Table S1. Ecogeographical variables considered in the characterization of the bread wheat landraces obtained from various sources compiled by CAPFITOGEN [27].

Ecogeographic component	Description	Abbreviation	Unit
Bioclimatic	Monthly precipitation (January to June)	prec_1 to 12	mm
	Monthly mean temperature (January to June)	tmean_1 to 12	°C
	Monthly minimum temperature (January to June)	tmin_1 to 12	°C
	Monthly maximum temperature (January to June)	tmax_1 to 12	°C
	Annual mean temperature	bio_1	°C
	Mean daily temperature range (Mean monthly (max temp - min temp))	bio_2	°C
	Isothermality (bio_2/bio_7) (* 100)	bio_3	-
	Temperature seasonality (standard deviation *100)	bio_4	-
	Maximum temperature of hottest month	bio_5	°C
	Minimum temperature of coldest month	bio_6	°C
	Annual temperature range (BIO5-BIO6)	bio_7	°C
	Mean temperature of wettest quarter	bio_8	°C
	Mean temperature of driest quarter	bio_9	°C
	Mean temperature of hottest quarter	bio_10	°C
	Mean temperature of coldest quarter	bio_11	°C
	Annual precipitation	bio_12	mm
	Precipitation of wettest month	bio_13	mm
	Precipitation of driest month	bio_14	mm
	Precipitation seasonality (Coefficient of variation)	bio_15	mm
	Precipitation of wettest quarter	bio_16	mm
	Precipitation of driest quarter	bio_17	mm
	Precipitation of hottest quarter	bio_18	mm
	Precipitation of coldest quarter	bio_19	mm
Geophysical	Northness (1 if it faces northwards. - 1 if it faces southwards)	northness	°
	Eastness (1 if it faces eastwards. - 1 if it faces westwards)	eastness	°
	Altitude (meters above sea level)	Alt	m
Edaphic	Topsoil clay fraction	t_clay	% weight
	Topsoil sand fraction	t_sand	% weight
	Subsoil clay content	s_clay	% weight
	Topsoil pH (H2O)	t_pH	-log(H+)
	Topsoil reference bulk density	bulk_density	% weight

Table S3. Means of the ecogeographical variables (see Table S1) ordered according to their significant differences (p < 0.05) between resistant and susceptible landraces, based on their IT and DS values at the seedling stage for the leaf rust isolates Huesca 14 and Peralta García 14.

	Huesca 14			**Peralta García 14**		
	Variable	**Resistant**	**Susceptible**	**Variable**	**Resistant**	**Susceptible**
IT	bulk_density	1.34	1.40			
DS	bulk_density	1.34	1.41	bio_13	94.11	65.9
				bio_16	250.4	175.46
				prec_3	63.94	48.3
				bio_12	723.14	540.98
				prec_10	74.46	53.35
				prec_9	55	40.8
				prec_12	80.24	54.02
				prec_2	61.95	42.88
				bio_19	208.34	141.28
				bio_4	53.72	60.81
				prec_4	65.46	53.74
				tmax_7	26.48	28.54
				bio_7	25.13	28.67
				bio_5	26.69	28.57
				bio_2	9.63	10.96
				bio_18	120	89.19
				prec_1	66.15	44.38
				tmax_8	26.38	28.03
				prec_8	35.61	24.49

Table S5. Means of the ecogeographical variables (see Table S1) ordered according to their significant differences (p < 0.05) between resistant and susceptible landraces, based on their leaf rust severity at adult stage in field plots at three locations (Cordoba, Jerez, and Granada).

Cordoba			Jerez			Granada		
Variable	Resistant	Susceptible	Variable	Resistant	Susceptible	Variable	Resistant	Susceptible
bio_13	114.38	81.45	t_clay	21.32	31.77	prec_8	52.52	28.17
prec_10	87.66	64.87	t_pH	5.59	7.34	prec_7	40.68	22.2
bio_19	270.24	182.53	prec_10	92.5	60.47	bio_14	40.46	22.13
prec_12	104.38	70.15	bio_7	22.53	28.39	bio_18	160.59	99.74
bio_16	305.59	219.98	bio_2	8.86	10.98	bio_17	145.58	91.07
prec_1	85.58	57.41	bio_4	475.65	596.72	tmax_8	23.75	27.49
bio_12	858.33	640.99	prec_9	64.24	45.1	tmax_7	23.65	27.85
prec_11	99.73	71.43	bio_13	118.12	75.55	tmax_6	20.79	24.04
t_pH	5.99	6.94	bio_16	314.43	204.06	bio_5	23.99	27.96
prec_4	72.8	59.42	bio_12	890.8	609.04	prec_4	80.1	59.67
prec_2	80.28	54.96	prec_11	108.72	66.65	t_pH	5.65	6.91
prec_3	84.86	59.09	prec_1	85.87	51.04	bio_4	468.66	577.08
			prec_2	79	50.81	bio_7	22.18	27.27
			bio_19	268.67	166.23	tmax_9	21.12	23.86
			tmin_2	2.97	0.28	prec_9	66.38	47.72
			prec_12	103.8	64.39	bio_12	890.59	649.08
			prec_4	77.8	57.35	tmean_7	18.49	21.14
			tmin_1	2.36	-0.26	tmean_8	18.59	20.95
			prec_3	77.78	55.88	bio_2	8.74	10.48
			bio_6	2.34	-0.26	bio_10	17.83	20.04
			bio_18	141.24	97.11			
			tmax_7	24.52	28.1			
			tmean_1	6.05	3.86			
			tmin_12	3.09	0.84			
			tmin_3	4.66	2.47			
			bio_5	24.87	28.13			
			bio_11	6.53	4.56			
			tmin_10	8.92	6.94			
			tmax_8	24.74	27.57			
			tmin_11	5.03	3.03			
			tmean_2	6.88	5.05			
			tmax_6	21.69	24.07			
			bio_17	125.29	91.57			
			tmax_1	9.79	8.04			
			s_clay	15.88	26.15			

Table S6. Pearson correlation (p < 0.05) between latency period and ecogeographical variables (see Table S1) evaluated for partial disease resistance to the Jerez Califa 13 isolate at seedling stage.

Variable	Variable	r value	p-valor
Latency period	tmin_2	0.61	<0.0001
	tmin_1	0.60	<0.0001
	tmin_3	0.60	<0.0001
	bio_6	0.60	<0.0001
	tmean_1	0.58	<0.0001
	tmin_10	0.58	<0.0001
	tmin_11	0.58	<0.0001
	tmin_12	0.58	<0.0001
	Alt	-0.58	<0.0001
	tmean_2	0.57	<0.0001
	bio_11	0.57	<0.0001
	tmin_4	0.57	0.0001
	tmean_12	0.56	0.0001
	tmin_5	0.56	0.0001
	bio_2	-0.56	0.0001
	tmean_11	0.54	0.0001
	tmax_1	0.54	0.0001
	tmin_9	0.54	0.0001
	tmean_3	0.53	0.0002
	bio_7	-0.53	0.0002
	tmax_12	0.51	0.0003
	tmean_10	0.51	0.0004
	prec_10	0.5	0.0005
	bio_4	-0.49	0.0005
	tmin_6	0.48	0.0007
	tmax_2	0.48	0.0009
	tmean_4	0.47	0.0012
	bio_1	0.46	0.0015
	tmax_11	0.45	0.0017
	tmin_8	0.45	0.0021
	bio_13	0.43	0.0034
	tmean_5	0.43	0.0035
	bio_8	0.42	0.0043
	bio_16	0.41	0.0048
	tmin_7	0.41	0.0056
	tmax_3	0.39	0.0082
	prec_11	0.37	0.0113
	prec_12	0.37	0.0128
	prec_9	0.37	0.0131
	bio_19	0.36	0.0164
	tmax_10	0.35	0.0172
	prec_1	0.35	0.0191
	prec_2	0.34	0.0214
	bio_12	0.34	0.0237
	tmean_9	0.33	0.0279
	prec_3	0.3	0.0448

Table S7. Means of the ecogeographical variables (see Table S1) ordered according to their significant differences ($p < 0.05$) between the two disease severity groups for yellow rust at the seedling stage.

Variable	Resistant	Susceptible
bio_19	197.18	170.89
prec_12	76.06	65.55
bio_4	517.57	584.66
bio_7	24.28	27.46

Table S8. Ecogeographical variables significantly different (p < 0.05) between the origin sites of the agroecological zones 4 and 9.

Variable	Zone 4	Zone 9
prec_1	44.85	97.35
prec_2	44.26	87.23
prec_3	50.36	78.52
prec_4	53.38	88.63
prec_7	22.31	39.15
prec_8	25.32	51.45
prec_9	41.83	72.9
prec_10	52.82	98.27
prec_11	55.85	122.41
prec_12	55.02	116.25
tmean_1	3.11	7.6
tmean_2	4.37	8.28
tmean_3	7.11	10.07
tmean_4	9.38	11.17
tmean_7	20.94	18.63
tmean_8	20.62	19.11
tmean_10	11.76	14.17
tmean_11	7	10.17
tmean_12	4.16	8.31
tmax_1	7.25	11.06
tmax_2	9.23	11.86
tmax_3	12.43	13.91
tmax_6	24.07	21.08
tmax_7	28.24	23.24
tmax_8	27.69	23.85
tmax_9	23.7	21.71
tmax_11	11.71	13.99
tmax_12	8.13	11.93
tmin_1	-0.98	4.18
tmin_2	-0.43	4.73
tmin_3	1.84	6.27
tmin_4	3.82	7.09
tmin_5	7.06	9.77
tmin_9	10.91	13.09
tmin_10	6.39	10.09
tmin_11	2.35	6.39
tmin_12	0.24	4.74
bio_1	11.34	12.95
bio_2	11.16	8.1
bio_3	37.67	40.55
bio_4	621.1	405.15
bio_5	28.26	23.85
bio_6	-0.98	4.17
bio_7	29.25	19.68
bio_11	3.85	8.03
bio_12	554.9	979.42
bio_13	66.56	130.27
bio_14	21.95	39.15
bio_16	179.17	341.52
bio_17	88.63	146.87
bio_18	93.57	163.5
bio_19	144.13	300.83
t_sand	36.86	42.4
t_pH	7.28	5.8

Table S9. Means of the ecogeographical variables (see Table S1) ordered according to their significant differences (p < 0.05) between the two disease severity groups for yellow rust at the adult stage in the field evaluation.

Variable	Resistant	Susceptible
bio_13	107.78	63.05
prec_11	99.92	53.32
prec_4	73.07	50.07
bio_12	820.09	511.21
prec_10	82	52.47
bio_16	293.92	169.28
prec_1	83.63	42.68
bio_19 (Precipitation of coldest quarter)	257.48	138.08
east	-0.07	0.06
prec_12 (December precipitation)	98.47	52.44
prec_2	75.37	42.97
bio_2	9.4	11.48
tmax_7	25.72	29.49
bio_7 (Annual temperature range)	24.07	29.51
bio_5	25.99	29.49
prec_3	74.38	48.05
tmax_8	25.72	28.96
bio_4 (Temperature seasonality)	505.38	618.67
tmax_6	22.53	25.28
bio_18	118.86	75.69
prec_9	56.04	38.49
t_pH	6.34	7.51
tmax_9	22.62	24.99
prec_8	34.54	20.11
bio_6	1.92	-0.02
prec_5	67.7	55.2
prec_7	27.42	16.43
bio_14	27.42	16.43
tmean_7	19.78	22.1
bio_17	107.53	73.17