

Supplementary Table 1: Estimates of genetic parameters based on the three parameters model (m, a and d) for the various traits in four cowpea crosses

Trait	Parameter	Padi-tuya x PBRC Estimate	Kirkhouse x PBRC Estimate	Wang-kae x PBRC Estimate	Apagbaala x PBRC Estimate
PB	m	2.8709±0.1004***	2.7284±0.108***	0.325±0.055***	2.6514±0.075***
	a	0.2291±0.093ns	0.0352±0.103ns	0.1864±0.055ns	0.0239±0.073ns
	d	0.0755±0.206ns	-0.0402±0.219ns	-0.1898±0.093ns	-0.04±0.164ns
	χ^2	6.37 p-v=0.095	13.84 p-v=0.003	5.66 p-v=0.129	10.62 p-v=0.014
DFF	m	39.2167±0.561***	38.9571±0.232***	39.5437±0.58***	40.0596±0.262***
	a	2.2019±0.542*	1.6957±0.221**	2.0632±0.567*	2.6298±0.257**
	d	-0.7912±1.209ns	-0.703±0.532ns	-1.0981±1.189ns	0.1412±0.509ns
	χ^2	35.67 p-v=0	7.55 p-v=0.056	41.35 p-v=0	7.31 p-v=0.063
DFPM	m	62.6456±0.389***	61.6078±0.441***	62.8299±0.441***	62.9493±0.697***
	a	2.1515±0.372*	2.0493±0.434*	2.7822±0.434**	3.0853±0.663*
	d	-1.6722±0.797ns	-1.3559±0.982ns	-1.343±0.881ns	-1.2613±1.227ns
	χ^2	10.33 p-v=0.016	21.9 p-v=1e-04	16.28 p-v=0.001	19.57 p-v=2e-04
NMDP/P	m	0.4296±0.079*	0.2057±0.086ns	0.2802±0.055**	0.277±0.079
	a	0.3152±0.08*	0.1885±0.086ns	0.1717±0.056*	0.1662±0.079
	d	-0.3101±0.134ns	-0.0452±0.148ns	-0.1777±0.087ns	-0.0894±0.138
	χ^2	9.63 p-v=0.022	21.9 p-v=2e-04	4.63 p-v=0.201	
PL	m	13.3131±0.152***	13.4858±0.296***	13.366±0.232***	13.8041±0.3788***
	a	-0.0252±0.146ns	0.0662±0.292ns	0.1766±0.225ns	-0.094±0.371ns
	d	1.0944±0.343*	1.1189±0.623ns	0.7825±0.476ns	1.0726±0.7274ns
	χ^2	2.19 p-v=0.534	7.86 p-v=0.049	3.71 p-v=0.295	18.5 p-v=3e-04
NSP	m	10.1899±0.640***	9.8458±0.164***	9.0816±0.142***	10.2442±0.428***
	a	-0.2969±0.630ns	0.0804±0.161ns	0.1081±0.135ns	0.0191±0.429ns
	d	-0.4753±1.529ns	1.0182±0.341ns	1.1331±0.307*	0.6011±0.838ns
	χ^2	95.84 p-v=0	3.44 p-v=0.329	2.07 p-v=0.558	29.14 p-v=0

Note: PB = primary branches, DFF = days to 50% flowering, DFPM = days to first pod maturity, PL = pod length, NSP = seed per pod and NMDP/P = number of Maruca damaged pods per plant. *** = Significant at $P \leq 0.001$, ** = Significant at $P \leq 0.01$, * = significant at $P \leq 0.05$ and ns = non-significant. M = intercept, a = additive gene effects, d = dominance gene effects and χ^2 = Chi-square

Supplementary Table 2: Estimates of genetic parameters based on the six-parameter model (m, a, d, aa, ad and dd) for four cowpea crosses

Trait/component	m	a	d	aa	ad	dd	Type of epistasis
Padi-tuya x PBRC							
DFF	43.0641±1.1193***	2.4211±0.1794***	-8.1257±2.8072**	- 3.8852±1.1048***	-2.7703±0.8016***	2.6616±1.8569ns	DEDD
DFPM	64.4706±1.322***	2.4023±0.2396***	-5.0119±3.2601ns	-1.7841±1.3001ns	-2.3006±0.9295*	1.0746±2.1302ns	DEDD
NMDP/P	0.5512±0.2885ns	0.386±0.0552***	-0.5537±0.7344ns	-0.0705±0.2832ns	-0.6747±0.2231**	0.1025±0.4665ns	DEDD
NSP	14.8719±1.0337***	-0.3766±0.1178**	- 16.7558±2.6125***	-4.4065±1.027***	1.5863±0.7289*	13.6506±1.7171***	DEDD
Kirkhouse x PBRC							
PB	3.4775±0.3074***	0.0216±0.0548ns	-2.3459±0.7755**	-0.6867±0.3025*	0.1234±0.2273ns	1.7684±0.5124***	DEDD
DFPM	62.8422±1.2913***	2.2228±0.1721***	-1.9534±3.3199ns	-1.44±1.2798ns	-2.5788±0.9627**	-1.7555±2.1981ns	CEDD
NMDP/P	-0.1903±0.3273ns	0.1436±0.0377***	1.6241±0.8869ns	0.3467±0.3251ns	-0.1538±0.2746ns	-1.3672±0.5738*	DEDI
PL	16.6933±1.201***	0.1233±0.196ns	-7.5478±3.252*	-3.1853±1.1849**	-1.2±1.0211ns	5.5412±2.214*	DEDD
Wang-kae x PBRC							
DFF	41.433±1.0895***	2.1502±0.1689***	-2.2925±2.7779ns	-2.2543±1.0764*	-1.3147±0.8121ns	-1.9739±1.818ns	CEDD
DFPM	66.0414±1.337***	2.9509±0.2069***	-7.6242±3.3548*	-3.3476±1.3209*	-2.1162±0.9614*	2.5495±2.1624ns	DEDD
Apagbaala x PBRC							
PB	2.8429±0.2993***	0.0746±0.0427ns	-0.2786±0.7477ns	-0.1952±0.2962ns	-0.6111±0.2094**	-0.0143±0.4903ns	CEDD
DFPM	68.9772±1.8032***	2.8825±0.3384***	- 16.1365±4.1792***	- 5.9486±1.7712***	1.2064±1.0973ns	9.4843±2.5417***	DEDD
NMDP/P	0.7986±0.3045**	0.1773±0.0439***	-1.0275±0.7588ns	-0.5314±0.3013ns	-0.4593±0.2149*	0.3539±0.4745ns	DEDD
PL	17.2326±3.1078***	- 0.1393±0.1619ns	-9.2153±6.4699ns	-3.2067±3.1036ns	0.9318±0.8428ns	7.4202±3.4381*	DEDD
NSP	9.1356±0.937***	0.0304±0.151ns	0.9714±2.4642ns	1.4229±0.9248ns	0.4154±0.754ns	1.5679±1.6175ns	CEDI

Note: PB = primary branches, DFF = days to 50% flowering, DFPM = days to first pod maturity, PL = pod length, NSP = seed per pod and NMDP/P = number of Maruca damaged pods per plant. *** = Significant at $P \leq 0.001$, ** = Significant at $P \leq 0.01$ and * = significant at $P \leq 0.05$. DEDD= duplicate epistasis between dominant decreaseers, DEDI = duplicate epistasis between dominant increaseers, CEDD = complementary epistasis between dominant decreaseers and CEDI = complementary epistasis between. M = intercept, a = additive gene effects, d = dominance gene effects, aa = additive x additive gene effects, ad = additive x dominance gene effects and dd = dominance x dominance gene effects

Supplementary Table 3: Additive-dominance epistasis and Chi-square values for the re-estimated parameters

Trait/Test	m	a	d	aa	ad	dd	χ^2
Padi-tuya x PBRC							
DFF	39.2167±0.561***	2.2019±0.5422*	-0.7912±1.2092ns				35.67
DFPM	62.0303±0.3413***	2.0388±0.5741*			-1.6528±2.4635ns		22.16
NMDP/P	0.2913±0.0737*	0.232±0.1082ns			-0.3669±0.5861ns		23.64
NSP	14.8719±1.0337***	-0.3766±0.1178**	-16.7558±2.6125***	-4.4065±1.027***	1.5863±0.7289*	13.6506±1.7171***	0
Kirkhouse x PBRC							
PB	2.5533±0.3133**		0.2111±0.4738ns	0.1958±0.334ns			12.9
DFPM	61.1474±0.3485***	2.2253±0.5331**			-2.5431±2.9662ns		28.77
NMDP/P	14.8719***	-0.3766	-16.7558	-4.4065	1.5863±	13.6506	0
PL	16.4767±0.9962**		-6.8982±2.6882ns	-2.9767±0.9825ns		5.1081±1.8316ns	1.42
Wang-kae x PBRC							
DFF	39.0885±0.578***	2.041±0.642*		0.096±0.9623ns			52.94
DFPM	64.6329±0.7077**	2.9414±0.2438ns	-3.8028±1.0203ns	-1.9858±0.7554ns	-2.1301±1.1334ns		1.39
Apagbaala x PBRC							
PB	64.6329±0.7077**	2.9414±0.2438*	-3.8028±1.0203ns	-1.9858±0.7554ns	-2.1301±1.1334ns		28.61
DFPM	40.2371±0.2217***	2.6102±0.2382**		-0.2823±0.3625ns			4.83
NMDP/P	61.1474±0.3485***	2.2253±0.5331**			-2.5431±2.9662ns		1553.76
PL	64.6329±0.7077**	2.9414±0.2438*	-3.8028±1.0203ns	-1.9858±0.7554ns	-2.1301±1.1334		1.53
NSP	64.6329±0.7077**	2.9414±0.2438*	-3.8028±1.0203ns	-1.9858±0.7554ns	-2.1301±1.1334ns		2.62

Note: PB = primary branches, DFF = days to 50% flowering, DFPM = days to first pod maturity, PL = pod length, NSP = seed per pod and NMDP/P = number of Maruca damaged pods per plant. *** = Significant at $P \leq 0.001$, ** = Significant at $P \leq 0.01$ and * = significant at $P \leq 0.05$. m = intercept, a = additive gene effects, d = dominance gene effects, aa = additive x additive gene effects, ad = additive x dominance gene effects and dd = dominance x dominance gene effects, χ^2 = Chi-square

Supplementary Table 4: Estimates of variance components and heritability of four cowpea crosses

Variance	PB	DFF	DFPM	NMDP/P	PL	NSP	PB	DFF	DFPM	NMDP/P	PL	NSP
Padi-tuya x PBRC						Kirkhouse x PBRC						
VE	0.99	5.58	9.63	0.48	6.60	2.64	0.45	4.08	4.71	0.20	5.92	4.12
VA	0.26	4.60	9.02	0.16	0.69	2.70	0.38	2.70	3.43	-0.37	-3.68	3.42
VD	-0.61	-3.55	-8.75	-0.23	-0.78	0.09	-0.34	-2.04	-0.36	0.51	2.58	-1.89
VAD	-0.10	0.35	-0.07	-0.03	-0.54	-0.42	-0.01	-0.12	-0.77	-0.06	-1.46	-0.46
VG	1.25	4.60	9.02	0.16	0.69	2.79	0.38	2.70	3.43	0.51	2.58	3.42
VP	1.25	10.18	18.65	0.63	7.29	5.43	0.82	6.78	8.14	0.71	8.50	7.54
Hns	0.21	0.45	0.48	0.25	0.09	0.50	0.46	0.40	0.42	0.00	0.30	0.45
Wang-kae x PBRC						Apagbaala x PBRC						
VE	0.66	3.98	5.93	0.35	7.29	4.93	0.33	5.57	18.07	0.30	4.33	3.78
VA	0.09	2.13	5.13	0.11	-2.91	2.54	0.33	7.81	30.63	0.29	158.66	-1.25
VD	-0.11	-0.36	-1.76	-0.05	1.56	-1.52	-0.18	-4.14	-26.28	-0.11	-78.36	1.01
VAD	0.03	0.52	-0.86	-0.04	1.08	0.88	0.04	-1.16	-3.46	-0.04	0.03	0.06
VG	0.09	2.13	5.13	0.11	1.56	2.54	0.33	7.81	30.63	0.29	158.66	1.01
VP	0.74	6.11	11.06	0.46	8.85	7.47	0.66	13.38	48.70	0.60	162.99	4.79
Hns	0.12	0.35	0.46	0.25	0.00	0.34	0.50	0.58	0.63	0.49	0.97	0.00

Note: PB = primary branches, DFF = days to 50% flowering, DFPM = days to first pod maturity, PL = pod length, NSP = seed per pod and NMDP/P = number

of Maruca damaged pods per plant. V_E = environmental variance, V_A = additive variance, V_D = dominance variance, V_{AD} = additive x dominance variance, V_G = genotypic variance, V_P = phenotypic variance and H_{ns} = narrow sense heritability