Supplementary Table 1 to 6

Supplementary Figure 1

Table S1. Name and geographic coordinates of sampling locations. The number of *Helicoverpa armigera* moths analyzed in each month (2006) for stable carbon isotope ratio and gossypol is reported.

Sampling location	Latitude (°E)	Longitude (°N)	Month					
			6	7	8	9	10	11
Guider	9.94	13.94	60	58	19	23	20	8
Djalingo	9.23	13.45	60	60	16	15	53	54
Tcholliré	8.40	14.17	60	60	46	8	9	29

Table S2. Standard values of relative survival of *Helicoverpa armigera* genotypes on Cry1Ac/Cry2Ab cotton (LB_{3g}). We assumed a fitness cost associated with resistance to Cry1Ac but not Cry2Ab and D_{LC} values of 0.26 and 0.0 for resistance to Cry1Ac and Cry2Ab, respectively (Table S3). Other survival values were calculated in sensitivity analyses assessing the effect of dominance (see Methods).

Month	*Survival of genotypes*								
	ss1ss2	*rs1ss2*	*rr1ss2*	*ss1rs2*	*rs1rs2*	*rr1rs2*	*ss1rr2*	*rs1rr2*	*rr1rr2*
July & August	0.006	0.036	0.124	0.006	0.036	0.124	0.030	0.187	0.652
September	0.032	0.093	0.125	0.032	0.093	0.125	0.170	0.487	0.659
October	0.070	0.130	0.125	0.070	0.130	0.125	0.370	0.685	0.660

Table S3. Effects of dominance of resistance (D_{LC}), presence of non-cotton refuges, abundance of non-Bt cotton refuges (*Pref*) and initial frequency of resistance alleles (p_o) on the number of years to achieve > 20% survival on Cry1Ac/Cry2Ab cotton. Simulations considered movement of *H. armigera* from non-cotton hosts to cotton at three locations in Cameroon, in the absence of long-range migration.

Sampling location	D_{LC} (Cry1Ac)	D_{LC} (Cry2Ab)	p_0 (Cry2Ab) = 0.0033					p_0 (Cry2Ab) = 0.033				
			no refuges	non-cotton refuges	+ 5% *Pref*	+ 20% *Pref*	+ 50% *Pref*	no refuges	non-cotton refuges	+ 5% *Pref*	+ 20% *Pref*	+ 50% *Pref*
p_0 (Cry1Ac) = 0.0003												
Guider	0.3	0	30	345	376	494	941	3	41	44	57	105
		0.1	3	35	38	48	89	2	19	20	26	46
		0.3	2	16	17	21	37	1	10	11	14	23
		0.5	2	11	11	14	24	1	7	7	9	15
	0.5	0	30	292	357	494	941	3	40	44	57	105
		0.1	3	34	37	48	89	2	19	20	26	46
		0.3	2	15	16	21	37	1	10	11	13	23
		0.5	1	11	11	14	24	1	7	7	9	15
Djalingo	0.3	0	30	59	70	124	363	3	11	12	19	42
		0.1	3	10	11	16	35	2	6	7	9	19
		0.3	2	5	6	8	15	1	4	4	5	9
		0.5	2	4	4	5	10	1	3	3	4	6
	0.5	0	30	55	61	93	363	3	9	10	16	42
		0.1	3	8	9	14	35	2	5	6	9	19
		0.3	2	5	5	7	15	1	4	4	5	9
		0.5	1	4	4	5	10	1	3	3	4	6
Tcholliré	0.3	0	30	161	182	255	531	3	20	23	30	60
		0.1	3	18	20	26	50	2	10	11	14	26
		0.3	2	8	9	11	20	1	5	6	7	12
		0.5	2	6	6	8	13	1	4	4	5	8
	0.5	0	30	119	137	231	531	3	19	22	30	60
		0.1	3	17	19	26	50	2	10	11	14	26
		0.3	2	8	9	11	20	1	5	6	7	12
		0.5	1	6	6	8	13	1	4	4	5	8
p_0 (Cry1Ac) = 0.003												
Guider	0.3	0	30	345	376	494	941	3	41	44	57	105
		0.1	3	35	38	48	89	2	19	20	26	46
		0.3	2	16	17	21	37	1	10	11	13	23
		0.5	1	11	11	14	24	1	7	7	9	15
	0.5	0	30	285	348	494	941	3	38	42	57	105
		0.1	3	32	36	48	89	2	17	19	25	46
		0.3	2	14	15	20	37	1	9	10	13	23
		0.5	1	10	11	14	24	1	6	7	8	15
Djalingo	0.3	0	30	58	68	120	363	3	10	11	18	42
		0.1	3	9	10	16	35	2	6	6	9	19
		0.3	2	5	5	7	15	1	3	4	5	9
		0.5	1	4	4	5	10	1	3	3	4	6
	0.5	0	30	54	60	91	362	3	9	10	14	41
		0.1	3	8	9	13	35	2	5	5	8	18

		0.3	2	4	5	7	14	1	3	3	5	9
		0.5	1	4	4	5	10	1	3	3	3	6
Tcholliré	0.3	0	30	158	182	255	531	3	20	22	30	60
		0.1	3	18	20	26	50	2	10	11	14	26
		0.3	2	8	9	11	20	1	5	6	7	12
		0.5	1	6	6	8	13	1	4	4	5	8
	0.5	0	30	117	134	225	531	3	18	20	29	60
		0.1	3	16	18	25	50	2	9	10	14	26
		0.3	2	8	8	11	20	1	5	6	7	12
		0.5	1	6	6	8	13	1	4	4	5	8

Table S4. Frequency of resistance alleles *r1* (Cry1Ac, top) and *r2* (Cry2Ab, bottom) at the time when > 20% survival on Cry1Ac/Cry2Ab cotton occurred (see Table S3). Simulations considered movement of *H. armigera* from non-cotton hosts to cotton at three locations in Cameroon, in the absence of long-range migration.

Sampling location	D_{LC} (Cry1Ac)	D_{LC} (Cry2Ab)	p_0 (Cry2Ab) = 0.0033					p_0 (Cry2Ab) = 0.033				
			no refuges	non-cotton refuges	+ 5% *Pref*	+ 20% *Pref*	+ 50% *Pref*	no refuges	non-cotton refuges	+ 5% *Pref*	+ 20% *Pref*	+ 50% *Pref*
p_0 (Cry1Ac) = 0.0003												
Guider	0.3	0	0.99	<0.01	<0.01	<0.01	<0.01	0.97	<0.01	<0.01	<0.01	<0.01
			0.81	0.88	0.84	0.83	0.81	0.64	0.89	0.86	0.85	0.79
		0.1	0.97	<0.01	<0.01	<0.01	<0.01	0.71	<0.01	<0.01	<0.01	<0.01
			0.78	0.83	0.84	0.78	0.78	0.86	0.82	0.78	0.80	0.75
		0.3	0.71	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01
			0.74	0.68	0.66	0.63	0.60	0.61	0.63	0.65	0.65	0.59
		0.5	0.71	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01
			0.75	0.54	0.48	0.49	0.46	0.64	0.52	0.48	0.49	0.46
	0.5	0	0.88	0.21	0.18	<0.01	<0.01	0.85	0.06	0.03	<0.01	<0.01
			0.81	0.76	0.84	0.83	0.81	0.64	0.86	0.87	0.85	0.79
		0.1	0.84	0.07	0.03	<0.01	<0.01	0.73	0.05	0.02	<0.01	<0.01
			0.57	0.79	0.78	0.78	0.78	0.68	0.84	0.79	0.81	0.75
		0.3	0.73	0.02	0.01	<0.01	<0.01	0.34	0.02	0.02	<0.01	<0.01
			0.60	0.61	0.59	0.63	0.60	0.61	0.64	0.65	0.60	0.59
		0.5	0.34	0.01	0.01	<0.01	<0.01	0.34	0.01	<0.01	<0.01	<0.01
			0.41	0.54	0.48	0.49	0.46	0.64	0.52	0.48	0.50	0.46
Djalingo	0.3	0	0.99	0.61	0.58	0.35	0.00	0.97	0.30	0.14	0.03	0.00
			0.81	0.65	0.92	0.88	0.84	0.64	0.97	0.87	0.93	0.84
		0.1	0.97	0.24	0.13	0.02	<0.01	0.71	0.03	0.03	0.01	<0.01
			0.78	0.93	0.86	0.79	0.72	0.86	0.91	0.93	0.81	0.77
		0.3	0.71	0.02	0.02	0.01	<0.01	0.06	0.01	0.01	<0.01	<0.01
			0.74	0.67	0.73	0.68	0.57	0.61	0.77	0.70	0.63	0.53
		0.5	0.71	0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01
			0.75	0.61	0.53	0.44	0.44	0.64	0.64	0.59	0.58	0.42
	0.5	0	0.88	0.51	0.53	0.46	<0.01	0.85	0.50	0.44	0.36	<0.01
			0.81	0.55	0.59	0.81	0.84	0.64	0.76	0.61	0.77	0.84
		0.1	0.84	0.45	0.40	0.31	<0.01	0.73	0.14	0.18	0.17	0.01
			0.57	0.62	0.56	0.64	0.73	0.68	0.72	0.80	0.85	0.78
		0.3	0.73	0.18	0.08	0.05	<0.01	0.34	0.10	0.06	0.03	<0.01
			0.60	0.68	0.56	0.55	0.57	0.61	0.77	0.70	0.63	0.53
		0.5	0.34	0.07	0.04	0.01	<0.01	0.34	0.03	0.02	0.02	<0.01
			0.41	0.61	0.53	0.45	0.44	0.64	0.64	0.59	0.58	0.42
Tcholliré	0.3	0	0.99	0.05	<0.01	<0.01	<0.01	0.97	<0.01	<0.01	<0.01	<0.01
			0.81	0.87	0.89	0.81	0.78	0.64	0.82	0.91	0.78	0.77
		0.1	0.97	<0.01	<0.01	<0.01	<0.01	0.71	<0.01	<0.01	<0.01	<0.01
			0.78	0.82	0.84	0.75	0.68	0.86	0.80	0.81	0.75	0.69
		0.3	0.71	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01
			0.74	0.55	0.59	0.51	0.48	0.61	0.54	0.61	0.53	0.48
		0.5	0.71	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01
			0.75	0.49	0.42	0.46	0.36	0.64	0.51	0.47	0.46	0.39
	0.5	0	0.88	0.34	0.29	0.18	<0.01	0.85	0.13	0.14	0.01	<0.01

			0.81	0.71	0.68	0.79	0.78	0.64	0.74	0.86	0.79	0.77
		0.1	0.84	0.14	0.11	0.02	<0.01	0.73	0.04	0.03	0.01	<0.01
			0.57	0.74	0.76	0.76	0.68	0.68	0.81	0.81	0.75	0.69
		0.3	0.73	0.01	0.02	<0.01	<0.01	0.34	0.01	0.01	<0.01	<0.01
			0.60	0.55	0.59	0.52	0.48	0.61	0.54	0.61	0.54	0.48
		0.5	0.34	0.01	<0.01	<0.01	<0.01	0.34	<0.01	<0.01	<0.01	<0.01
			0.41	0.49	0.42	0.46	0.36	0.64	0.51	0.47	0.46	0.39
p_0 (Cry1Ac) = 0.003												
Guider	0.3	0	0.99	<0.01	<0.01	<0.01	<0.01	0.99	<0.01	<0.01	<0.01	<0.01
			0.81	0.88	0.84	0.83	0.81	0.64	0.89	0.86	0.85	0.80
		0.1	0.98	<0.01	<0.01	<0.01	<0.01	0.90	<0.01	<0.01	<0.01	<0.01
			0.57	0.83	0.84	0.78	0.78	0.86	0.82	0.79	0.81	0.75
		0.3	0.90	<0.01	<0.01	<0.01	<0.01	0.31	0.01	<0.01	<0.01	<0.01
			0.74	0.68	0.66	0.63	0.60	0.61	0.63	0.65	0.60	0.59
		0.5	0.31	<0.01	<0.01	<0.01	<0.01	0.31	0.01	<0.01	<0.01	<0.01
			0.41	0.54	0.48	0.49	0.46	0.64	0.52	0.48	0.50	0.46
	0.5	0	0.88	0.23	0.18	<0.01	<0.01	0.86	0.16	0.07	<0.01	<0.01
			0.81	0.81	0.83	0.83	0.81	0.64	0.84	0.79	0.86	0.80
		0.1	0.86	0.17	0.13	<0.01	<0.01	0.79	0.10	0.09	0.02	<0.01
			0.57	0.75	0.80	0.79	0.78	0.68	0.72	0.77	0.76	0.75
		0.3	0.79	0.09	0.06	0.02	<0.01	0.56	0.08	0.08	0.04	<0.01
			0.60	0.57	0.55	0.59	0.61	0.61	0.58	0.61	0.62	0.59
		0.5	0.56	0.06	0.05	0.02	<0.01	0.50	0.04	0.05	0.02	<0.01
			0.41	0.48	0.50	0.50	0.46	0.51	0.45	0.50	0.44	0.46
Djalingo	0.3	0	0.99	0.61	0.55	0.31	<0.01	0.99	0.44	0.30	0.12	<0.01
			0.81	0.69	0.78	0.75	0.84	0.64	0.91	0.74	0.86	0.84
		0.1	0.98	0.39	0.28	0.13	<0.01	0.90	0.21	0.10	0.05	<0.01
			0.57	0.83	0.73	0.84	0.73	0.86	0.92	0.79	0.83	0.78
		0.3	0.90	0.12	0.06	0.03	<0.01	0.31	0.03	0.06	0.03	<0.01
			0.74	0.68	0.56	0.54	0.57	0.61	0.59	0.71	0.63	0.53
		0.5	0.31	0.07	0.04	0.02	<0.01	0.31	0.05	0.03	0.02	<0.01
			0.41	0.61	0.53	0.45	0.44	0.64	0.64	0.59	0.58	0.43
	0.5	0	0.88	0.58	0.53	0.45	<0.01	0.86	0.47	0.49	0.38	0.02
			0.81	0.84	0.56	0.78	0.81	0.64	0.58	0.71	0.61	0.79
		0.1	0.86	0.50	0.48	0.42	0.04	0.79	0.40	0.27	0.29	0.03
			0.57	0.61	0.62	0.73	0.77	0.68	0.80	0.61	0.78	0.72
		0.3	0.79	0.24	0.32	0.25	0.02	0.56	0.15	0.10	0.18	0.03
			0.60	0.48	0.62	0.62	0.50	0.61	0.60	0.52	0.67	0.55
		0.5	0.56	0.31	0.21	0.11	0.02	0.50	0.19	0.14	0.04	0.02
			0.41	0.64	0.56	0.47	0.45	0.51	0.66	0.61	0.43	0.43
Tcholliré	0.3	0	0.99	0.08	<0.01	<0.01	<0.01	0.99	0.01	0.01	<0.01	<0.01
			0.81	0.80	0.91	0.82	0.78	0.64	0.83	0.80	0.79	0.77
		0.1	0.98	0.02	0.01	<0.01	<0.01	0.90	0.01	0.01	<0.01	<0.01
			0.57	0.83	0.84	0.75	0.68	0.86	0.81	0.81	0.75	0.69
		0.3	0.90	0.01	0.01	<0.01	<0.01	0.31	0.01	0.01	<0.01	<0.01
			0.74	0.55	0.59	0.52	0.48	0.61	0.54	0.61	0.54	0.48
		0.5	0.31	0.01	0.01	<0.01	<0.01	0.31	0.01	0.01	<0.01	<0.01
			0.41	0.49	0.42	0.46	0.36	0.64	0.51	0.47	0.46	0.39
	0.5	0	0.88	0.36	0.29	0.14	<0.01	0.86	0.29	0.22	0.06	<0.01
			0.81	0.81	0.66	0.68	0.78	0.64	0.81	0.74	0.75	0.78
		0.1	0.86	0.29	0.26	0.08	0.00	0.79	0.12	0.11	0.06	<0.01
			0.57	0.76	0.78	0.71	0.68	0.68	0.71	0.72	0.78	0.69
		0.3	0.79	0.11	0.06	0.04	<0.01	0.56	0.05	0.07	0.03	<0.01
			0.60	0.59	0.48	0.53	0.49	0.61	0.55	0.63	0.55	0.48

	0.5	0.56	0.07	0.04	0.03	<0.01	0.50	0.04	0.03	0.02	<0.01
		0.41	0.51	0.44	0.47	0.36	0.51	0.52	0.48	0.46	0.39

Table S5. Effects of dominance of resistance (D_{LC}), abundance of non-Bt cotton refuges (*Pref*) and initial frequency of resistance alleles (p_o) on the mean number of years (with 0.05- and 0.95-quantile) to achieve > 20% survival on Cry1Ac/Cry2Ab cotton. For each generation and region, the proportion of moths produced by non-cotton hosts ($f_{non\,cot}$) was sampled repeatedly (1,000 iterations) from the Student distribution, according to Monte Carlo simulation (see Methods).

Sampling location	D_{LC} (Cry1Ac)	D_{LC} (Cry2Ab)		p_0 (Cry2Ab) = 0.0033 non-cotton refuges	+ 5% *Pref*	+ 20% *Pref*	+ 50% *Pref*	p_0 (Cry2Ab) = 0.033 non-cotton refuges	+ 5% *Pref*	+ 20% *Pref*	+ 50% *Pref*
p_0 (Cry1Ac) = 0.0003											
Guider	0.3	0.1	Mean	36	38	50	93	19	21	27	48
			0.05	22	24	32	66	12	14	18	34
			0.95	55	59	74	132	29	33	39	68
		0.5	Mean	11	12	14	25	7	8	9	16
			0.05	7	8	10	18	5	5	7	11
			0.95	16	17	20	35	10	11	13	21
Djalingo	0.3	0.1	Mean	9	11	16	35	6	6	9	19
			0.05	6	8	13	31	4	5	8	17
			0.95	12	13	19	40	7	8	11	21
		0.5	Mean	4	4	5	10	3	3	4	6
			0.05	3	3	5	9	2	2	3	6
			0.95	5	5	6	11	3	3	4	7
Tcholliré	0.3	0.1	Mean	18	20	26	51	10	11	14	27
			0.05	12	13	18	39	7	8	10	20
			0.95	27	29	37	66	14	16	20	35
		0.5	Mean	6	7	8	14	4	4	5	8
			0.05	5	5	6	11	3	3	4	6
			0.95	8	9	10	17	5	5	6	10

Table S6. Effects of dominance of resistance to Cry2Ab (D_{LC}), abundance of non-Bt cotton refuges (*Pref*) and initial frequency of the Cry2Ab resistance allele (p_o) on the number of years to achieve >20% survival on Cry1Ac/Cry2Ab cotton at Djalingo (Cameroon). Simulations considered movement of *H. armigera* from non-cotton hosts to cotton and patterns of long-range migration.

Pattern of migration		D_{LC} (Cry2Ab)	p_0 (Cry2Ab) = 0.0033				p_0 (Cry2Ab) = 0.033			
MR1	*MR2*		non-cotton refuges	+ 5% *Pref*	+ 20% *Pref*	+ 50% *Pref*	non-cotton refuges	+ 5% *Pref*	+ 20% *Pref*	+ 50% *Pref*
0.98	0.20	0	365	438	714	1760	40	48	78	190
		0.1	34	41	65	157	19	22	34	80
		0.3	14	16	25	59	10	11	16	36
		0.5	9	10	16	36	6	7	10	21
0.90	0.10	0	664	799	1308	3243	68	83	137	343
		0.1	56	68	112	283	30	36	58	143
		0.3	21	25	41	103	15	17	26	63
		0.5	12	15	24	61	8	10	15	36
0.90	0.90	0	86	103	164	398	12	14	20	45
		0.1	11	12	18	38	6	7	10	20
		0.3	5	6	8	16	4	4	5	10
		0.5	4	4	6	11	3	3	4	6
0.10	0.90	0	63	74	138	367	11	13	19	42
		0.1	10	11	16	36	6	7	9	19
		0.3	5	6	8	15	4	4	5	9
		0.5	4	4	6	10	3	3	4	6
0.10	0.10	0	95	115	235	652	12	14	24	61
		0.1	11	12	20	49	6	7	11	25
		0.3	5	6	8	18	4	4	6	11
		0.5	4	4	6	11	3	3	4	7

MR1 is the proportion of moths from southern regions colonizing the cotton belt in June-July; *MR2* the proportion of moths from the cotton belt contributing to the pool of migrants moving south in October-November. The dominance of resistance to Cry1Ac (D_{LC}) was 0.26, and the initial frequency of the Cry1Ac resistance allele was 0.0003 (Table 2).

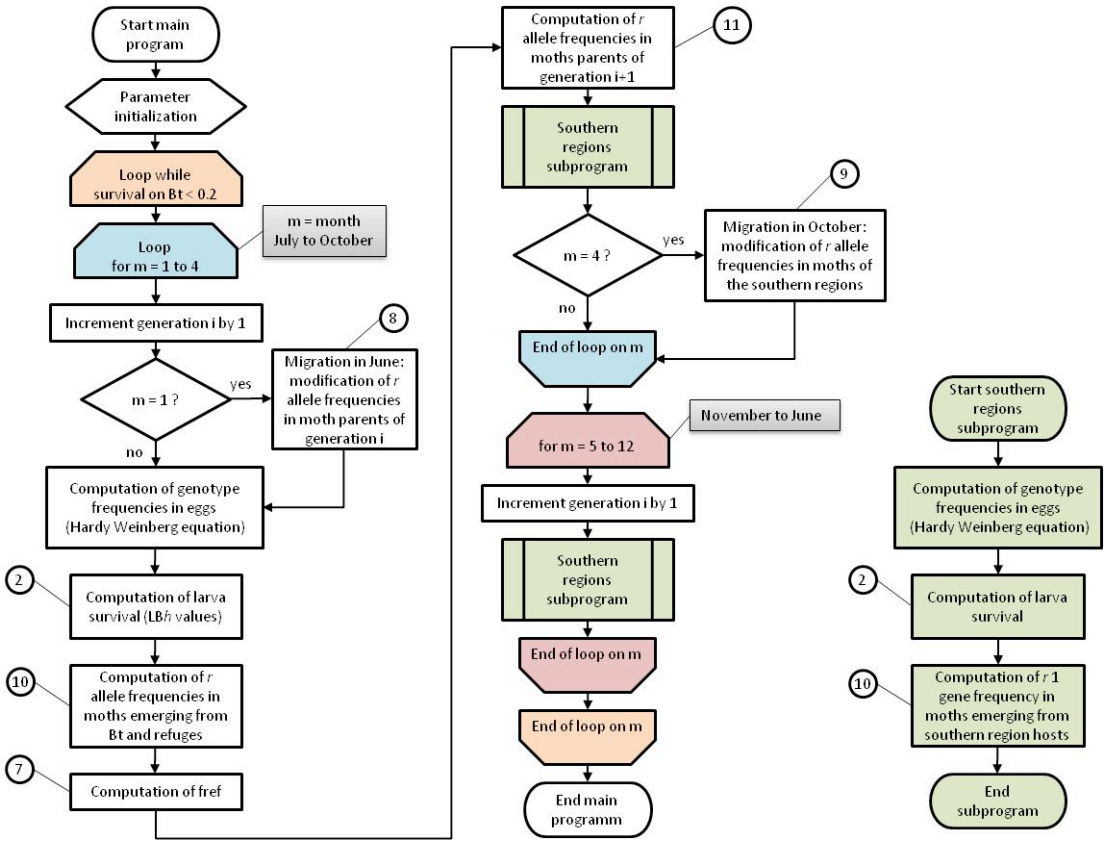

Figure S1. General description of the simulation model. Circled numbers refer to the corresponding equation number in Materials and Methods.