybrid in each trial. Totals per trial: Early = 13 (GS1), 9 (GS2), 4 (GS3), 26 overall; Late = 13 (GS1), 5 (GS2), 2 (GS3), 20 overall.

Hybrid	Early			Late		
	GS1	GS2	GS3	GS1	GS2	GS3
A	✓			✓		
B	✓	✓	✓	✓	✓	✓
C	✓	✓		✓		
D	✓	✓		✓	✓	
E	✓			✓		
F	✓	✓		✓		
G	✓	✓	✓	✓	✓	
H	✓			✓		
I	✓	✓	✓	✓	✓	
J	✓			✓		
K	✓	✓	✓	✓	✓	
L	✓	✓		✓		✓
M	✓	✓		✓		

**Table S4.** Flowering dates and critical flowering period (–7/+21 days; ~28 days) for early and late plantings across three growing seasons (GS1 = 2020–2021; GS2 = 2021–2022 for early planting and 2022–2023 for late planting; GS3 = 2023–2024), showing the flowering window and the mean temperature and precipitation during the corresponding critical period.

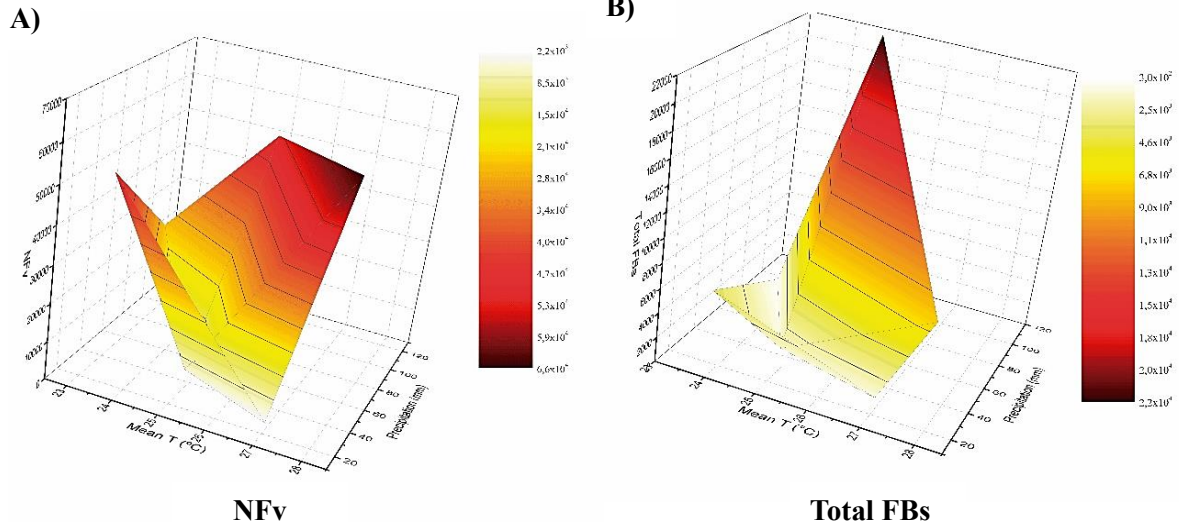
Planting Date	Campaign	Flowering period	Critical period (–7/+21)		
			Dates	Mean T (°C)	Precip (mm)
Early	GS1	16–20 Dec 20	11 Dec 20 – 8 Jan 21	24.9	34.5
	GS2	15–20 Dec 21	10 Dec 21 – 7 Jan 22	27.0	22.5
	GS3	20–27 Dec 23	16 Dec 23 – 13 Jan 24	23.5	93.2
Late	GS1	18–23 Feb 21	13 Feb – 13 Mar 21	23.4	36.2
	GS2	1–10 Mar 23	26 Feb – 26 Mar 23	27.8	29.5
	GS3	11–16 Feb 24	6 Feb – 5 Mar 24	24.7	112.7

**Table S5.** Overview of studies examining the relationship between *Fusarium verticillioides* presence/colonization metrics in maize grain and fumonisins (FBs) accumulation.

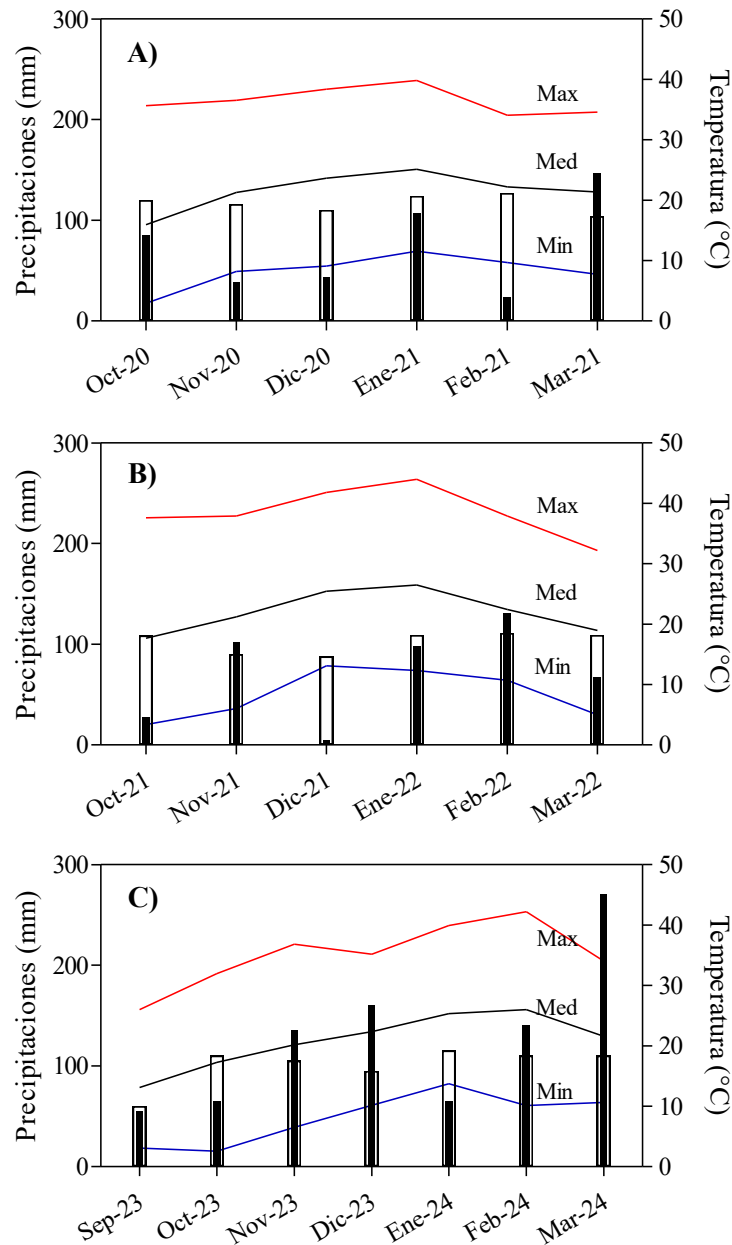
<b>Study</b>	<b>Type of measurement related to <i>Fusarium verticillioides</i></b>	<b>Outcome regarding correlation with FBs</b>
Cao et al., 2014	Incidence in grains (infection and infestation), and ergosterol content	Strong positive correlation with infection, weak correlation with infestation, no correlation with ergosterol
Munhoz et al., 2015	Incidence and severity of ear rot	Positive correlation, but with high interannual variability
Silva et al., 2017	Fungal counts (CFU g <sup>-1</sup> ) in grain	No correlation
van Rensburg et al., 2017	Fungal biomass (determined by qPCR)	Positively related, but the magnitude of FBs synthesis per unit biomass depends strongly on environmental variables
Links et al., 2019	Fungal biomass (quantified by qPCR), ear rot severity	Strong positive correlations
Castañares et al., 2019	Incidence in ears	Positive but weak or inconsistent correlation
Krnjaja et al., 2019	Incidence in ears	Some positive correlations, but dependent on year and hybrid
Ponce-García et al., 2020	Fungal counts (CFU g <sup>-1</sup> ) in grain	No correlation; hybrid genetics strongly influenced outcomes
Arias-Martín et al., 2021	Quantification of fungal DNA in grain	Generally no consistent correlation
Pérez-Pizá et al., 2024	Fungal counts in grains (NFv; CFU g <sup>-1</sup> ); incidence in grains (infection, IFv)	Positive correlations

## FIGURES

**Fig. S1.** Three-dimensional response surfaces showing the combined effects of mean temperature and accumulated precipitation during the critical flowering period on A) fumonisins (Total FB) accumulation and B) *Fusarium verticillioides* (NFv) colony counts for early and late plantings across three growing seasons (GS1 = 2020–2021; GS2 = 2021–2022 for early planting and 2022–2023 for late planting; GS3 = 2023–2024)



**Fig. S2.** Meteorological conditions during the early planting period field experiments of maize conducted at San Antonio de Areco (AER INTA San Antonio de Areco), Buenos Aires, Argentina, across three growing seasons: A) 2020–2021 (GS1); B) 2021–2022 (GS2); C) 2023–2024 (GS3). Bars represent monthly precipitation (black bars, corresponding to the experimental period; open bars, long-term historical means), while lines indicate maximum (red), mean (black), and minimum (blue) monthly air temperatures. Historical precipitation data correspond to the periods 1982–2019, 1982–2020, and 1982–2022 for GS1, GS2 and GS3, respectively. Meteorological data were obtained from the NASA POWER Data Access Viewer (<https://power.larc.nasa.gov/data-access-viewer/>).



**Fig. S3.** Meteorological conditions during the early planting period field experiments of maize conducted at San Antonio de Areco (AER INTA San Antonio de Areco), Buenos Aires, Argentina, across three growing seasons: A) 2020–2021 (GS1); B) 2022–2023 (GS2); C) 2023–2024 (GS3). Bars represent monthly precipitation (black bars, corresponding to the experimental period; open bars, long-term historical means), while lines indicate maximum (red), mean (black), and minimum (blue) monthly air temperatures. Historical precipitation data correspond to the periods 1982–2019, 1982–2020, and 1982–2022 for GS1, GS2 and GS3, respectively. Meteorological data were obtained from the NASA POWER Data Access Viewer (<https://power.larc.nasa.gov/data-access-viewer/>).

