

Table S1: Operation costs

Notation	Definition	Value
C_C	Cost for one cross	100€
C_{DH}	Cost for each doubled haploid	37€
C_M^2	Cost for multiplication for one line at step 2	10€
C_M^3	Cost for multiplication for one line at step 3	50€
C_M^4	Cost for multiplication for one line at step 4	100€
C_P^3	Cost for field evaluation of one line at step 3	100€
C_P^4	Cost for field evaluation of one line at step 4	500€
C_G	Cost to genotype one line	10€ or 37€ depending on the scenario

Table S2: Description of the 36 scenarios

Scenario	CT (M€)	Average annual CT (M€)	C_G (€)	λ	h²
1	22.5	1.5	37	0.75	0.7
2	45	3	37	0.75	0.7
3	22.5	1.5	37	0.5	0.7
4	45	3	37	0.5	0.7
5	22.5	1.5	37	0.25	0.7
6	45	3	37	0.25	0.7
7	22.5	1.5	37	0.75	0.4
8	45	3	37	0.75	0.4
9	22.5	1.5	37	0.5	0.4
10	45	3	37	0.5	0.4
11	22.5	1.5	37	0.25	0.4
12	45	3	37	0.25	0.4
13	22.5	1.5	37	0.75	0.2
14	45	3	37	0.75	0.2
15	22.5	1.5	37	0.5	0.2
16	45	3	37	0.5	0.2
17	22.5	1.5	37	0.25	0.2
18	45	3	37	0.25	0.2
19	22.5	1.5	10	0.75	0.7
20	45	3	10	0.75	0.7
21	22.5	1.5	10	0.5	0.7
22	45	3	10	0.5	0.7
23	22.5	1.5	10	0.25	0.7
24	45	3	10	0.25	0.7
25	22.5	1.5	10	0.75	0.4
26	45	3	10	0.75	0.4
27	22.5	1.5	10	0.5	0.4
28	45	3	10	0.5	0.4
29	22.5	1.5	10	0.25	0.4
30	45	3	10	0.25	0.4
31	22.5	1.5	10	0.75	0.2
32	45	3	10	0.75	0.2
33	22.5	1.5	10	0.5	0.2
34	45	3	10	0.5	0.2
35	22.5	1.5	10	0.25	0.2
36	45	3	10	0.25	0.2

h²: trait heritability. λ: relative selection rate. CT: Total cost. C_G: genotyping cost

Table S3: Progeny size under different strategies and scenarios

Breeding scheme	Average annual	C_G	λ	N_c	N_2	N_3	N_4	N_2/N_c	N_3/N_c	N_4/N_c
PS	1.5M€	---	0.25	400	62,317	12 463	4436	156	31	11
			0.5	400	82,710	16 542	1819	207	41	5
			0.75	400	92,056	18 411	620	230	46	2
	3M€	---	0.25	400	133,186	26 637	7841	333	67	20
			0.5	400	173,744	34 749	2636	434	87	7
			0.75	400	188,511	37 702	741	471	94	2
GPS.n2 and GPSopt.n2	1.5M€	10€	0.25	400	80,738	16 148	5387	202	40	13
			0.5	400	122,798	24 560	2216	307	61	6
			0.75	400	143,022	28 604	692	358	72	2
	37€	10€	0.25	400	75,666	15 133	5131	189	38	13
			0.5	400	111,716	22 343	2114	279	56	5
			0.75	400	128,921	25 784	674	322	64	2
GPS.n2 and GPSopt.n2	3M€	10€	0.25	400	176,686	35 337	9692	442	88	24
			0.5	400	262,291	52 458	3239	656	131	8
			0.75	400	294,270	58 854	828	736	147	2
	37€	10€	0.25	400	164,883	32 977	9203	412	82	23
			0.5	400	237,977	47 595	3085	595	119	8
			0.75	400	265,198	53 040	807	663	133	2
GPS. N _c and GPSopt.N _c	1.5M€	10€	0.25	517	80,595	16 119	5380	156	31	10
			0.5	592	122,448	24 490	2213	207	41	4
			0.75	620	142,581	28 516	691	230	46	1
	37€	10€	0.25	484	75,569	15 114	5126	156	31	11
			0.5	539	111,486	22 297	2112	207	41	4
			0.75	559	128,633	25 727	674	230	46	1
GPS.n2 and GPSopt.n2	3M€	10€	0.25	530	176,514	35 303	9685	333	67	18
			0.5	603	261,908	52 382	3237	434	87	5
			0.75	624	293,817	58 763	828	471	94	1
	37€	10€	0.25	495	164,767	32 953	9198	333	67	19
			0.5	548	237,724	47 545	3084	434	87	6
			0.75	562	264,903	52 981	807	471	94	1

CT: annual cost of the breeding program. C_G : individual genotyping cost. λ : Relative selection rate. N_c , N_2 , N_3 , N_4 : Number of crosses and number of progenies at the beginning of steps 2, 3 and 4 respectively

Table S4: Contribution of input parameters to the genetic gain

Trait	Factor	F	P value	% of SS	Factor value	Number of records	Means	
Genetic gain	Strategy	1909.9	<2 × 10 ⁻¹⁶	16.7	PS	7200	15.3	
					GPS.n2	7200	15.0	
					GPS.Nc	7200	14.9	
					GPSopt.n2	7200	18.0	
					GPSopt.Nc	7200	17.9	
	λ	300.0	<2 × 10 ⁻¹⁶	0.7	0.25	12,000	16.3	
					0.5	12,000	16.7	
					0.75	12,000	15.6	
	h ²	18,379.2	<2 × 10 ⁻¹⁶	40.1	0.2	12,000	13.3	
					0.4	12,000	16.4	
					0.7	12,000	18.9	
	Average annual	1123.2	<2 × 10 ⁻¹⁶	2.5	1.5M€	18,000	15.6	
					3M€	18,000	16.7	
						Trait 1	1800	19.7
						Trait 2	1800	14.2
						Trait 3	1800	16.6
						Trait 4	1800	13.8
						Trait 5	1800	18.0
						Trait 6	1800	15.2
						Trait 7	1800	12.8
					Trait 8	1800	14.6	
					Trait 9	1800	15.0	
	QTL sampling	390.9	<2 × 10 ⁻¹⁶	0.9	Trait 10	1800	16.0	
Trait 11					1800	16.2		
Trait 12					1800	16.2		
Trait 13					1800	16.0		
Trait 14					1800	15.7		
Trait 15					1800	20.6		
Trait 16					1800	18.7		
Trait 17					1800	17.2		
Trait 18					1800	16.9		
Trait 19					1800	15.1		
					Trait 20	1800	15.7	

h²: trait heritability. λ: relative selection rate. CT: Total cost. C_G: genotyping cost (37€). % of SS: (Sum of squares) / (Total sum of squares). Number of records: number of records for each factor value. Means: average genetic gain for each factor value

Table S5: Contribution of input parameters to the genetic gain for the 10, 50 and 100 best lines

Trait	Factor	F	P value	% of SS
Genetic gain 10	Strategy	808.3	$<2 \times 10^{-16}$	10.4
	λ	533.3	$<2 \times 10^{-16}$	1.7
	h^2	8566.7	$<2 \times 10^{-16}$	27.6
	CT	570.4	$<2 \times 10^{-16}$	1.8
	QTL sampling	183.6	$<2 \times 10^{-16}$	0.6
Genetic gain 50	Strategy	1284.9	$<2 \times 10^{-16}$	13.9
	λ	486.5	$<2 \times 10^{-16}$	1.3
	h^2	12,316.8	$<2 \times 10^{-16}$	33.3
	CT	820.1	$<2 \times 10^{-16}$	2.2
	QTL sampling	300.3	$<2 \times 10^{-16}$	0.8
Genetic gain 100	Strategy	1519.0	$<2 \times 10^{-16}$	15.2
	λ	411.2	$<2 \times 10^{-16}$	1.0
	h^2	14,302.2	$<2 \times 10^{-16}$	35.7
	CT	930.5	$<2 \times 10^{-16}$	2.3
	QTL sampling	368.9	$<2 \times 10^{-16}$	0.9

h^2 : trait heritability. λ : relative selection rate. CT: Total cost. C_G : genotyping cost = 37€. % of SS: (Sum of squares)/(Total sum of squares)

Table S6: Evolution of genetic gain and polymorphism rate

strategy	year	CG	CT	Lambda	h2	Genetic gain	Polymorphism rate
GPS	5	10	3	0.25	0.2	2.58	0.96
GPS	10	10	3	0.25	0.2	7.94	0.94
GPS	15	10	3	0.25	0.2	12.72	0.91
GPSopt	5	10	3	0.25	0.2	4.01	0.92
GPSopt	10	10	3	0.25	0.2	10.96	0.87
GPSopt	15	10	3	0.25	0.2	16.41	0.83
PS	5	10	3	0.25	0.2	2.93	0.97
PS	10	10	3	0.25	0.2	7.63	0.95
PS	15	10	3	0.25	0.2	11.84	0.93
GPS	5	10	3	0.25	0.4	4.69	0.96
GPS	10	10	3	0.25	0.4	10.8	0.93
GPS	15	10	3	0.25	0.4	15.99	0.9
GPSopt	5	10	3	0.25	0.4	6.32	0.93
GPSopt	10	10	3	0.25	0.4	13.71	0.87
GPSopt	15	10	3	0.25	0.4	19.22	0.83
PS	5	10	3	0.25	0.4	5.16	0.96
PS	10	10	3	0.25	0.4	10.73	0.94
PS	15	10	3	0.25	0.4	15.54	0.92
GPS	5	10	3	0.25	0.7	6.75	0.95
GPS	10	10	3	0.25	0.7	13.32	0.92
GPS	15	10	3	0.25	0.7	18.66	0.9
GPSopt	5	10	3	0.25	0.7	8.59	0.93
GPSopt	10	10	3	0.25	0.7	16.27	0.87
GPSopt	15	10	3	0.25	0.7	21.68	0.83
PS	5	10	3	0.25	0.7	7.1	0.96
PS	10	10	3	0.25	0.7	13.27	0.93
PS	15	10	3	0.25	0.7	18.4	0.9
GPS	5	10	3	0.5	0.2	2.82	0.94
GPS	10	10	3	0.5	0.2	8.56	0.9
GPS	15	10	3	0.5	0.2	13.58	0.87
GPSopt	5	10	3	0.5	0.2	3.88	0.9
GPSopt	10	10	3	0.5	0.2	10.79	0.84
GPSopt	15	10	3	0.5	0.2	16.07	0.8
PS	5	10	3	0.5	0.2	3.58	0.97
PS	10	10	3	0.5	0.2	8.66	0.95
PS	15	10	3	0.5	0.2	13.1	0.93
GPS	5	10	3	0.5	0.4	4.75	0.94
GPS	10	10	3	0.5	0.4	11.11	0.9
GPS	15	10	3	0.5	0.4	16.41	0.87
GPSopt	5	10	3	0.5	0.4	6.07	0.91
GPSopt	10	10	3	0.5	0.4	13.66	0.85
GPSopt	15	10	3	0.5	0.4	19.05	0.81
PS	5	10	3	0.5	0.4	5.78	0.96
PS	10	10	3	0.5	0.4	11.67	0.93
PS	15	10	3	0.5	0.4	16.59	0.91
GPS	5	10	3	0.5	0.7	6.71	0.94
GPS	10	10	3	0.5	0.7	13.43	0.91
GPS	15	10	3	0.5	0.7	18.84	0.88

GPSopt	5	10	3	0.5	0.7	8.21	0.92
GPSopt	10	10	3	0.5	0.7	16.14	0.86
GPSopt	15	10	3	0.5	0.7	21.6	0.82
PS	5	10	3	0.5	0.7	7.46	0.95
PS	10	10	3	0.5	0.7	13.84	0.92
PS	15	10	3	0.5	0.7	19.08	0.9
GPS	5	10	3	0.75	0.2	2.52	0.91
GPS	10	10	3	0.75	0.2	7.7	0.85
GPS	15	10	3	0.75	0.2	12.24	0.82
GPSopt	5	10	3	0.75	0.2	3.43	0.87
GPSopt	10	10	3	0.75	0.2	9.65	0.81
GPSopt	15	10	3	0.75	0.2	14.33	0.76
PS	5	10	3	0.75	0.2	3.68	0.97
PS	10	10	3	0.75	0.2	8.81	0.94
PS	15	10	3	0.75	0.2	13.3	0.93
GPS	5	10	3	0.75	0.4	4.3	0.92
GPS	10	10	3	0.75	0.4	10.18	0.87
GPS	15	10	3	0.75	0.4	15.15	0.83
GPSopt	5	10	3	0.75	0.4	5.37	0.89
GPSopt	10	10	3	0.75	0.4	12.3	0.83
GPSopt	15	10	3	0.75	0.4	17.36	0.78
PS	5	10	3	0.75	0.4	5.91	0.96
PS	10	10	3	0.75	0.4	11.77	0.93
PS	15	10	3	0.75	0.4	16.72	0.91
GPS	5	10	3	0.75	0.7	6.03	0.92
GPS	10	10	3	0.75	0.7	12.32	0.88
GPS	15	10	3	0.75	0.7	17.47	0.84
GPSopt	5	10	3	0.75	0.7	7.25	0.9
GPSopt	10	10	3	0.75	0.7	14.82	0.84
GPSopt	15	10	3	0.75	0.7	20.03	0.79
PS	5	10	3	0.75	0.7	7.58	0.95
PS	10	10	3	0.75	0.7	13.91	0.92
PS	15	10	3	0.75	0.7	19.14	0.9
GPS	5	10	1.5	0.25	0.2	2.12	0.96
GPS	10	10	1.5	0.25	0.2	6.92	0.94
GPS	15	10	1.5	0.25	0.2	11.3	0.92
GPSopt	5	10	1.5	0.25	0.2	3.75	0.93
GPSopt	10	10	1.5	0.25	0.2	10.27	0.87
GPSopt	15	10	1.5	0.25	0.2	15.41	0.83
PS	5	10	1.5	0.25	0.2	2.42	0.97
PS	10	10	1.5	0.25	0.2	6.74	0.95
PS	15	10	1.5	0.25	0.2	10.63	0.93
GPS	5	10	1.5	0.25	0.4	4.15	0.96
GPS	10	10	1.5	0.25	0.4	9.66	0.94
GPS	15	10	1.5	0.25	0.4	14.53	0.91
GPSopt	5	10	1.5	0.25	0.4	5.9	0.93
GPSopt	10	10	1.5	0.25	0.4	12.83	0.87
GPSopt	15	10	1.5	0.25	0.4	18.19	0.83
PS	5	10	1.5	0.25	0.4	4.52	0.96
PS	10	10	1.5	0.25	0.4	9.68	0.94
PS	15	10	1.5	0.25	0.4	14.21	0.92

GPS	5	10	1.5	0.25	0.7	6.04	0.96
GPS	10	10	1.5	0.25	0.7	12.04	0.93
GPS	15	10	1.5	0.25	0.7	17.13	0.91
GPSopt	5	10	1.5	0.25	0.7	8	0.93
GPSopt	10	10	1.5	0.25	0.7	15.21	0.88
GPSopt	15	10	1.5	0.25	0.7	20.66	0.84
PS	5	10	1.5	0.25	0.7	6.36	0.96
PS	10	10	1.5	0.25	0.7	12.11	0.94
PS	15	10	1.5	0.25	0.7	17.04	0.91
GPS	5	10	1.5	0.5	0.2	2.38	0.95
GPS	10	10	1.5	0.5	0.2	7.5	0.91
GPS	15	10	1.5	0.5	0.2	12.24	0.88
GPSopt	5	10	1.5	0.5	0.2	3.71	0.91
GPSopt	10	10	1.5	0.5	0.2	10.29	0.85
GPSopt	15	10	1.5	0.5	0.2	15.46	0.8
PS	5	10	1.5	0.5	0.2	3.05	0.97
PS	10	10	1.5	0.5	0.2	7.75	0.95
PS	15	10	1.5	0.5	0.2	11.94	0.93
GPS	5	10	1.5	0.5	0.4	4.29	0.95
GPS	10	10	1.5	0.5	0.4	10.08	0.91
GPS	15	10	1.5	0.5	0.4	15.15	0.89
GPSopt	5	10	1.5	0.5	0.4	5.73	0.92
GPSopt	10	10	1.5	0.5	0.4	12.82	0.86
GPSopt	15	10	1.5	0.5	0.4	18.09	0.81
PS	5	10	1.5	0.5	0.4	5.15	0.96
PS	10	10	1.5	0.5	0.4	10.59	0.94
PS	15	10	1.5	0.5	0.4	15.29	0.92
GPS	5	10	1.5	0.5	0.7	6.09	0.95
GPS	10	10	1.5	0.5	0.7	12.32	0.92
GPS	15	10	1.5	0.5	0.7	17.51	0.89
GPSopt	5	10	1.5	0.5	0.7	7.81	0.92
GPSopt	10	10	1.5	0.5	0.7	15.29	0.87
GPSopt	15	10	1.5	0.5	0.7	20.65	0.82
PS	5	10	1.5	0.5	0.7	6.78	0.96
PS	10	10	1.5	0.5	0.7	12.75	0.93
PS	15	10	1.5	0.5	0.7	17.77	0.91
GPS	5	10	1.5	0.75	0.2	2.21	0.93
GPS	10	10	1.5	0.75	0.2	6.94	0.87
GPS	15	10	1.5	0.75	0.2	11.29	0.84
GPSopt	5	10	1.5	0.75	0.2	3.28	0.89
GPSopt	10	10	1.5	0.75	0.2	8.93	0.82
GPSopt	15	10	1.5	0.75	0.2	13.53	0.77
PS	5	10	1.5	0.75	0.2	3.2	0.97
PS	10	10	1.5	0.75	0.2	7.98	0.95
PS	15	10	1.5	0.75	0.2	12.24	0.93
GPS	5	10	1.5	0.75	0.4	3.81	0.93
GPS	10	10	1.5	0.75	0.4	9.23	0.88
GPS	15	10	1.5	0.75	0.4	14.03	0.85
GPSopt	5	10	1.5	0.75	0.4	5.09	0.9
GPSopt	10	10	1.5	0.75	0.4	11.69	0.84
GPSopt	15	10	1.5	0.75	0.4	16.72	0.79

PS	5	10	1.5	0.75	0.4	5.27	0.96
PS	10	10	1.5	0.75	0.4	10.78	0.94
PS	15	10	1.5	0.75	0.4	15.54	0.92
GPS	5	10	1.5	0.75	0.7	5.51	0.93
GPS	10	10	1.5	0.75	0.7	11.46	0.89
GPS	15	10	1.5	0.75	0.7	16.49	0.86
GPSopt	5	10	1.5	0.75	0.7	6.94	0.91
GPSopt	10	10	1.5	0.75	0.7	14.17	0.85
GPSopt	15	10	1.5	0.75	0.7	19.37	0.8
PS	5	10	1.5	0.75	0.7	6.9	0.96
PS	10	10	1.5	0.75	0.7	12.85	0.93
PS	15	10	1.5	0.75	0.7	17.88	0.91
GPS	5	37	1.5	0.25	0.2	2.04	0.96
GPS	10	37	1.5	0.25	0.2	6.76	0.94
GPS	15	37	1.5	0.25	0.2	11.09	0.92
GPSopt	5	37	1.5	0.25	0.2	3.82	0.93
GPSopt	10	37	1.5	0.25	0.2	10.22	0.87
GPSopt	15	37	1.5	0.25	0.2	15.3	0.83
PS	5	37	1.5	0.25	0.2	2.47	0.97
PS	10	37	1.5	0.25	0.2	6.78	0.95
PS	15	37	1.5	0.25	0.2	10.68	0.93
GPS	5	37	1.5	0.25	0.4	4.03	0.96
GPS	10	37	1.5	0.25	0.4	9.5	0.94
GPS	15	37	1.5	0.25	0.4	14.31	0.91
GPSopt	5	37	1.5	0.25	0.4	5.86	0.93
GPSopt	10	37	1.5	0.25	0.4	12.76	0.87
GPSopt	15	37	1.5	0.25	0.4	18.08	0.83
PS	5	37	1.5	0.25	0.4	4.48	0.96
PS	10	37	1.5	0.25	0.4	9.65	0.94
PS	15	37	1.5	0.25	0.4	14.17	0.92
GPS	5	37	1.5	0.25	0.7	5.99	0.96
GPS	10	37	1.5	0.25	0.7	11.93	0.93
GPS	15	37	1.5	0.25	0.7	16.97	0.91
GPSopt	5	37	1.5	0.25	0.7	8.01	0.93
GPSopt	10	37	1.5	0.25	0.7	15.17	0.88
GPSopt	15	37	1.5	0.25	0.7	20.57	0.84
PS	5	37	1.5	0.25	0.7	6.31	0.96
PS	10	37	1.5	0.25	0.7	12.08	0.94
PS	15	37	1.5	0.25	0.7	16.99	0.92
GPS	5	37	1.5	0.5	0.2	2.36	0.95
GPS	10	37	1.5	0.5	0.2	7.42	0.91
GPS	15	37	1.5	0.5	0.2	12.1	0.89
GPSopt	5	37	1.5	0.5	0.2	3.61	0.91
GPSopt	10	37	1.5	0.5	0.2	10.11	0.85
GPSopt	15	37	1.5	0.5	0.2	15.15	0.8
PS	5	37	1.5	0.5	0.2	3.08	0.97
PS	10	37	1.5	0.5	0.2	7.8	0.95
PS	15	37	1.5	0.5	0.2	11.98	0.93
GPS	5	37	1.5	0.5	0.4	4.19	0.95
GPS	10	37	1.5	0.5	0.4	9.89	0.91
GPS	15	37	1.5	0.5	0.4	14.91	0.89

GPSopt	5	37	1.5	0.5	0.4	5.68	0.91
GPSopt	10	37	1.5	0.5	0.4	12.75	0.86
GPSopt	15	37	1.5	0.5	0.4	18.04	0.81
PS	5	37	1.5	0.5	0.4	5.16	0.96
PS	10	37	1.5	0.5	0.4	10.62	0.94
PS	15	37	1.5	0.5	0.4	15.3	0.92
GPS	5	37	1.5	0.5	0.7	6.05	0.95
GPS	10	37	1.5	0.5	0.7	12.22	0.92
GPS	15	37	1.5	0.5	0.7	17.41	0.89
GPSopt	5	37	1.5	0.5	0.7	7.79	0.92
GPSopt	10	37	1.5	0.5	0.7	15.15	0.87
GPSopt	15	37	1.5	0.5	0.7	20.47	0.82
PS	5	37	1.5	0.5	0.7	6.76	0.96
PS	10	37	1.5	0.5	0.7	12.71	0.93
PS	15	37	1.5	0.5	0.7	17.73	0.91
GPS	5	37	1.5	0.75	0.2	2.12	0.92
GPS	10	37	1.5	0.75	0.2	6.72	0.87
GPS	15	37	1.5	0.75	0.2	10.99	0.84
GPSopt	5	37	1.5	0.75	0.2	3.19	0.89
GPSopt	10	37	1.5	0.75	0.2	8.78	0.82
GPSopt	15	37	1.5	0.75	0.2	13.31	0.77
PS	5	37	1.5	0.75	0.2	3.19	0.97
PS	10	37	1.5	0.75	0.2	8	0.95
PS	15	37	1.5	0.75	0.2	12.26	0.93
GPS	5	37	1.5	0.75	0.4	3.77	0.93
GPS	10	37	1.5	0.75	0.4	9.06	0.88
GPS	15	37	1.5	0.75	0.4	13.8	0.85
GPSopt	5	37	1.5	0.75	0.4	5.01	0.9
GPSopt	10	37	1.5	0.75	0.4	11.6	0.84
GPSopt	15	37	1.5	0.75	0.4	16.65	0.78
PS	5	37	1.5	0.75	0.4	5.28	0.96
PS	10	37	1.5	0.75	0.4	10.78	0.94
PS	15	37	1.5	0.75	0.4	15.56	0.92
GPS	5	37	1.5	0.75	0.7	5.41	0.93
GPS	10	37	1.5	0.75	0.7	11.21	0.89
GPS	15	37	1.5	0.75	0.7	16.18	0.86
GPSopt	5	37	1.5	0.75	0.7	6.94	0.91
GPSopt	10	37	1.5	0.75	0.7	14.17	0.85
GPSopt	15	37	1.5	0.75	0.7	19.23	0.8
PS	5	37	1.5	0.75	0.7	6.89	0.96
PS	10	37	1.5	0.75	0.7	12.86	0.93
PS	15	37	1.5	0.75	0.7	17.93	0.91

Table S7: Contribution of input parameters to polymorphism rate

Trait	Factor	F	P value	% of SS
% of alleles	Strategy	3,805.55	$<2 \times 10^{-16}$	39.1
	λ	5,345.81	$<2 \times 10^{-16}$	13.7
	h^2	76.20	$<2 \times 10^{-16}$	0.2
	Average annual CT	306.43	$<2 \times 10^{-16}$	0.8
	QTL sampling	49.45	2.11×10^{-12}	0.1

h^2 : trait heritability. λ : relative selection rate. CT: Total cost. C_G : genotyping cost (37€). % of SS: (Sum of squares) / (Total sum of squares). The polymorphism rate was calculated as the percentage of alleles present in both the reference population and the selected progenies.

Table S8: Evolution of expected heterozygosity (He) over cycles

λ	h^2	strategy	He					
			All the markers			QTL		
			Year 5	Year 10	Year 15	Year 5	Year 10	Year 15
0.25	0.2	PS	0.26	0.25	0.24	0.25	0.23	0.21
		GPS.n2	0.25	0.24	0.23	0.24	0.22	0.2
		GPS.Nc	0.25	0.24	0.23	0.24	0.22	0.2
		GPSopt.n2	0.2	0.18	0.16	0.19	0.16	0.13
		GPSopt.Nc	0.2	0.19	0.17	0.19	0.17	0.13
	0.4	PS	0.25	0.24	0.23	0.24	0.22	0.19
		GPS.n2	0.25	0.24	0.22	0.24	0.21	0.18
		GPS.Nc	0.25	0.24	0.22	0.24	0.21	0.18
		GPSopt.n2	0.21	0.19	0.16	0.19	0.16	0.12
		GPSopt.Nc	0.21	0.19	0.17	0.2	0.16	0.12
	0.7	PS	0.25	0.24	0.23	0.21	0.19	0.16
		GPS.n2	0.25	0.23	0.22	0.23	0.2	0.17
		GPS.Nc	0.25	0.23	0.22	0.23	0.2	0.17
		GPSopt.n2	0.21	0.19	0.17	0.2	0.16	0.11
		GPSopt.Nc	0.21	0.19	0.17	0.2	0.16	0.11
0.5	0.2	PS	0.25	0.25	0.24	0.25	0.23	0.21
		GPS.n2	0.23	0.21	0.2	0.23	0.19	0.16
		GPS.Nc	0.24	0.22	0.2	0.23	0.2	0.17
		GPSopt.n2	0.19	0.17	0.14	0.18	0.15	0.1
		GPSopt.Nc	0.19	0.17	0.15	0.18	0.15	0.11
	0.4	PS	0.25	0.24	0.23	0.24	0.21	0.18
		GPS.n2	0.24	0.22	0.2	0.23	0.19	0.16
		GPS.Nc	0.24	0.22	0.2	0.23	0.19	0.16
		GPSopt.n2	0.19	0.17	0.14	0.18	0.15	0.1
		GPSopt.Nc	0.2	0.18	0.15	0.19	0.15	0.11
	0.7	PS	0.25	0.24	0.22	0.23	0.2	0.17
		GPS.n2	0.24	0.22	0.2	0.22	0.19	0.15
		GPS.Nc	0.24	0.22	0.21	0.22	0.19	0.16
		GPSopt.n2	0.2	0.18	0.15	0.19	0.15	0.1
		GPSopt.Nc	0.21	0.18	0.16	0.19	0.15	0.1
0.75	0.2	PS	0.26	0.25	0.24	0.25	0.23	0.21
		GPS.n2	0.22	0.19	0.16	0.21	0.16	0.13
		GPS.Nc	0.22	0.18	0.16	0.21	0.17	0.14
		GPSopt.n2	0.18	0.15	0.12	0.17	0.13	0.09
		GPSopt.Nc	0.18	0.14	0.12	0.17	0.13	0.09
	0.4	PS	0.25	0.24	0.23	0.24	0.21	0.18
		GPS.n2	0.22	0.19	0.17	0.21	0.16	0.13
		GPS.Nc	0.22	0.19	0.17	0.21	0.17	0.14
		GPSopt.n2	0.18	0.16	0.13	0.17	0.13	0.09
		GPSopt.Nc	0.19	0.16	0.13	0.18	0.13	0.09
	0.7	PS	0.25	0.24	0.22	0.23	0.2	0.17
		GPS.n2	0.22	0.2	0.18	0.21	0.17	0.14
		GPS.Nc	0.23	0.21	0.19	0.21	0.17	0.14
		GPSopt.n2	0.19	0.17	0.14	0.18	0.13	0.09
		GPSopt.Nc	0.2	0.17	0.14	0.18	0.14	0.09

h^2 : trait heritability. λ : relative selection rate. Average annual total cost (CT) = 3 M€ and genotyping cost (C_G) = 37€.

Table S9: Evolution of parental contribution over cycles

λ	h^2	strategy	Number of lines that contributed as parents			Number of parents that represented 25% of the parental contributions			Number of parents that represented 75% of the parental contributions			Shannon index		
			Year 5	Year 10	Year 15	Year 5	Year 10	Year 15	Year 5	Year 10	Year 15	Year 5	Year 10	Year 15
0.25	0.2	PS	129.77	110.2	102.59	9.79	7.46	6.76	57.92	42.97	38.31	4.55	4.28	4.17
		GPS.n2	105.44	87.61	80.76	7.53	5.78	5.45	44.24	32.52	29.08	4.29	4.01	3.9
		GPS.Nc	110.31	92.68	86.03	8.03	6.25	5.74	46.97	35.28	31.44	4.35	4.09	3.98
		GPSopt.n2	76.52	45.79	36.91	1.76	1.65	1.59	18.37	9.87	8.65	3.23	2.8	2.65
		GPSopt.NC	82.25	49.73	40.1	1.87	1.66	1.59	20.79	10.73	9.2	3.3	2.85	2.7
	0.4	PS	113.02	92.71	84.21	7.38	5.35	4.87	46.36	32.61	28.44	4.33	4	3.87
		GPS.n2	99.54	79.84	72.8	6.16	4.6	4.28	39.16	27.38	24.24	4.17	3.83	3.71
		GPS.Nc	103.78	83.94	77.01	6.43	4.84	4.43	40.89	29.19	25.72	4.21	3.9	3.77
		GPSopt.n2	71.66	42.71	34.47	1.72	1.56	1.51	17.11	9.32	8.04	3.16	2.72	2.57
		GPSopt.NC	77.53	47.22	38.21	1.84	1.6	1.53	18.99	10.06	8.59	3.25	2.8	2.64
	0.7	PS	97.94	78.03	70.25	5.79	4.14	3.86	36.96	25.64	22.36	4.11	3.75	3.62
		GPS.n2	90.5	70.79	63.25	5.04	3.81	3.53	32.71	23.03	20.17	3.99	3.64	3.51
		GPS.Nc	94.93	75.03	67.63	5.22	3.9	3.63	34.96	24.27	21	4.05	3.7	3.56
		GPSopt.n2	65.91	40.44	33.09	1.7	1.57	1.55	14.87	8.67	7.65	3.09	2.67	2.53
		GPSopt.Nc	71.45	44.01	35.57	1.74	1.61	1.56	16.31	9.28	8.1	3.15	2.74	2.59
0.5	0.2	PS	122.28	103.71	96.12	8.7	6.66	6.15	52.72	39.45	35.19	4.45	4.19	4.08
		GPS.n2	66.94	53.11	48.85	4.06	3.34	3.22	23.32	17.83	16.42	3.68	3.4	3.31
		GPS.Nc	74	58.75	54.09	4.37	3.59	3.45	26.18	19.61	18.11	3.79	3.51	3.42
		GPSopt.n2	56.29	34.96	28.61	1.61	1.56	1.49	11.95	7.64	6.83	2.92	2.55	2.42
		GPSopt.Nc	63.52	39.56	33.02	1.72	1.58	1.51	13.85	8.55	7.55	3.05	2.67	2.54
	0.4	PS	105.47	85.22	77.23	6.22	4.7	4.36	41.2	28.88	25.31	4.21	3.87	3.74
		GPS.n2	68.9	54.72	49.89	3.72	3.1	2.97	23.02	17.38	15.89	3.65	3.36	3.27
		GPS.Nc	74.48	58.94	53.34	3.99	3.27	3.04	25.31	18.7	16.68	3.75	3.44	3.33
		GPSopt.n2	59.89	36.11	29.31	1.46	1.33	1.35	12.17	7.64	6.76	2.9	2.52	2.4
		GPSopt.Nc	63.28	39.12	32.21	1.63	1.56	1.54	13.42	8.21	7.41	3.02	2.63	2.5

0.7	PS	91.09	72.68	64.86	5.04	3.76	3.55	33.23	23.28	20.44	4	3.65	3.52	
	GPS.n2	67.25	52.1	46.76	3.52	2.84	2.67	21.41	15.67	13.78	3.58	3.26	3.13	
	GPS.Nc	74.41	58.75	52.85	3.79	3.01	2.85	24.41	17.69	15.81	3.7	3.39	3.27	
	GPSopt.n2	56.89	34.39	28.04	1.49	1.38	1.36	11.51	7.09	6.29	2.87	2.47	2.33	
	GPSopt.Nc	62.35	39.13	31.83	1.6	1.46	1.45	12.81	7.94	7.11	2.99	2.6	2.47	
0.2	PS	118.89	99.32	92.01	8.27	6.46	6.06	50.61	37.84	33.91	4.41	4.15	4.04	
	GPS.n2	40.91	30.42	27.3	2.33	2.12	2.07	12.03	9.46	8.97	3.02	2.74	2.67	
	GPS.Nc	46.8	35.03	31.91	2.65	2.29	2.28	13.88	10.94	10.19	3.17	2.9	2.81	
	GPSopt.n2	43.88	27.56	22.62	1.42	1.33	1.32	8.59	6.11	5.55	2.65	2.32	2.21	
	GPSopt.Nc	50.08	31.11	25.45	1.44	1.33	1.31	9.82	6.47	5.83	2.72	2.37	2.25	
0.75	0.4	PS	103.35	83.27	75.31	6.03	4.51	4.17	39.86	28.09	24.57	4.18	3.84	3.71
		GPS.n2	45.24	33.35	29.85	2.47	2.11	2.04	13.19	9.89	9.17	3.1	2.79	2.7
		GPS.Nc	51.55	39.19	35.48	2.66	2.32	2.24	14.93	11.41	10.73	3.24	2.96	2.88
		GPSopt.n2	48.04	29.41	23.66	1.39	1.29	1.25	8.7	6	5.44	2.65	2.3	2.18
		GPSopt.Nc	52.34	33.09	27.01	1.43	1.34	1.34	10.04	6.65	6.08	2.77	2.41	2.29
0.7	PS	88.88	70.46	63.33	4.84	3.73	3.39	31.76	22.25	19.67	3.95	3.61	3.48	
	GPS.n2	48.96	36.84	32.74	2.51	2.19	2.11	13.94	10.43	9.38	3.15	2.84	2.74	
	GPS.Nc	54.07	41.29	36.76	2.56	2.11	2.05	15.41	11.01	9.97	3.25	2.91	2.8	
	GPSopt.n2	49.88	30.79	24.51	1.39	1.25	1.23	9.34	5.92	5.34	2.69	2.31	2.17	
	GPSopt.Nc	53.09	33.88	27.49	1.49	1.36	1.32	10.16	6.66	5.96	2.79	2.42	2.29	

h^2 : trait heritability. λ : relative selection rate. Average annual total cost (CT) = 3 M€ and genotyping cost (C_G) = 37€.

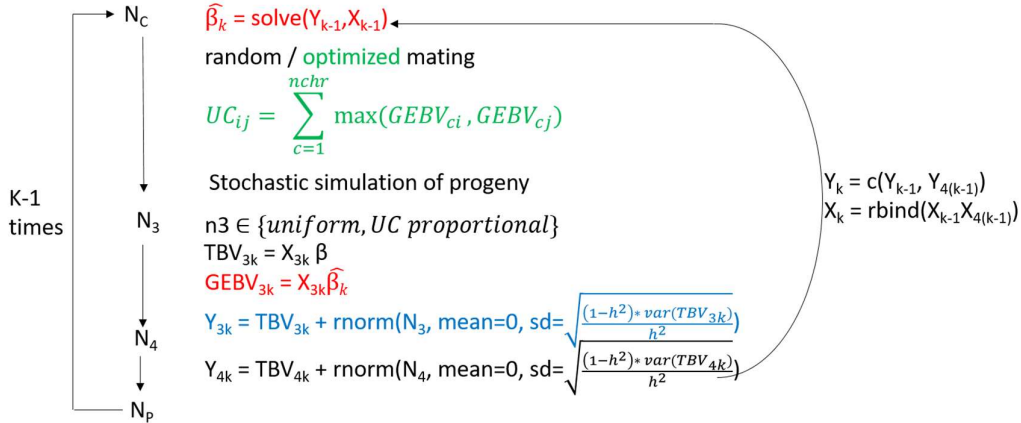
GPSopt

Input parameters:

strategy $\in \{PS, GPS, GPSopt\}$

scenario = c(map, X_{ref} , Y_{ref} , β_{ref} , CC, CDH, CM2, CM3, CM4, CP3, CP4, CG, NC, NP, K, CT, λ , α_2 , h^2 , rep_j)

START $Y_0 = Y_{ref}$
 $X_0 = X_{ref}$



Outputs: $X_k, Y_k, TBV_k, ped_k, cross_k, He_k, sim_k, polymorphism_k, fav_k$

Figure S1: Description of the algorithm.

Rep: repetition. $j \in \{1-10\}$; Map: genetic map. first column with chromosome name. second column with genetic position; X: matrix of genotypes (number of lines rows. number of markers columns. coded with 0 and 1). Y: vector of phenotypes for the lines; ref: relative to the reference (initial) data set. β : vector of true marker effects for the simulated trait ; $\hat{\beta}$ vector of marker effects estimated by RR-BLUP ; CC. CDH. CM. CP. CG. CT: unit costs for cross. double haploid. multiplication. field evaluation. genotyping and total (3 cycles in our case); N_p : number of parents ; N_C : Number of crosses ; N_3 and N_4 : number of progenies at the beginning of steps 3 and 4 respectively ; K: number of cycles. k : cycle number ; λ : relative selection rate ; h^2 : heritability of the targeted trait. TBV: True Breeding Value; GEBV: Genomic Estimated Breeding Value; UC: Utility Criterion. i.e. cross value; ped: table of pedigrees for the progenies selected at each cycle; cross: list of crosses; He: mean Nei diversity among the N_p selected lines; sim: mean Rodgers similarity among the N_p selected lines; polymorphism: proportion of polymorphic initial alleles among the N_p selected lines; fav: proportion of initial favourable alleles among the N_p selected lines.