Supplementary Material

Table S1. Design of 54 simulated scenarios.

Scenario	Number of genotypes	Correlations between traits	Correlations between environments	Heritabilities of traits
1	100	0.2	0.2	0.2
2				0.5
3				0.8
4			0.5	0.2
5				0.5
6				0.8
7			0.8	0.2
8				0.5
9				0.8
10		0.5	0.2	0.2
11				0.5
12				0.8
13			0.5	0.2
14				0.5
15				0.8
16			0.8	0.2
17				0.5
18				0.8
19		0.8	0.2	0.2
20				0.5
21				0.8

22	500	0.2	0.5	0.2
23				0.5
24				0.8
25			0.8	0.2
26				0.5
27				0.8
28		0.2	0.2	0.2
29				0.5
30				0.8
31			0.5	0.2
32				0.5
33				0.8
34			0.8	0.2
35				0.5
36				0.8
37		0.5	0.2	0.2
38				0.5
39				0.8
40			0.5	0.2
41				0.5
42				0.8
43			0.8	0.2
44				0.5
45				0.8

46	0.8	0.2	0.2	0.2
47				0.5
48				0.8
49			0.5	0.2
50				0.5
51				0.8
52			0.8	0.2
53				0.5
54				0.8

Table S2. Coefficient of determination for the genotype-by-environment interaction (GEI) effects (R^2_{GEI}) for each scenario and trait, expressed as a percentage, used as an indicator of the relative importance of GEI in the phenotypic variation.

Trait	Scenario	R^2_{GEI}	Scenario	R^2_{GEI}
Trait 1	C1	14.81%	C28	16.69%
Trait 2	C1	20.19%	C28	14.67%
Trait 3	C1	14.84%	C28	13.65%
Trait 4	C1	22.08%	C28	17.47%
Trait 1	C2	42.41%	C29	40.35%
Trait 2	C2	32.35%	C29	37.66%
Trait 3	C2	43.76%	C29	38.23%
Trait 4	C2	42.08%	C29	39.99%
Trait 1	C3	74.44%	C30	66.57%
Trait 2	C3	61.03%	C30	70.91%
Trait 3	C3	61.39%	C30	66.16%
Trait 4	C3	71.11%	C30	66.24%
Trait 1	C4	8.95%	C31	12.57%
Trait 2	C4	8.35%	C31	11.42%
Trait 3	C4	14.22%	C31	8.75%

Trait 4	C4	5.2%	C31	8.71%
Trait 1	C5	30.54%	C32	25.1%
Trait 2	C5	35.68%	C32	24.47%
Trait 3	C5	25.42%	C32	20.78%
Trait 4	C5	26.84%	C32	24.4%
Trait 1	C6	45.27%	C33	39.96%
Trait 2	C6	40.45%	C33	42.46%
Trait 3	C6	46.14%	C33	38.77%
Trait 4	C6	33.49%	C33	40.8%
Trait 1	C7	0%	C34	5.08%
Trait 2	C7	4.05%	C34	4.32%
Trait 3	C7	7.94%	C34	4.16%
Trait 4	C7	4.13%	C34	2.96%
Trait 1	C8	12.42%	C35	11.1%
Trait 2	C8	4.73%	C35	9.6%
Trait 3	C8	12.23%	C35	12.61%
Trait 4	C8	9.82%	C35	8.95%
Trait 1	C9	12.06%	C36	17.1%
Trait 2	C9	15%	C36	21.15%
Trait 3	C9	18.27%	C36	18.56%
Trait 4	C9	12.17%	C36	15.46%
Trait 1	C10	16.84%	C37	19.39%
Trait 2	C10	17.65%	C37	16.79%
Trait 3	C10	19.57%	C37	17.15%
Trait 4	C10	17.89%	C37	19.63%
Trait 1	C11	40.13%	C38	45.44%
Trait 2	C11	38.77%	C38	44.52%
Trait 3	C11	41.82%	C38	37.21%
Trait 4	C11	40.95%	C38	42.9%
Trait 1	C12	70.42%	C39	68.74%
Trait 2	C12	66.12%	C39	67.44%
Trait 3	C12	73.02%	C39	65.81%
Trait 4	C12	64.51%	C39	64.4%
Trait 1	C13	7.04%	C40	9.67%

Trait 2	C13	9.36%	C40	12.53%
Trait 3	C13	7.79%	C40	11.88%
Trait 4	C13	20.72%	C40	10.54%
Trait 1	C14	29.48%	C41	25.02%
Trait 2	C14	26.11%	C41	23.16%
Trait 3	C14	33.1%	C41	23.88%
Trait 4	C14	28.19%	C41	27.78%
Trait 1	C15	44.4%	C42	45.04%
Trait 2	C15	34.32%	C42	41.3%
Trait 3	C15	41.65%	C42	46.77%
Trait 4	C15	37%	C42	43.26%
Trait 1	C16	3.4%	C43	3.61%
Trait 2	C16	3.17%	C43	4.64%
Trait 3	C16	6.2%	C43	5.28%
Trait 4	C16	3.2%	C43	5.76%
Trait 1	C17	10.83%	C44	10.54%
Trait 2	C17	15.46%	C44	8.35%
Trait 3	C17	13.23%	C44	9.43%
Trait 4	C17	13.88%	C44	8.6%
Trait 1	C18	19.09%	C45	17.6%
Trait 2	C18	16.82%	C45	15.73%
Trait 3	C18	17.05%	C45	15.69%
Trait 4	C18	17.28%	C45	17.5%
Trait 1	C19	13.32%	C46	16.29%
Trait 2	C19	26.32%	C46	17.38%
Trait 3	C19	14.65%	C46	15.6%
Trait 4	C19	13.34%	C46	13.11%
Trait 1	C20	38.88%	C47	38.83%
Trait 2	C20	44.33%	C47	38.7%
Trait 3	C20	41.64%	C47	35.48%
Trait 4	C20	37.33%	C47	38.57%
Trait 1	C21	69.24%	C48	64.38%
Trait 2	C21	77.19%	C48	60.94%
Trait 3	C21	66.82%	C48	62.71%

Trait 4	C21	66.36%	C48	64.17%
Trait 1	C22	3.03%	C49	13.8%
Trait 2	C22	14.83%	C49	14.04%
Trait 3	C22	10.98%	C49	13.4%
Trait 4	C22	10.01%	C49	15.43%
Trait 1	C23	28.86%	C50	24.81%
Trait 2	C23	26.93%	C50	25.69%
Trait 3	C23	21.53%	C50	27.87%
Trait 4	C23	29.42%	C50	27.1%
Trait 1	C24	40.38%	C51	41.45%
Trait 2	C24	43.16%	C51	45.55%
Trait 3	C24	36.71%	C51	45.73%
Trait 4	C24	41.94%	C51	46.17%
Trait 1	C25	8.74%	C52	3.55%
Trait 2	C25	4.87%	C52	3.09%
Trait 3	C25	5.2%	C52	4.52%
Trait 4	C25	3.34%	C52	6.52%
Trait 1	C26	7.87%	C53	10.34%
Trait 2	C26	8.36%	C53	11.03%
Trait 3	C26	11.8%	C53	10.31%
Trait 4	C26	9.61%	C53	11.3%
Trait 1	C27	22.81%	C54	19.47%
Trait 2	C27	19.39%	C54	15.18%
Trait 3	C27	27.17%	C54	18.22%
Trait 4	C27	20.88%	C54	18.1%

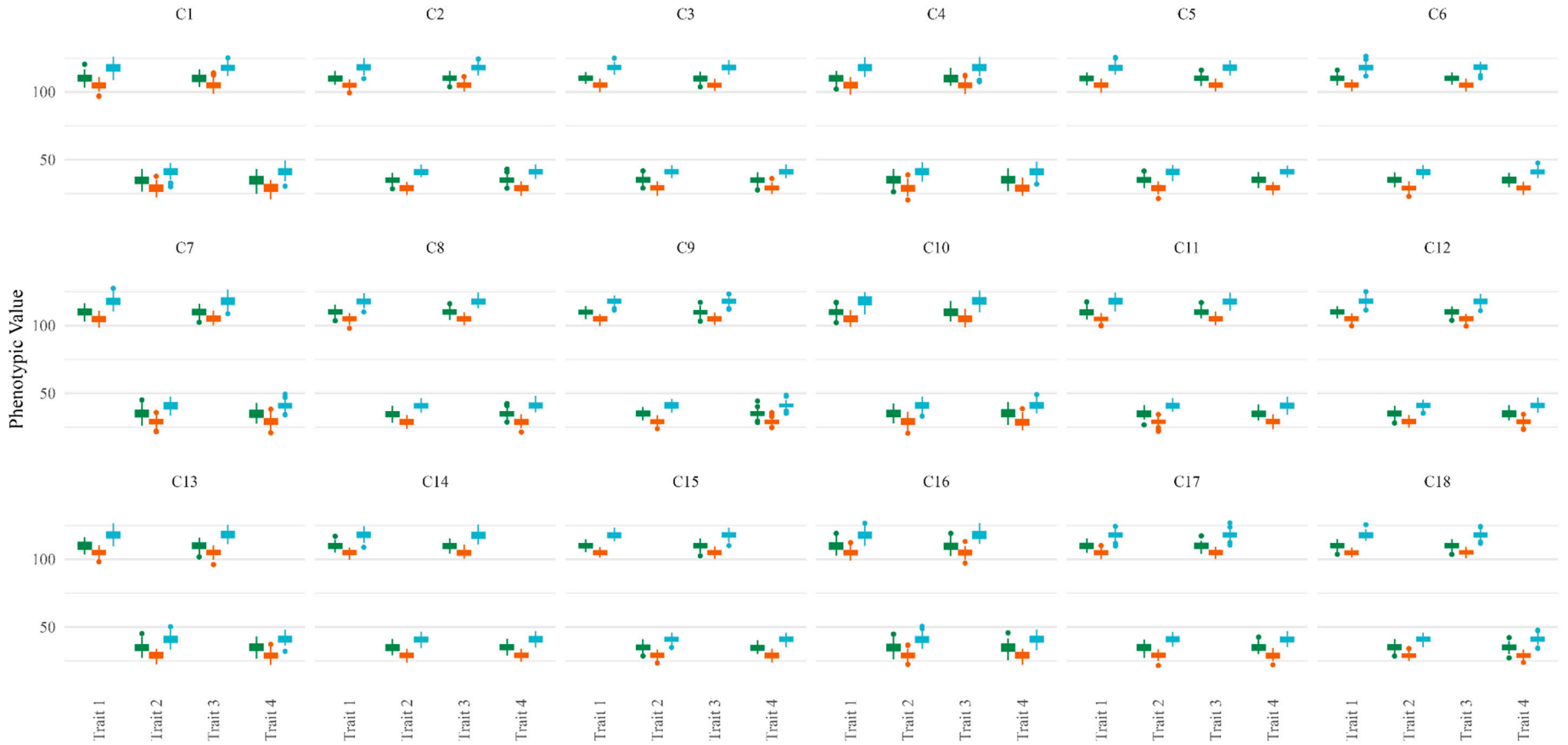


Figure S1. The phenotypic values of 100 genotypes for each trait in scenarios C1–C18 are presented as boxplots. Within each trait, three boxplots represent the environments: green, orange, and blue correspond to environments 1, 2, and 3, respectively. Scenarios C1–C3, C4–C6, and C7–C9 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits of scenarios C1-C9 was fixed at 0.2. Scenarios C10–C12, C13–C15, and C16–C18 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between the traits of scenarios C10-C18 was fixed at 0.5.

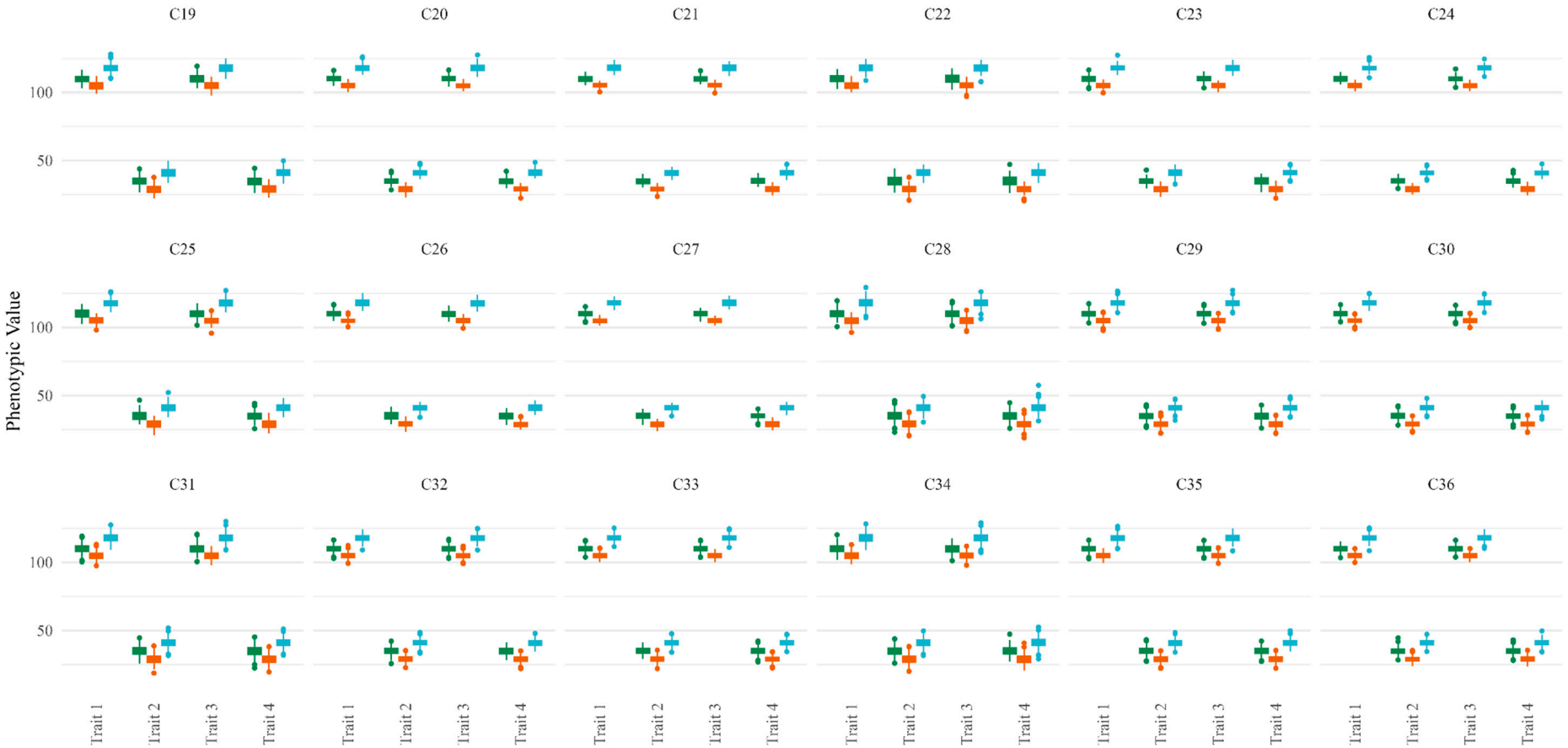


Figure S2. The phenotypic values of 100 genotypes for each trait in scenarios C19–C27, and of 500 genotypes for each trait in scenarios C28-C36, are presented as boxplots. Within each trait, three boxplots represent the environments: green, orange, and blue correspond to environments 1, 2, and 3, respectively. Scenarios C19–C21, C22–C24, and C25–C27 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits of scenarios C19-C27 was fixed at 0.8. Scenarios C28–30, C31–C33, and C34–C36 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between the traits of scenarios C28-C36 was fixed at 0.2.

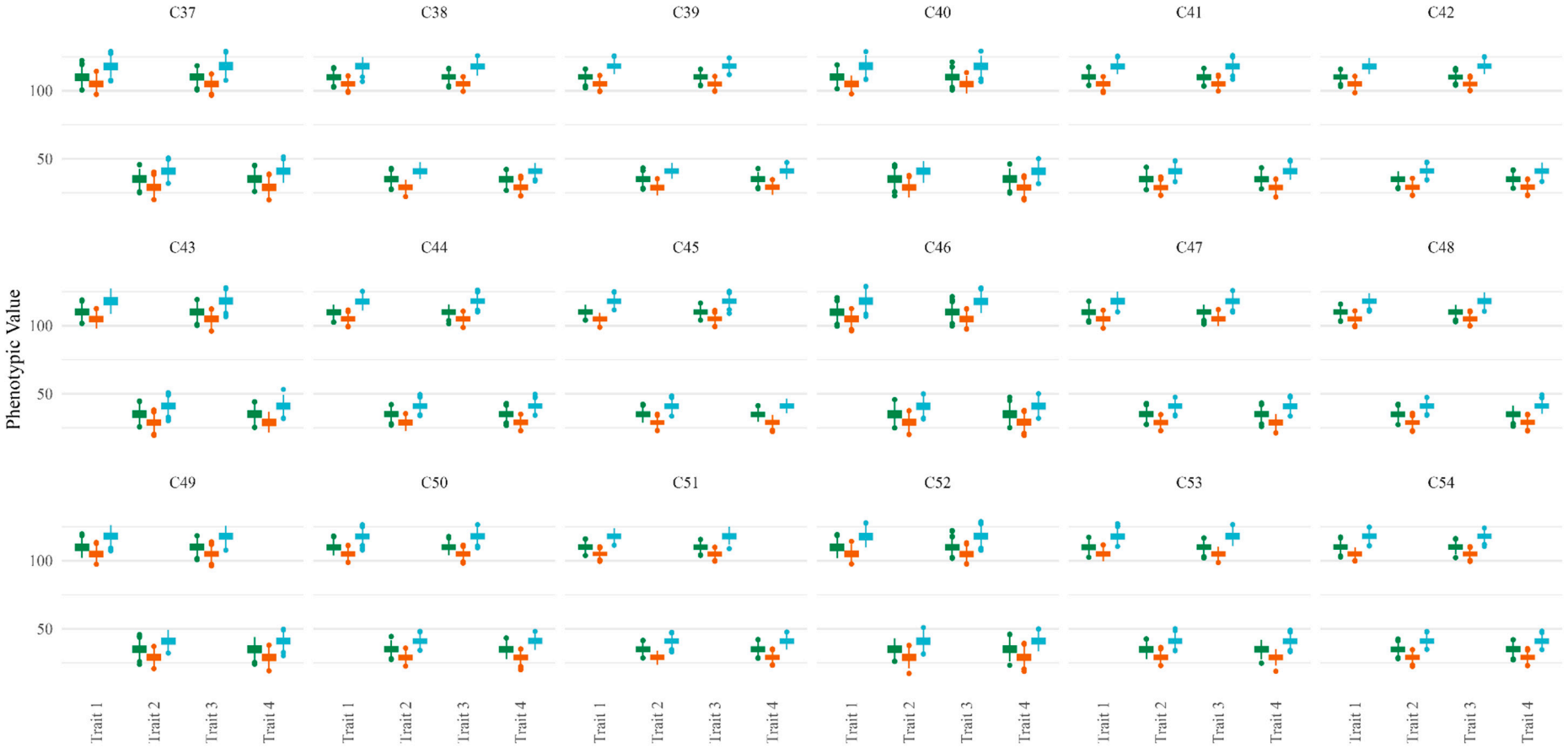


Figure S3. The phenotypic values of 500 genotypes for each trait in scenarios C37–C54 are presented as boxplots. Within each trait, three boxplots represent the environments: green, orange, and blue correspond to environments 1, 2, and 3, respectively. Scenarios C37–C39, C40–C42, and C43–C45 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between the traits of scenarios C37-C45 was fixed at 0.5. Scenarios C46–C48, C49–C51, and C52–C54 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between the traits of scenarios C46-C54 was fixed at 0.8.

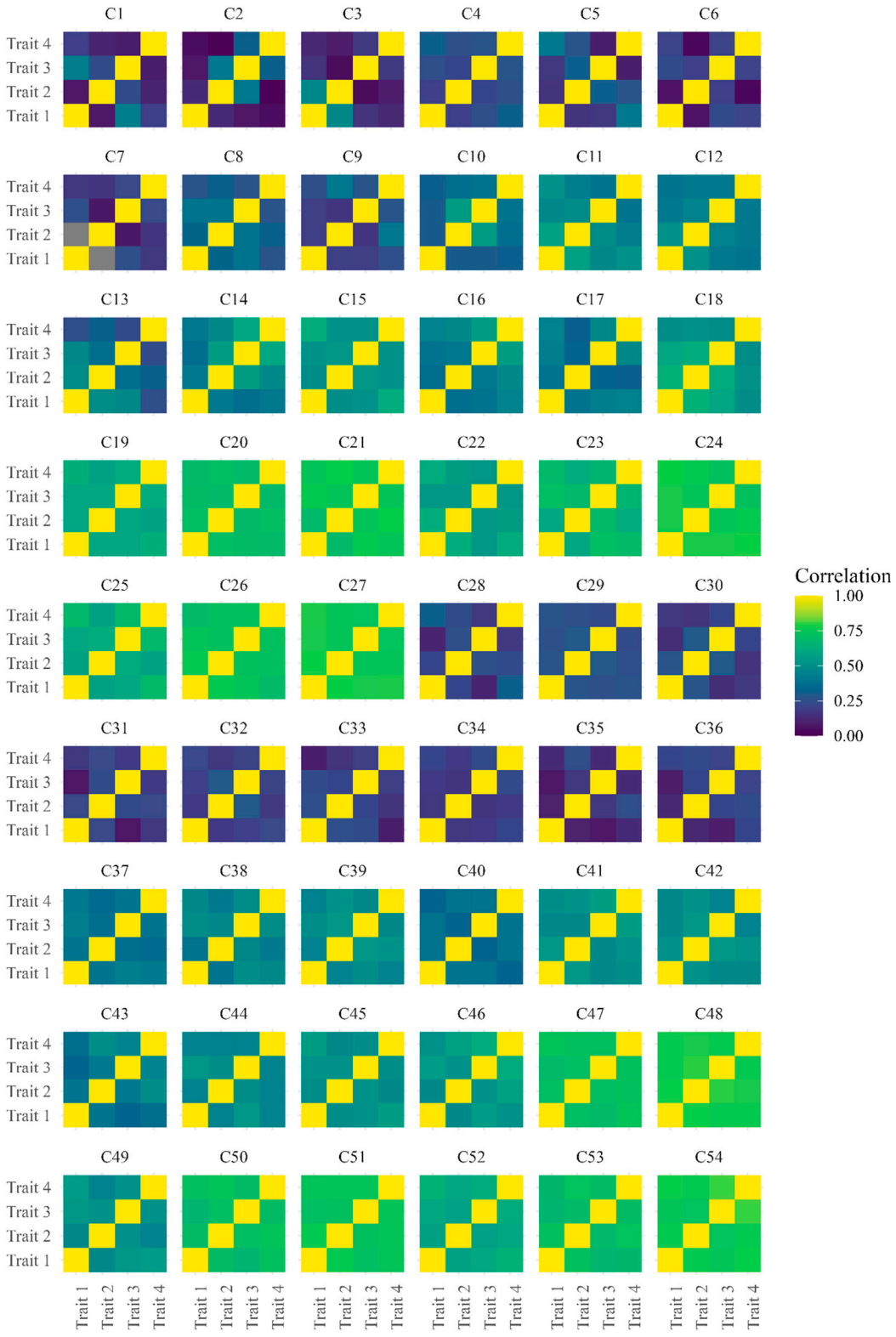


Figure S4. The correlations between traits for each of the 54 scenarios (C1–C54) are based on the mean performance of genotypes across replications and environments. Scenarios C1–C9 and C28-C36 were simulated with low correlation (0.2) structures among traits. Scenarios C10-C18 and C37-C45 were simulated with moderate correlation (0.5) structures among traits. Scenarios C19-C27 and C46-C54 were simulated with high correlation (0.8) structures among traits.

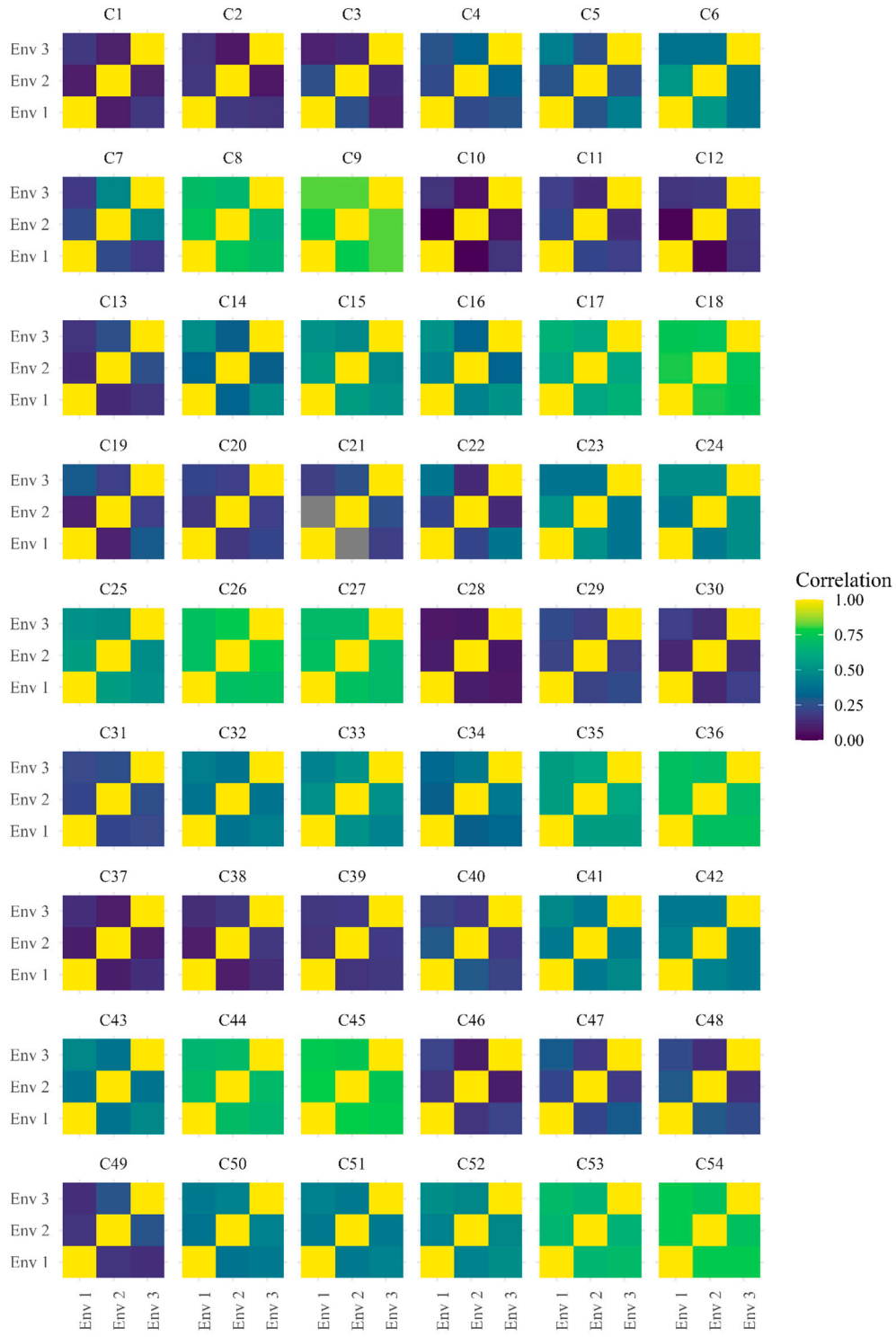


Figure S5. The correlations between environments (Env) for each of the 54 scenarios (C1–C54) are based on the mean performance of genotypes across replications and traits. Scenarios C1–C3, C10-C12, C19-C21, C28-C30, C37-C39, and C46-C48 were simulated with low correlation (0.2) structures among environments. Scenarios C4–C6, C13-C15, C22-C24, C31-C33, C40-C42, and C49-51 were simulated with moderate correlation (0.5) structures among environments. Scenarios C7–C9, C16-C18, C25-C27, C34-C36, C43-C46, and C52-C54 were simulated with high correlation (0.8) structures among environments.

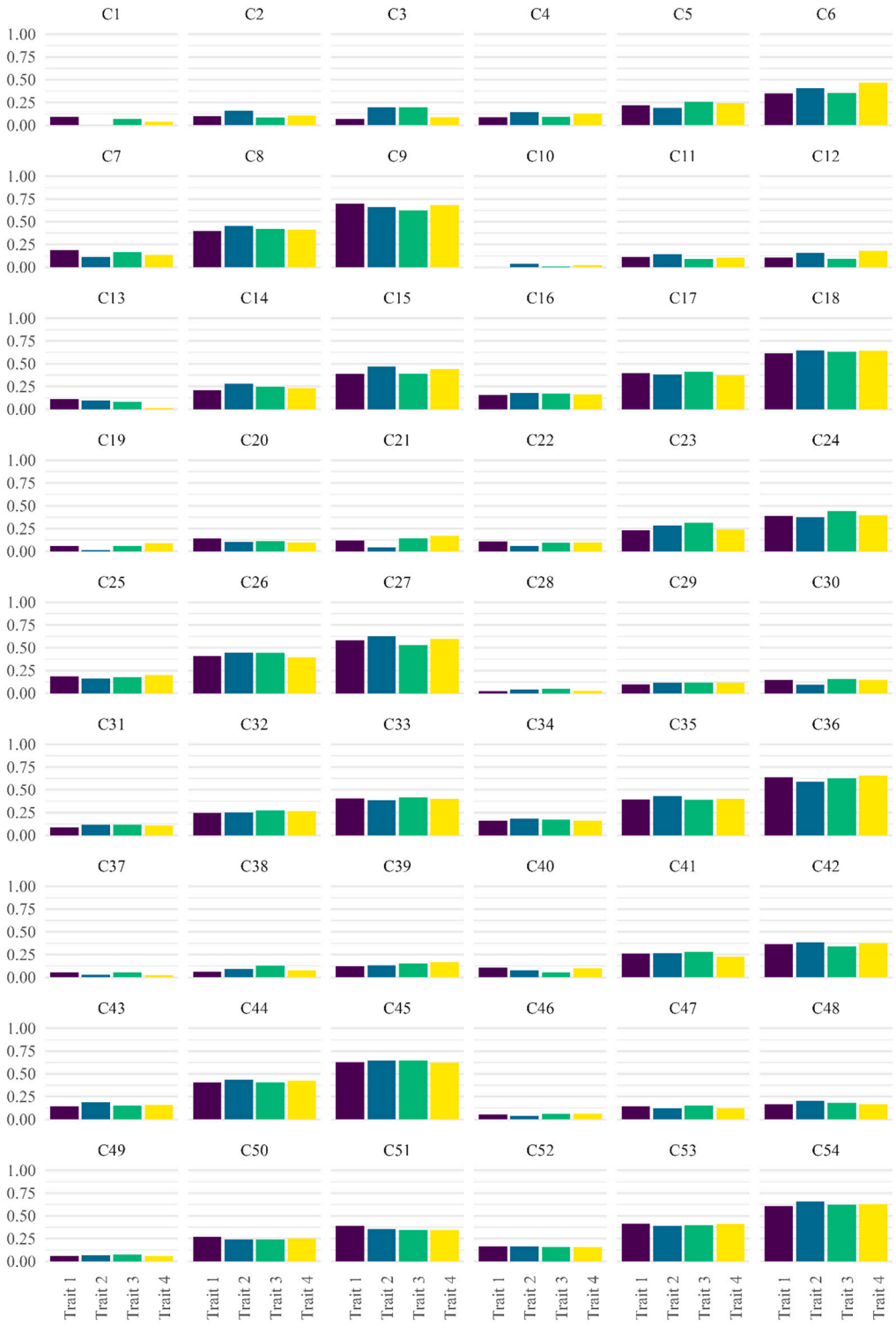


Figure S6. The heritability of traits for each of the 54 scenarios (C1–C54) is based on the mean performance of genotypes across replications and environments. Scenarios C1, C4, C7, C10, C13, C16, C19, C22, C25, C28, C31, C34, C37, C40, C43, C46, C49, and C52 were simulated with low heritability (0.2) structures of the traits. Scenarios C2, C5, C8, C11, C14, C17, C20, C23, C26, C29, C32, C35, C38, C41, C44, C47, C50, and C53 were simulated with moderate heritability (0.5) structures of the traits. Scenarios C3, C6, C9, C12, C15, C18, C21, C24, C27, C30, C33, C36, C39, C42, C45, C48, C51, and C54 were simulated with high heritability (0.8) structures of the traits.

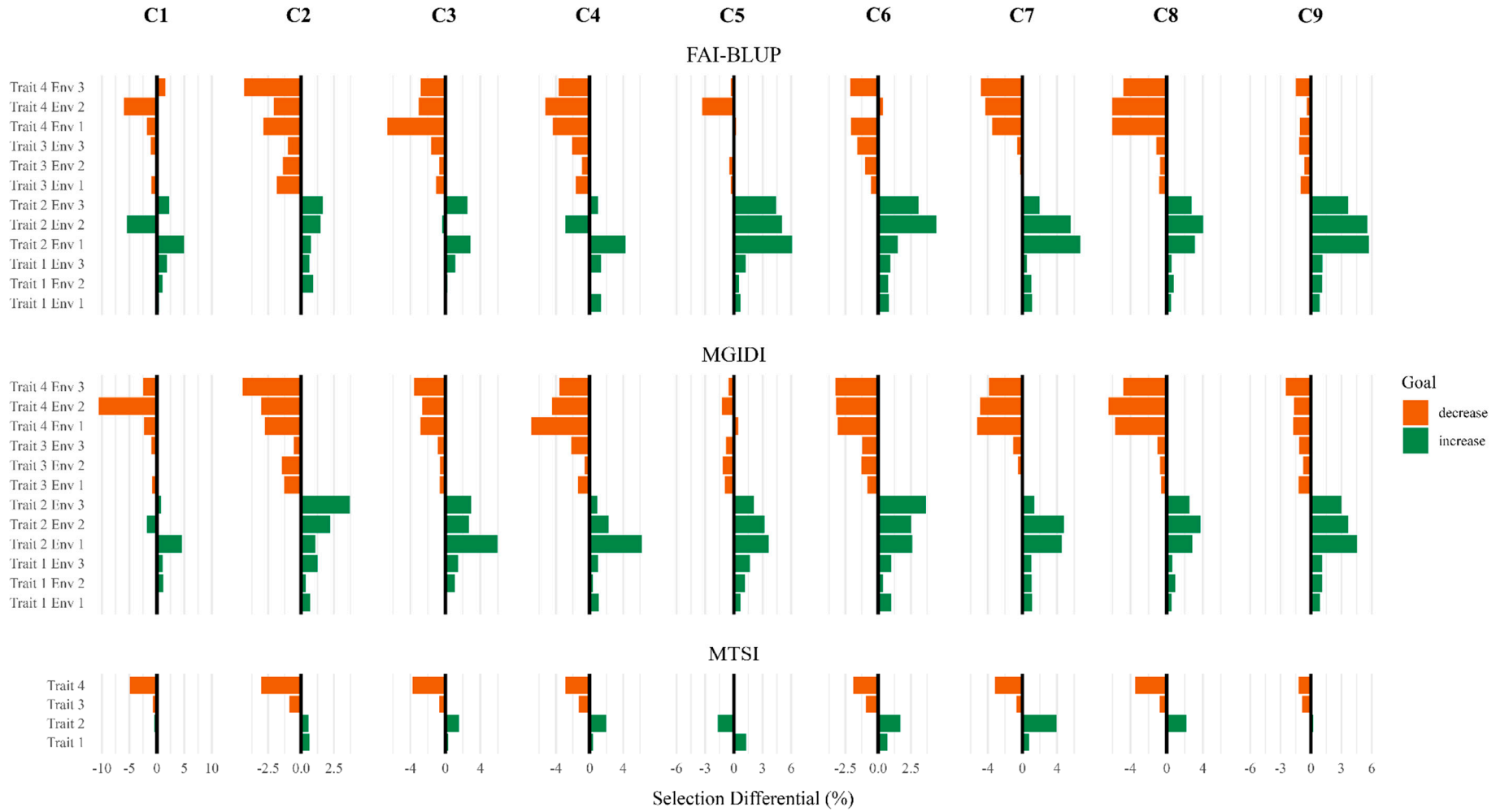


Figure S7. Selection differentials (%) obtained via the FAI-BLUP, MGIDI, and MTSI indexes, selecting 20 of 100 genotypes in the C1-C9 scenarios. Green bars indicate traits for which an increase is desired, while orange bars indicate traits targeted for reduction. Scenarios C1–C3, C4–C6, and C7–C9 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits was fixed at 0.2 for all cases.

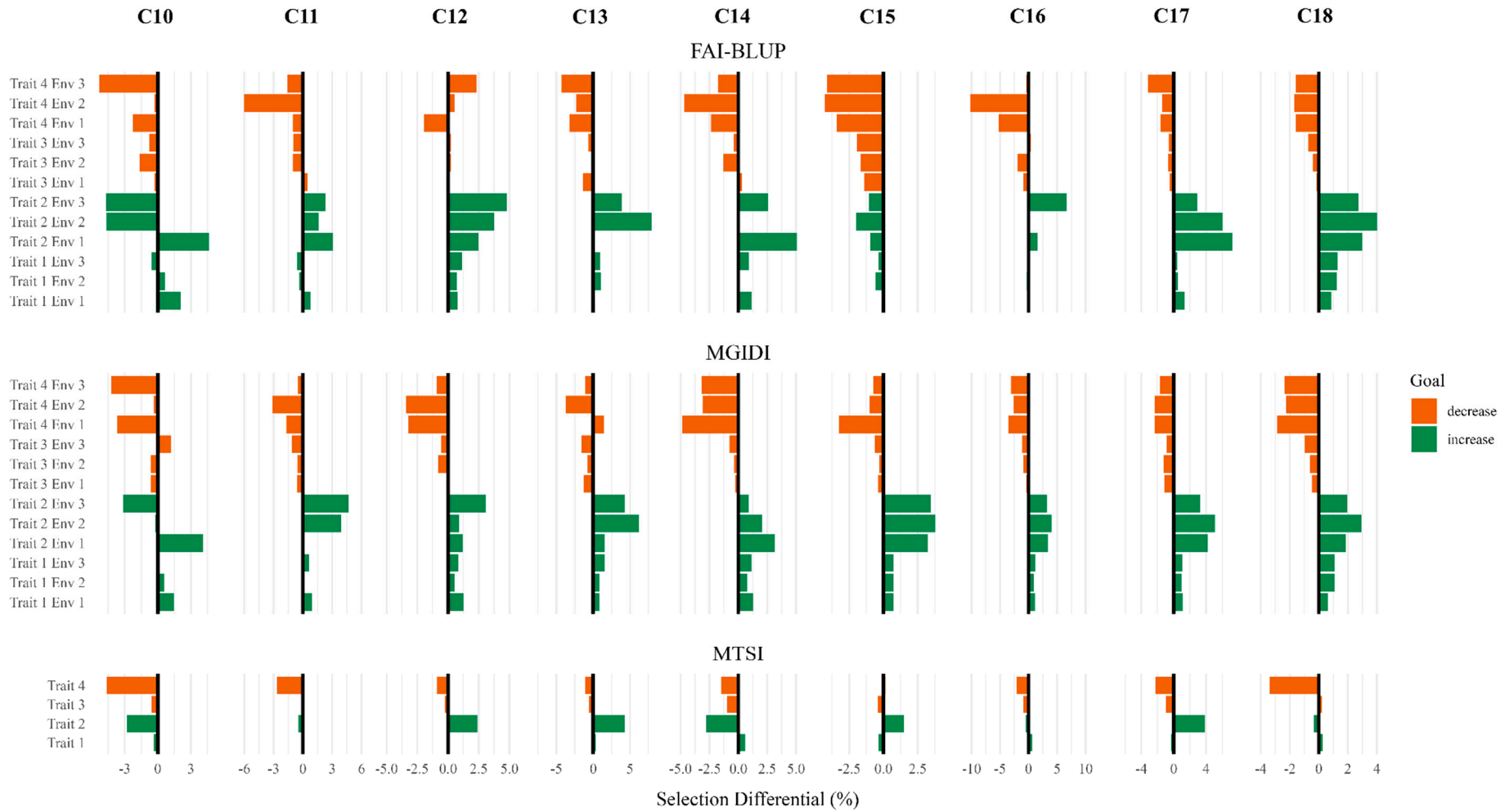


Figure S8. Selection differentials (%) obtained via the FAI-BLUP, MGIDI, and MTSI indexes, selecting 20 of 100 genotypes in the C10-C18 scenarios. Green bars indicate traits for which an increase is desired, while orange bars indicate traits targeted for reduction. Scenarios C10–C12, C13–C15, and C16–C18 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits was fixed at 0.5 for all cases.

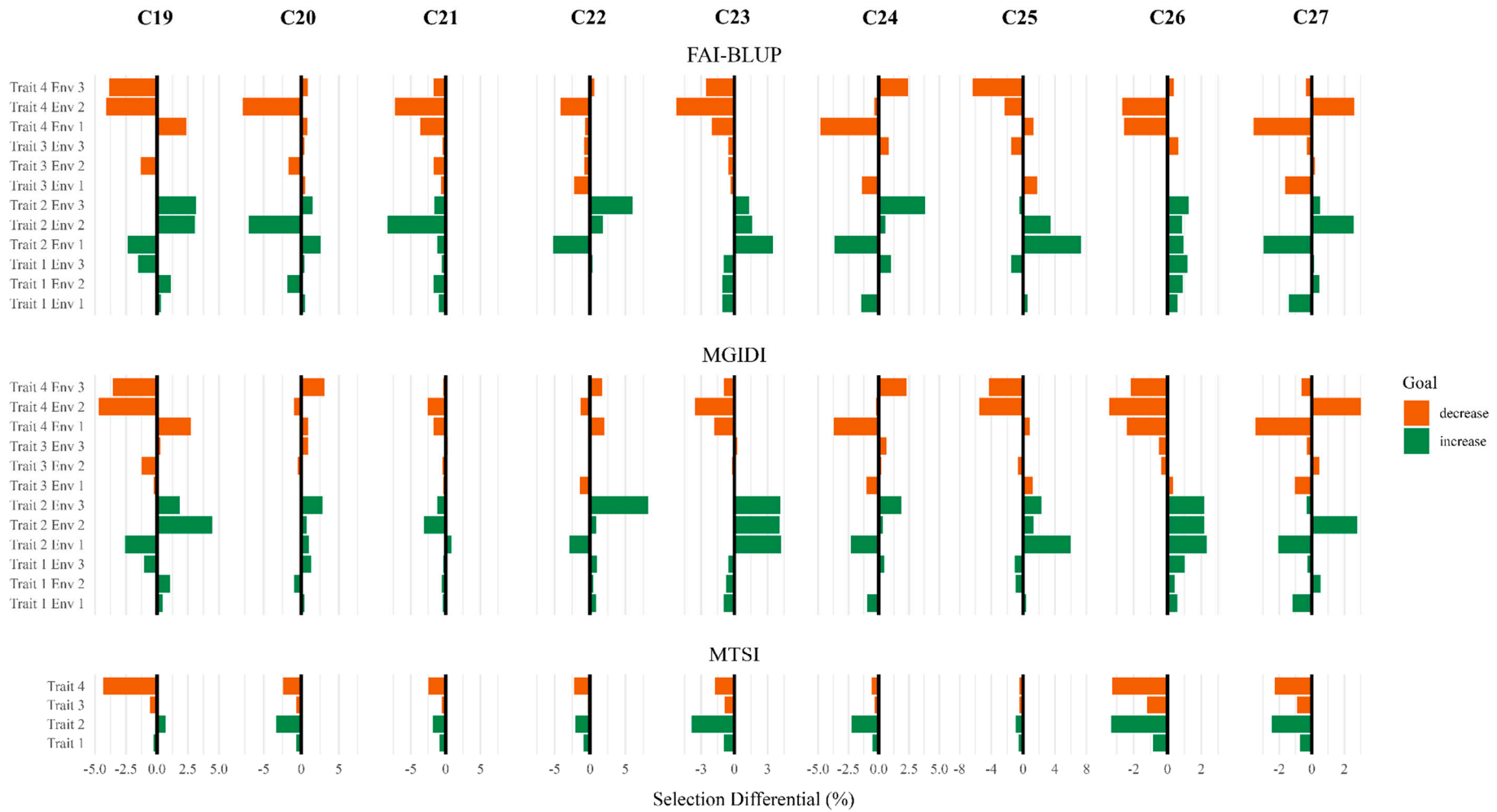


Figure S9. Selection differentials (%) obtained via the FAI-BLUP, MGIDI, and MTSI indexes, selecting 20 of 100 genotypes in the C19-C27 scenarios. Green bars indicate traits for which an increase is desired, while orange bars indicate traits targeted for reduction. Scenarios C19–C21, C22–C24, and C25–C27 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits was fixed at 0.8 for all cases.

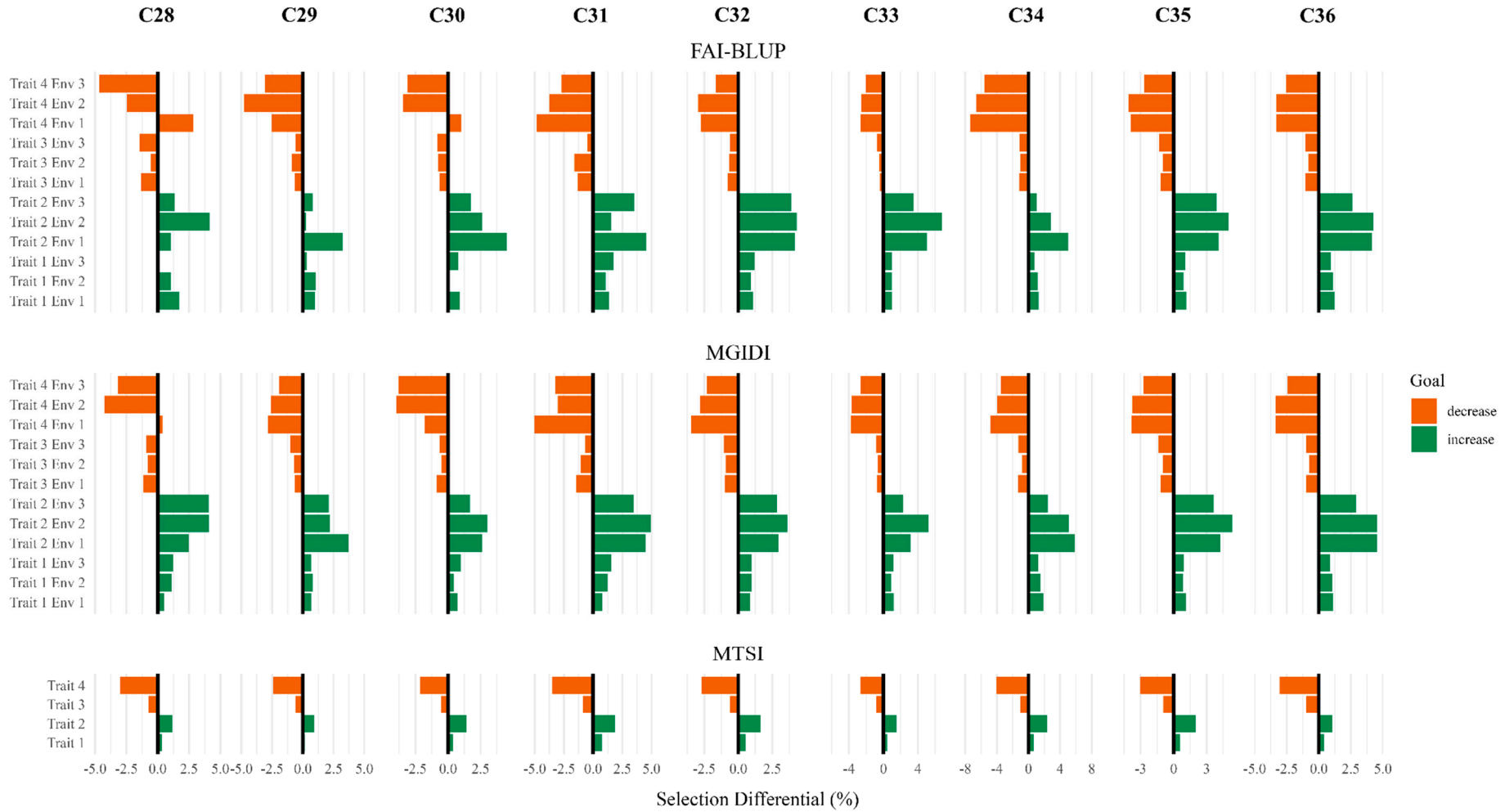


Figure S10. Selection differentials (%) obtained via the FAI-BLUP, MGIDI, and MTSI indexes, selecting 100 of 500 genotypes in the C28-C36 scenarios. Green bars indicate traits for which an increase is desired, while orange bars indicate traits targeted for reduction. Scenarios C28–30, C31–C33, and C34–C36 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits was fixed at 0.2 for all cases.

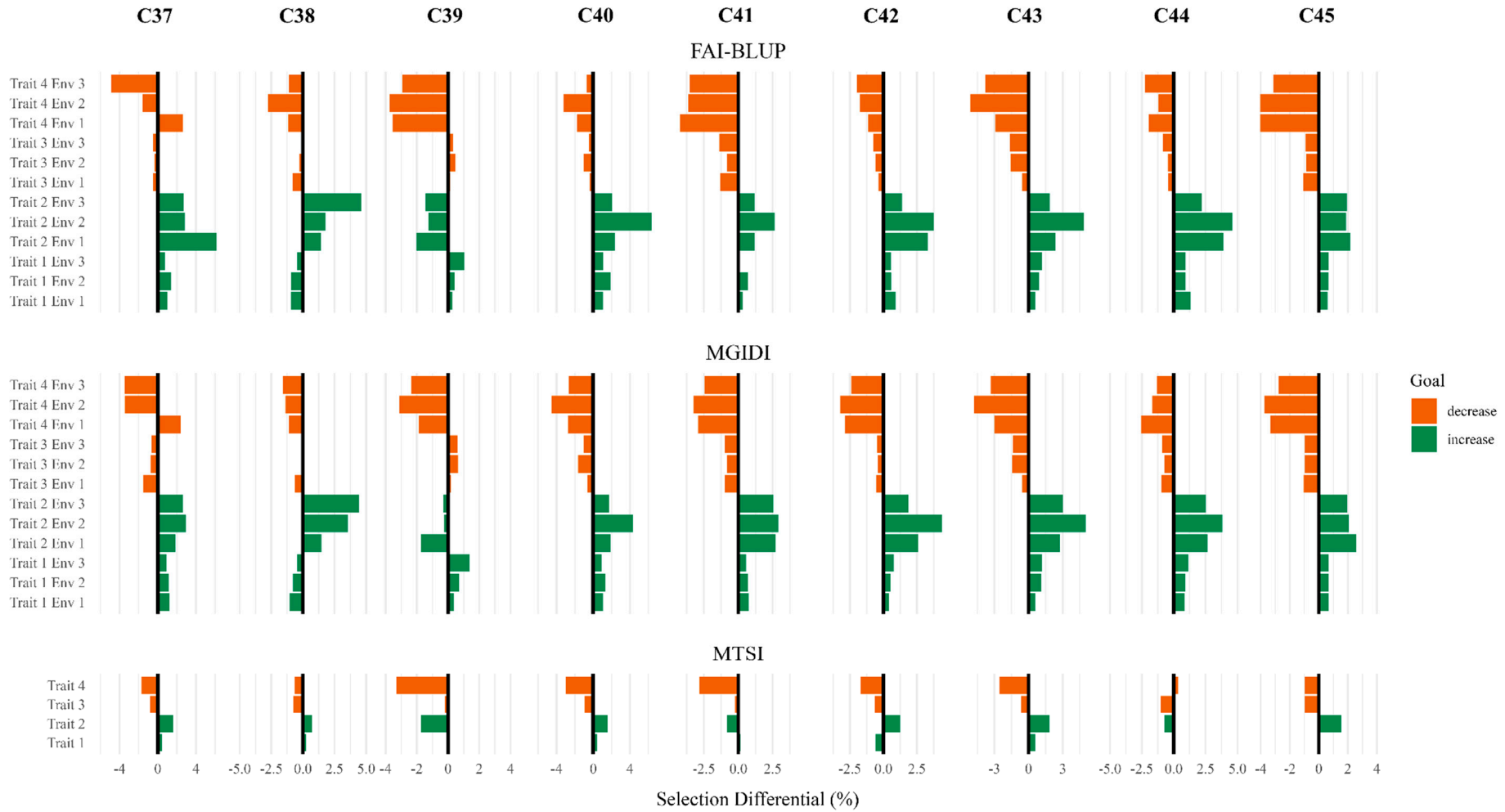


Figure S11. Selection differentials (%) obtained via the FAI-BLUP, MGIDI, and MTSI indexes, selecting 100 of 500 genotypes in the C37-C45 scenarios. Green bars indicate traits for which an increase is desired, while orange bars indicate traits targeted for reduction. Scenarios C37–C39, C40–C42, and C43–C45 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits was fixed at 0.5 for all cases.

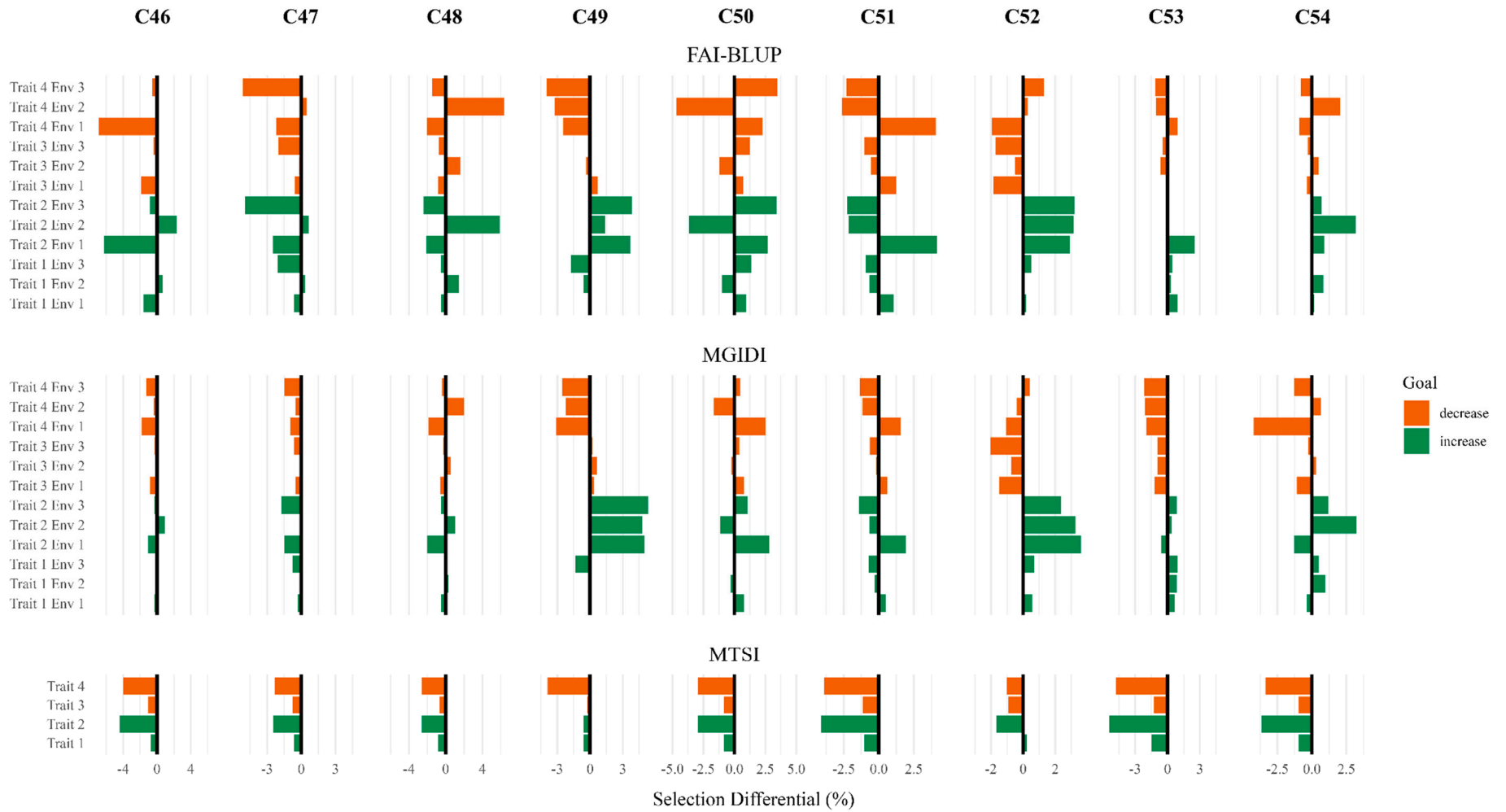


Figure S12. Selection differentials (%) obtained via the FAI-BLUP, MGIDI, and MTSI indexes, selecting 100 of 500 genotypes in the C46-C54 scenarios. Green bars indicate traits for which an increase is desired, while orange bars indicate traits targeted for reduction. Scenarios C46–C48, C49–C51, and C52–C54 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits was fixed at 0.8 for all cases.

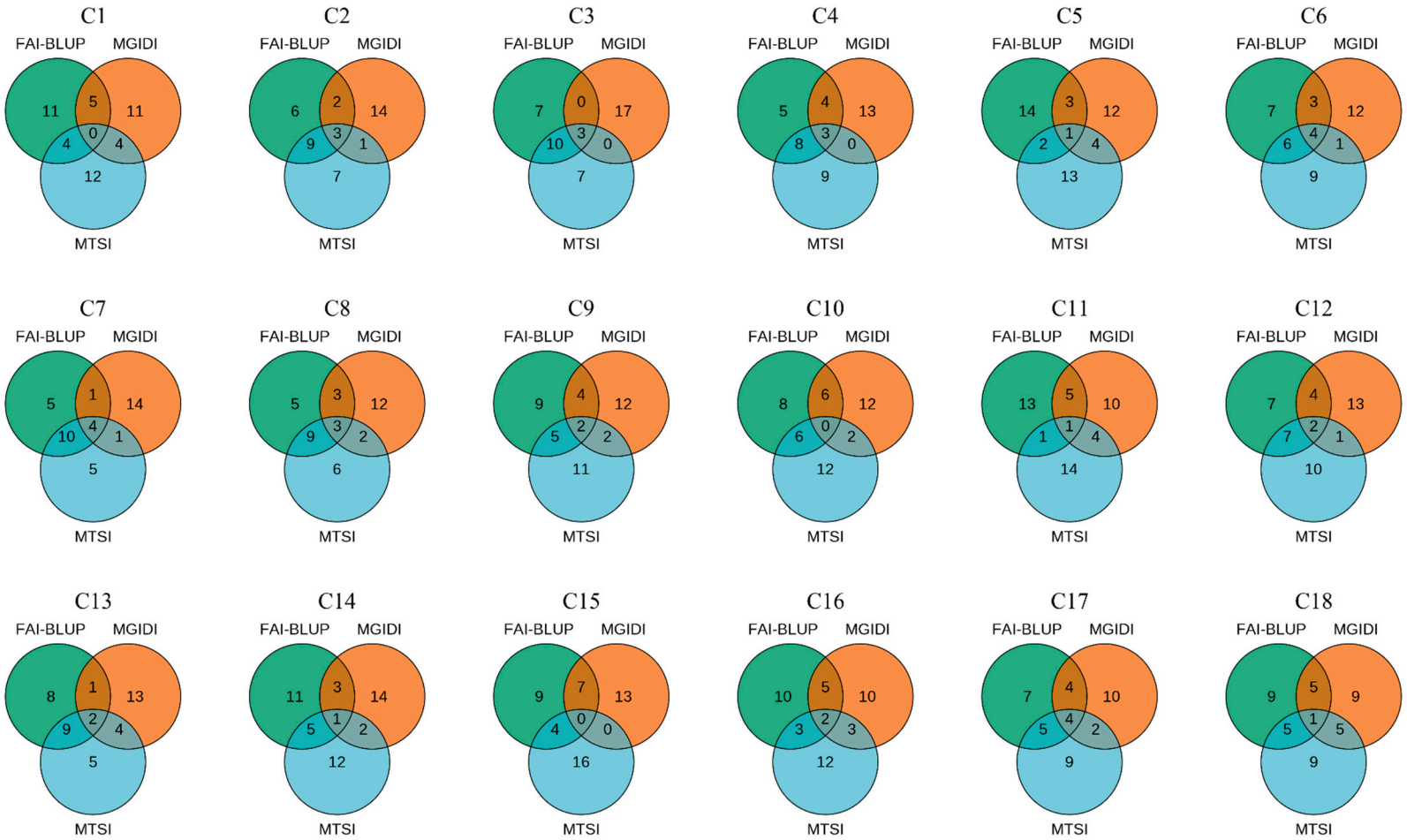


Figure S13. Coincidence between 20 genotypes selected (out of 100) by each index among the scenarios C1-C18. Scenarios C1–C3, C4–C6, and C7–C9 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits of scenarios C1-C9 was fixed at 0.2. Scenarios C10–C12, C13–C15, and C16–C18 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between the traits of C10-C18 was fixed at 0.5.

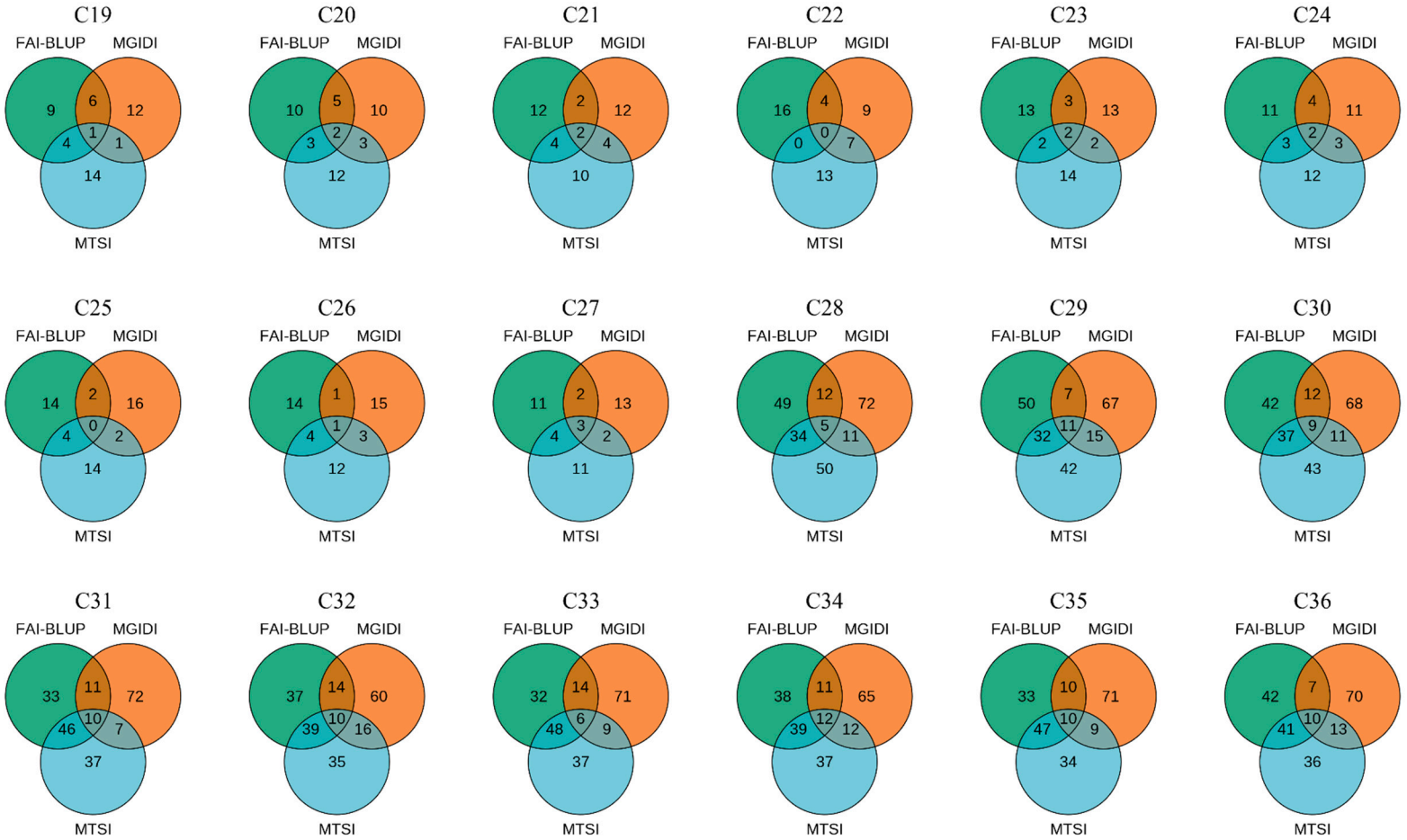


Figure S14. Coincidence between 20 genotypes selected (out of 100) and 100 genotypes (out of 500) by each index among the scenarios C19-C27 and C28-C36, respectively. Scenarios C19–C21, C22–C24, and C25–C27 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between traits of scenarios C19-C27 was fixed at 0.8. Scenarios C28–30, C31–C33, and C34–C36 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between the traits of scenarios C28-C36 was fixed at 0.2.

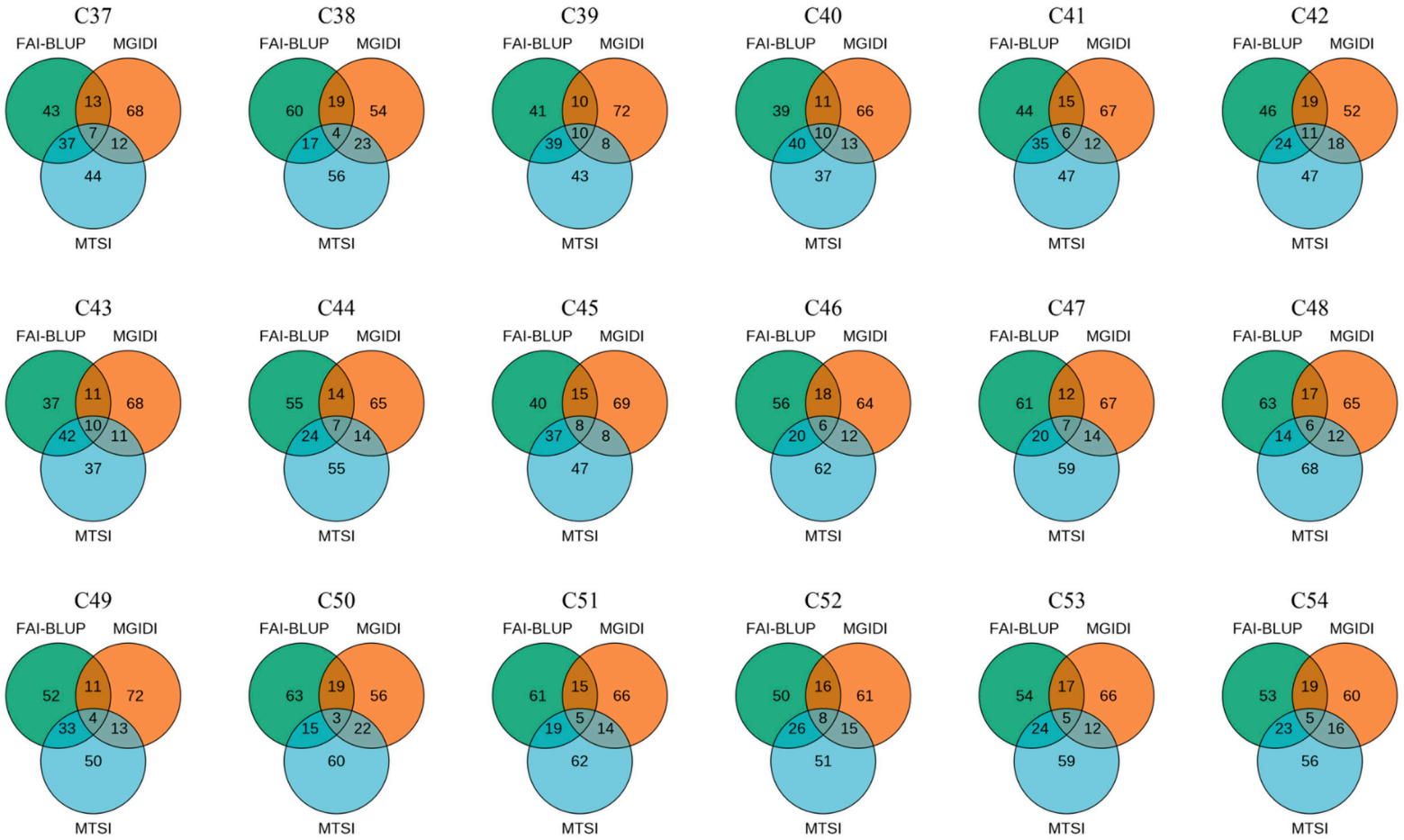


Figure S15. Coincidence between 100 genotypes selected (out of 500) by each index among the scenarios C37-C54. Scenarios C37–C39, C40–C42, and C43–C45 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between the traits of scenarios C37-C45 was fixed at 0.5. Scenarios C46–C48, C49–C51, and C52–C54 represent gradients of low (0.2), moderate (0.5), and high (0.8) environmental correlation, respectively. Within each group, trait heritability increases progressively (0.2, 0.5, and 0.8). The correlation between the traits of scenarios C46-C54 was fixed at 0.8.