Supplementary Table S1. Test results for the two potting media[1].

Sample	Rep	pH[2]	EC[2]	TC[3]	TN[3]	NH_3-N[4]	NO_3-N[5]	NO_2-N[5]	Available Element[6]									
									Ca	Cu	Fe	K	Mg	Mn	Na	P	S	Zn
			dS/m	Wt %	Wt %	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil	1	7.98	0.105	0.668	0.036	4.2	3.4	0.08	4633	2.5	105.0	218	1810	133	168	46.4	32	0.72
	2	8.00	0.103	0.666	0.030	4.5	3.1	0.08	4826	2.5	109.3	220	1838	142	172	49.4	31	0.79
	3	8.02	0.106	0.693	0.031	4.4	3.2	0.08	4789	2.6	107.7	222	1822	137	170	48.3	31	0.76
Mean		8.00	0.105	0.676	0.032	4.4	3.2	0.08	4749	2.5	107.3	220	1823	137	170	48.1	31	0.75
UQ23	1	5.81	2.830	26.507	0.615	154.6	734.9	5.65	5687	30.0	353.5	1365	1825	16	274	194.4	1604	7.32
	2	5.81	2.810	26.935	0.604	167.7	764.7	6.47	5831	28.8	356.0	1371	1822	17	266	191.4	1733	7.08
	3	5.82	2.820	26.327	0.591	150.2	752.1	5.75	5895	29.2	368.3	1387	1876	16	282	201.2	1729	7.62
Mean		5.81	2.820	26.590	0.603	157.5	750.6	5.96	5804	29.3	359.3	1374	1841	16	274	195.7	1688	7.34

[1] The two potting media are Gatton vertosol soil (Soil) and a potting mix of 70% composted pine bark + 30% coco peat with 2 g/L Osmocote and 1 g/L Dolomite (UQ23).

[2] 1:5 soil water extracts are prepared and mixed for 1 hour. Conductivity and pH electrodes are used to measure the respective properties.

[3] 1.0 g of sample is weighed out into a ceramic boat which is placed into the induction furnace of a LECO 928 model combustion analyser set at 1200 ℃ and calibrated with EDTA. The carbon and sulphur present is combusted to CO_2 and SO_2, which are determined with infrared detection cells. The nitrogen present is combusted to N_2, NO_2 and NO. The oxides are reduced to N_2 which is determined quantitatively using a thermal conductivity cell. Results are automatically expressed as weight percentages. To convert to mg/kg multiply the Wt % result by 10000.

[4] 1:10 soil solution extracts in 2 M potassium chloride are prepared and mixed for 1 hour, with the extracted ammonium nitrogen present being determined colorimetrically on centrifuged and filtered extracts using a SEAL AQ400 colorimetric analyser. The chemistry used is the reaction of ammonia with sodium salicylate and nitroprusside in a weakly alkaline buffer in the presence of free chlorine to produce an easily determinable ammonium salicylate complex using at a wavelength of 650 nm. Sample concentrations obtained above in mg/L are converted to mg/kg by multiplying by the volume and dividing by the weight.

[5] 1:10 soil solution extracts in 2 M potassium chloride are prepared and mixed for 1 hour, with the extracted nitrate nitrogen present being determined colorimetrically on centrifuged and filtered extracts using a SEAL AQ400 colorimetric analyser. The chemistry used reduces the nitrate to nitrite using a cadmium reduction column and then measures the colour produced by reacting the nitrite with sulfanilamide and NED at 540 nm. Sample concentrations obtained above in mg/L are converted to mg/kg by multiplying by the volume and dividing by the weight.

[6] Mehlich-3 Extractable elements 4 g of sample is weighed out and extracted with 40 mL of Mehlich-3 reagent for 5 minutes. The extracted elements were determined on centrifuged and filtered extracts using a Varian Thermo iCAP PRO XP ICPOES instrument. Sample concentrations obtained above in mg/L are converted to mg/kg by multiplying by the volume and dividing by the weight.

Supplementary Table S2. Variance components and their standard error for the 16 traits (Table 2A) from the mixed model analysis.

Trait	Source	Component	Std.error[1]
Plant height (Height, cm)	Media	31.81	48.12
	EntryName	23.57	16.79
	Media:EntryName	18.11	11.56
	Row|Rep	4.95	5.51
	Column|Rep	0	NA
	Residual	40.69	7.37
Leaf area (LeafArea, cm^2)	Media	291,138	423,795
	EntryName	212,884	115,598
	Media:EntryName	56,221	46,123
	Row|Rep	95,562	42,779
	Column|Rep	20,119	22,496
	Residual	193,793	38,362
Above-ground dry matter (ShootDW, g)	Media	112.51	164.39
	EntryName	109.08	57.02
	Media:EntryName	22.70	19.79
	Row|Rep	55.00	22.56
	Column|Rep	0	NA
	Residual	90.82	17.04
Seed weight (SeedWt, g)	Media	25.01	36.64
	EntryName	29.81	15.23
	Media:EntryName	6.25	4.76
	Row|Rep	10.49	4.54
	Column|Rep	0	NA
	Residual	18.85	3.58
Harvest Index (HarvestIndex)	Media	0.0003	0.0006
	EntryName	0.0069	0.0033
	Media:EntryName	0.0012	0.0006
	Row|Rep	0.0001	0.0001
	Column|Rep	0	NA
	Residual	0.0009	0.0002
Total water consumption (WUtotal, g)	Media	10,233,134	14,919,644
	EntryName	6,756,802	3,802,482
	Media:EntryName	2,176,824	1,686,832
	Row|Rep	4,869,287	1,854,011
	Column|Rep	53,549	508,902
	Residual	6,705,076	1,333,054
Total water consumption before flowering (WUpre, g)	Media	623,792	906,775
	EntryName	298,817	177,987
	Media:EntryName	84,482	92,010
	Row|Rep	100,389	81,823
	Column|Rep	0	NA
	Residual	563,919	102,123

Supplementary Table S2. *Cont*.

Trait	Source	Component	Std.error[1]
Total water consumption after flowering (WUpost, g)	Media	5,770,893	8,473,109
	EntryName	4,193,473	2,425,904
	Media:EntryName	1,391,360	1,161,009
	Row|Rep	3,761,987	1,415,334
	Column|Rep	1	NA
	Residual	5,048,625	945,143
Stomatal conductance before flowering (SC44, mmol/m^2/s)	Media	0.012	0.017
	EntryName	0.002	0.002
	Media:EntryName	0	NA
	Row|Rep	0.007	0.004
	Column|Rep	0	NA
	Residual	0.024	0.004
Stomatal conductance after flowering (SC53, mmol/m^2/s)	Media	0.003	0.005
	EntryName	0	0.001
	Media:EntryName	0	NA
	Row|Rep	0.001	0.001
	Column|Rep	0	NA
	Residual	0.009	0.001
WUEyield (WUEyield_total, g/kg)	Media	0	0.01
	EntryName	0.11	0.05
	Media:EntryName	0.01	0.01
	Row|Rep	0.01	0
	Column|Rep	0	NA
	Residual	0.01	0
WUE-yield before flowering (WUEyield_pre, g/kg)	Media	0.41	1.01
	EntryName	2.68	2.09
	Media:EntryName	1.12	1.6
	Row|Rep	3.79	1.99
	Column|Rep	0	NA
	Residual	10.6	1.94
WUE-yield after flowering (WUEyield_post, g/kg)	Media	0.01	0.02
	EntryName	0.17	0.08
	Media:EntryName	0.01	0.01
	Row|Rep	0.01	0.01
	Column|Rep	0	NA
	Residual	0.03	0.01
WUE-biomass (WUEbio_total, g/kg)	Media	0	0.01
	EntryName	0.18	0.09
	Media:EntryName	0.04	0.03
	Row|Rep	0.01	0.01
	Column|Rep	0	NA
	Residual	0.08	0.02

Supplementary Table S2. *Cont*.

Trait	Source	Component	Std.error[1]
WUE-biomass before flowering (WUEbio_pre, g/kg)	Media	5.70	9.96
	EntryName	3.11	5.91
	Media:EntryName	3.21	7.13
	Row|Rep	17.82	9.60
	Column|Rep	0	NA
	Residual	54.86	9.97
WUE-biomass after flowering (WUEbio_post, g/kg)	Media	0.03	0.06
	EntryName	0.30	0.15
	Media:EntryName	0.04	0.04
	Row|Rep	0	NA
	Column|Rep	0	NA
	Residual	0.21	0.03

[1] Missing standard error (NA) means the variance component is very small (Boundary).

Supplementary Table S3. Predicted value and the standard error of the 16 traits (Table 2A) for the twelve mungbean genotypes for each potting media.

Genotype	Media[1]	Plant height (cm)	Leaf area (cm^2)	Shoot dry weight (g)	Seed weight (g)	Harvest Index	Water consumption (g)[2]			Stomatal conductance[3]		Water use efficiency (WUE, g/kg)					
												Yield[4]			Shoot biomass[5]		
							Total	Pre	Post	Pre	Post	Total	Pre	Post	Total	Pre	Post
Acc 54	Soil	35.05	351.54	5.65	0.73	0.08	3540.00	652.22	3152.53	0.55	0.30	0.10	3.87	0.16	1.30	14.77	1.64
Barimung 5		35.40	467.64	13.83	5.77	0.44	4510.66	738.02	3971.44	0.51	0.26	1.31	9.40	1.52	2.99	20.88	3.46
Berken		41.18	1339.18	31.00	15.04	0.50	9596.96	1941.96	7516.17	0.51	0.22	1.59	7.32	1.99	3.16	16.65	3.94
Celera II-AU		39.13	1626.16	34.59	14.99	0.44	10481.34	1862.99	8623.12	0.57	0.24	1.41	8.79	1.76	3.25	19.98	4.02
Chaeraejong 8		37.97	820.91	23.62	10.26	0.44	7769.92	1423.81	6472.53	0.52	0.24	1.32	8.51	1.63	3.07	19.46	3.79
Crystal		41.43	1078.37	31.05	14.09	0.45	9348.20	1772.20	7564.02	0.51	0.24	1.48	8.71	1.86	3.27	19.51	4.09
Green Dragon		35.41	897.41	24.78	10.02	0.42	7761.44	1346.21	6482.94	0.60	0.30	1.31	9.24	1.58	3.22	20.96	3.79
Jade-AU		37.12	903.92	25.16	10.60	0.43	8192.52	1251.35	7030.79	0.52	0.30	1.27	9.94	1.52	2.99	22.12	3.59
King		50.74	1342.60	32.56	12.65	0.38	9569.03	1764.87	7825.37	0.50	0.23	1.29	7.94	1.58	3.31	19.44	4.11
Opal-AU		48.49	1502.81	37.12	16.04	0.42	10988.17	1786.45	9195.92	0.48	0.23	1.45	9.37	1.72	3.37	21.15	4.07
Satin II		36.50	1277.86	31.76	14.46	0.46	9600.29	1598.97	8017.50	0.56	0.28	1.49	10.60	1.80	3.22	22.14	3.91
Yellow Mungbean		45.89	1338.87	31.11	13.55	0.44	10000.54	1710.48	8372.78	0.51	0.27	1.36	9.30	1.65	3.13	20.75	3.81
Acc 54	UQ23	59.03	1414.83	23.67	5.76	0.25	9844.24	1791.94	8137.95	0.42	0.22	0.55	5.53	0.72	2.32	17.04	2.95
Barimung 5		39.02	458.50	14.74	5.90	0.39	4782.75	1229.07	3780.82	0.38	0.22	1.05	6.30	1.47	2.64	16.10	3.76
Berken		43.82	1377.30	31.44	16.77	0.54	10117.56	1815.29	8340.03	0.39	0.21	1.65	9.83	2.01	3.12	19.65	3.81
Celera II-AU		46.85	2279.73	44.64	20.02	0.44	13712.10	2914.32	10743.24	0.48	0.21	1.44	7.94	1.82	3.26	18.16	4.15

Supplementary Table S3. *Cont*.

Genotype	Media[1]	Plant height (cm)	Leaf area (cm^2)	Shoot dry weight (g)	Seed weight (g)	Harvest Index	Water consumption (g)[2]			Stomatal conductance[3]		Water use efficiency (WUE, g/kg)					
												Yield[4]			Shoot biomass[5]		
							Total	Pre	Post	Pre	Post	Total	Pre	Post	Total	Pre	Post
Chaeraejong 8	UQ23	45.56	1405.05	35.25	16.00	0.46	11356.95	2012.33	9266.69	0.39	0.22	1.40	8.09	1.71	3.06	18.11	3.73
Crystal		49.33	2232.31	57.88	28.37	0.48	16883.00	3314.78	13381.56	0.52	0.20	1.65	8.76	2.05	3.37	18.92	4.22
Green Dragon		41.83	1776.82	44.40	20.51	0.46	13357.81	2225.41	11010.70	0.48	0.23	1.52	8.39	1.83	3.31	18.77	4.01
Jade-AU		40.69	1334.91	37.11	15.79	0.42	11467.04	1647.60	9737.14	0.43	0.24	1.34	9.71	1.59	3.18	21.67	3.75
King		56.13	2122.22	44.57	18.89	0.43	13241.09	3152.92	10002.44	0.40	0.21	1.44	7.00	1.96	3.33	17.05	4.53
Opal-AU		46.87	2087.91	46.44	20.17	0.43	13349.39	2959.28	10281.68	0.48	0.22	1.45	7.01	1.87	3.33	17.02	4.25
Satin II		42.92	2566.16	56.76	27.67	0.48	17123.53	3454.58	13452.22	0.53	0.22	1.62	7.98	2.03	3.29	17.74	4.15
Yellow Mungbean		58.44	2284.37	50.87	21.76	0.42	15822.68	2873.36	12817.21	0.38	0.21	1.38	8.04	1.69	3.23	18.74	3.98
Standard error		2.80	219.02	4.64	2.12	0.01	1284.34	331.18	1100.95	0.06	0.03	0.06	1.28	0.08	0.13	2.47	0.20

[1] Soil = Vertosol soil from Gatton; UQ23 = 70% composted pine bark + 30% coco peat with 2 g/L Osmocote and 1 g/L Dolomite.

[2] Water consumption for the total growing period (Total), before flowering (pre), and after flowering (post).

[3] Measured before flowering (pre) at 44 days after sowing (DAS) and after flowering (post) at 35 DAS.

[4] Water use efficiency based on seed weight and total water consumption (Total), before, and after flowering water consumption (pre and post, respectively).

[5] Water use efficiency based on total shoot biomass and total water consumption (Total), before, and after flowering water consumption (pre and post, respectively).

(A)

(B)

(C)

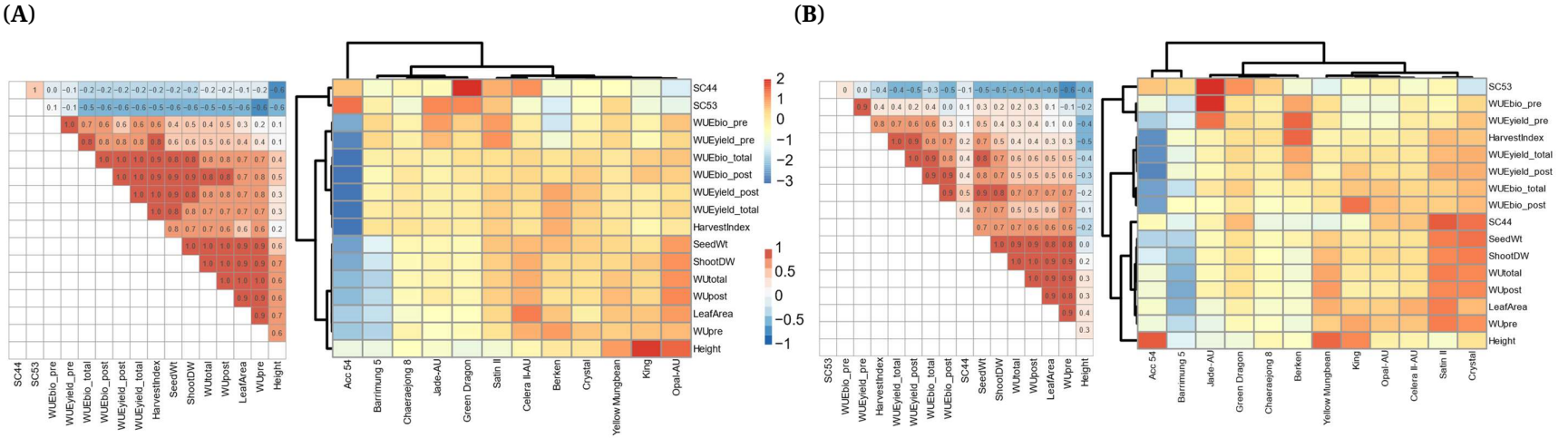
(D)

(E)

(F)

(G)

Supplementary Figure S1. Construction of the inverted-bottle pot (IBP) system. (**A**) The entire pot set-up based on 4L ANOVApot®. (**B**) Pot with upper water shedding container (65 mm × 116 mm top, 90 mm bottom) removed to reveal the bottom of the inverted bottle (250 mm × 85 mm) lying within the central conduit (89 mm outside diameter (OD) × 225 mm). (**C**) Bottle with cap (40 mm diameter) with a central hole (15 mm) and marble (16 mm) placed beside. (**D**) Internal view of central conduit revealing capillary mat draped over the central well of 4L ANOVApot® with a section of the plastic grid in place. (**E**) Rainfall plastic deflecting sheet (398 mm diameter) with a central hole (82 mm) and plant hole (30 mm) edge placed 15 mm from the edge of the central hole. Laces threaded through peripheral holes (8 mm) and tightened to secure the deflecting sheet in place. (**F**) Top of central conduit with adhesive tapes to prevent deflecting sheet sliding downwards. (**G**) All components with plant hole conduit (32 mm OD × 17 mm) in position. A plastic sheet beneath the capillary mat is included for added anti-drainage security (unnecessary if the pot is sealed). The wraparound silver reflecting insulation is not included here.



Supplementary Figure S2. Heatmap for the correlation matrix among the 16 traits (Table 2A) and heatmap for the column standardised predicted values of genotypes table for (**A**) Gatton vertosol soil and (**B**) potting mix UQ23 (70% composted pine bark + 30% coco peat with 2 g/L Osmocote and 1 g/L Dolomite). The traits and genotypes are ordered based on their optimised dendrogram (right and bottom). Each dendrogram used average squared Euclidean distance as dissimilarity measures and Wards' method as the clustering strategy.