Table S1. SIMPER analysis (1.3D = Fumigant; PE = Pellet; CTR=Control) on the abundance of nematode taxa (number of nematodes/ml of soil) in Caserta site in June 2022. Av. Diss., Average dissimilarity; Contr., Cumulative contribution.

Taxon	**Av. Diss. %**	**Contr. %**	**1.3D**	**PE**	**CTR**
Rhabditidae	1.858	25.88	211±10.3	258±17.4	243,8±13.4
Cephalobidae	1.681	49.29	244±7.7	221.2±25.6	239±8.1
Aphelenchidae	1.486	69.99	0.2±0.2	0,2±0.2	3±0.55
Tylenchidae	1.131	85.75	12.8±1.4	19±1.6	21±3.21
Dorylaimidae	0.8436	97.5	2±0.7	3,4±0.5	2.2±0.6
Plectidae	0.1795	100	0	0,2±0.2	0
Steinernematidae	0	100	0	0	0
Overall dissimilarity	**7.18%**				

Table S2. SIMPER analysis (1.3D = Fumigant; PE = Pellet; CTR=Control) on the abundance of nematode taxa (number of nematodes/ml of soil) in Caserta site in November 2022. Av. Diss., Average dissimilarity; Contr., Cumulative contribution.

Taxon	**Av. Diss. %**	**Contr. %**	**1.3D**	**PE**	**CTR**
Aphelenchidae	2.46	23.42	0	13±1.5	10±2.1
Rhabditidae	2.208	44.44	612±18.3	470.8±14.5	613±10.3
Tylenchidae	1.636	60.01	8±0.7	28.2±0.9	15±2.6
Cephalobidae	1.627	75.5	319±9.1	384±8.8	295±6.9
Dorylaimidae	1.027	85.27	1±0.3	5±0.7	3.2±0.9
Plectidae	0.9783	94.59	2±0.3	1.2±0.6	0
Steinernematidae	0.5688	100	0	1±0.3	0
Overall dissimilarity	**10.5%**				

Table S3. SIMPER analysis (1.3 D = Fumigant; PE = Pellet; CTR=Control) on the abundance of nematode taxa (number of nematodes/ml of soil) in Caserta site in February 2023. Av. Diss., Average dissimilarity; Contr., Cumulative contribution.

Taxon	Av. Diss. %	Contr. %	1.3D	PE	CTR
Rhabditidae	3.92	33.68	207±12.1	301±9.9	344±8.7
Aphelenchidae	2.141	52.07	0	5.2±0.6	3±0.8
Tylenchidae	1.632	66.1	12±1.4	27±2.8	19±1.6
Cephalobidae	1.427	78.35	112±3.9	145±9.4	121±6.1
Plectidae	1.173	88.43	0.2±0.2	2±0.5	0.2±0.2
Dorylaimidae	1.17	98.48	5±0.8	10.8±1.4	5±0.9
Steinernematidae	0.1764	100	0	0.2±0.2	0
Overall dissimilarity	**11.64%**				

Table S4. SIMPER analysis (1.3D = Fumigant; PE = Pellet; CTR=Control) on the abundance of nematode taxa (number of nematodes/ml of soil) in Caserta site in May 2023. Av. Diss., Average dissimilarity; Contr., Cumulative contribution.

Taxon	Av. Diss. %	Contr. %	1.3D	PE	CTR
Rhabditidae	4.581	37.01	214±10.5	383±12.5	367±7.1
Aphelenchidae	2.57	57.78	0.2±0.2	10±1	2±0.5
Tylenchidae	2.288	76.27	11±0.7	34.4±4	26±2.7
Dorylaimidae	1.339	87.09	2.6±0.7	9±0.9	8±0.5
Cephalobidae	1.296	97.56	131±4.7	163.8	141±6.8
Plectidae	0.3019	100	0	0.2±0.2	0.2±0.2
Steinernematidae	0	100	0	0	0
Overall dissimilarity	**12.38%**				

Table S5. SIMPER analysis (1.3D T1 = Fumigant one treatment; 1.3D T2 = Fumigant two treatments; PE = Pellet; CTR=Control) on the abundance of nematode taxa (number of nematodes/ml of soil) in Caserta site in June 2023. Av. Diss., Average dissimilarity; Contr., Cumulative contribution.

Taxon	Av. Diss. %	Contr. %	1.3D T1	1.3D T2	PE	CTR
Tylenchidae	12.76	24.22	22±3.4	9±1.9	42±1.9	39±3.8
Rhabditidae	12.05	47.1	144±7.4	226±7	512±14.1	453±21.1
Plectidae	10.93	67.84	0	0	3±0.5	0
Cephalobidae	9.338	85.57	223±12.1	151±8.3	301±11.2	284±4.6
Aphelenchidae	3.947	93.06	2±0.7	0	19±2.3	8±1.1
Steinernematid	1.849	96.57	0	0	2±0.5	0.2±0.2
Dorylaimidae	1.808	100	2.8±0.6	0.8±0.4	11±1.3	10±0.8
Overall diss.	**52.68%**					

Table S6. SIMPER analysis (1.3D T1 = Fumigant one treatment; 1.3D T2 = Fumigant two treatments; PE = Pellet; CTR=Control) on the abundance of nematode taxa (number of nematodes/ml of soil) in Caserta site in November 2023. Av. Diss., Average dissimilarity; Contr., Cumulative contribution.

Taxon	Av. Diss. %	Contr. %	1.3D T1	1.3 DT2	PE	CTR
Rhabditidae	4.502	28.38	309±17.5	233±5.9	488.2±6.9	399±8.9
Cephalobidae	3.744	51.99	301±16.5	139±4.5	259±17.2	255±11
Aphelenchidae	2.53	67.95	0.2±0.2	0.2±0.2	9.2±1.2	12±1.2
Dorylaimidae	2.394	83.04	5±0.5	0.2±0.2	12±2.9	13±2.1
Tylenchidae	1.075	89.82	19±2.5	15±2.4	9.2±1.2	16±2.3
Plectidae	0.8082	94.92	0	0	2±0.3	0.2±0.2
Steinernematid	0.8063	100	0	0	3±1.1	0
Overall diss.	**15.86%**					

Table S7. SIMPER analysis (1.3D T1 = Fumigant one treatment; 1.3D T2 = Fumigant two treatments; PE = Pellet; CTR=Control) on the abundance of nematode taxa (number of nematodes/ml of soil) in Caserta site in February 2024. Av. Diss., Average dissimilarity; Contr., Cumulative contribution.

Taxon	Av. Diss. %	Contr. %	1.3 DT1	1.3D T2	PE	CTR
Rhabditidae	6.615	38.21	124±10.3	249±6.7	441±17.1	257.2±3.5
Dorylaimidae	2.819	54.5	3.2±0.5	0.2±0.2	7±1.8	17±1.8
Aphelenchidae	2.277	67.65	0.2±0.2	0	6±0.7	7±0.8
Tylenchidae	2.276	80.79	17±2.4	14.4±2.2	46±2.4	17±2.6
Cephalobidae	2.056	92.67	189±8.4	141±8.1	202±17.5	163±3.5
Plectidae	0.7953	97.26	0	0	0	2±0.7
Steinernema	0.4742	100	0	0	1.2±0.7	0
Overall diss.	**17.31%**					

Table S8. SIMPER analysis (1.3D T1 = Fumigant one treatment; 1.3D T2 = Fumigant two treatments; PE = Pellet; CTR=Control) on the abundance of nematode taxa (number of nematodes/ml of soil) in Caserta site in May 2024. Av. Diss., Average dissimilarity; Contr., Cumulative contribution.

Taxon	Av. Diss. %	Contr. %	1.3D T1	1.3D T2	PE	CTR
Cephalobidae	3.132	19.71	239±7	142.4±31.3	159±9.2	201±6.3
Aphelenchidae	3.031	38.78	3±0.7	0.2±0.2	24±2.3	9±0.7
Tylenchidae	2.489	54.45	26±2	11±2	51±1.5	31±4.8
Rhabditidae	2.33	69.11	218±14.8	288±9	318.8±6.9	333.2±3.6
Dorylaimidae	2.16	82.7	6±0.8	2.2±0.7	19±3.3	16±0.8
Steinernemat	1.74	93.65	0	0	10±0.9	0
Plectidae	1.009	100	0	0	2±0.3	1.2±0.4
Overall diss.	**15.89%**					

Table S9. Soil nematode biodiversity indices, 1.3D T1, fumigation applied once; 1.3D fumigation applied twice; PE, pellet; CTR, control during crop year 2022-23 and 2022-24. Mean values with standard errors are reported (±). Letters indicate significant differences between groups (ANOVA $p < 0.05$). Summary of the significance of the effects of managements (M), year (Y), and season (S) on soil biological indicators and their interactions are reported. Significant *p*-values are in bold.

	Dominance	**Shannon**	**Evenness**	**Brillouin**	**Menhinick**	**Margalef**	**Equitability**	**Fisher α**	**Berger-Parker**
Management									
1.3 D T2	0.40±0.01 a	1.05±0.02 c	0.59±0.01 a	1.03±0.02d	0.18±0.01 c	0.60±0.02d	0.67±0.01 a	0.72±0.02d	0.50±0.02 c
1.3 D T1	0.40±0.01 a	1.09±0.02b	0.55±0.02b	1.08±0.02 c	0.19±0.01 bc	0.67±0.02 c	0.64±0.02 b	0.80±0.02 c	0.53±0.02 a
PE	0.36±0.01 b	1.20±0.02 a	0.48±0.01 c	1.19±0.02 a	0.23±0.01 a	0.88±0.02 a	0.62±0.01 bc	1.04±0.02 a	0.46±0.02 d
CTR	0.39±0.01 a	1.11±0.02 b	0.49±0.01 c	1.10±0.02 b	0.20±0.01 b	0.76±0.02 b	0.61±0.01 c	0.90±0.02 b	0.51±0.02 b
Years									
2022-23	0.37±0.01 b	1.13±0.01 a	0.53±0.01 a	1.11±0.01 a	0.21±0.01 a	0.74±0.02 a	0.64±0.01 a	0.88±0.02 a	0.47±0.01 b
2023-24	0.39±0.01 a	1.11±0.02 b	0.52±0.02 a	1.10±0.2 b	0.20±0.01 b	0.74±0.02 a	0.63±0.01 a	0.87±0.03 a	0.52±0.01 a
Season									
June	0.33±0.003 d	1.19±0.01 a	0.58±0.01 a	1.18±0.01 a	0.19±0.004 c	0.70±0.02 c	0.69±0.01 a	0.83±0.02 c	0.41±0.01 d
November	0.39±0.01 b	1.08±0.02 b	0.50±0.01 c	1.07±0.02 b	0.16±0.01 d	0.70±0.03 c	0.61±0.01 c	0.81±0.03 c	0.51±0.02 b
February	0.45±0.01 a	1.02±0.02 c	0.49±0.02 c	0.99±0.02 c	0.27±0.01 a	0.80±0.03 a	0.59±0.01 d	0.96±0.03 a	0.59±0.02 a
May	0.36±0.01 c	1.18±0.03 a	0.54±0.01 b	1.16±0.02 b	0.20±0.01 b	0.76±0.02 b	0.65±0.01 b	0.89±0.03 b	0.47±0.02 c
P value									
Main effect									
M	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**
Y	**0.00001**	**0.00001**	0.06	0.23	**0.004**	0.27	0.04	0.32	**0.00001**
S	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**
Interaction									
M+Y	**0.00001**	**0.00001**	**0.0005**	**0.00001**	**0.0002**	**0.00001**	0.19	**0.00001**	**0.00001**
M+S	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.00001**	**0.0002**	**0.00001**	**0.0001**	**0.00001**
T+S	**0.00001**	**0.00001**	**0.0001**	**0.00001**	**0.0001**	**0.0002**	**0.00001**	**0.0002**	**0.00001**
M+Y+S	**0.00001**	**0.00001**	0.08	**0.00001**	**0.00001**	**0.00001**	**0.0002**	**0.00001**	**0.00001**

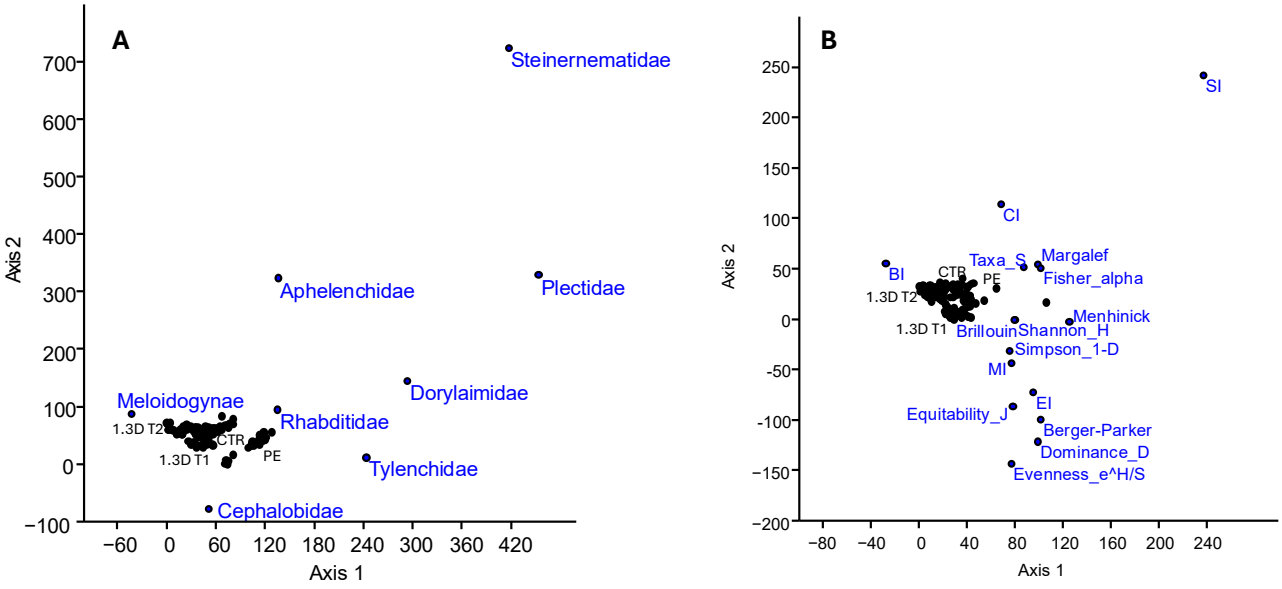


Figure S1. Detrended correspondence analysis (DCA) for nematode taxa abundance (A) and biological indicators (B).