

Details	Items	Specifications
drone	Weight	
	Diagonal Size (Propellers Excluded)	350 mm
	Max speed	S-mode: 6 m/s P-mode: 5 m/s
	Satellite positioning systems	
Digital camera	Sensor	1" CMOS Effective pixels: 20M
	Lens	FOV 84 °8.8 mm/24 mm (35 mm format equivalent) f/2.8 - f/11 auto focus at 1 m - ∞
	ISO Range	Video: 100 - 3200 (Auto) 100 - 6400 (Manual) Photo: 100 - 3200 (Auto) 100- 12800 (Manual)
	Mechanical Shutter Speed	8 - 1/2000 s
	Electronic Shutter Speed	8 - 1/8000 s
	Image Size	3:2 Aspect Ratio: 5472 × 3648 4:3 Aspect Ratio: 4864 × 3648 16:9 Aspect Ratio: 5472 × 3078
	PIV Image Size	4096×2160(4096×2160 24/25/30/48/50p) 3840×2160(3840×2160 24/25/30/48/50/60p) 2720×1530(2720×1530 24/25/30/48/50/60p) 1920×1080(1920×1080 24/25/30/48/50/60/120p) 1280×720(1280×720 24/25/30/48/50/60/120p)
	Still Photography Modes	Single Shot Burst Shooting: 3/5/7/10/14 frames Auto Exposure Bracketing (AEB): 3/5 bracketed frames at 0.7 EV Bias Interval: 2/3/5/7/10/15/20/30/60 s
	Video Recording Modes	H.265 C4K:4096×2160 24/25/30p @100Mbps 4K:3840×2160 24/25/30p @100Mbps 2.7K:2720×1530 24/25/30p @65Mbps 2.7K:2720×1530 48/50/60p @80Mbps FHD:1920×1080 24/25/30p @50Mbps FHD:1920×1080 48/50/60p @65Mbps FHD:1920×1080 120p @100Mbps

Table S1. Technical specifications of the DJI Phantom 4 Pro UAV used in the field experiment.

		HD:1280×720 24/25/30p @25Mbps HD:1280×720 48/50/60p @35Mbps HD:1280×720 120p @60Mbps H.264 C4K:4096×2160 24/25/30/48/50/60p @100Mbps 4K:3840×2160 24/25/30/48/50/60p @100Mbps 2.7K:2720×1530 24/25/30p @80Mbps 2.7K:2720×1530 48/50/60p @100Mbps FHD:1920×1080 24/25/30p @60Mbps FHD:1920×1080 48/50/60 @80Mbps FHD:1920×1080 120p @100Mbps HD:1280×720 24/25/30p @30Mbps HD:1280×720 48/50/60p @45Mbps
	PIV Image Size	4096×2160(4096×2160 24/25/30/48/50p) 3840×2160(3840×2160 24/25/30/48/50/60p) 2720×1530(2720×1530 24/25/30/48/50/60p) 1920×1080(1920×1080 24/25/30/48/50/60/120p) 1280×720(1280×720 24/25/30/48/50/60/120p)
	Still Photography Modes	Single Shot Burst Shooting: 3/5/7/10/14 frames Auto Exposure Bracketing (AEB): 3/5 bracketed frames at 0.7 EV Bias Interval: 2/3/5/7/10/15/20/30/60 s
	Video Recording Modes	H.265 C4K:4096×2160 24/25/30p @100Mbps 4K:3840×2160 24/25/30p @100Mbps 2.7K:2720×1530 24/25/30p @65Mbps 2.7K:2720×1530 48/50/60p @80Mbps FHD:1920×1080 24/25/30p @50Mbps FHD:1920×1080 48/50/60p @65Mbps FHD:1920×1080 120p @100Mbps HD:1280×720 24/25/30p @25Mbps HD:1280×720 48/50/60p @35Mbps HD:1280×720 120p @60Mbps H.264 C4K:4096×2160 24/25/30/48/50/60p @100Mbps 4K:3840×2160 24/25/30/48/50/60p @100Mbps 2.7K:2720×1530 24/25/30p @80Mbps 2.7K:2720×1530 48/50/60p @100Mbps FHD:1920×1080 24/25/30p @60Mbps FHD:1920×1080 48/50/60 @80Mbps FHD:1920×1080 120p @100Mbps HD:1280×720 24/25/30p @30Mbps HD:1280×720 48/50/60p @45Mbps
	Supported File Systems	FAT32 (≤32 GB); exFAT (>32 GB)

	Photo	JPEG, DNG (RAW), JPEG + DNG
	Video	MP4/MOV (AVC/H.264; HEVC/H.265)
	Supported SD Cards	Micro SD Max Capacity: 128GB Write speed ≥ 15 MB/s, Class 10 or UHS-1 rating required
Gimbel	Stabilization	3-axis (pitch, roll, yaw)
	Controllable Range	Pitch: -90 ° to +30 °
	Max Controllable Angular Speed	Pitch: 90 %s
	Angular Vibration Range	± 0.02 °
Remote Controller	Operating Frequency	
	Max Operating Distance	2.400 - 2.483 GHz (Unobstructed, free of interference) FCC: 4.3 mi (7 km) CE: 2.2 mi (3.5 km) SRRC: 2.5 mi (4 km) 5.725 - 5.825 GHz (Unobstructed, free of interference) FCC: 4.3 mi (7 km) CE: 1.2 mi (2 km) SRRC: 3.1 mi (5 km)
Battery	Voltage	17.4 V
	Rated Power	100 W

Trait	Coefficient									
	X-1010					Triticale1				
	<i>a</i>	<i>b</i>	<i>X</i> ₀	RMSE	R ²	<i>a</i>	<i>b</i>	<i>X</i> ₀	RMSE	R ²
Volume	17393.56 (880)	6.3 (0.21)	52.5 (0.7)	66.2	0.99	14247.87(282)	4.3 (0.07)	50.4 (0.2)	35.4	1
SCA	179.8 (15)	8.6 (0.63)	44.38 (0.92)	2.44	0.99	927.4 (162)	10.5 (0.7)	47.2 (0.9)	2.34	0.99
Height	45.5 (5.429)	11.71 (2.5)	32.96 (3.6)	2.08	0.98	80 (32.4)	15 (3.42)	53.1 (12.3)	1.87	0.98
Upper width	16.7 (1.2)	4.2 (1.4)	24.5 (0.2)	1.74	0.95	28.6 (8.1)	6.3 (2.1)	44.8 (4.9)	2.08	0.96

PSA	540.72 (722)	1.01 (0.07)	47.35 (1.48)	7.8	0.99	625 (36)	0.84 (0.06)	74.33 (1.4)	9.16	0.99
------------	-----------------	----------------	-----------------	-----	------	-------------	----------------	----------------	------	------

Table S2. Coefficient and their standard error (in parentheses) estimates from the sigmoid regression between X-1010 and tritcale1 genotype volume (cm³), shoot convex area (SCA) (cm²), height (cm), upper-width (cm) and projected shoot area (PSA) (cm²) with time (day), and their respective Root Mean Square Error (RMSE) and coefficient of determination (R²). Values were extracted were made between 7 and 56 days after sowing. Leaf projected shoot area was extracted from the 2-D model while height, volume, upper-width and CA from the 3-D model.

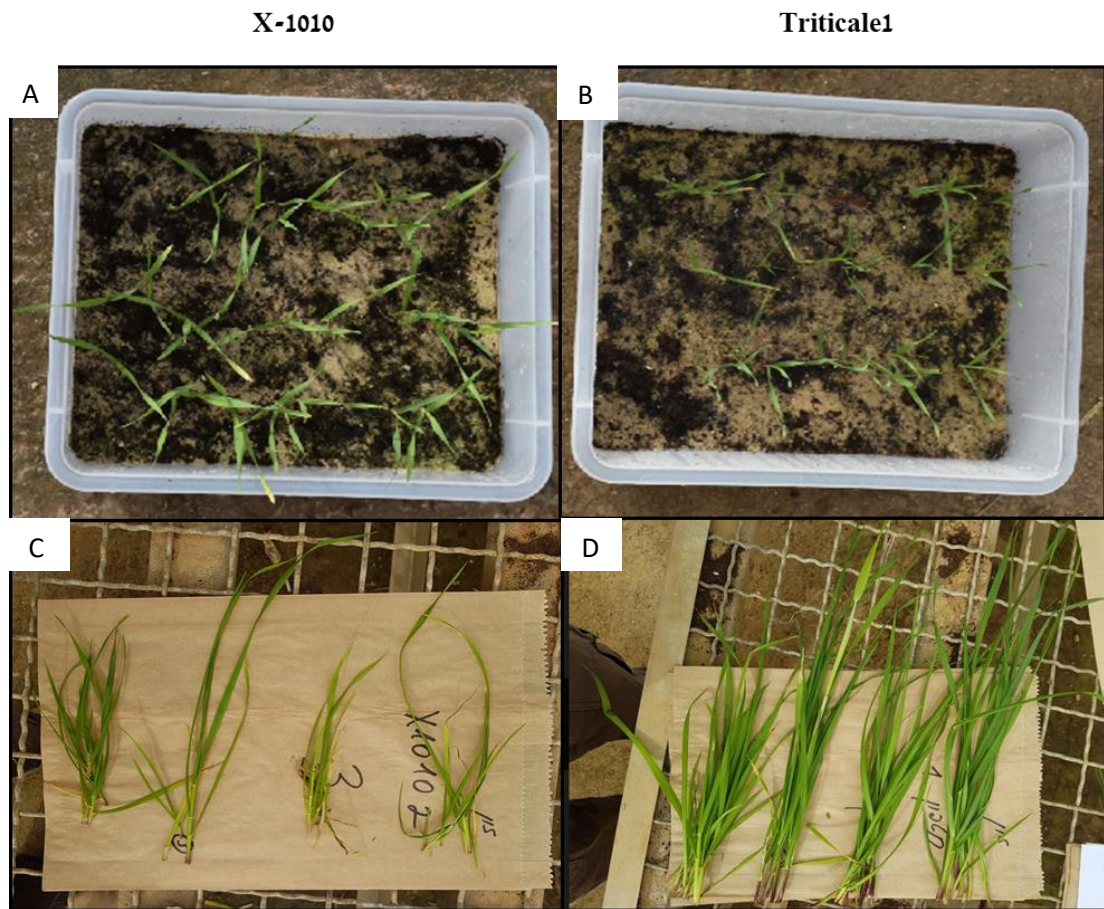


Figure S1. Illustration of the controlled conditions competition experiment. (A) X-1010 and (B) Triticale1 genotype plants imaged 6 weeks after seeding, and correspondingly, *Lolium multiflorum* plants that developed next to (C) X-1010 and (D) Triticale1 genotypes.