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Rapid Diagnosis of Nitrogen Nutrition Status in Summer Maize over Its Life Cycle by a Multi-Index Synergy Model Using Ground Hyperspectral and UAV Multispectral Sensor Data

Nana Han [1,2], Baozhong Zhang [1,3,*], Yu Liu [1,3], Zhigong Peng [1,3], Qingyun Zhou [1,2] and Zheng Wei [1,3]

Supplementary materials

Table S1. Number of experimental observations (n), tissue sampling date, hyperspectral acquisition date and local time, UAV sampling area and local time.

Year	stage	Sampling date (DD.MM.YY)	Hyperspectral		Nitrogen Concentration	UAV	
			Observation *n*	Observation time	Subsample *n*	Observation Area	Observation time
2017	**V6**	07.16.17	45	10:00-14:00	15	-	-
	V10	07.25.17	45	10:00-14:00	15	-	-
	V12	07.31.17	45	10:00-14:00	15	-	-
	VT	08.07.17	45	10:00-14:00	15	-	-
	R1	08.17.17	45	10:00-14:00	15	-	-
	R2	08.29.17	45	10:00-14:00	15	-	-
	R3	09.11.17	45	10:00-14:00	15	-	-
	R6	09.24.17	45	10:00-14:00	15	-	-
2018	V10	07.26.18	45	10:00-14:00	15	-	-
	V12	08.03.18	45	10:00-14:00	15	-	-
	VT	08.15.18	45	10:00-14:00	15	-	-
	R1	08.21.18	45	10:00-14:00	15	-	-
	R2	08.31.18	45	10:00-14:00	15	-	-
	R3	09.16.18	45	10:00-14:00	15	-	-
	R6	09.24.18	45	10:00-14:00	15	-	-
2019	V6	07.21.19	45	10:00-14:00	15	40mx50m	10:00-12:00
	V10	07.26.19	45	10:00-14:00	15	40mx50m	10:00-12:00
	V12	08.03.19	45	10:00-14:00	15	40mx50m	10:00-12:00
	VT	08.16.19	45	10:00-14:00	15	40mx50m	10:00-12:00
	R1	08.23.19	45	10:00-14:00	15	40mx50m	10:00-12:00
	R2	08.31.19	45	10:00-14:00	15	40mx50m	10:00-12:00
	R3	09.15.19	45	10:00-14:00	15	40mx50m	10:00-12:00
	R6	09.25.19	45	10:00-14:00	15	40mx50m	10:00-12:00

Note: "-"represents no observation.

Table S2. Nitrogen concentration of summer maize plants

Date	Nitrogen Concentration(%)		
(DD.MM.YY)	min.	mean	max.
07.16.17	2.73	3.13	3.42
07.25.17	2.46	3.00	3.30
07.31.17	1.41	2.24	2.65
08.07.17	1.20	1.75	2.77
08.17.17	1.07	1.54	2.09
08.29.17	1.15	1.44	2.21
09.11.17	0.60	1.05	1.37
09.24.17	0.70	1.00	1.24
07.26.18	1.55	2.36	2.99
08.03.18	1.05	1.88	2.93
08.15.18	1.06	1.61	2.80
08.21.18	0.72	1.35	2.02
08.31.18	1.03	1.32	1.85
09.16.18	0.73	1.10	1.48
09.24.18	0.83	1.13	1.45
07.21.19	3.12	3.64	5.40
07.26.19	2.16	2.47	3.07
08.03.19	2.13	2.73	3.41
08.16.19	1.05	1.71	2.18
08.23.19	0.73	1.55	2.27
08.31.19	0.60	1.21	1.77
09.15.19	0.44	0.99	1.94
09.25.19	0.39	0.79	1.14

Figure S1. UAV aerial photography operations

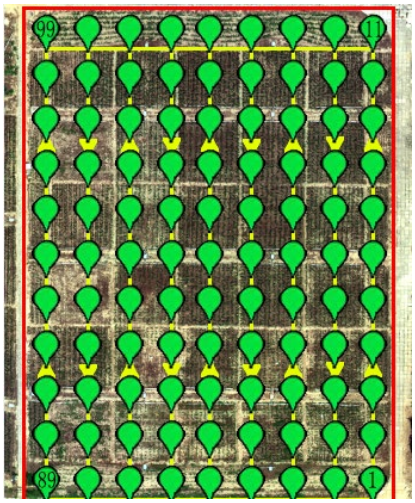

Figure S2 UAV route.

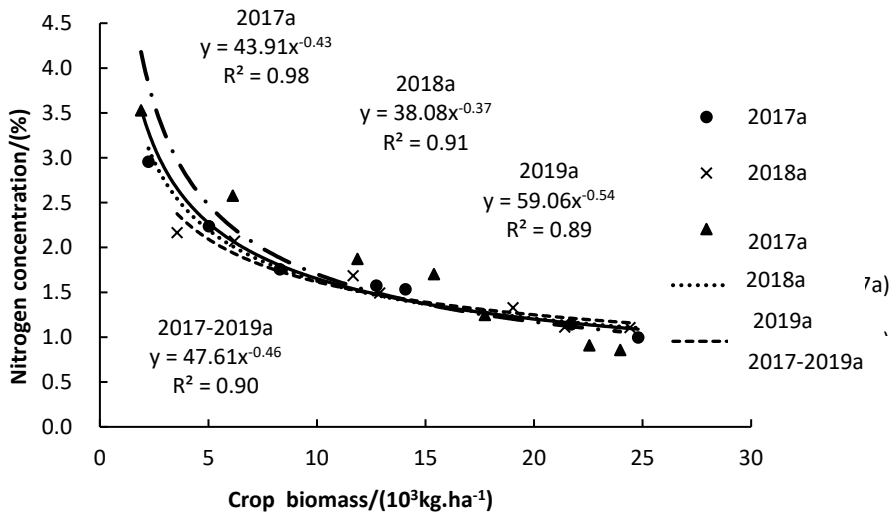

Figure S3 Relationship between plant critical nitrogen concentration and crop biomass of summer maize. "•" represented the data in 2017. "×" represented the data in 2018. "▲"represented the data in 2019.