

Supplementary

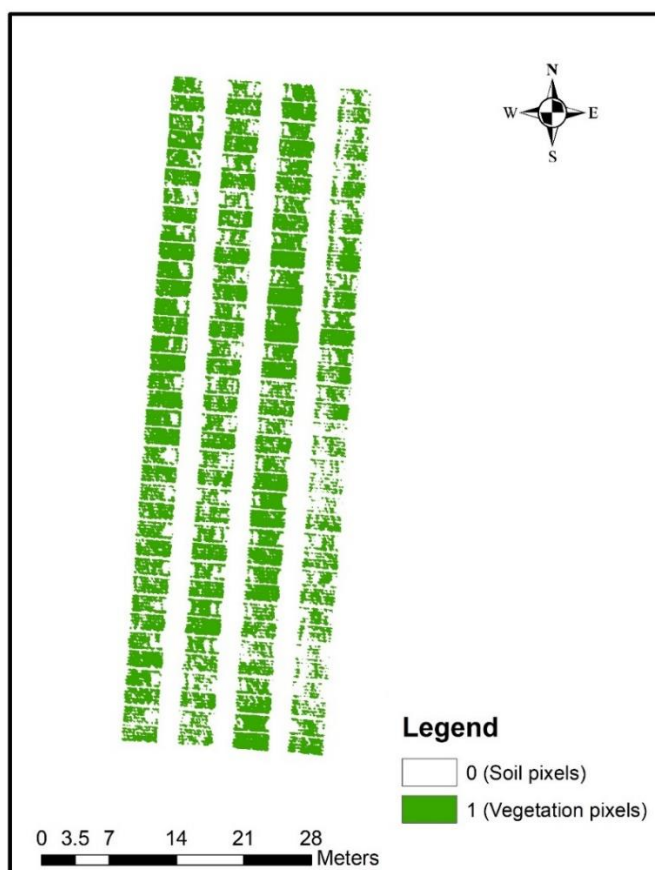
Supplementary Table S1. Wheat genotypes for 2018 experiment sites [15,48,59]

Name	Breeder	Grade	Target Australian region
Corack	AGT*	APW ¹	WA, relatively drought tolerant
Emu Rock	Inter-grain**	AH ²	WA
Flanker	LPB***	APH ³	NSW and Qld, some resistance to stripe, stem and leaf rust
Gregory	EGA****	APH ³	NSW and Qld
Gladius	AGT*	AH ²	
Hartog	DAFQ*****	APH ³	NSW and Qld
Lancer	LPB***	APH ³	NSW and Qld
Mace	AGT*	AH ²	NSW and Qld, less susceptible to downgrading
Mitch	AGT*	AH ²	NSW and Qld
Magenta	Intergrain**	APW ¹	WA
Janz	DAFQ*****	APH ³	eastern Australia
Scout	LPB***	APW ¹	Victoria and SA
Trojan	LPB***	APW ¹	South and WA
Wallup	AGT*	APH ³	WA
Sunco	AGT*	APH ³	NSW and Qld
Bremer	AGT*	AH ²	WA
Condo	AGT*	AH ²	NSW and Victoria
Elmore	AGT*	AH ²	NSW and Qld

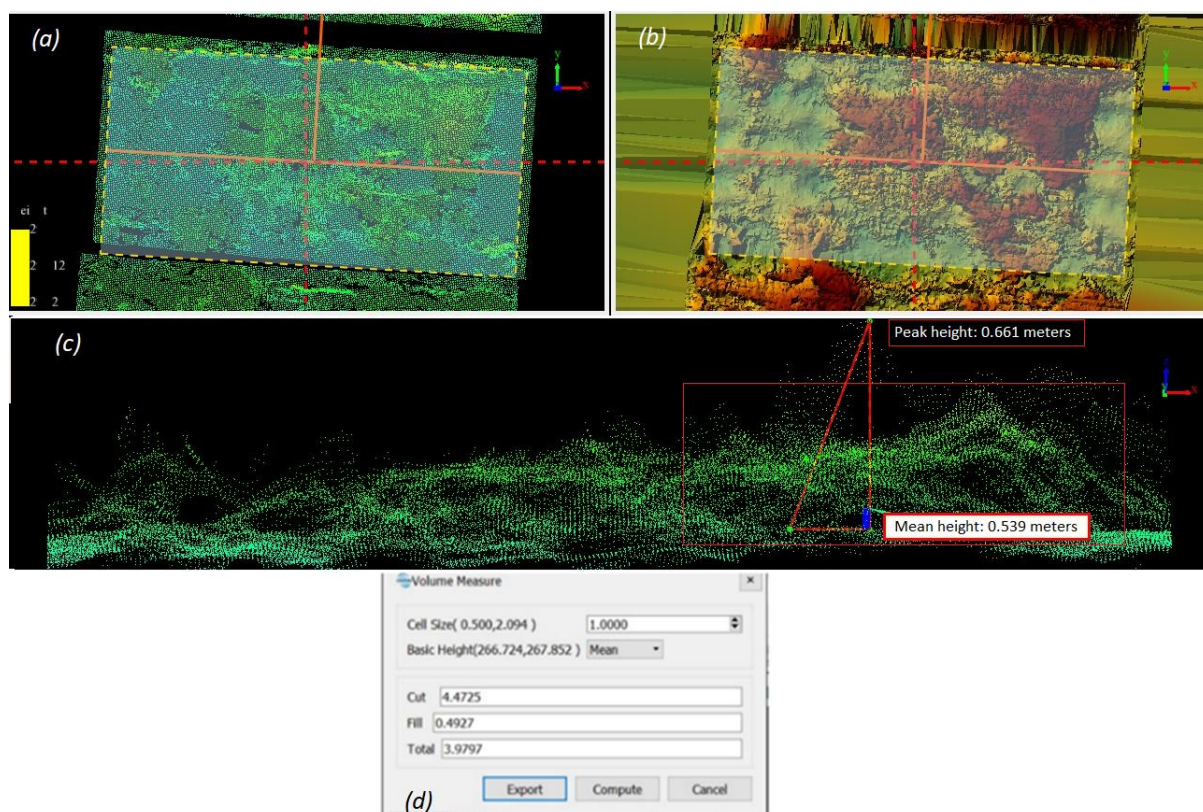
*Australian Grain Technologies, **International Maize and Wheat Improvement Centre (CIMMYT), **Commonwealth Scientific and Industrial Research Organisation (CSIRO), **International Centre for Agricultural Research in Dry Areas (ICARDA), ***Long Reach Plant Breeders, ****Enterprise Grains Australia (EGA), *****Queensland Department of Agriculture and Fisheries (DAFQ). ¹Australian Premium White, ²Australian Hard, ³Australian Prime Hard.



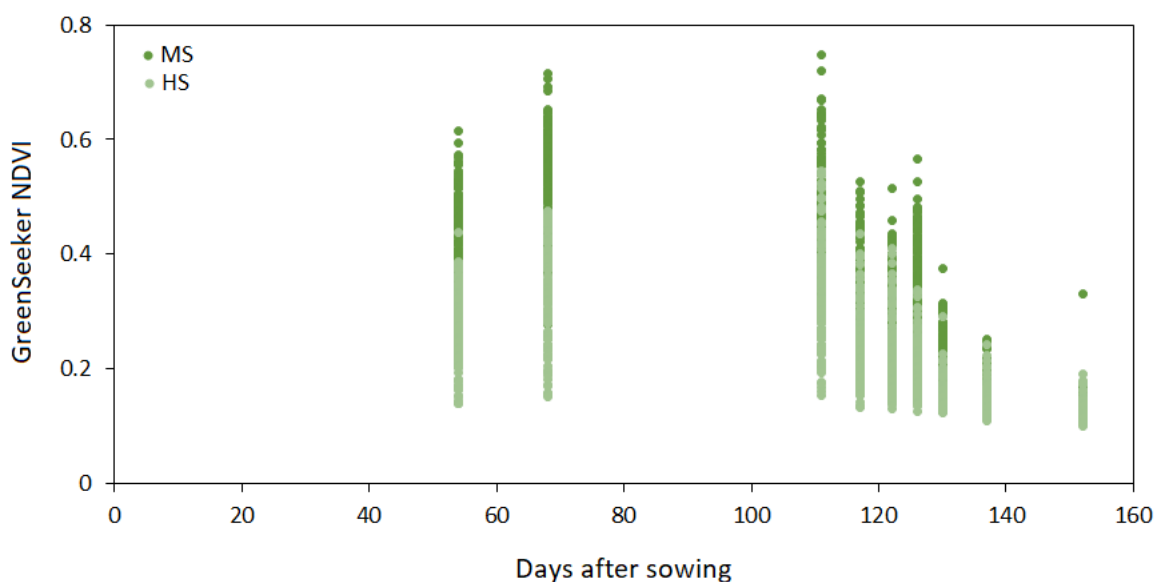
Supplementary Figure S1. Drone image of a representative plot illustrating a typical destructive biomass sampling area ('yellow' square box indicating 0.5×3 middle rows area) and plant reflectance measurements area using GreenSeeker and ASD FieldSpec ('orange' rectangular box including 3 middle rows) within the plot. One of the propeller markers for GPS location calibration is shown in the lower left hand of the image [15].



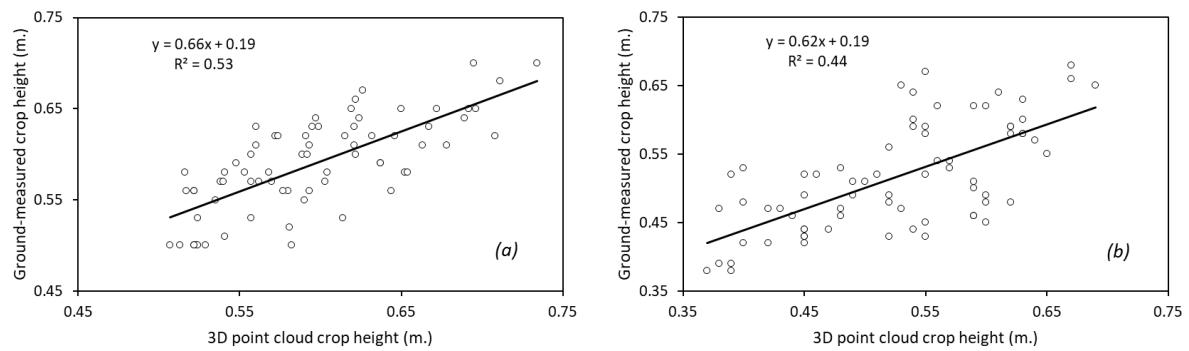
Supplementary Figure S2. A representative site image showing classified and separated soil and canopy pixels using Otsu's algorithm



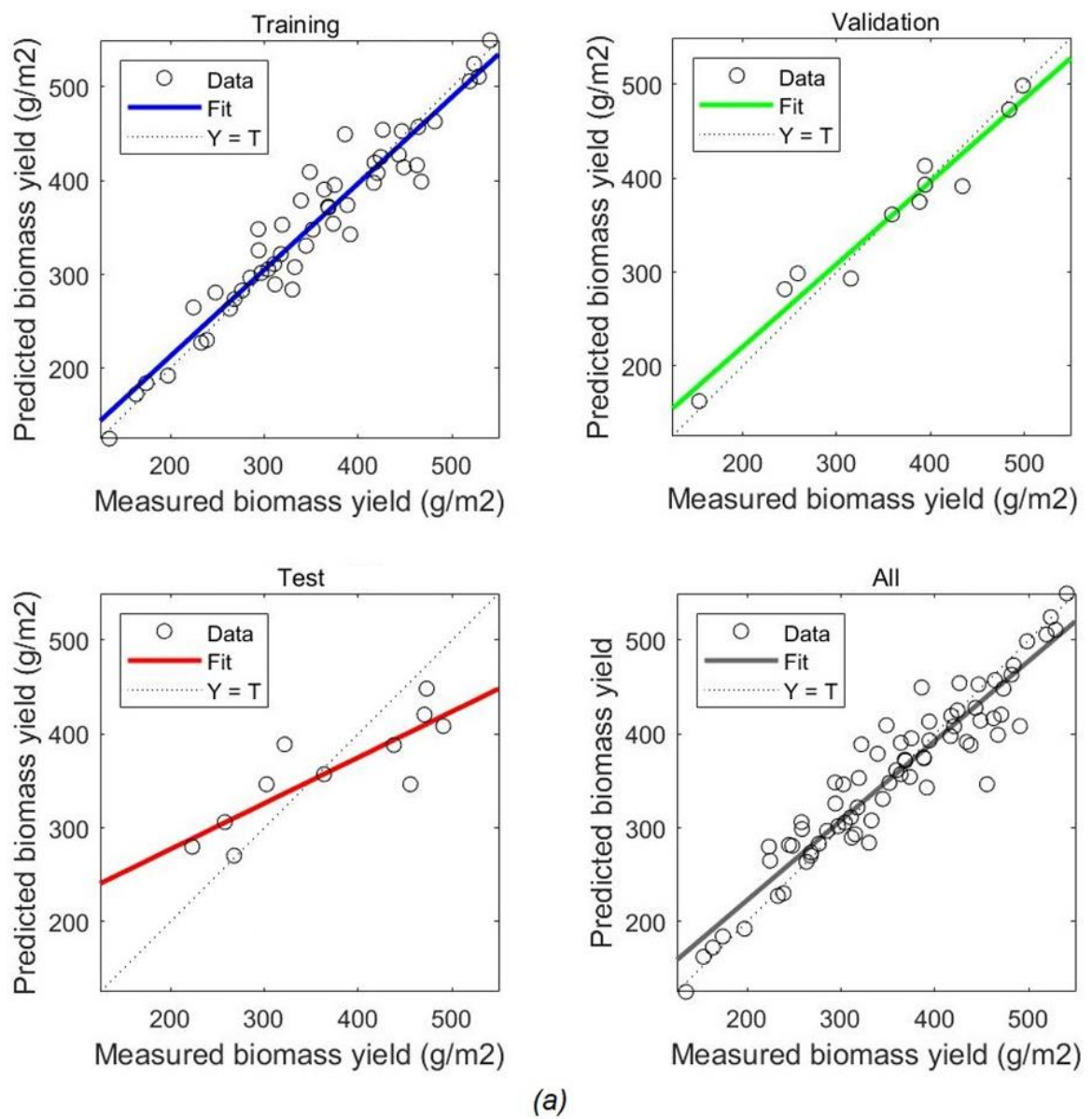
Supplementary Figure S3. A representation of crop height extraction method using RGB-3D point cloud techniques, (a) aerial view of the plot-wise 3D point clouds, (b) triangulated irregular network (TIN), (c) cross-sectional profile of a single plot for measurement of crop height, (d) crop volume measurement.

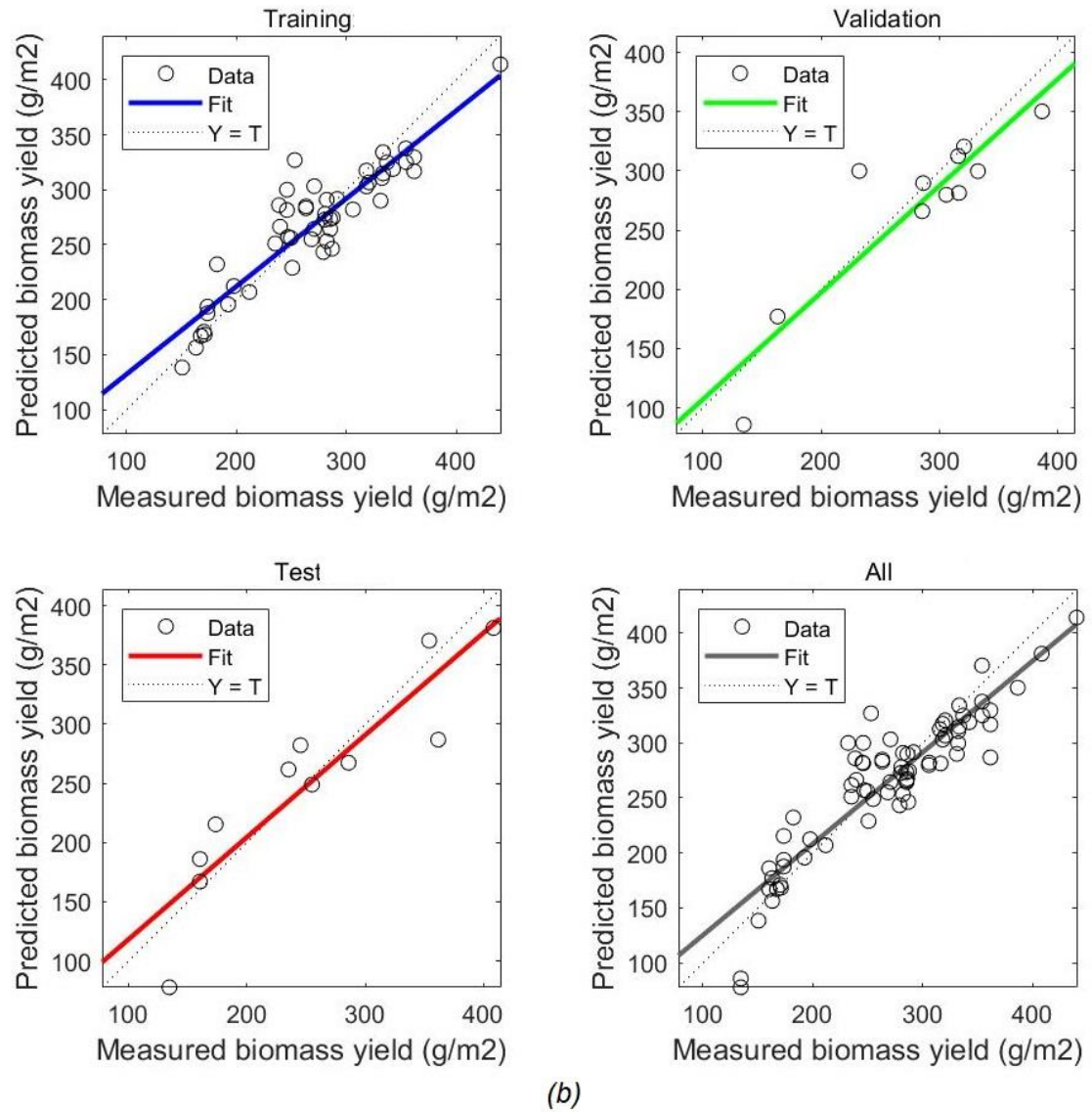


Supplementary Figure S4. Seasonal GreenSeeker NDVI values of the moderately sodic (MS) and the highly sodic (HS) site.

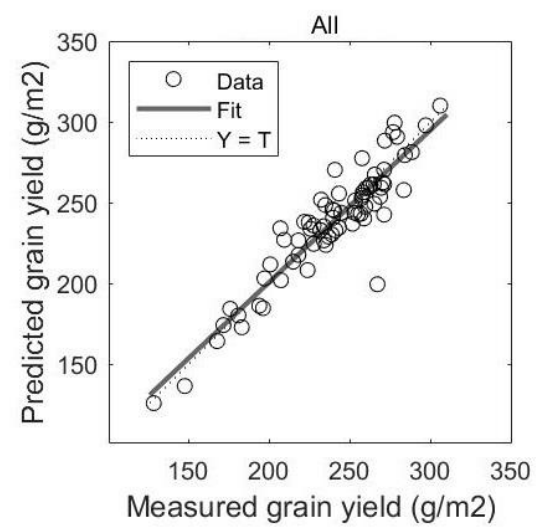
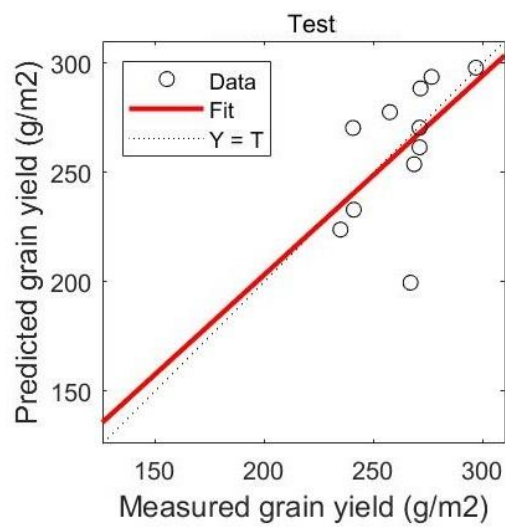
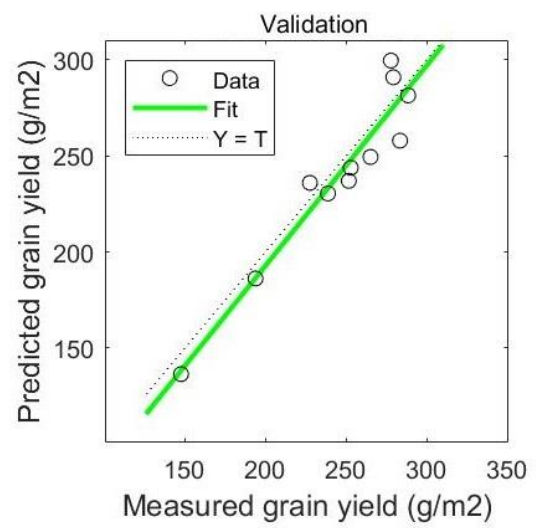
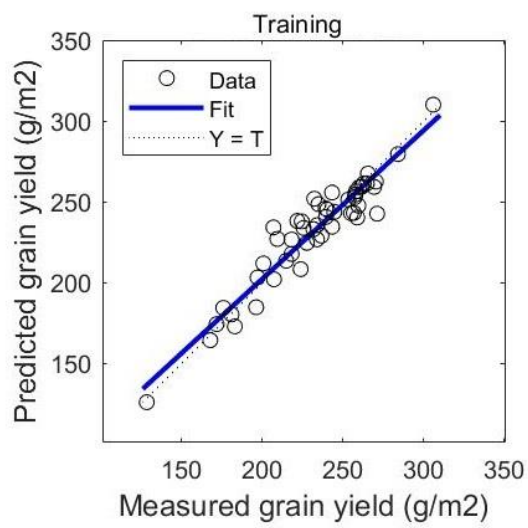


Supplementary Figure S5. Correlation between ground-measured crop height and 3D point cloud derived crop height; **(a)** moderately sodic site, **(b)** highly sodic site; $n = 72$.

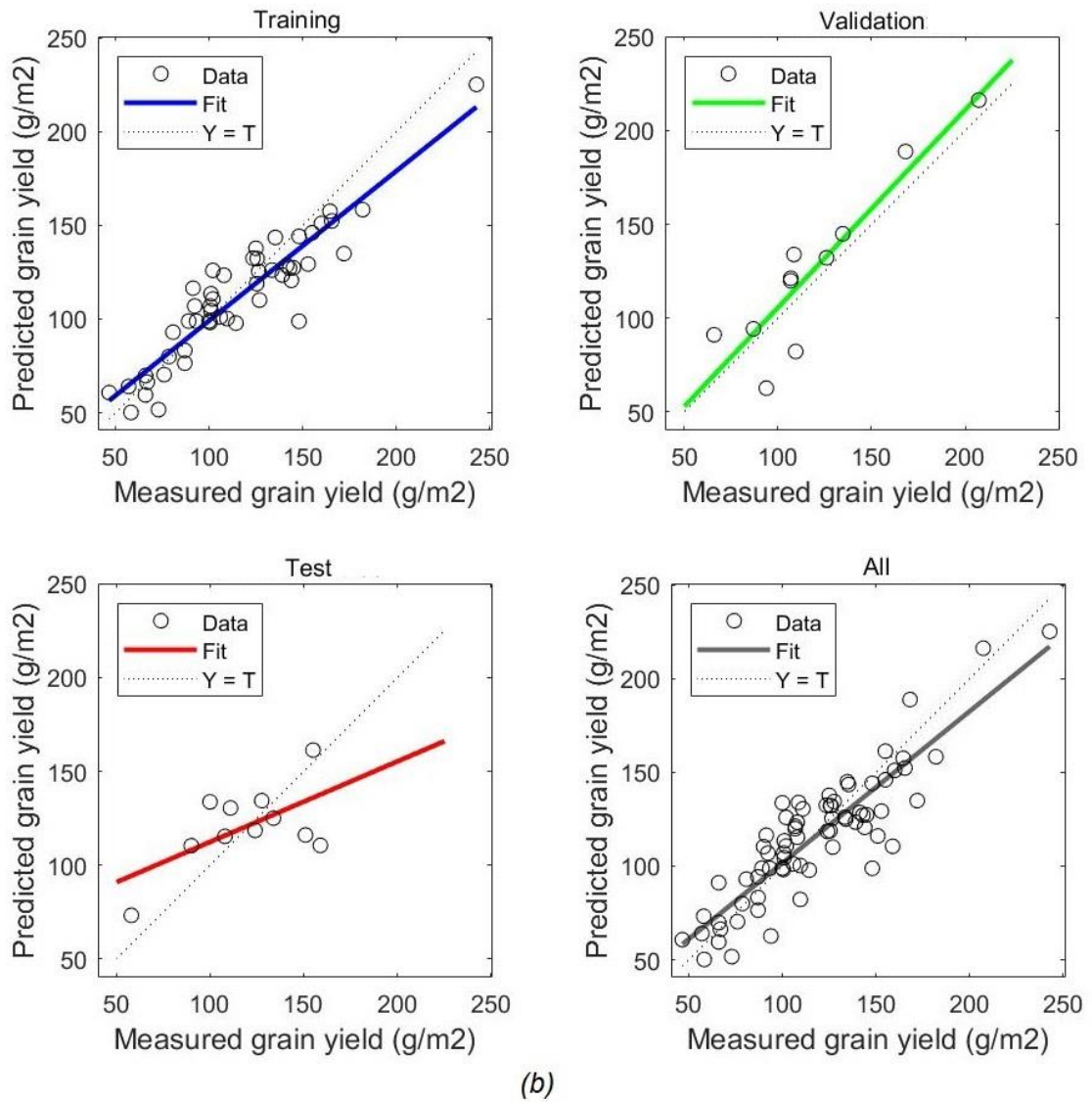




Supplementary Figure S6. Cross-validation of correlation between ground-measured biomass yield and ANN predicted biomass yield as a function of UAV-multispectral VIs and 3D point cloud crop height; (a) moderately sodic (MS) and (b) highly sodic site (HS); $n = 72$



(a)



Supplementary Figure S7. Cross-validation of correlation between ground-measured grain yield and ANN predicted grain yield as a function of UAV-multispectral VIs and 3D point cloud crop height; (a) moderately sodic (MS) and (b) highly sodic site (HS); $n=72$