**Cropping systems alter plant volatile emissions in the field through soil legacy effects**

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**Contents of this file**

Text S1 to S2

Table S1

**Text S1**

*Methods for analysis and identification of VOCs*

We determined the identities and relative amounts of VOC emitted using gas chromatography-mass spectrometry (GC-MS). To do so, volatile traps were eluted with 200 µL of methylene chloride (Fisher Scientific, Fair Lawn, NJ). Following elution,10 µL of a 30 ng µL-1 solution of *n*-nonyl acetate (Sigma-Aldrich, Saint Louis, MO) in methylene chloride was added as an internal standard and samples were stored at −70 °C until analysis. For chemical analysis, 3 µL of each sample was injected onto an Agilent Technologies 6890 GC-5973 MS fitted with an HP-5MS column (30 m x 0.25 mm, 0.25 µm film thickness; J&W Scientific, Folsom, CA). Helium was used as the carrier gas at a flow rate of 1.2 mL min–1 and injector temperature was set to 250 °C. The oven profile consisted of an initial temperature of 50 °C followed by a ramp of 5 °C min–1 to 200 °C, then a second ramp of 25 °C min–1 to 275 °C. Volatile compounds were identified by comparing retention times and mass spectra with commercial standards using ChemStation software (Agilent Technologies, Wilmington, DE) and the NIST Mass Spectral Library (National Institute of Standards and Technology, Gaithersburg, MD). All standards were purchased from Sigma Aldrich (Saint Louis, MO) with the exception of decanal and β-ocimene (The Good Scents Company, Oak Creek, WI). When we could not identify compounds with commercial standard, we used the mass spectra to determine the compound family (i.e. monoterpene, alkane, etc.). We quantified the relative concentrations of each compound by comparing its peak area with that of the internal standard, *n*-nonyl acetate, and report concentrations as nonyl acetate equivalents. Concentrations of compounds were standardized for the number of hours for which they were collected and for aboveground plant biomass (ng nonyl acetate equivalents g-1 h-1).

**Text S2**

*Methods for temperature and PAR collection*

Chamber temperature was measured every minute using Thermochron temperature iButtons (Maxim Integrated, San Jose, CA). Hourly photosynthetically active radiation (PAR) was collected from the local Northern Agricultural Research Center meteorological station. Temperature and PAR data were averaged over the sampling time and these values were used to calculate basal VOC emission rates.

**Table S1.** *P*-values and mean emission rates (ng nonyl acetate equivalents gFW-1 h-1) with standard errors (enclosed in brackets) for total compounds, families of compounds, and individual compounds in response to cropping system and year, controlling for sample day. When the interaction term (cropping system x year) was significant, it was included in the final model. Bolded values denote significant differences among cropping systems within a growing season (α <0.05).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Compound** | **ID1** | **P-value for fixed effects included in final model** | **2018** | **2019** |
| **Fallow** | **Cover** | **Fallow** | **Cover** |
| **Total VOC emissions** |  | Cropping system= 0.9Year= 0.7Cropping system x Year = 0.001 | **3.42 (1.92)** | **2.14 (1.92)** | **3.23 (1.92)** | **5.43 (1.92)** |
| ***Ketones*** |  | Cropping system= 0.03Year= 0.7Cropping system x Year = 0.0006 | 0.64 (2.45) | 0.41 (2.45) | **0.41 (2.45)** | **1.91 (2.45)** |
|  6-methyl-5-heptene-2one | SS | Cropping system= 0.9Year= 0.9Cropping system x Year = 0.03 | 0.07 (2.21) | 0.03 (2.21) | 0.03 (2.21) | 0.07 (2.21) |
|  2-undecanone | SS | Cropping system= 0.02Year= 0.2Cropping system x Year = 0.0003 | 0.02 (0.004) | 0.009 (0.004) | **0.03 (0.004)** | **0.15 (0.004)** |
|  2-tridecanone | SS | Cropping system= 0.03Year= 0.4Cropping system x Year = 0.03 | 0.05 (5.00) | 0.06 (5.00) | **0.17 (5.00)** | **1.25 (5.00)** |
|  2-pentadecanone | SS | Cropping system= 0.2Year= 0.9Cropping system x Year = 0.03 | 0.18 (2.34) | 0.11 (2.34) | **0.08 (2.34)** | **0.32 (2.34)** |
|  Hexahydrofarnesyl acetone | SS | Cropping system= 0.005Year= 0.9 | **0.03 (2.13)** | **0.07 (2.13)** | **0.03 (2.13)** | **0.06 (2.13)** |
| ***Aldehydes*** |  | Cropping system= 0.02Year= 0.8Cropping system x Year < 0.0001 | **1.60 (1.51)** | **1.04 (1.51)** | **0.65 (1.51)** | **2.05 (1.51)** |
|  Benzaldehyde | SS | Cropping system= 0.002Year= 0.6 | **0.01 (1.85)** | **0.03 (1.85)** | **0.02 (1.85)** | **0.05 (1.85)** |
|  Octanal | SS | Cropping system= 0.02Year= 0.5Cropping system x Year < 0.0001 | 0.18 (1.63) | 0.12 (1.63) | **0.04 (1.63)** | **0.15 (1.63)** |
|  Nonanal | SS | Cropping system= 0.09Year= 0.4Cropping system x Year = 0.0001 | **0.66 (1.60)** | **0.38 (1.60)** | **0.15 (1.60)** | **0.51 (1.60)** |
|  Ethylbenzaldehyde | SS | Cropping system= 0.8Year= 0.6 | 0.05 (0.003) | 0.06 (0.003) | 0.04 (0.003) | 0.04 (0.003) |
|  Decanal | SS | Cropping system= 0.06Year= 0.9Cropping system x Year = 0.0003 | 0.30 (1.60) | 0.19 (1.60) | **0.13 (1.60)** | **0.46 (1.60)** |
|  ALD14 | NIST | Cropping system< 0.0001Year= 0.02Cropping system x Year < 0.0001 | 0.004 (0.002) | 0.003 (0.002) | **0.14 (0.002)** | **0.47 (0.002)** |
|  ALD24 | NIST | Cropping system= 0.06Year= 0.5Cropping system x Year = 0.0007 | 0.04 (1.41) | 0.03 (1.41) | **0.03 (1.41)** | **0.09 (1.41)** |
|  ALD34 | NIST | Cropping system= 0.2Year= 0.3Cropping system x Year = 0.008 | 0.29 (2.09) | 0.22 (2.09) | **0.05 (2.09)** | **0.10 (2.09)** |
|  ALD44 | NIST | Cropping system= 0.7Year= 0.4Cropping system x Year = 0.04 | 0.02 (1.75) | 0.01 (1.75) | 0.03 (1.75) | 0.05 (1.75) |
| ***Terpenes*** |  | Cropping system= 0.04Year= 0.6 | **0.17 (3.59)** | **0.11 (3.59)** | **0.58 (3.59)** | **0.35 (3.59)** |
| $ α$-pinene | SS | Cropping system= 0.01Year= 0.5Cropping system x Year = 0.02 | 0.01 (0.002) | 0.01 (0.002) | **0.01 (0.002)** | **0.02 (0.002)** |
| $ β$-pinene | SS | Cropping system= 0.008Year= 0.3Cropping system x Year = 0.04 | 0.05 (0.004) | 0.05 (0.004) | **0.03 (0.004)** | **0.002 (0.004)** |
|  Limonene | SS | Cropping system= 0.5Year= 0.3 | 0.004 (0.002) | 0.007 (0.002) | 0.03 (0.002) | 0.03 (0.002) |
| $ β$-ocimene | SS | Cropping system= 0.03Year= 0.8 | **0.02 (0.01)** | **0.01 (0.01)** | **0.02 (0.01)** | **0.002 (0.01)** |
|  Linalool | SS | Cropping system= 0.4Year= 0.6 | 0.04 (2.37) | 0.03 (2.37) | 0.09 (2.37) | 0.067(2.37) |
|  ST12 | NIST | Cropping system= 0.2Year= 0.3 | 0.00 (0.11) | 0.00 (0.11) | 0.42 (0.11) | 0.37 (0.11) |
|  ST22 | NIST | Cropping system= 0.02Year= 0.8Cropping system x Year = 0.03 | 0.05 (0.05) | 0.04 (0.05) | **0.22 (0.05)** | **0.02 (0.05)** |
| ***Alkanes and alkenes*** |  | Cropping system= 0.04Year= 0.8 | **0.79 (1.97)** | **0.56 (1.97)** | **1.11 (1.97)** | **0.79 (1.97)** |
|  Decane | SS | Cropping system= 0.3Year= 0.6 | 0.07 (0.01) | 0.03 (0.01) | 0.03 (0.01) | 0.004 (0.01) |
|  ALK13 | NIST | Cropping system= 0.006Year= 0.2Cropping system x Year = 0.0002 | 0.0007 (0.01) | 0.003 (0.01) | **0.15 (0.01)** | **0.05 (0.01)** |
|  ALK23 | NIST | Cropping system= 0.05Year= 0.1 | **0.01 (0.004)** | **0.002 (0.004)** | **0.10 (0.004)** | **0.07 (0.004)** |
|  ALK33 | NIST | Cropping system= 0.3Year= 0.2 | 0.12 (1.47) | 0.14 (1.47) | 0.03 (1.47) | 0.04 (1.47) |
|  ALK43 | NIST | Cropping system= 0.8Year= 0.7 | 0.04 (1.71) | 0.05 (1.71) | 0.06 (1.71) | 0.06 (1.71) |
|  ALK53 | NIST | Cropping system= 0.2Year= 0.5 | 0.01 (0.01) | 0.001 (0.01) | 0.03 (0.01) | 0.01 (0.01) |
|  Tridecane | SS | Cropping system= 0.6Year= 0.8 | 0.08 (1.94) | 0.07 (1.94) | 0.11 (1.94) | 0.10 (1.94) |
|  ALK63 | NIST | Cropping system= 0.3Year= 0.2 | 0.05 (0.004) | 0.04 (0.004) | 0.01 (0.004) | 0.004 (0.004) |
|  ALK73 | NIST | Cropping system= 0.01Year= 0.2 | **0.01 (0.03)** | **0.004 (0.03)** | **0.37 (0.03)** | **0.30 (0.03)** |
|  Tetradecane | SS | Cropping system= 0.6Year= 0.8Cropping system x Year = 0.05 | 0.07 (1.78) | 0.05 (1.78) | 0.07 (1.78) | 0.08 (1.78) |
|  Pentadecane | SS | Cropping system= 0.8Year= 0.9 | 0.15 (1.92) | 0.13 (1.92) | 0.17 (1.92) | 0.15 (1.92) |
| ***Green leaf volatiles (GLV)*** |  | Cropping system= 0.02Year= 0.6 | **0.04 (1.99)** | **0.02 (1.99)** | **0.07 (1.99)** | **0.03 (1.99)** |
|  *Z*-3-hexenyl acetate | SS | Cropping system= 0.02Year= 0.6 | **0.04 (1.99)** | **0.02 (1.99)** | **0.07 (1.99)** | **0.03 (1.99)** |

1Identification (ID) of compounds based upon comparison of retention time and mass spectra with synthetic standards (SS) or comparison of mass spectra using NIST Mass Spectral Search Program (NIST)

2SQT = unidentified sesquiterpene

3ALK = unidentified alkane or alkene

4ALD = unidentified aldehydes