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Host suitability of different wheat lines to *Pratylenchus thornei* under naturally infested field conditions in Turkey

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Summary – The root-lesion nematode, *Pratylenchus thornei*, attacks a wide range of crops and causes significant reductions in global grain production. Breeding programmes are currently restricted to using parents with moderate resistance to *P. thornei* as cereal cultivars with complete resistance are yet to be identified. This study evaluated 484 of CIMMYT's spring wheat accessions for resistance to *P. thornei* of which 56 lines were pre-identified as resistant under controlled growth room conditions. These lines were further evaluated for their resistance and tolerance reactions under field conditions, where 14 accessions maintained their resistance and 16 were moderately resistant against *P. thornei*. Four lines gave excellent resistant and tolerance reactions to *P. thornei*. The relationship between the nematode reproduction factor (P_f/P_i) and wheat grain yield in field experiments fits a linear regression model. These findings could be useful for improving *P. thornei* resistance in wheat.

Keywords – resistance, root-lesion nematode, susceptible, tolerance, *Triticum*, yield.

The root-lesion nematode, *Pratylenchus thornei*, is a serious constraint for agricultural production systems worldwide. Under optimal soil temperature and moisture levels, *P. thornei* can complete its life cycle in 3-8 weeks (Agrios, 1988), enabling it to increase its population density several times in one cropping cycle. *Pratylenchus thornei* feeding destroys lateral roots, limiting their ability to draw water and nutrients from the soil (McGawley & Overstreet, 1998). Susceptible plants growing in fields with high *P. thornei* infestations show various above- and below-ground symptoms (Loof, 1978), although nematode damage is often difficult to estimate and quantify as symptoms may be indistinct or affected by several biotic and abiotic factors (Vanstone & Russ, 2001). Above-ground symptoms include uneven growth with dying, unthrifty, and/or yellowish plants, which can be confused with symptoms of water or nitrogen deficiency (Smiley, 2009). Below ground, infected plants show brownish roots, with fewer and shorter root branches. In severe cases, plants can be easily pulled from the soil as a result of root destruction (Smiley *et al*., 2004a, b). In addition to direct root damage, *P. thornei* invasions can also facilitate the penetration of other root pathogens, creating disease complexes that further deteriorate root function (Castillo *et al*., 1998). Assessing nematode damage solely on visible root symptoms may therefore be misleading due to concomitant infections with other fungi (Lasserre *et al*., 1994; Taheri *et al*., 1994). The addition of fertiliser to offset the poor growth caused by nematodes may exacerbate the problem as nitrogen enhances nematode reproduction, creating greater inoculum densities that can be destructive for a successive crop (Thompson *et al*., 1995).

The extent of nematode damage is generally density-dependent, with field studies showing a linear correlation between *P. thornei* population densities and yield losses of wheat and other crops (Owen *et al*., 2014). Yield losses due to *P. thornei* typically range from 10 to 30% but can reach up to 70% in some crops. For wheat, studies have

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reported *P. thornei* induced yield losses of 37% in Mexico (Nicol & Ortiz-Monasterio, 2004), 50% in the USA (Smiley *et al*., 2005a, b) and 70% in Australia (Thompson *et al*., 2008). In Turkey, *P. thornei* is considered to be the predominant species of the *Pratylenchus* genus and is widespread throughout cereal-growing regions, including the Mediterranean, Aegean, and Central, East and South Anatolia, causing estimated annual yield losses of 19% (Toktay, 2008; Kepenekci, 2012).

The best long-term management strategy for root-lesion nematodes is to grow wheat cultivars that are both resistant (*i.e.*, limits nematode multiplication) and tolerant (*i.e.*, yields are not significantly reduced, despite nematode attack) to the most economically important nematodes species (Taylor *et al*., 1999; Thompson *et al*., 1999, 2008; Williams *et al*., 2002; Vanstone *et al*., 2008). Crop rotation alone is often not effective due to the polyphagous nature of *P. thornei*. Breeding wheat accessions for nematode resistance is therefore an effective and economical method of minimising crop losses by preventing nematode reproduction and reducing disease pressure by leaving fewer nematodes in the soil to attack subsequent crops. The International Wheat and Maize Improvement Center (CIMMYT) has traditionally improved wheat germplasm for developing countries through a shuttle-breeding programme (van Ginkel *et al*., 2000), in which selection pressure is applied to segregating plant populations by alternate seasonal plantings between central and northwestern Mexico. CIMMYT has developed bread and durum wheat germplasm on nematode-infested sites for more than 50 years, yet little is known about their resistance and tolerance. This study aimed to validate the host reactions of spring wheat accessions in fields naturally infested with *P. thornei*.

Materials and methods

Germplasm selection

A total of 484 entries were evaluated from three sets of CIMMYT germplasm: the 29th Semi-Arid Wheat Screening Nursery (29th SAWSN; 126 entries), Spring Durum Wheat Nursery (SDWN; 208 entries), and Spring Bread Wheat Nursery (SBWN; 150 entries). Germplasm was first screened against *P. thornei* and *P. neglectus* under controlled growth room conditions at the Transitional Zone Agricultural Research Institute in Eskisehir, Turkey (see Table S1 in the Supplementary Material in the online edition of this journal, that can be accessed via https://brill.com/view/journals/nemy/nemy-overview.xml). Each entry was tested in three replicates and repeated twice. The most resistant accessions (56 entries) – 27 entries from the 29th SAWSN, 13 entries from SDWN, and 16 entries from SBWN – were selected for further evaluation under field conditions.

Experimental site

The study was conducted during the 2014-2015 and 2015-2016 growing seasons in Yenicepınar village (40°45′32″N; 31°45′07″E), Bolu province, Turkey. Soil at the site was characterised by shallow, sandy-clay-loamy texture with a plant-limiting hardpan layer at *ca* 60 cm below the surface. The site was chosen based on the Ímren *et al*. (2017) survey reports of heavy *P. thornei* infestation (840 indv. (100 g soil)$^{-1}$) and is characterised by wet cold winters and hot dry summers. Average annual temperature is 10.9°C. Annual precipitation ranges from 511 to 584 mm; yearly patterns fluctuate but most precipitation occurs in early winter (December) and spring (April) (Fig. 1). Average soil temperatures during April, May and June were 2.8, 8.4 and 11.3°C, respectively, for both the 2014-2015 and 2015-2016 growing seasons (TSMS, 2017).

Field experiments

A group of 56 entries which showed promising resistance potential against *P. thornei* under growth room condition were used for testing in two repeated trials in fields naturally infested with *P. thornei* during 2014-2015 and 2015-2016, sown at the beginning of November and harvested at mid-July (Table 1). Five standard control (reference) lines recognised internationally for their resistant/susceptible reactions to *P. thornei* were also included (Table 1). Bread wheat lines 'GS50a', '20617 CROC_1/AE.SQUARROSA (224)//OPATA', '20615 CROC_1/AE.SQUARROSA (224)//OPATA', 'Gatcher' and 'Seri' were chosen as control lines (CL) for their partial resistance or susceptible with tolerance or intolerance to *P. thornei* (Thompson *et al*., 1999).

Trials were planted in October for both seasons, with each entry sown in a plot measuring 2 m wide × 1 m long consisting of eight rows with 20 cm between rows. Seeds were sown at a rate of 550-600 seeds m^{-2}. Plots were arranged in a randomised complete block design with three replicates and trials were repeated once (2014-2015 and 2015-2016) for data validation. Trials were fertilised at the time of sowing with 10-10-10-5 NPKS at a rate of

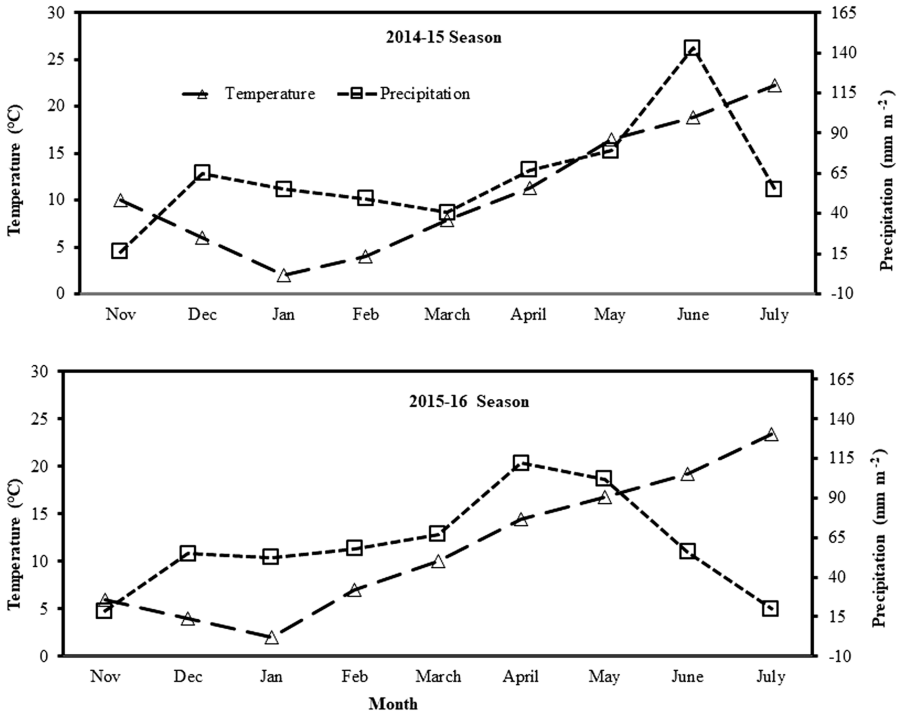


Fig. 1. Monthly total precipitation, average temperature and soil temperature during the 2014-2015 and 2015-2016 growing seasons in the experimental field area in Bolu, Turkey.

20 kg ha^{-1}. Bronate® herbicide (MCPA + bromoxynil) was applied at 470 ml ha^{-1} to control broad-leaf weeds. Trials were terminated in July; at harvest, spikes from each plot were manually harvested using a sickle and threshed with a small harvester. Grain weight per plot was measured and recorded.

Nematode sampling

Five soil subsamples of 250 cm^2 each were taken per plot in a zigzag pattern at the beginning of the growing seasons to assess nematode initial populations (P_i) per plot, 3 weeks after sowing. Samples were taken from around seed rows to a depth of 20 cm using a soil auger (2.5 cm diam.). Nematodes were extracted from the soil and root samples at the beginning of November using the Baermann funnel technique (Southey, 1986). The soil was left on extraction trays for 3 days before the water suspension was collected and concentrated by the use of a 20 μm sieve. *Pratylenchus thornei* were counted in 1 ml aliquots using a dissecting microscope (Zeiss V20) at 40× magnification. Similar sampling and extraction methods were performed again at maturity, *ca* mid-July, to determine final nematode population density (P_f) per plot. Reproduction Factor (RF) was calculated as RF = P_f/P_i.

The resistance reaction of an accession was classified into one of five distinctive groups based on the RF. The groups were: Resistant (R) = RF equal to or less than 1; Moderately Resistant (MR) = RF between 1-2, slightly more nematodes than in a resistant control; Moderately Susceptible (MS) = RF between 2-3, significantly more nematodes than in a resistant control, but not as many as in the susceptible control; Susceptible (S) = RF between 3-4, as many nematodes as in the susceptible control and number of nematodes per root system considered damaging; and Highly Susceptible (HS) = RF more than 4, more nematodes than in the susceptible control (Dababat *et al*., 2016), and taking into account the reaction of the known control lines used in the study. The tolerance reaction of an accession was classified into four groups based on the RF and yield potential. The groups were: Tolerant (T) = plants yielded well despite low nematode attack; Moderately Tolerant (MT) = plants yielded moderately under moderate nematode attack; Intolerant (IT) = plants yielded poorly even under low nematode pressure; Highly

Table 1. CIMMYT advanced spring wheat lines from the 29th Semi-Arid Wheat Screening Nursery (29th SAWSN), Spring Wheat Nursery (SBWN), and Spring Durum Wheat Nurseries (SDWN) with accession cross name, germplasm identification (GID), cross identification (CID), selection identification (SID), resistance reaction under growth room conditions (RR-GR), resistance reaction under field conditions (RR-F) and tolerance reaction (TR) against *Pratylenchus thornei*.

Ent	Cross name	Nursery	GID	CID	SID	RR-GR	RR-F	TR
L1	ROLF07/3/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	6001239	504090	84	MR	MR	IT
L2	POTCH 93/4/MILAN/KAUZ//PRINIA/3/BAV92/5/ MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	5999970	512755	69	MR	MR	IT
L3	D67.2/PARANA 66.270//AE.SQUARROSA (320)/ 3/CUNNINGHAM/4/WBLL1*2/TUKURU	29th SAWSN	6001137	495387	100	MR	MS	IT
L4	ONIX/ROLF07	29th SAWSN	6000384	504248	70	MR	HS	IT
L5	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	6000615	506887	99	MR	MR	MT
L6	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	6000624	506887	108	MR	S	MT
L7	BAV92/SERI	29th SAWSN	6001233	285851	1380	MR	R	MT
L8	ESDA/KKTS	29th SAWSN	6001472	495073	28	MR	MS	MT
L9	SOKOLL*2/4/CHEN/AEGILOPS SQUARROSA (TAUS)//FCT/3/STAR	29th SAWSN	6001643	496027	103	MR	MS	MT
L10	MILAN/KAUZ//PRINIA/3/BAV92/4/ATTILA/BAV92// PASTOR/5/CNO79//PF70354/MUS/3/PASTOR/4/BAV92	29th SAWSN	6000648	506898	48	MR	S	MT
L11	SOKOLL*2/4/CHEN/AEGILOPS SQUARROSA (TAUS)//FCT/3/STAR	29th SAWSN	6001642	496027	102	MR	MR	MT
L12	SOKOLL//FRTL/2*PIFED	29th SAWSN	6001172	495447	74	MR	MR	MT
L13	GK ARON/AG SECO 7846//2180/4/2*MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	6001012	506830	97	MR	MR	MT
L14	MILAN/KAUZ//PRINIA/3/BAV92/5/TRAP#1/BOW// VEE#5/SARA/3/ZHE JIANG 4/4/DUCULA	29th SAWSN	6000269	504111	157	MR	S	MT
L15	SERI*3//RL6010/4*YR/3/PASTOR/4/BAV92/5/MONARCA F2007/ 6/PVN//CAR422/ANA/5/BOW/CROW//BUC/PVN/3/YR/4/TRAP#1	29th SAWSN	6000104	512926	130	MR	R	MT
L16	SOKOLL/TRCH	29th SAWSN	6001064	495192	161	MR	S	MT
L17	NSM*4/14-2//FRTL/2*PIFED/3/VORB	29th SAWSN	6000219	512786	100	MR	R	MT
L18	ACHTAR*3//KANZ/KS85-8-5/4/MILAN/KAUZ//PRINIA/ 3/BAV92/5/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	5999984	512797	149	MR	MR	MT
L19	BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/CASKOR/ 3/CROC_1/AE.SQUARROSA (224)//OPATA/7/PASTOR// MILAN/KAUZ/3/BAV92	29th SAWSN	6001673	496096	39	MR	S	T
L20	PASTOR*2/BAV92/3/FRET2/KUKUNA//FRET2	29th SAWSN	6001418	494962	59	MR	MS	T
L21	ACHTAR/4/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	6000537	504457	64	MR	MR	T
L22	SOKOLL//PBW343*2/KUKUNA/3/ATTILA/PASTOR	29th SAWSN	6000921	507064	90	MR	MR	T
L23	CUNNINGHAM/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ	29th SAWSN	6001457	494983	41	MR	S	T
L24	ONIX/4/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	6000396	504250	105	MR	MS	T
L25	EGA BONNIE ROCK*2/5/FRET2*2/4/SNI/TRAP#1/3/ KAUZ*2/TRAP//KAUZ	29th SAWSN	6000085	512870	88	MR	S	T
L26	ONIX/ROLF07	29th SAWSN	6000387	504248	73	MR	MR	T
L27	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/ T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/ 5/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	6000240	512908	135	MR	MR	T
L28	WBLL1*2/KURUKU//HEILO	SBWN	6175947	516107	102	R	S	MT
L29	ATTILA*2/PBW65*2//KACHU	SBWN	6175962	516338	29	R	MR	MT
L30	SAUAL/YANAC//SAUAL	SBWN	6178533	516539	55	R	MR	MT

Table 1. (Continued.)

Ent	Cross name	Nursery	GID	CID	SID	RR-GR	RR-F	TR
L31	PBW343*2/KUKUNA*2//FRTL/PIFED	SBWN	6179227	516587	46	MR	R	MT
L32	WBLL1*2/4/BABAX/LR42//BABAX/3/BABAX/LR42//BABAX	SBWN	6179255	516641	62	MR	MR	T
L33	ATTILA*2/PBW65*2//W485/HD29	SBWN	6176409	516715	24	R	S	MT
L34	ATTILA*2/PBW65*2/4/BOW/NKT//CBRD/3/CBRD	SBWN	6176558	516782	44	R	MS	MT
L35	QUAIU/5/FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ	SBWN	6178997	520167	40	R	MR	MT
L36	C80.1/3*BATAVIA//2*WBLL1/4/D67.2/PARANA 66.270// AE.SQUARROSA (320)/3/CUNNINGHAM/5/T.DICOCCON PI225332/AE.SQUARROSA (895)//WBLL1/3/2*WBLL1	SBWN	6280219	522444	53	R	S	MT
L37	BABAX/LR39//BABAX/3/VORB/4/SUNCO/2*PASTOR	SBWN	6280233	518855	125	R	R	T
L38	VORB/4/D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/5/D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM	SBWN	6280381	518898	124	R	R	T
L39	T.TAU.83.2.29/ATTILA//ATTILA/3/EXCALIBUR	SBWN	6280415	517297	78	R	R	T
L40	VORB*2/3/PFAU/WEAVER//KIRITATI	SBWN	6424871	522420	252	S	R	MT
L41	FRANCOLIN #1/4/BABAX/LR42//BABAX*2/3/KURUKU	SBWN	6179347	520068	59	MR	MS	T
L42	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/ ATTILA/2*PASTOR/5/QUAIU #3	SBWN	6181747	520853	28	S	MS	IT
L43	H45/4/KRICHAUFF/FINSI/3/URES/PRL//BAV92	SBWN	6278849	522811	30	R	MR	MT
L44	RANCO//CIT71/CII/3/COMDK/4/TCHO//SHWA/MALD/ 3/CREX/5/SNITAN/6/YAZI_1/AKAKI_4//SOMAT_3/ 3/AUK/GUIL//GREEN	SDWN	6004486	496493	44	MR	R	T
L45	MOHAWK/6/LOTUS_5/F3LOCAL(SEL.ETHIO.135.85)/ 5/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	6004811	504706	94	R	MS	T
L46	GUANAY/3/FULVOUS_1/MFOWL_13//JUPARE C 2001/8/R143/ RUFF//STIL/3/YAV79/4/SHWA/MALD/5/ALTAR 84/6/TILO_1/ LOTUS_4/7/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	6005080	505483	98	R	HS	HT
L47	MERIDIANO/3/SOMAT_3/PHAX_1//TILO_1/LOTUS_4/5/ TATLER_1/TARRO_1/3/CANELO_8//SORA/2*PLATA_12/4/ ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	6139502	515598	112	R	R	MT
L48	AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/ SOMBRA_20/4/SNITAN/5/SOMAT_4/INTER_8/6/SOMO/ CROC_4//LOTUS_1/3/KITTI/4/JUPARE C 2001	SDWN	6139776	510524	288	R	S	T
L49	ZENIT/5/SORA/2*PLATA_12//RASCON_37/4/ARMENT//SRN_3/ NIGRIS_4/3/CANELO_9.1/6/MINIMUS_4/GRO_2/3/PROZANA/ ARLIN//MUSK_6/5/SULA/RBCE_2/3/HUI//CIT71/CII/4/ RYPS27_3/SKARV_3	SDWN	6421007	521621	58	R	R	MT
L50	PRECO/6/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/ 3/POD_9/4/RASCON_37/TARRO_2//RASCON_37/5/ARMENT// SRN_3/NIGRIS_4/3/CANELO_9.1/7/1A.1D 5+1-06/3*MOJO// RCOL/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	6421062	527469	67	R	R	IT
L51	SOMAT_4/INTER_8/5/CREX//BOY/YAV_1/3/PLATA_6/4/ PORRON_11/6/MINIMUS_6/PLATA_16//IMMER/3/SORA/ 2*PLATA_12/7/RASCON_22/RASCON_21//MOJO_2/3/ GUANAY/4/RCOL/5/SORA/2*PLATA_12//SOMAT_3	SDWN	6421363	526447	154	R	R	MT
L52	KIRKI_1/HIMAN_9/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/ ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/6/ADAMAR_15// ALBIA_1/ALTAR 84/3/SNITAN/4/SOMAT_4/INTER_8/5/ SOOTY_9/RASCON_37/7/1A.1D 5+1-06/3*MOJO//RCOL/4/ ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	6421497	527534	105	R	MS	MT

Table 1. (Continued.)

Ent	Cross name	Nursery	GID	CID	SID	RR-GR	RR-F	TR
L53	MÂALI/5/LOTUS_5/SORD_1/3/CANELO_8//SORA/ 2*PLATA_12/4/YAZI_1/AKAKI_4//SOMAT_3/3/ AUK/GUIL//GREEN	SDWN	6421550	521203	39	R	MS	MT
L54	BELLAROI/6/RASCON_22/RASCON_21//MOJO_2/3/GUANAY/ 4/RCOL/5/SORA/2*PLATA_12//SOMAT_3/8/PLATA_3//CREX/ ALLA/3/YAZI_10/4/JUPARE C 2001/7/CHEN_11/POC//TANTLO/ 5/ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/2*TC60//JO69/6/ MINIMUS/COMB DUCK_2//CHAM_3	SDWN	6634315	538221	95	R	R	IT
L55	1A.1D 5+1-06/3*MOJO//RCOL/4/ARMENT//SRN_3/NIGRIS_4/ 3/CANELO_9.1/11/SOOTY_9/RASCON_37/3/SOOTY_9/ TARRO_1//AJAIA_2/10/PLATA_10/6/MQUE/4/USDA573//QFN/ AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/ 9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	6635117	537793	61	R	S	IT
L56	SOMAT_4/INTER_8/3/RASCON_21/KNAR_3//PLATA_8/4/ CNDO/PRIMADUR//HAI-OU_17/3/SNITAN/9/GEDIZ/FGO// GTA/3/SRN_1/4/TOTUS/5/ENTE/MEXI_2//HUI/4/YAV_1/ 3/LD357E/2*TC60//JO69/6/SOMBRA_20/7/JUPARE C 2001/8/CS/TH.CU//GLEN/3/GEN/4/MYNA/VUL/ 5/2*DON87/6/2*BUSCA_3	SDWN	6635238	537883	86	R	S	MT
CL1	CROC_1/AE.SQUARROSA (224)//OPATA					R	MR	T
CL2	CROC_1/AE.SQUARROSA (224)//OPATA					R	R	T
CL3	GATCHER					S	MS	MT
CL4	GS50A					R	MR	T
CL5	Seri					S	HS	MT

The five control (reference) lines (CL) used in the study are listed at the end of this table. Abbreviations: moderately resistant (MR), resistant (R), intolerant (IT), tolerant (T), moderately tolerant (MT), highly tolerant (HT), moderately susceptible (MS), highly susceptible (HS) and susceptible (S).

Tolerant (HT) = plants yielded well even though under high nematode attack (Smiley *et al*., 2014).

Statistical analysis

Data were analysed using analysis of variance (ANOVA). Significant differences between lines were detected using protected least significant difference at $P < 0.001$ using SPSS statistical software V 17.0 (SPSS). Linear regression analyses were also conducted to reveal relationships between the *P. thornei* RF and the grain yield of each wheat line. Population structure was determined by principal component analysis using R 3.4.3 software to distinguish principal groups of wheat lines based on their resistance/susceptibility and tolerance to *P. thornei* by calculating yield and the RF of nematodes. The coefficient of determination (R^2) was calculated using XLSTAT software 2016.02.28451 (Addinsoft). Nematode variables were transformed to $\log_{10}(x + 1)$ before analysis.

Results

During the 2014-2015 growing season, soil temperatures ranged from −4.7 to 13.7°C, while in 2015-2016 they ranged from −5.3 to 14.1°C (TSMS, 2017). Temperatures increased gradually in March and April, at the early tillering stage, based on the Zadoks 13-21 growth scale (Zadoks *et al*., 1974), with the highest temperatures recorded in August (Fig. 1). Total precipitation was 636 mm and 611 mm in the 2014-2015 and 2015-2016 growing seasons, respectively (Fig. 1).

The 29th semi-arid wheat screening nursery (SAWAN)

The 27 lines from the 29th SAWSN were evaluated for their host status to *P. thornei* based on the numbers of nematodes extracted from roots and soil. Reactions ranged from resistant (L7, RF = 0.88; L17, RF = 0.81) to susceptible (L4, RF = 6.8) (Fig. 2A). The RF of

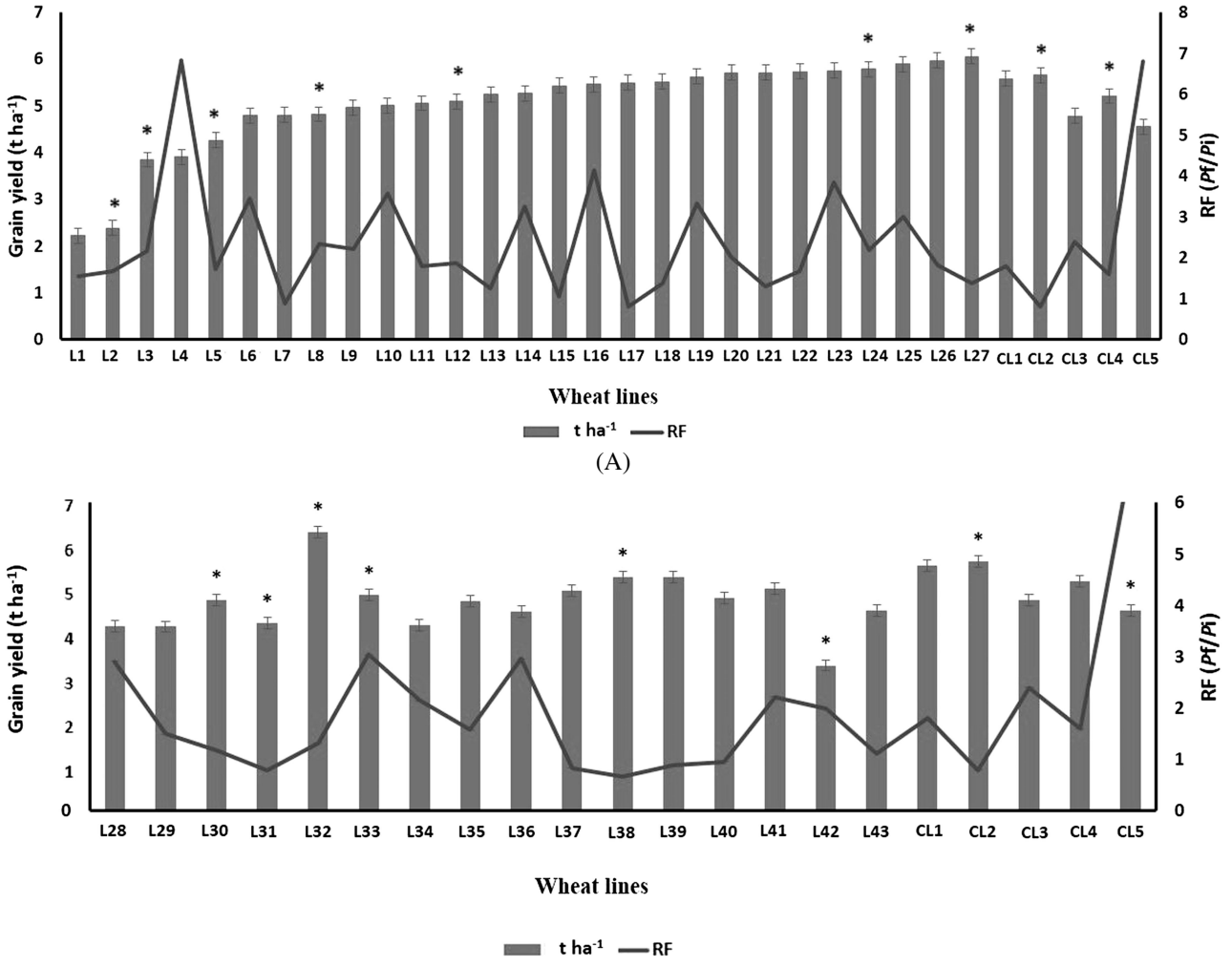
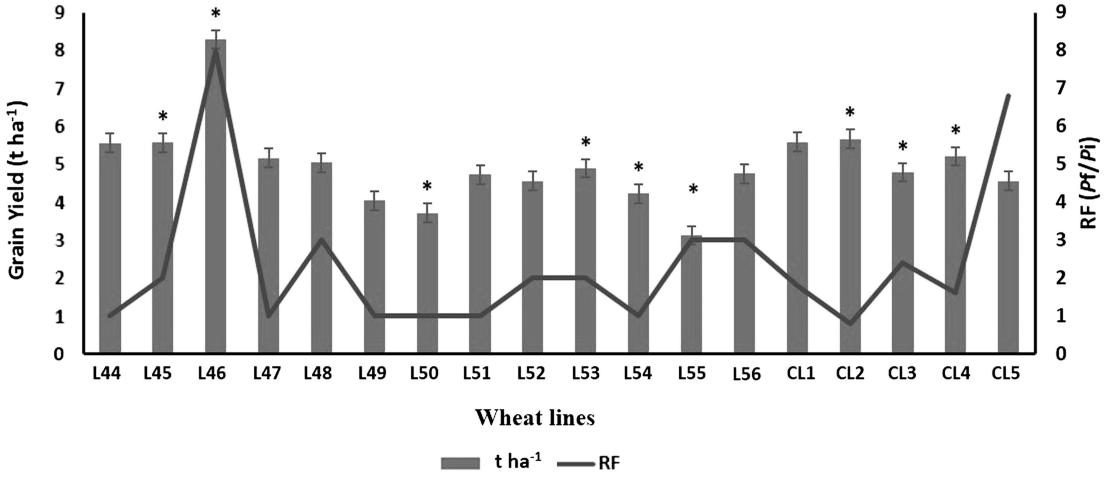


Fig. 2. A: Mean grain yield and *Pratylenchus thornei* reproduction factor (RF) in Bolu province, Turkey, during the 2014-2015 and 2015-2016 growing seasons. Stars represent homogeneous groups based on protected least significant difference test for each variable at $P < 0.001$. A: 27 wheat lines from the 29th Semi-Arid Wheat Spring Nursery (29th SAWSN) and five known control (reference) lines (CL); B: 16 wheat lines from the 29th Semi-Arid Wheat Spring Nursery (SBWN) and five known CL lines; C: 13 wheat lines from the 29th Semi-Arid Wheat Spring Nursery (SDWN) and five known CL lines; D: combined three wheat nurseries (29th SAWSN, SBWN and SDWN). Error lines on bars represent the standard error (n = 6).

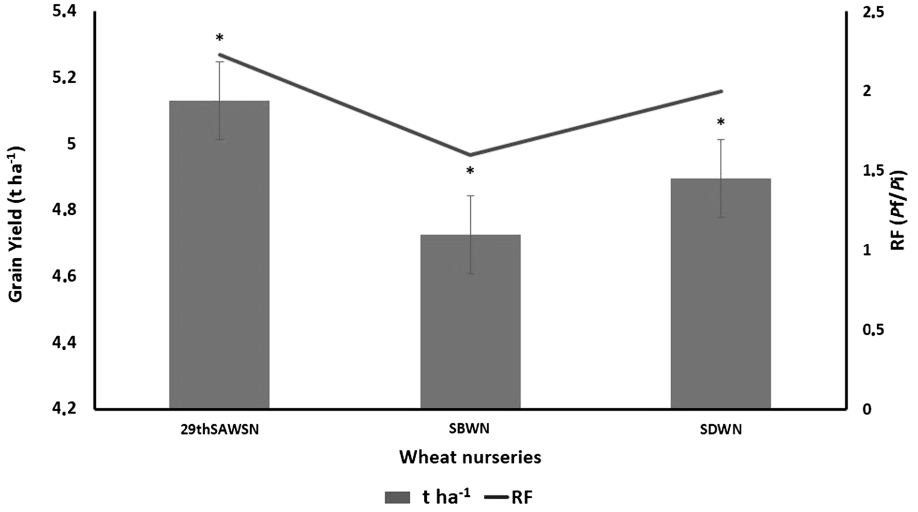
control lines ranged from 0.8 (CL2) to 2.4 (CL3). The RF values for L7 and L17 were significantly lower than any other line evaluated (Fig. 2A). Grain yields ranged from 2.22 t ha^{-1} (L1) to 6.05 t ha^{-1} (L27). After L7 and L17, lines L20, L21, L22, L23, L24, L25, L26 and L27 were the most resistant, with RF values of 2.1, 1.3, 1.7, 3.8, 2.2, 3.0, 1.8 and 1.4, respectively (Fig. 2A). Control lines CL1, CL2, CL3, CL4, and CL5 had RF values of 1.8, 0.8, 2.4, 1.6, and 6.8, respectively, confirming the susceptibility of CL3 and CL5 to *P. thornei*. Regression analyses clearly showed that *P. thornei* RF was negatively correlated with grain yield ($R^2 = 0.90$; Fig. 3A).

Spring bread wheat nursery (SBWN)

We found significant differences ($P \leqslant 0.05$) in host status of the SBWN lines to *P. thornei*, ranging from resistant to susceptible in terms of reproduction factor (RF) (Fig. 2B). Of the 16 lines tested, five (L31, L37, L38, L39,



(C)



(D)

Fig. 2. (Continued.)

L40) were as resistant as the controls with known resistance to *P. thornei* (CL1, CL2, CL4), with significantly lower RF compared to the other SBWN lines evaluated in this study. The lowest RF was achieved by L38 (0.66), while both L33 and L36 gave the highest RF (3.0). The highest grain yield was achieved by L32 (6.33 t ha^{-1}), with RF = 1.3, indicating that this line is both moderately resistant and tolerant to *P. thornei*. The control lines performed as expected, with reactions ranging from resistant (CL2, RF = 0.8; CL4, RF = 1.6) to susceptible (CL3, RF = 2.4; CL5, RF = 6.8). Regression analyses indicated a significant negative relationship between grain yield and RF ($R^2 = 0.93$) (Fig. 3B).

SPRING DURUM WHEAT NURSERY (SDWN)

There were significant differences ($P < 0.001$) across the 15 SDWN lines evaluated, with *P. thornei* RF ranging from 1.0 to 8.0. A total of six lines (L44, L47, L49, L50, L51, L54) were determined to be resistant (Fig. 2C). These lines did not support nematode reproduction and the resulting RF was below 1.0. The remaining nine lines showed moderate susceptibility to *P. thornei*. Interestingly, L46 had the highest grain yield (8.29 t ha^{-1}), despite a RF of 6.0, indicating that this line has excellent tolerance to *P. thornei*. Despite this anomaly, regression analysis gave a significant negative relationship be-

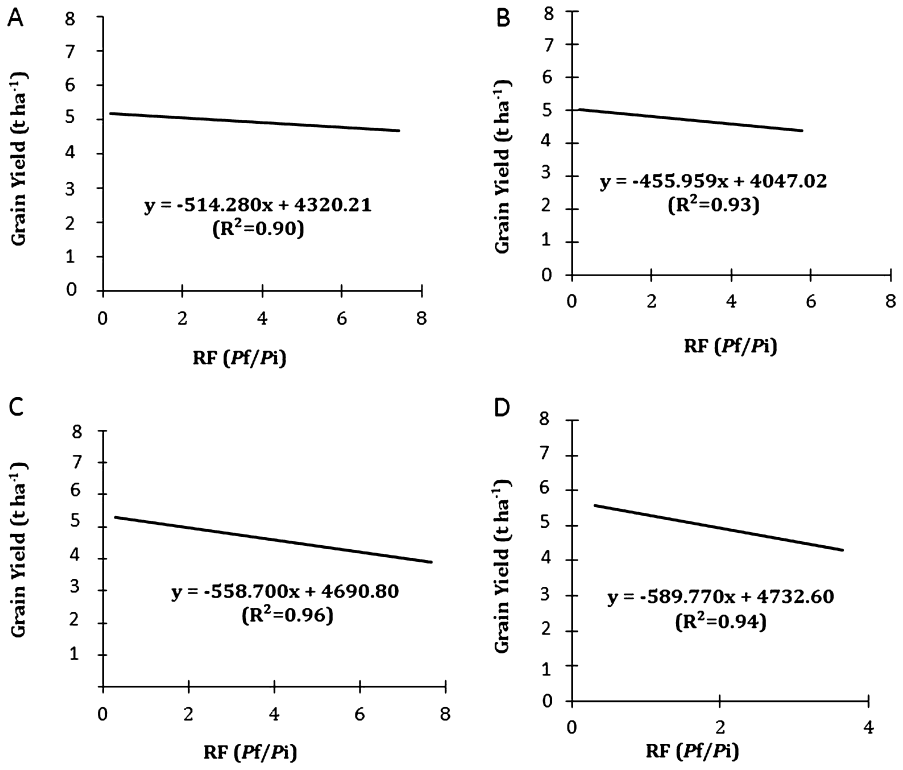


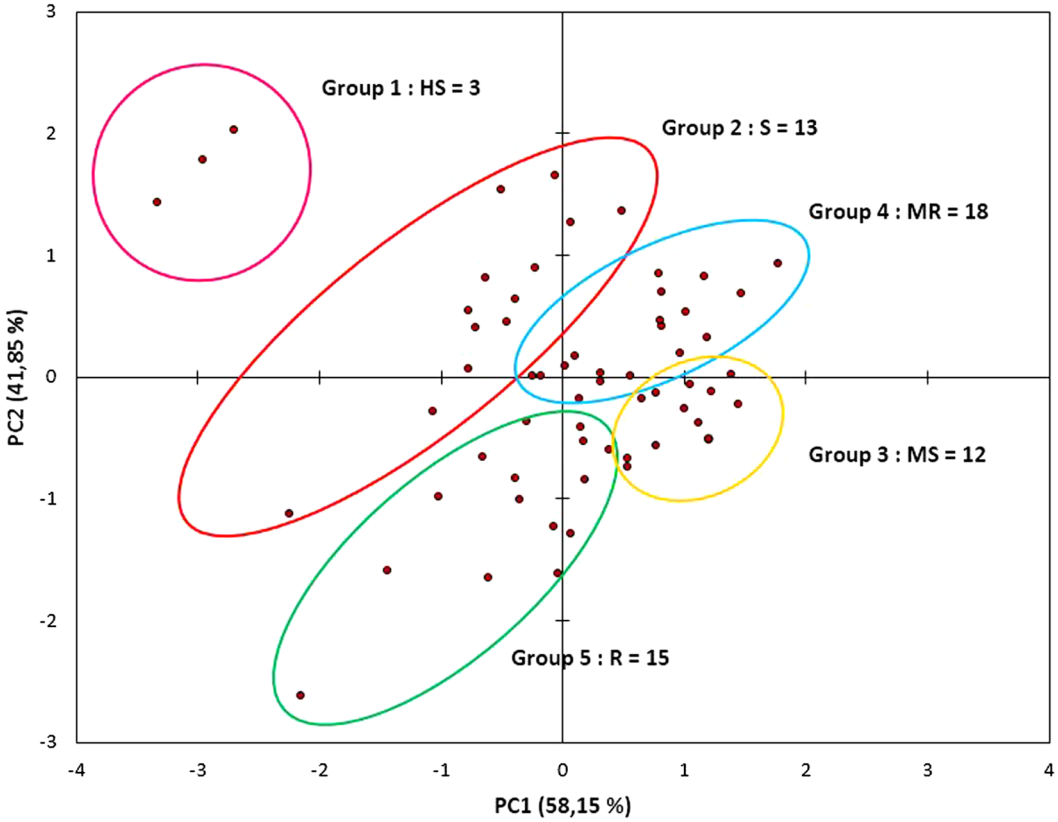
Fig. 3. Log-linear regressions of grain yield and *Pratylenchus thornei* reproduction factor (RF) in three wheat nurseries. All R^2 values were significant at $P < 0.001$. All values show the mean of 2 years, each with three replicates. A: 29th Semi-Arid Wheat Screening Nursery (29th SAWSN); B: Spring Wheat Nursery (SBWN); C: Spring Durum Wheat Nursery (SDWN); D: combination of the three nurseries. The link represents the predicted log-linear regression model. Equations were back-transformed on kg ha^{-1}.

tween RF and grain yield ($R^2 = 0.96$) as shown in Figure 3C.

As shown in (Fig. 2D), the 29th SAWSN showed both higher yields and higher RF, compared to the SBWN trial, which confirms some tolerance of the 29th SAWSN lines against *P. thornei*. For SBWN lines, grain yield was low even at low initial densities of nematodes (P_i); this higher yield in the presence of the nematodes may be suggestive of tolerance and further work is warranted. Analysis of population structure based on RF (resistant reaction) displayed five distinct groups among the 61 lines evaluated (including controls) (Fig. 4A). Group 1 comprised three highly susceptible lines (HS), including L4 (29th SAWSN) and L46 (SDWN). Group 2 comprised 13 susceptible lines (S), including L6 (29th SAWSN), L33 (SBWN) and L48 (SDWN). Group 3 comprised 12 moderately susceptible lines (MS), including L3 (29th SAWSN), L34 (SBWN) and L53 (SDWN). Resistant lines are represented well in two distinct groups: Group 4 comprised 18 moderately resistant ones (MR), such as L1 (29th SAWSN) and L29 (SBWN), while the final group, Group 5, comprised 15 resistant lines (R) including L7 (29th SAWSN), L37 (SBWN) and L47 (SDWN). The PCA based on RF and yield (tolerance reaction) displayed four groups (Fig. 4B). Group 1 consisted of 20 tolerant lines (T) including L22 (29th SAWSN), L32 (SBWN) and L45 (SDWN), while Group 2 comprised 33 moderately tolerant lines (MT) as indicated in Table 1. However, Group 3 consisted of only one line (L46 from SDWN), which was highly tolerant (HT) to *P. thornei*. Finally, Group 4 consisted of eight intolerant lines (IT), such as L2 (29th SAWSN), L42 (SBWN) and L50 (SDWN).

Discussion

The use of resistant wheat varieties is considered the most economically feasible and environmentally sustainable method for controlling *P. thornei*. Many studies have attempted to identify new sources of root-lesion nematode

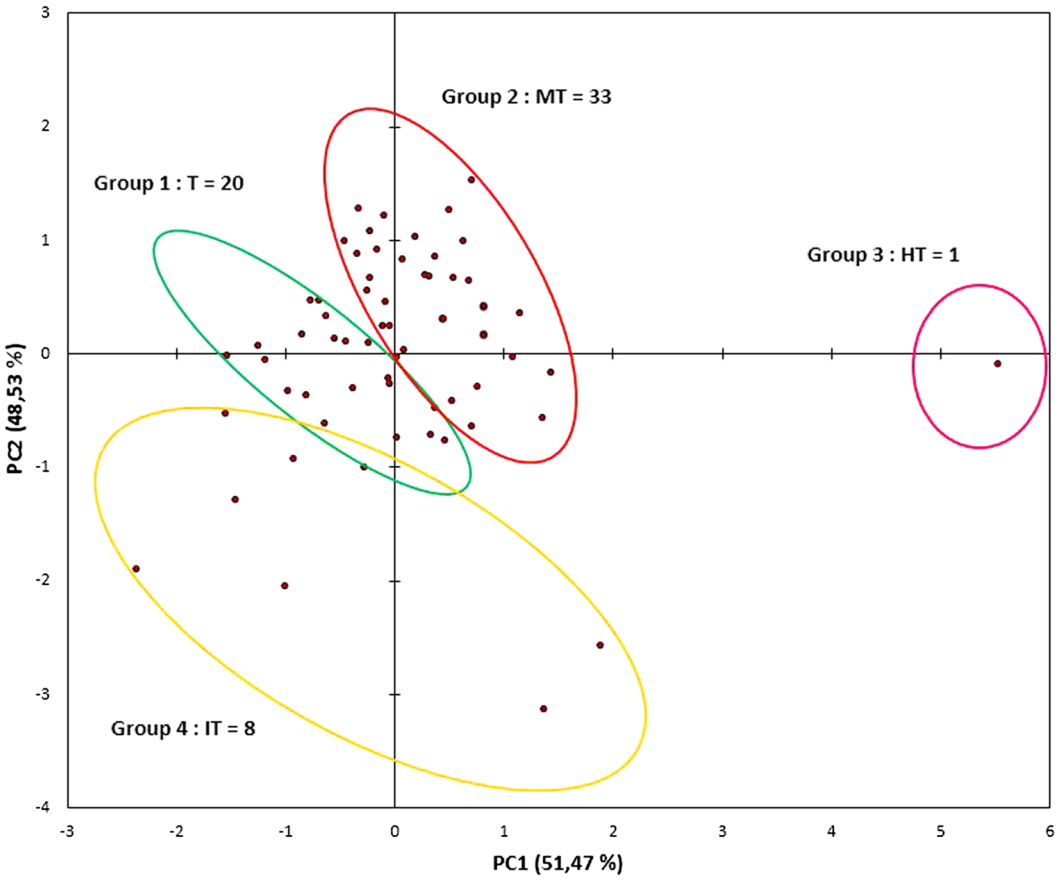


(A)

Fig. 4. A: Principal component analysis (Kendall type) showing the population structure for a set of 61 lines from CIMMYT's wheat nurseries: 29th Semi-Arid Wheat Screening Nursery (29th SAWSN), Spring Wheat Nursery (SBWN) and Spring Durum Wheat Nursery (SDWN) based on their resistance reaction; B: Principal component analysis (Kendall type) showing the population structure for a set of 61 lines from CIMMYT's wheat nurseries: 29th SAWSN, SBWN and SDWN based on their tolerance reaction. Abbreviations: R: resistant; MR: moderately resistant; MS: moderately susceptible; S: susceptible; HS: highly susceptible; IT: intolerant; T: tolerant; MT: moderately tolerant; HT: highly tolerant.

resistance (Zwart *et al*., 2005; Thompson & Seymour, 2011). Nematode resistance in wheat has been reported from pot (glasshouse and growth chamber) and field experiments (Thompson *et al*., 2015; Dababat *et al*., 2016; Mokrini *et al*., 2018). Tolerant varieties suffer little yield reduction even when their roots are invaded by nematodes, while resistant varieties reduce the rate of nematode multiplication in the roots (Roberts, 2002).

In Turkey, breeders have selected wheat varieties for *Pratylenchus* resistance for decades due to high infection pressure. Toktay *et al*. (2012) identified 31 wheat lines resistant to *P. thornei* and found that four wheat lines had dual resistance to *P. thornei* and *Heterodera avenae*. Glasshouse resistance experiments conducted by Toktay *et al*. (2008) showed that the national bread wheat variety 'Adana 99' (PFAU/SERI82//BOG"S") was resistant to an Adana population of *P. thornei*. In a more recent study, Toktay *et al*. (2015) examined 32 wild emmers and 42 wheat cultivars grown in Turkey for their resistance to *P. thornei* and *P. neglectus* under *in vitro* conditions. They found 25 and 35 wheat varieties with moderate resistance to *P. thornei* and *P. neglectus*, respectively, while 17 lines exhibited multiple resistance reactions to both nematodes. Similarly, Ímren *et al*. (2015) investigated 82 durum wheat varieties grown in Turkey for their responses to *P. thornei* and *P. neglectus* under *in vitro* conditions. They found no varieties with complete resistance to either *P. thornei* or *P. neglectus* and wheat varieties ranged from susceptible to moderately resistant, against both *P. thornei* and *P. neglectus*.



(B)

Fig. 4. (Continued.)

In Australia, several lines identified as resistant to *P. thornei* or *P. neglectus* have been evaluated internationally (Sheedy *et al*., 2008; Keil *et al*., 2009; Fatemeh *et al*., 2012) and maintained the same level of resistance, suggesting that pathotypes do not occur within *P. thornei* or *P. neglectus* populations. Kranti & Kanwar (2012) reported several lines resistant to the Indian population of *P. thornei*, including the CIMMYT line CROC_1/AE.SQUARROSA (224)//OPATA, AUS 15854, PBW 343, PBW 550, Raj MR 1, and 'Raj 3765' and they concluded that AUS 15854, CYMMIT line and 'Raj MR1' have dual resistance to both *P. thornei* and *H. avenae*. Similarity, Nicol *et al*. (2009) reported that 'Raj' (MR variety) and other CIMMYT lines were resistant to *P. thornei*. Thompson & Seymour (2011) reported that two wheat cultivars ('Morocco 426' and 'Iraq 43') were the best parents tested in a glasshouse for breeding for resistance to *P. thornei*.

Lines from the three nurseries evaluated within this study were identified with a range of responses, from resistant to susceptible to *P. thornei* in the field, with several lines from each of the three nurseries identified as resistant (RF $\leqslant$ 1.0). Fourteen lines were resistant to *P. thornei*: L7, L15, and L17 (29th SAWSN); L31, L37, L38, L39 and L40 (SWSN); and L44, L47, L49, L50, L51 and L54 (DWSN). Recently, Mokrini *et al*. (2018) confirmed the resistance of the CIMMYT lines CROC_1/AE.SQUARROSA (224)//OPATA and AUS 4930.7/2 PASTOR to Moroccan *P. thornei*, even in the presence of the cereal cyst nematode *H. avenae*. Meanwhile, Thompson *et al*. (1999), Hollaway *et al*. (2000), Talavera & Vanstone (2001) and Kranti & Kanwar (2012) reported that in Australia, Spain and India, most durum lines have greater resistance compared to *Triticum aestivum*, which strongly supports our findings. Generally, durum wheat has been reported by many researchers to be more resistant to the cereal ne-

matodes when compared to bread wheat (Talavera & Vanstone 2001; Nombela & Romero, 2001; Gao *et al*., 2012). Talavera & Vanstone (2001) reported that the durum wheat 'Dopendro' was resistant to *P. thornei* in Spain. A wide range of tolerance among susceptible lines was detected. Such variability in tolerance might be influenced by host plant genetics and environmental factors that can affect plant growth.

We found significant negative correlations between RF and wheat yields. This agrees with Smiley *et al*. (2005b), who described a strong inverse correlation between wheat grain yield and *P. thornei* initial populations (P_i) in the soil and nematode density in mature roots. They evaluated the relationship between RF and yield on two distinct wheat varieties as the intolerant/susceptible 'Machete' shows a negative effect of yield and higher RF, in contrast to the moderately tolerant/moderately susceptible 'Krichauff'. Similarly, Owen *et al*. (2014) evaluated biomass and total wheat yield of 'Strzelecki' in *P. thornei*-infested fields and found a negative correlation between *P. thornei* P_i and grain yield. Another *Pratylenchus* species, *P. neglectus*, has been reported to influence wheat growth negatively in the Pacific Northwest (Smiley *et al*., 2005c). Meanwhile, Gitti *et al*. (2015) described the impact of *P. thornei* and *P. neglectus* populations on wheat in Iran, where there was a negative correlation between grain yield and nematode RF values in the soil. Other studies have found the same negative correlation between RF and wheat yield for other nematodes. For example, Ímren & Elekcioğlu (2014) described a negative relationship between the RF of cereal cyst nematodes, *H. avenae*, and grain yield of selected lines ('Seri-82', 'Osmaniyem' and 'Karatopak') from Turkey's eastern Mediterranean region.

Pratylenchus thornei multiplication in the three evaluated nurseries during the 2014-2015 and 2015-2016 growing seasons was influenced by the host plant, biotic and abiotic factors (Griffin *et al*., 1996; McSorley, 2003). *Pratylenchus thornei* RF declined during the 2015-2016 growing season for the 29th SAWSN when compared to 2014-2015, yet increased for the SDWN and SBWN nurseries. This difference in *P. thornei* population numbers may be due to adaptation of the population to its environment (Dao, 1970; Moens & Perry, 2009). In the region where trials were conducted, winter precipitation during 2015-2016 was slightly higher than in 2014-2015. Furthermore, the soil temperature was lower compared to long-term averages of the region in both seasons, which may have limited the survival of *P. thornei* in the soil (Kandel *et al*., 2013).

In conclusion, nematode resistance should contribute to nematode management, especially when combined with tolerance. There are lines that may be highly tolerant to *P. thornei* and produce higher yields in infested fields, but, at the same time, these lines increase the risk level for the other successive intolerant crops. This is the case for the 29th SAWSN, where lines went through heat and drought screening in Mexico and, therefore, show high yields even under high nematode pressure. This study provides baseline information for selecting appropriate wheat lines for use in future root-lesion nematode management programmes involving resistant lines especially the four spring bread wheat lines (L37, L38, L39 and L44) and the spring durum wheat lines (L47, L49 and L51), which demonstrated resistant and tolerant to *P. thornei* under field conditions.

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Table S1. List of CIMMYT advanced spring wheat lines (484) originated from the 29th Semi-Arid Wheat Screening Nursery (29th SAWSN), Spring Bread Wheat Nursery (SBWN) and Spring Durum Wheat Nurseries (SDWN) with accession cross name, germplasm identification (GID), cross identification (CID), selection identification (SID), resistance reaction under growth room conditions (RR-GR), against both *Pratylenchus thornei* (Pt) and *P. neglectus* (Pn), plus the control (reference) lines presented in Table 1 in the manuscript.

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
1	1	W15.92/4/PASTOR//HXL7573/2*BAU/3/WBLL1	29th SAWSN	473251	5435924	30	S	MS
2	2	POTCH 93/4/MILAN/KAUZ//PRINIA/3/BAV92/5/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	512755	5999970	69	MS	MR
3	3	ACHTAR*3//KANZ/KS85-8-5/4/MILAN/KAUZ//PRINIA/3/BAV92/5/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	512797	5999989	154	S	S
4	4	QG 4.37A/4/MILAN/KAUZ//PRINIA/3/BAV92/5/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	512844	6000027	121	MS	MS
5	5	NSM*4/14-2//FRTL/2*PIFED/3/VORB	29th SAWSN	512786	6000219	100	MR	MR
6	6	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/5/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	512908	6000229	124	MS	MS
7	7	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/5/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	512908	6000238	133	HS	HS
8	8	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/ONIX	29th SAWSN	504237	6000355	155	MS	MS
9	9	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/ONIX	29th SAWSN	504237	6000365	165	S	HS
10	10	ONIX/ROLF07	29th SAWSN	504248	6000384	70	MR	MR
11	11	ONIX/ROLF07	29th SAWSN	504248	6000390	76	MS	MS
12	12	ONIX/4/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	504250	6000404	113	S	S
13	13	ACHTAR/4/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	504457	6000537	64	MR	MR
14	14	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000614	98	MS	HS
15	15	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000617	101	S	MR
16	16	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000619	103	MR	HS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
17	17	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000623	107	MR	MS
18	18	MILAN/KAUZ//PRINIA/3/BAV92/4/ATTILA/BAV92// PASTOR/5/CNO79//PF70354/MUS/3/PASTOR/4/BAV92	29th SAWSN	506898	6000648	48	MR	MR
19	19	SOKOLL*2/TROST	29th SAWSN	507062	6000906	97	S	MR
20	20	SOKOLL*2/TROST	29th SAWSN	507062	6000909	100	MS	S
21	21	SOKOLL//PBW343*2/KUKUNA/3/ATTILA/PASTOR	29th SAWSN	507064	6000917	86	MS	MS
22	22	SOKOLL*2/ROLF07	29th SAWSN	507102	6000973	57	S	HS
23	23	GK ARON/AG SECO 7846//2180/4/2*MILAN/ KAUZ//PRINIA/3/BAV92	29th SAWSN	506830	6001013	98	S	MR
24	24	GK ARON/AG SECO 7846//2180/4/2*MILAN/ KAUZ//PRINIA/3/BAV92	29th SAWSN	506830	6001014	99	S	MS
25	25	GK ARON/AG SECO 7846//2180/4/2*MILAN/ KAUZ//PRINIA/3/BAV92	29th SAWSN	506830	6001016	101	MR	HS
26	26	SW89-5124*2/FASAN/3/ALTAR 84/AE.SQ//2*OPATA	29th SAWSN	495230	6001072	91	MS	HS
27	27	SOKOLL/ROLF07	29th SAWSN	495241	6001093	91	S	MR
28	28	SOKOLL//FRTL/2*PIFED	29th SAWSN	495447	6001172	74	MR	MR
29	29	SOKOLL//FRTL/2*PIFED	29th SAWSN	495447	6001179	81	MS	MS
30	30	BAV92/SERI	29th SAWSN	285851	6001235	1382	MR	S
31	31	ROLF07/3/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	504090	6001239	84	MR	MR
32	32	ROLF07/3/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	504090	6001240	85	HS	MS
33	33	MILAN/KAUZ//PRINIA/3/BAV92/4/WBLL1*2/KUKUNA	29th SAWSN	494935	6001357	32	HS	S
34	34	ATTILA/BAV92//PASTOR/3/ATTILA*2/PBW65	29th SAWSN	494965	6001439	49	S	MS
35	35	CUNNINGHAM/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ	29th SAWSN	494983	6001457	41	MS	MR
36	36	ESDA/KKTS	29th SAWSN	495073	6001472	28	MR	MR
37	37	GOUBARA-1/2*SOKOLL	29th SAWSN	495915	6001556	79	MR	MS
38	38	SOKOLL*2/3/PASTOR//MUNIA/ALTAR 84	29th SAWSN	496026	6001639	97	S	MR
39	39	SOKOLL*2/3/PASTOR//MUNIA/ALTAR 84	29th SAWSN	496026	6001641	99	MS	S
40	40	SOKOLL*2/4/CHEN/AEGILOPS SQUARROSA (TAUS)//FCT/3/STAR	29th SAWSN	496027	6001643	103	MR	MS
41	41	SOKOLL*2/4/CHEN/AEGILOPS SQUARROSA (TAUS)//FCT/3/STAR	29th SAWSN	496027	6001645	105	HS	S
42	42	BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/ CASKOR/3/CROC_1/AE.SQUARROSA (224)// OPATA/7/PASTOR//MILAN/KAUZ/3/BAV92	29th SAWSN	496096	6001669	35	MS	S
43	43	BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/ CASKOR/3/CROC_1/AE.SQUARROSA (224)// OPATA/7/PASTOR//MILAN/KAUZ/3/BAV92	29th SAWSN	496096	6001673	39	MR	MR
44	44	BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/ CASKOR/3/CROC_1/AE.SQUARROSA (224)// OPATA/7/PASTOR//MILAN/KAUZ/3/BAV92	29th SAWSN	496096	6001675	41	HS	MR
45	45	GONDO/MONARCA F2007/4/GONDO// SHA5/WEAVER/3/PASTOR	29th SAWSN	512743	6001847	133	MS	MS
46	46	PASTOR*2/BAV92/5/FRET2*2/4/SNI/ TRAP#1/3/KAUZ*2/TRAP//KAUZ	29th SAWSN	494961	6001910	50	MS	MR
47	47	PASTOR*2/BAV92/5/FRET2*2/4/SNI/ TRAP#1/3/KAUZ*2/TRAP//KAUZ	29th SAWSN	494961	6001912	52	MR	HS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
48	48	BABAX/LR39//BABAX/3/FILIN/2*PASTOR	29th SAWSN	512108	5999744	54	HS	S
49	49	BABAX/LR39//BABAX/3/FILIN/2*PASTOR	29th SAWSN	512108	5999745	55	MS	MR
50	50	YAR/AE.SQUARROSA (518)/3/PRL/SARA// TSI/VEE#5/4/ATTILA/5/BERKUT	29th SAWSN	512186	5999851	69	S	MS
51	51	YAR/AE.SQUARROSA (518)/3/PRL/SARA// TSI/VEE#5/4/ATTILA/5/BERKUT	29th SAWSN	512186	5999854	72	HS	HS
52	52	ACHTAR*3//KANZ/KS85-8-5/4/MILAN/KAUZ// PRINIA/3/BAV92/5/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	512797	5999983	148	MS	S
53	53	ACHTAR*3//KANZ/KS85-8-5/4/MILAN/KAUZ// PRINIA/3/BAV92/5/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	512797	5999984	149	MR	MR
54	54	QG 4.37A/4/MILAN/KAUZ//PRINIA/3/BAV92/5/ MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	512844	6000047	141	MR	MS
55	55	QG 78.5//2*INQALAB 91*2/TUKURU	29th SAWSN	512849	6000050	146	HS	S
56	56	QG 78.5//2*INQALAB 91*2/TUKURU	29th SAWSN	512849	6000062	158	MS	MS
57	57	QG 78.5//2*INQALAB 91*2/TUKURU	29th SAWSN	512849	6000064	160	MS	HS
58	58	QG 78.5//2*INQALAB 91*2/TUKURU	29th SAWSN	512849	6000067	163	MS	MS
59	59	EGA BONNIE ROCK*2/5/FRET2*2/4/SNI/TRAP#1/3/ KAUZ*2/TRAP//KAUZ	29th SAWSN	512870	6000083	86	MS	HS
60	60	EGA BONNIE ROCK*2/5/FRET2*2/4/SNI/TRAP#1/3/ KAUZ*2/TRAP//KAUZ	29th SAWSN	512870	6000085	88	MR	MR
61	61	HUANIL//2*WBLL1*2/KUKUNA	29th SAWSN	512888	6000092	102	HS	S
62	62	HUANIL//2*WBLL1*2/KUKUNA	29th SAWSN	512888	6000093	103	MS	HS
63	63	SERI*3//RL6010/4*YR/3/PASTOR/4/BAV92/5/MONARCA F2007/6/PVN//CAR422/ANA/5/BOW/CROW// BUC/PVN/3/YR/4/TRAP#1	29th SAWSN	512926	6000104	130	MR	MR
64	64	SERI*3//RL6010/4*YR/3/PASTOR/4/BAV92/5/MONARCA F2007/6/PVN//CAR422/ANA/5/BOW/CROW// BUC/PVN/3/YR/4/TRAP#1	29th SAWSN	512926	6000107	133	HS	HS
65	65	SERI*3//RL6010/4*YR/3/PASTOR/4/BAV92/5/MONARCA F2007/6/PVN//CAR422/ANA/5/BOW/CROW// BUC/PVN/3/YR/4/TRAP#1	29th SAWSN	512926	6000123	149	HS	HS
66	66	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/ T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/ 5/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	512908	6000227	122	HS	MS
67	67	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/ T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/ 5/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	512908	6000230	125	MR	S
68	68	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/ T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/ 5/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	512908	6000234	129	HS	S
69	69	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/ T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/ 5/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	512908	6000240	135	MR	MR
70	70	MILAN/KAUZ//PRINIA/3/BAV92/5/TRAP#1/BOW// VEE#5/SARA/3/ZHE JIANG 4/4/DUCULA	29th SAWSN	504111	6000264	152	S	MS
71	71	MILAN/KAUZ//PRINIA/3/BAV92/5/TRAP#1/BOW// VEE#5/SARA/3/ZHE JIANG 4/4/DUCULA	29th SAWSN	504111	6000269	157	MR	MR
72	72	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/ONIX	29th SAWSN	504237	6000353	153	MS	MS
73	73	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/ONIX	29th SAWSN	504237	6000359	159	MR	MS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
74	74	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/ONIX	29th SAWSN	504237	6000363	163	HS	S
75	75	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/ONIX	29th SAWSN	504237	6000368	168	HS	HS
76	76	ONIX/ROLF07	29th SAWSN	504248	6000387	73	MR	MR
77	77	ONIX/4/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	504250	6000396	105	MR	MR
78	78	ONIX/4/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	504250	6000399	108	MS	MS
79	79	BARCENAS S2002/4/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	504493	6000547	54	S	HS
80	80	FDC36//ATTILA*2/PBW65	29th SAWSN	504539	6000566	32	MR	MS
81	81	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000615	99	MR	MR
82	82	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000616	100	MS	MS
83	83	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000618	102	S	S
84	84	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000622	106	MR	S
85	85	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000624	108	MR	MR
86	86	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000625	109	MS	S
87	87	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/FRET2/ KUKUNA//FRET2/6/MILAN/KAUZ//PRINIA/3/BAV92	29th SAWSN	506887	6000628	112	S	MS
88	88	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/ ATTILA*2/PBW65/6/PBW343*2/TUKURU	29th SAWSN	506892	6000630	45	HS	HS
89	89	MILAN/KAUZ//PRINIA/3/BAV92/4/PASTOR*2/ BAV92/5/ROLF07	29th SAWSN	506897	6000640	36	MS	MS
90	90	RL6043/4*NAC//PASTOR/3/BAV92/4/ATTILA/ PASTOR/5/PBW343*2/TUKURU	29th SAWSN	506911	6000684	81	HS	S
91	91	SOKOLL//PBW343*2/KUKUNA/3/ATTILA/PASTOR	29th SAWSN	507064	6000921	90	MR	MR
92	92	SOKOLL//PBW343*2/KUKUNA/3/ATTILA/PASTOR	29th SAWSN	507064	6000922	91	S	HS
93	93	SW89-5124*2/FASAN/3/ALTAR 84/AE.SQ//2*OPATA/4/ARREHANE	29th SAWSN	507096	6000940	42	MS	MS
94	94	SOKOLL*2/ROLF07	29th SAWSN	507102	6000970	54	HS	HS
95	95	CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/2*JANZ*2/6/BORL95/3*JANZ	29th SAWSN	507180	6000993	125	MS	MS
96	96	SOKOLL//ATTILA/PASTOR/3/PBW343*2/TUKURU	29th SAWSN	507236	6000999	94	MR	S
97	97	SOKOLL//ATTILA/PASTOR/3/PBW343*2/TUKURU	29th SAWSN	507236	6001006	101	S	HS
98	98	GK ARON/AG SECO 7846//2180/4/2*MILAN/ KAUZ//PRINIA/3/BAV92	29th SAWSN	506830	6001012	97	MR	MR
99	99	TROST/6/CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/PASTOR	29th SAWSN	495132	6001043	75	MS	MR
100	100	TROST/6/CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/PASTOR	29th SAWSN	495132	6001045	77	MS	MS
101	101	SOKOLL/TROST	29th SAWSN	495180	6001056	79	S	HS
102	102	SOKOLL/TRCH	29th SAWSN	495192	6001064	161	MR	MR
103	103	SOKOLL/TRCH	29th SAWSN	495192	6001066	163	MR	MS
104	104	SW89-5124*2/FASAN/3/ALTAR 84/AE.SQ//2*OPATA	29th SAWSN	495230	6001074	93	HS	HS
105	105	SOKOLL/ROLF07	29th SAWSN	495241	6001087	85	MR	S
106	106	SOKOLL/ROLF07	29th SAWSN	495241	6001089	87	MS	MS
107	107	SOKOLL/ROLF07	29th SAWSN	495241	6001091	89	MS	MR

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
108	108	CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/2*JANZ/6/SOKOLL	29th SAWSN	495362	6001124	113	MR	MS
109	109	CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/2*JANZ/6/SOKOLL	29th SAWSN	495362	6001126	115	HS	HS
110	110	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/4/WBLL1*2/TUKURU	29th SAWSN	495387	6001137	100	MR	MR
111	111	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/4/WBLL1*2/TUKURU	29th SAWSN	495387	6001138	101	MR	MS
112	112	BAV92/SERI	29th SAWSN	285851	6001233	1380	MR	MR
113	113	ROLF07/3/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	29th SAWSN	504090	6001241	86	MR	HS
114	114	T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR/ 3/PBW343*2/KUKUNA/4/PBW343*2/KUKUNA	29th SAWSN	506652	6001247	48	S	MS
115	115	RL6043/4*NAC//PASTOR/3/BAV92/4/ATTILA/BAV92//PASTOR	29th SAWSN	494951	6001392	79	HS	S
116	116	PASTOR*2/BAV92/3/FRET2/KUKUNA//FRET2	29th SAWSN	494962	6001418	59	MR	MR
117	117	PASTOR*2/BAV92/3/FRET2/KUKUNA//FRET2	29th SAWSN	494962	6001420	61	MR	S
118	118	ESDA/KKTS	29th SAWSN	495073	6001471	27	MS	MR
119	119	GOUBARA-1/2*SOKOLL	29th SAWSN	495915	6001548	71	HS	S
120	120	GOUBARA-1/2*SOKOLL	29th SAWSN	495915	6001549	72	MS	MS
121	121	GOUBARA-1/2*SOKOLL	29th SAWSN	495915	6001552	75	MR	MS
122	122	PSN/BOW//MILAN/3/2*PARUS/PASTOR	29th SAWSN	495988	6001604	15	HS	S
123	123	SOKOLL*2/4/CHEN/AEGILOPS SQUARROSA (TAUS)//FCT/3/STAR	29th SAWSN	496027	6001642	102	MR	MR
124	124	FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ/5/ONIX	29th SAWSN	504237	6000370	170	S	MR
125	125	PASTOR*2/BAV92/5/FRET2*2/4/SNI/TRAP#1/3/ KAUZ*2/TRAP//KAUZ	29th SAWSN	494961	6001911	51	MS	S
126	126	TUKURU/4/CROC_1/AE.SQUARROSA (224)//YACO/3/MUNIA/5/BABAX/LR42//BABAX	29th SAWSN	496164	6001966	110	HS	HS
127	1	LOCAL CHECK	SBWN	61665	304660	1	MS	MS
128	2	PBW343	SBWN	8890	2430154	1549	MR	MS
129	3	PRL/2*PASTOR	SBWN	320356	3822784	163	MS	MR
130	4	MUNAL #1	SBWN	448400	5398530	62	MS	S
131	5	WBLL1*2/KURUKU//HEILO	SBWN	516107	6175947	102	MR	MS
132	6	ATTILA*2/PBW65*2//KACHU	SBWN	516338	6175962	29	MR	MS
133	7	ROLF07*2/3/PRINIA/PASTOR//HUITES	SBWN	516365	6176022	26	MR	MS
134	8	CNO79//PF70354/MUS/3/PASTOR/4/BAV92*2/5/FH6-1-7	SBWN	516463	6178402	89	MR	S
135	9	KACHU #1/KIRITATI//KACHU	SBWN	516534	6178517	60	MR	S
136	10	SAUAL/YANAC//SAUAL	SBWN	516539	6178533	55	MR	MS
137	11	PRL/2*PASTOR*2//FH6-1-7	SBWN	516549	6178556	29	MS	MS
138	12	PBW343*2/KUKUNA*2//FRTL/PIFED	SBWN	516587	6179222	41	S	S
139	13	PBW343*2/KUKUNA*2//FRTL/PIFED	SBWN	516587	6179227	46	MR	MS
140	14	WBLL1*2/4/BABAX/LR42//BABAX/3/BABAX/LR42//BABAX	SBWN	516641	6179255	62	MR	MR
141	15	ATTILA*2/PBW65*2//MURGA	SBWN	516676	6176308	70	MS	HS
142	16	ROLF07*2/5/REH/HARE//2*BCN/3/CROC_1/AE.SQUARROSA (213)//PGO/4/HUITES	SBWN	516682	6176334	16	R	MR
143	17	ATTILA*2/PBW65*2//W485/HD29	SBWN	516715	6176409	24	MR	MR
144	18	ATTILA*2/PBW65*2/4/BOW/NKT//CBRD/3/CBRD	SBWN	516782	6176558	44	R	MS
145	19	ROLF07*2/5/FCT/3/GOV/AZ//MUS/4/DOVE/BUC	SBWN	516817	6178875	20	MS	S

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
146	20	MUNAL #1/FRANCOLIN #1	SBWN	520059	6176914	44	MR	MS
147	21	FRNCLN/ROLF07	SBWN	520071	6177828	17	MS	S
148	22	FRNCLN/ROLF07	SBWN	520071	6177834	23	MS	MS
149	23	PAURAQ/4/PFAU/SERI.1B//AMAD/3/WAXWING	SBWN	520073	6179118	20	MS	MS
150	24	PFAU/SERI.1B//AMAD/3/WAXWING/4/BABAX/LR42//BABAX*2/3/KURUKU	SBWN	520091	6178973	61	MR	S
151	25	QUAIU/5/FRET2*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ	SBWN	520167	6178997	40	R	MR
152	26	TACUPETO F2001*2/BRAMBLING//WBLL1*2/BRAMBLING	SBWN	520200	6174847	58	R	S
153	27	FRANCOLIN #1/WBLL1	SBWN	520211	6174858	26	R	S
154	28	WBLL1*2/BRAMBLING/5/WBLL1*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ	SBWN	520218	6174867	33	MR	MR
155	29	BECARD/KACHU	SBWN	520227	6174886	43	MR	MR
156	30	BECARD/KACHU	SBWN	520227	6174889	46	MR	R
157	31	ALTAR 84/AE.SQUARROSA (221)//3*BORL95/3/URES/JUN//KAUZ/4/WBLL1/5/MILAN/S87230//BAV92	SBWN	520259	6174903	29	MR	S
158	32	TRCH/HUIRIVIS #1	SBWN	520372	6177148	75	MS	S
159	33	PFAU/SERI.1B//AMAD/3/WAXWING/4/HUIRIVIS #1	SBWN	520376	6177174	56	MS	MR
160	34	BECARD/AKURI	SBWN	520469	6177395	31	MS	MS
161	35	KBIRD//WBLL1*2/KURUKU	SBWN	520478	6177447	78	S	MS
162	36	KINGBIRD #1//INQALAB 91*2/TUKURU	SBWN	520543	6177595	37	S	S
163	37	KINGBIRD #1//INQALAB 91*2/TUKURU	SBWN	520543	6177598	40	MS	MR
164	38	PBW343*2/KUKUNA//TECUE #1	SBWN	520553	6177648	104	MR	HS
165	39	QUAIU #3//MILAN/AMSEL	SBWN	520698	6174949	31	MS	S
166	40	ROLF07*2/5/REH/HARE//2*BCN/3/CROC_1/AE.SQUARROSA (213)//PGO/4/HUITES	SBWN	520762	6175022	43	MR	MS
167	41	NAC/TH.AC//3*PVN/3/MIRLO/BUC/4/2*PASTOR/5/KACHU/6/KACHU	SBWN	520792	6175076	46	MS	HS
168	42	WAXWING/4/BL 1496/MILAN/3/CROC_1/AE.SQUARROSA (205)//KAUZ/5/FRNCLN	SBWN	520845	6175216	19	MS	S
169	43	WBLL1*2/KURUKU/6/CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/2*JANZ/7/WBLL1*2/KURUKU	SBWN	520860	6175234	23	S	S
170	44	UP2338*2/VIVITSI/3/FRET2/TUKURU//FRET2/4/MISR 1	SBWN	520906	6177947	39	R	MR
171	45	UP2338*2/VIVITSI/3/FRET2/TUKURU//FRET2/4/MISR 1	SBWN	520906	6177951	43	MR	S
172	46	WAXWING*2/HEILO	SBWN	520973	6175411	48	MS	S
173	47	BAV92//IRENA/KAUZ/3/HUITES/4/GONDO/TNMU/5/BAV92//IRENA/KAUZ/3/HUITES	SBWN	520976	6175439	61	MS	MR
174	48	WBLL1*2/TUKURU//FN/2*PASTOR/3/FRET2/KIRITATI	SBWN	520984	6178935	24	MS	MS
175	49	PVN/5/2*REH/HARE//2*BCN/3/CROC_1/AE.SQUARROSA (213)//PGO/4/HUITES	SBWN	521033	6178095	50	MS	S
176	50	KFA/2*KACHU	SBWN	521063	6179220	67	MS	MS
177	51	LOCAL CHECK	SBWN	61665	304660	1	MR	MR
178	52	PBW343	SBWN	8890	2430154	1549	MR	MR
179	53	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/4/VORB	SBWN	522741	6278812	196	MR	S
180	54	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/4/VORB	SBWN	522741	6278814	198	MS	S
181	55	WORRAKATTA/2*PASTOR//VORB	SBWN	522778	6278837	61	S	S

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
182	56	VORB/3/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	SBWN	522977	6279000	1248	MS	MR
183	57	VORB/4/D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM	SBWN	517278	6279248	55	MS	MS
184	58	SOISSONS/KUKUNA//WBLL1*2/TUKURU	SBWN	518926	6279929	96	MR	MS
185	59	T.DICOCCON PI254156/3*KAUZ//2*STYLET	SBWN	512764	6280034	110	MS	MS
186	60	SERI*3//RL6010/4*YR/3/PASTOR/4/BAV92/5/VORB	SBWN	522917	6280161	46	MS	MR
187	61	C80.1/3*BATAVIA//2*WBLL1/4/D67.2/PARANA 66.270// AE.SQUARROSA (320)/3/CUNNINGHAM/5/T.DICOCCON PI225332/AE.SQUARROSA (895)//WBLL1/3/2*WBLL1	SBWN	522444	6280219	53	MR	MR
188	62	BABAX/LR39//BABAX/3/VORB/4/SUNCO/2*PASTOR	SBWN	518855	6280233	125	R	MS
189	63	VORB/4/D67.2/PARANA 66.270// AE.SQUARROSA (320)/3/CUNNINGHAM/5/D67.2/PARANA 66.270// AE.SQUARROSA (320)/3/CUNNINGHAM	SBWN	518898	6280380	123	MR	MR
190	64	VORB/4/D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/5/D67.2/PARANA 66.270// AE.SQUARROSA (320)/3/CUNNINGHAM	SBWN	518898	6280381	124	MR	MR
191	65	VORB/6/CPI8/GEDIZ/3/GOO//ALB/CRA/4/AE.SQUARROSA (208)/5/2*WESTONIA/7/CPI8/GEDIZ/3/GOO// ALB/CRA/4/AE.SQUARROSA (208)/5/2*WESTONIA	SBWN	518899	6280393	106	MR	MR
192	66	T.TAU.83.2.29/ATTILA//ATTILA/3/EXCALIBUR	SBWN	517297	6280415	78	MR	MR
193	67	KRICHAUFF/2*PASTOR/3/PFAU/WEAVER//KIRITATI/ 4/PFAU/WEAVER//KIRITATI	SBWN	522323	6424864	77	MS	MS
194	68	VORB*2/3/PFAU/WEAVER//KIRITATI	SBWN	522420	6424865	246	MS	HS
195	69	VORB*2/3/PFAU/WEAVER//KIRITATI	SBWN	522420	6424869	250	S	HS
196	70	VORB*2/3/PFAU/WEAVER//KIRITATI	SBWN	522420	6424871	252	S	MR
197	71	VORB*2/3/PFAU/WEAVER//KIRITATI	SBWN	522420	6424873	254	S	S
198	72	VORB*2/3/PFAU/WEAVER//KIRITATI	SBWN	522420	6424874	255	MS	HS
199	73	MURGA/KRONSTAD F2004	SBWN	515880	6175707	48	MR	HS
200	74	TACUPETO F2001/6/CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/PASTOR/7/ROLF07	SBWN	516472	6179274	48	MS	MR
201	75	TACUPETO F2001/6/CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/PASTOR/7/ROLF07	SBWN	516472	6179276	50	S	S
202	76	WBLL1*2/KUKUNA//KIRITATI/3/WBLL1*2/KUKUNA	SBWN	516498	6179291	68	S	MS
203	77	NORM/WBLL1//WBLL1/3/TNMU/4/WBLL1*2/TUKURU	SBWN	516511	6176149	22	S	MR
204	78	PBW343*2/KHVAKI*2//YANAC	SBWN	516605	6179562	28	S	MS
205	79	WBLL1*2/4/YACO/PBW65/3/KAUZ*2/TRAP//KAUZ*2/5/ CHUANMAI 32	SBWN	516957	6179538	37	S	MR
206	80	FRANCOLIN #1/4/BABAX/LR42//BABAX*2/3/KURUKU	SBWN	520068	6179344	56	MS	MR
207	81	FRANCOLIN #1/4/BABAX/LR42//BABAX*2/3/KURUKU	SBWN	520068	6179347	59	MR	MR
208	82	PFAU/SERI.1B//AMAD/3/WAXWING/4/BABAX/LR42// BABAX*2/3/KURUKU	SBWN	520091	6178981	69	MS	MR
209	83	WBLL1*2/KURUKU/4/BABAX/LR42//BABAX*2/3/KURUKU	SBWN	520238	6179542	28	MR	S
210	84	WBLL1*2/KURUKU/4/BABAX/LR42//BABAX*2/3/KURUKU	SBWN	520238	6179543	29	MR	MS
211	85	WBLL1*2/BRAMBLING//JUCHI	SBWN	520460	6181746	60	MR	MS
212	86	WBLL1*2/KKTS//KINGBIRD #1	SBWN	520471	6177411	78	S	MR
213	87	WBLL1*2/KKTS//KINGBIRD #1	SBWN	520471	6177412	79	HS	S
214	88	TACUPETO F2001//WBLL1*2/KKTS/3/WBLL1*2/BRAMBLING	SBWN	520757	6179457	32	S	HS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
215	89	TACUPETO F2001/SAUAL/4/BABAX/LR42//BABAX*2/3/KURUKU	SBWN	520758	6179136	46	MR	MR
216	90	WBLL1*2/KURUKU//KRONSTAD F2004/3/WBLL1*2/BRAMBLING	SBWN	520778	6179463	22	S	S
217	91	WBLL1*2/TUKURU*2//KRONSTAD F2004	SBWN	520781	6179465	31	HS	S
218	92	YAV_3/SCO//JO69/CRA/3/YAV79/4/AE.SQUARROSA (498)/5/LINE 1073/6/KAUZ*2/4/CAR//KAL/BB/3/NAC/5/KAUZ/7/KRONSTAD F2004/8/KAUZ/PASTOR//PBW343	SBWN	520820	6175176	47	S	MS
219	93	ATTILA*2/PBW65*2/5/REH/HARE//2*BCN/3/CROC_1/AE.SQUARROSA (213)//PGO/4/HUITES	SBWN	520844	6175211	28	MR	MS
220	94	ATTILA*2/PBW65*2/5/REH/HARE//2*BCN/3/CROC_1/AE.SQUARROSA (213)//PGO/4/HUITES	SBWN	520844	6175213	30	MS	MS
221	95	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/ATTILA/2*PASTOR/5/QUAIU #3	SBWN	520853	6181747	28	S	R
222	96	BABAX/LR42//BABAX/3/BABAX/LR42//BABAX/4/ATTILA/2*PASTOR/5/QUAIU #3	SBWN	520853	6181748	29	HS	MS
223	97	PRL/2*PASTOR*2//VORB	SBWN	520925	6179475	11	S	S
224	98	PFAU/WEAVER//KIRITATI/3/FRET2/TUKURU//FRET2/4/FRET2/TUKURU//FRET2	SBWN	521019	6178029	16	S	S
225	99	KSW/5/2*ALTAR 84/AE.SQUARROSA (221)//3*BORL95/3/URES/JUN//KAUZ/4/WBLL1	SBWN	521061	6179370	67	HS	HS
226	100	KFA/2*KACHU	SBWN	521063	6179221	68	S	MR
227	101	LOCAL CHECK	SBWN	61665	304660	1	MS	S
228	102	DHARWAR DRY	SBWN	95758	109278	12	S	MS
229	103	VOROBEY	SBWN	279807	3855011	61	S	S
230	104	W15.92/4/PASTOR//HXL7573/2*BAU/3/WBLL1	SBWN	473251	5435924	30	S	HS
231	105	GK ARON/AG SECO 7846//2180/4/2*MILAN/KAUZ//PRINIA/3/BAV92	SBWN	506830	6001014	99	S	MS
232	106	BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/CASKOR/3/CROC_1/AE.SQUARROSA (224)//OPATA/7/PASTOR//MILAN/KAUZ/3/BAV92	SBWN	496096	6001673	39	HS	S
233	107	BOW/VEE/5/ND/VG9144//KAL/BB/3/YACO/4/CHIL/6/CASKOR/3/CROC_1/AE.SQUARROSA (224)//OPATA/7/PASTOR//MILAN/KAUZ/3/BAV92	SBWN	496096	6001675	41	MS	MS
234	108	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/4/VORB	SBWN	522741	6278810	194	MR	MS
235	109	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/4/VORB	SBWN	522741	6278811	195	MR	MR
236	110	H45/4/KRICHAUFF/FINSI/3/URES/PRL//BAV92	SBWN	522811	6278849	30	MR	R
237	111	VORB/SOKOLL	SBWN	522931	6278940	40	MS	MS
238	112	VORB/SOKOLL	SBWN	522931	6278942	42	MR	S
239	113	VORB/SOKOLL	SBWN	522931	6278943	43	R	MS
240	114	DUCULA/GONDO//SOKOLL	SBWN	522955	6278982	107	MS	S
241	115	VORB/3/T.DICOCCON PI94625/AE.SQUARROSA (372)//3*PASTOR	SBWN	522977	6279005	1253	MR	MR
242	116	CNO79//PF70354/MUS/3/PASTOR/4/BAV92/5/MILAN/KAUZ//PRINIA/3/BAV92	SBWN	517169	6279186	36	MS	MS
243	117	EGA BONNIE ROCK/4/MILAN/KAUZ//PRINIA/3/BAV92	SBWN	517201	6279213	66	MS	S

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
244	118	EGA BONNIE ROCK/4/MILAN/KAUZ//PRINIA/3/BAV92	SBWN	517201	6279214	67	MS	MS
245	119	CNDO/R143//ENTE/MEXI_2/3/AEGILOPS SQUARROSA (TAUS)/4/WEAVER/5/2*JANZ/6/D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM	SBWN	517338	6279341	197	MR	MS
246	120	INQALAB 91*2/KUKUNA/4/TC14/2*HTG//DUCULA/3/PRINIA	SBWN	514487	6279585	56	MR	S
247	121	KANZ/5/CNO79//PF70354/MUS/3/PASTOR/4/ BAV92/6/PRL/SARA//TSI/VEE#5	SBWN	512788	6279600	49	S	HS
248	122	BABAX/KS93U76//BABAX/3/2*SOKOLL	SBWN	522317	6279628	85	MS	S
249	123	BABAX/KS93U76//BABAX/3/2*SOKOLL	SBWN	522317	6279631	88	S	MS
250	124	BABAX/KS93U76//BABAX/3/2*SOKOLL	SBWN	522317	6279632	89	S	MS
251	125	MILAN/KAUZ//PRINIA/3/BAV92/4/2*SOKOLL	SBWN	522326	6279671	335	MS	MR
252	126	SLVS/ATTILA//WBLL1*2/3/GONDO/CBRD	SBWN	522437	6279825	184	MS	S
253	127	SLVS/ATTILA//WBLL1*2/3/GONDO/CBRD	SBWN	522437	6279829	188	HS	S
254	128	SLVS/ATTILA//WBLL1*2/3/GONDO/CBRD	SBWN	522437	6279830	189	MS	MR
255	129	HUANIL/5/2*CNO79//PF70354/MUS/3/PASTOR/4/BAV92	SBWN	512886	6280037	49	S	S
256	130	PBW343*2/KUKUNA//WBLL1*2/KUKUNA	SBWN	512126	6280095	121	S	MS
257	131	PBW343*2/KUKUNA//WBLL1*2/KUKUNA	SBWN	512126	6280099	125	S	S
258	132	PBW343*2/KUKUNA//WBLL1*2/KUKUNA	SBWN	512126	6280103	129	S	MS
259	133	SLVS/ATTILA//WBLL1/4/FRAME*2/3/URES/JUN//KAUZ	SBWN	512148	6280120	49	HS	S
260	134	SLVS/ATTILA//WBLL1/4/FRAME*2/3/URES/JUN//KAUZ	SBWN	512148	6280121	50	MS	S
261	135	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/4/SKAUZ/BAV92	SBWN	522740	6280144	124	MS	S
262	136	T.DICOCCON PI225332/AE.SQUARROSA (895)//WBLL1/3/2*WBLL1/4/SOKOLL	SBWN	523019	6280202	88	MS	MS
263	137	KRICHAUFF/2*PASTOR//SOKOLL	SBWN	517174	6280250	106	S	HS
264	138	PVN//CAR422/ANA/5/BOW/CROW//BUC/PVN/3/YR/4/ TRAP#1/6/WORRAKATTA/2*PASTOR/7/PRL/2*PASTOR	SBWN	518884	6280379	49	HS	MS
265	139	KRICHAUFF/2*PASTOR/4/MILAN/KAUZ//PRINIA/3/BAV92	SBWN	517413	6280455	103	HS	S
266	140	BWD-4/3/ATTILA/BAV92//PASTOR/4/ATTILA*2/PBW65	SBWN	518959	6280483	58	MS	S
267	141	HEILO//SUNCO/2*PASTOR	SBWN	517568	6280551	109	MS	S
268	142	HEILO//SUNCO/2*PASTOR	SBWN	517568	6280553	111	S	S
269	143	CHIH95.7.4//INQALAB 91*2/KUKUNA	SBWN	528177	6280578	62	MS	MS
270	144	CHIH95.7.4//INQALAB 91*2/KUKUNA	SBWN	528177	6280583	67	MS	MR
271	145	SOKOLL//INQALAB 91*2/KUKUNA	SBWN	527264	6280588	79	MR	MR
272	146	SOKOLL//INQALAB 91*2/KUKUNA	SBWN	527264	6280591	82	R	MR
273	147	D67.2/PARANA 66.270//AE.SQUARROSA (320)/3/CUNNINGHAM/4/SKAUZ/BAV92	SBWN	522740	6424850	208	HS	S
274	148	KRICHAUFF/2*PASTOR//2*SOKOLL	SBWN	522319	6424861	120	MR	MR
275	149	KRICHAUFF/2*PASTOR//2*SOKOLL	SBWN	522319	6424863	122	MS	MS
276	150	BJY/COC//PRL/BOW/3/SARA/THB//VEE/4/PIFED/5/KIRITATI	SBWN	517316	6424879	64	MR	MR
277	1	CBC 509 CHILE/6/ECO/CMH76A.722//BIT/3/ALTAR 84/4/AJAIA_2/5/KJOVE_1/7/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/8/SOOTY_9/ RASCON_37//WODUCK/CHAM_3	SDWN	477583	5545604	46	HS	MR
278	2	SORA/2*PLATA_12/3/SORA/2*PLATA_12//SOMAT_3/ 4/AJAIA_13/YAZI//DIPPER_2/BUSHEN_3	SDWN	477836	5548261	28	S	MS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
279	3	RISSA/GAN//POHO_1/3/PLATA_3//CREX/ALLA*2/4/ ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	478118	5549854	59	HS	MS
280	4	TARRO_1/2*YUAN_1//AJAIA_13/YAZI/3/SOMAT_3/ PHAX_1//TILO_1/LOTUS_4/4/CANELO_8//SORA/2*PLATA_12	SDWN	478130	5549955	41	MS	S
281	5	PLATA_6/GREEN_17/3/CHEN/AUK//BISU*2/5/PLATA_3// CREX/ALLA/3/SOMBRA_20/4/SILVER_14/MOEWE	SDWN	478253	5550490	78	S	MS
282	6	PLATA_6/GREEN_17/3/CHEN/AUK//BISU*2/5/PLATA_3// CREX/ALLA/3/SOMBRA_20/4/SILVER_14/MOEWE	SDWN	478253	5550491	79	S	
283	7	POD_20//SULA/ACO89/3/SORA/2*PLATA_12//SOMAT_3/4/ PATKA_4/THKNEE_9//CABECA_1	SDWN	478258	5550513	33	S	MR
284	8	TOPDY_18/FOCHA_1//ALTAR 84/3/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/4/SOMAT_3/ GREEN_22/5/VRKS_3/3/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13	SDWN	478272	5550695	48	S	S
285	9	HUBEI//SOOTY_9/RASCON_37/3/2*SOOTY_9/RASCON_37/ 4/SOOTY_9/RASCON_37/5/SOOTY_9/RASCON_37	SDWN	478415	5551106	15	MS	R
286	10	CMH85.797//DUKEM_12/2*RASCON_21/9/USDA595/3/D67.3/ RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/ 7/HUI/YAV79/8/POD_9	SDWN	478452	5551495	113	MS	MR
287	11	CMH85.797//CADO/BOOMER_33/4/ARMENT//SRN_3/ NIGRIS_4/3/CANELO_9.1	SDWN	478455	5551563	76	R	MS
288	12	PLATA_7/ILBOR_1//SOMAT_3/3/CABECA_2/PATKA_4// ZHONG ZUO/2*GREEN_3	SDWN	489330	5828160	47	S	MS
289	13	PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/ HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/ POC//BUB/RUFO/4/FNFOOT/10/GREEN_32/CHEN_7// SILVER_14/3/DIPPER_2/BUSHEN_3/4/SNITAN	SDWN	489456	5828186	48	S	R
290	14	DUKEM_1//SORA/2*PLATA_12/3/SOMAT_4/INTER_8	SDWN	489797	5828266	79	HS	MR
291	15	ARTICO/AJAIA_3//HUALITA/10/PLATA_10/6/MQUE/4/ USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/ 8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/ 4/FNFOOT/11/CNDO/PRIMADUR//HAI-OU_17/3/SNITAN	SDWN	490001	5828328	65	HS	MS
292	16	NUS/SULA//5*NUS/4/SULA/RBCE_2/3/HUI//CIT71/CII*2/5/ ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	490165	5828385	57	S	MS
293	17	PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/ HUI/7/PLATA_13/8/RAFI97/9/MALMUK_1/SERRATOR_1/10/ ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/11/SHAG_21/ DIPPER_2//PATA_2/6/ARAM_7//CREX/ALLA/5/ENTE/MEXI_2// HUI/4/YAV_1/3/LD357E/2*TC60//JO69	SDWN	490270	5828419	88	MR	MS
294	18	PLATA_6/GREEN_17//SNITAN/4/ARMENT//SRN_3/NIGRIS_4/ 3/CANELO_9.1	SDWN	477187	5827184	79	MR	MR
295	19	CNDO/VEE//CELTA/3/PATA_2/6/ARAM_7//CREX/ALLA/5/ ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/2*TC60//JO69/9/ USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	477416	5827231	46	HS	MS
296	20	SOMAT_4/SILVER_1//POLARIS	SDWN	481145	5827332	61	HS	MS
297	21	DUKEM/3/RUFF/FGO//YAV79/4/GUANAY/5/SOMAT_4/ INTER_8	SDWN	496415	6004448	84	HS	R

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
298	22	EUDO//CHEN_1/TEZ/3/TANTLO_1/4/SNITAN/5/SOMAT_4/INTER_8	SDWN	496423	6004451	32	S	MR
299	23	RANCO//CIT71/CII/3/COMDK/4/TCHO//SHWA/MALD/3/CREX/5/SNITAN/6/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	496493	6004486	44	MR	MR
300	24	YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/5/2*NETTA_4/DUKEM_12//RASCON_19/3/SORA/2*PLATA_12/4/GREEN_18/FOCHA_1//AIRON_1	SDWN	501154	6004513	64	S	MR
301	25	YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/5/2*NETTA_4/DUKEM_12//RASCON_19/3/SORA/2*PLATA_12/4/GREEN_18/FOCHA_1//AIRON_1	SDWN	501154	6004515	66	HS	MS
302	26	YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/4/VRKS_3/3/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/5/PLAYERO	SDWN	501155	6004518	86	HS	MR
303	27	ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/4/TOSKA_26/RASCON_37//SNITAN/5/PLAYERO	SDWN	501170	6004534	252	S	MS
304	28	NETTA_4/DUKEM_12//RASCON_19/3/DIPPER/RISSA//ALTAR 84/AOS/4/SOMAT_4/INTER_8/7/SHAG_21/DIPPER_2//PATA_2/6/ARAM_7//CREX/ALLA/5/ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/2*TC60//JO69	SDWN	501423	6004615	139	HS	MS
305	29	MOHAWK/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9/10/SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	501523	6004688	156	S	MR
306	30	MOHAWK/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	501524	6004694	295	S	MS
307	31	MOULSABIL/CANELO_9.1/5/SKEST/KRM//SLA/3/SORA/2*PLATA_12/4/GREEN_18/FOCHA_1//AIRON_1/6/VANRRIKSE_6.2//1A-1D 2+12-5/3*WB881/5/SKEST/KRM//SLA/3/SORA/2*PLATA_12/4/GREEN_18/FOCHA_1//AIRON_1	SDWN	501598	6004733	82	HS	HS
308	32	YAV79//SOMAT_4/INTER_8/7/YAV79/6/CHEN_1/TEZ/3/GUIL//CIT71/CII/4/SORA/PLATA_12/5/STOT//ALTAR 84/ALD	SDWN	501619	6004742	228	S	MR
309	33	MOHAWK/6/LOTUS_5/F3LOCAL(SEL.ETHIO.135.85)/5/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	504706	6004811	94	MR	MS
310	34	SOOTY_9/RASCON_37//WODUCK/CHAM_3/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	504810	6004821	103	MS	MS
311	35	NOK_23//PLATA_6/GREEN_17/3/SORA/2*PLATA_12//SRN_3/NIGRIS_4	SDWN	504902	6004840	18	S	MS
312	36	AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/4/CHEN_1/TEZ/3/GUIL//CIT71/CII/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	504917	6004848	65	MS	MS
313	37	AVILLO_1/SNITAN//DIPPER_2/BUSHEN_3/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	504931	6004853	67	S	MR

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
314	38	CNDO/PRIMADUR//HAI-OU_17/3/SNITAN/4/PLATA_7/ ILBOR_1//SOMAT_3/5/HESSIAN-F_2/3/STOT//ALTAR 84/ALD	SDWN	505162	6004976	111	S	MR
315	39	CPAN.6018/RAJ911.5//2*PLATA_8/10/PLATA_10/6/MQUE/4/ USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/ THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/ FNFOOT/11/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	505166	6004991	136	MS	MS
316	40	63.96 HELIDUR/TOPDUR//LLOYD/4/DUKEM_1//PATKA_7/ YAZI_1/3/PATKA_7/YAZI_1/5/ARMENT//SRN_3/NIGRIS_4/ 3/CANELO_9.1	SDWN	505347	6005020	171	S	S
317	41	GUANAY/3/FULVOUS_1/MFOWL_13//JUPARE C 2001/8/R143/ RUFF//STIL/3/YAV79/4/SHWA/MALD/5/ALTAR 84/6/TILO_1/ LOTUS_4/7/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	505483	6005080	98	R	MR
318	42	TAMAROI/8/R143/RUFF//STIL/3/YAV79/4/SHWA/MALD/5/ ALTAR 84/6/TILO_1/LOTUS_4/7/CAMAYO	SDWN	514848	6139106	94	S	MS
319	43	WID22241/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/ 5/TARRO_1/2*YUAN_1//AJAIA_13/YAZI/3/SOMAT_4/ INTER_8/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	515490	6139130	229	R	MS
320	44	PH896-21/4/DUKEM_1//PATKA_7/YAZI_1/3/PATKA_7/YAZI_1	SDWN	510802	6139172	44	MR	MR
321	45	KOFA/4/ACUATICO_1/RASCON_33//ACUATICO_1/3/ARAM/ BOOMER/5/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	511290	6139255	75	HS	S
322	46	MOHAWK/3/SOMAT_3/PHAX_1//TILO_1/LOTUS_4/4/ DUKEM_1//PATKA_7/YAZI_1/3/PATKA_7/YAZI_1	SDWN	511282	6139317	234	S	MR
323	47	YU803-42/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/5/ TARRO_1/2*YUAN_1//AJAIA_13/YAZI/3/SOMAT_4/INTER_8/ 4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	515479	6139369	158	HS	MR
324	48	CLAUDIO/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	510897	6139379	80	MS	HS
325	49	MERIDIANO/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/ 3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	511035	6139406	127	MS	MR
326	50	CLAUDIO/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/POD_9/4/ RASCON_37/TARRO_2//RASCON_37/5/SORA/ 2*PLATA_12//SOMAT_3	SDWN	515550	6139439	61	S	MS
327	51	CLAUDIO/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL// GREEN/10/TARRO_1/2*YUAN_1//AJAIA_13/YAZI/9/ USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515552	6139443	65	MR	S
328	52	DUILLIO/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/ 10/RCOL/THKNEE_2/9/USDA595/3/D67.3/RABI//CRA/4/ ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515578	6139458	100		
329	53	MERIDIANO/3/SOMAT_3/PHAX_1//TILO_1/LOTUS_4/5/ TATLER_1/TARRO_1/3/CANELO_8//SORA/2*PLATA_12/ 4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	515598	6139502	112	MR	MR

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
330	54	ADAMAR_15//ALBIA_1/ALTAR 84/3/SNITAN/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/PLATA_7/ILBOR_1/5/BR12*3//BH1146*6/ALD/3/MUSK_1/4/MUSK_4/6/ARMENT//SRN_3/NIGRIS_4/3/	SDWN	515304	6196679	148	HS	S
331	55	ADAMAR_15//ALBIA_1/ALTAR 84/3/SNITAN/4/SOMAT_4/INTER_8/5/SOOTY_9/RASCON_37/6/BICHENA/AKAKI_7/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	515219	6139562	261		
332	56	ADAMAR_15//ALBIA_1/ALTAR 84/3/SNITAN/4/SOMAT_4/INTER_8/5/SOOTY_9/RASCON_37/6/BICHENA/AKAKI_7/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	515219	6139563	262	S	MS
333	57	ADAMAR_15//ALBIA_1/ALTAR 84/3/SNITAN/4/SOMAT_4/INTER_8/5/SOOTY_9/RASCON_37/6/BICHENA/AKAKI_7/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	515219	6139567	266	S	S
334	58	ADAMAR_15//ALBIA_1/ALTAR 84/3/SNITAN/4/SOMAT_4/INTER_8/5/SOOTY_9/RASCON_37/6/BICHENA/AKAKI_7/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	515219	6139572	271	S	HS
335	59	AINZEN_1//PLATA_6/GREEN_17/5/TATLER_1/TARRO_1/3/CANELO_8//SORA/2*PLATA_12/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	510505	6139596	129	MR	MR
336	60	AINZEN_1//PLATA_6/GREEN_17/5/TATLER_1/TARRO_1/3/CANELO_8//SORA/2*PLATA_12/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	510505	6139598	131		
337	61	AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/SOMAT_3/4/SOOTY_9/RASCON_37/10/AAZ//ALTAR 84/ALD/3/AJAIA/4/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/5/ATIL/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	510512	6139657	435	S	MS
338	62	AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/SOMBRA_20/4/SNITAN/5/SOMAT_4/INTER_8/6/BRAK_2/AJAIA_2//SOLGA_8/3/PATKA_4/THKNEE_9//CABECA_1/4/GUANAY/HUALITA	SDWN	510521	6139724	460		
339	63	AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/SOMBRA_20/4/SNITAN/5/SOMAT_4/INTER_8/6/GUAYACANINIA/KUCUK/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	515223	6139762	297	MR	MR
340	64	AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/SOMBRA_20/4/SNITAN/5/SOMAT_4/INTER_8/6/GUAYACANINIA/POMA_2//SNITAN	SDWN	510523	6139768	247	S	S
341	65	AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/SOMBRA_20/4/SNITAN/5/SOMAT_4/INTER_8/6/SOMO/CROC_4//LOTUS_1/3/KITTI/4/JUPARE C 2001	SDWN	510524	6139776	288	R	R
342	66	AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/SOMBRA_20/4/SNITAN/5/SOMAT_4/INTER_8/6/SOMO/CROC_4//LOTUS_1/3/KITTI/4/JUPARE C 2001	SDWN	510524	6139777	289	MR	S

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
343	67	ALTAR 84/860137//YAZI_1/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/8/GEDIZ/FGO//GTA/3/SRN_1/4/TOTUS/5/ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/2*TC60//JO69/6/SOMBRA_20/7/JUPARE C 2001/9/PLATA_8/4/GARZA/AFN//CRA/3/GTA/5/RASCON/6/TATLER_1/SOLGA_5//PON_2/7/PLATA_3//CREX	SDWN	515310	6196686	159	MR	MS
344	68	BICHENA/AKAKI_7/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/6/MUSK_1//ACO89/FNFOOT_2/4/MUSK_4/3/PLATA_3//CREX/ALLA/5/OLUS*2/ILBOR//PATKA_7/YAZI_1	SDWN	515233	6139874	174	S	S
345	69	BICHENA/AKAKI_7/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/6/RASCON_33/TISOMA_2/3/CANELO_8//SORA/2*PLATA_12/4/SOMAT_4/INTER_8	SDWN	515234	6139880	144	MR	MR
346	70	CF4-JS 21//RASCON_37/2*TARRO_2/10/AAZ//ALTAR 84/ALD/3/AJAIA/4/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/5/ATIL/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	510589	6139889	95	MS	MR
347	71	CIT71/DIPPER_1//ARIZA_2/3/PROZANA/ARLIN//MUSK_6/4/TATLER_1/TARRO_1//HYDRANASSA30/SILVER_5/10/PLATA_3//CREX/ALLA/3/SORA/2*PLATA_12/4/RASCON_37/GREEN_2/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515335	6139902	137	MR	MS
348	72	CIT71/DIPPER_1//ARIZA_2/3/PROZANA/ARLIN//MUSK_6/4/TATLER_1/TARRO_1//HYDRANASSA30/SILVER_5/10/PLATA_3//CREX/ALLA/3/SORA/2*PLATA_12/4/RASCON_37/GREEN_2/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515335	6139903	138	MS	S
349	73	CIT71/DIPPER_1//ARIZA_2/3/PROZANA/ARLIN//MUSK_6/4/TATLER_1/TARRO_1//HYDRANASSA30/SILVER_5/10/PLATA_3//CREX/ALLA/3/SORA/2*PLATA_12/4/RASCON_37/GREEN_2/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515335	6139904	139		
350	74	DACK/KIWI//OSTE/3/CHEN84_1/4/MEXI75/5/NIGRIS_4/6/CANELO_8//SORA/2*PLATA_12/7/SOMAT_4/INTER_8/8/GEDIZ/FGO//GTA/3/SRN_1/4/TOTUS/5/ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/2*TC60//JO69/6/SOMBRA_20/7/JUPARE C 2001	SDWN	515170	6139924	153	MS	S
351	75	E90040/MFOWL_13//LOTAIL_6/3/PROZANA/ARLIN//MUSK_6/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9/10/SORA/2*PLATA_12//RASCON_37/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	515342	6139932	108		
352	76	E90040/MFOWL_13//LOTAIL_6/3/PROZANA/ARLIN//MUSK_6/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9/10/TOSKA_26/RASCON_37//SNITAN/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	515341	6139934	127	R	MR

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
353	77	HAI-OU_17/CHEN_7//DAB_2/3/LABUD_1/WIZZA_7/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/CHEN_1/TEZ/3/GUIL//CIT71/CII/4/SORA/PLATA_12/5/STOT//ALTAR 84/ALD	SDWN	515175	6140005	150	MR	S
354	78	ISLOM_1/DUKEM_2//TARRO_3/5/CREX//BOY/YAV_1/3/PLATA_6/4/PORRON_11/6/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/7/DUKEM_1//PATKA_7/YAZI_1/3/PATKA_7/YAZI_1	SDWN	515357	6140043	87	MS	S
355	79	KIRKI_1/HIMAN_9/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/10/AVILLO_1/3/CANELO_8//SORA/2*PLATA_12/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515440	6140109	166	S	S
356	80	MUSK_2/DUSKY_10/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9/10/AVILLO_1/3/ISLOM_1/DUKEM_2//TARRO_3/7/ECO/CMH76A.722//BIT/3/ALTAR 84/4/AJAIA_2/5/KJOVE_1/6/MALMUK_1/SERRATOR_1	SDWN	515266	6140155	184	S	MR
357	81	PLATA_3//CREX/ALLA/3/SORA/2*PLATA_12/4/RASCON_37/GREEN_2/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9/11/BOOMER_33/ZAR/3/BRAK_2/AJAIA_2//SOLGA_8/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THK	SDWN	515267	6196676	116	MR	MR
358	82	SCRIP_1//DIPPER_2/BUSHEN_3/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/10/MINIMUS/COMB DUCK_2//CHAM_3/3/CANELO_9/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515287	6140202	42	MR	MS
359	83	MINIMUS_6/PLATA_16//IMMER/3/SOOTY_9/RASCON_37/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/ECO/CMH76A.722//BIT/3/ALTAR 84/4/AJAIA_2/5/KJOVE_1/6/MALMUK_1/SERRATOR_1	SDWN	511398	6140373	68	MR	S
360	84	SORA/2*PLATA_12//SRN_3/NIGRIS_4/7/EUDO//CHEN_1/TEZ/3/TANTLO_1/5/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/6/MOJO/KITTI/8/PLATA_7/ILBOR_1//HIMAN_12/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	515648	6140402	115	S	MS
361	85	MÂALI/3/MALMUK_1/SERRATOR_1//RASCON_37/TARRO_2	SDWN	515080	6140438	27	HS	MS
362	86	AAZ_4//SOMAT_4/INTER_8/7/R143/RUFF//STIL/3/YAV79/4/SHWA/MALD/5/ALTAR 84/6/TILO_1/LOTUS_4	SDWN	515516	6140450	52	R	MR
363	87	GUANAY/HUALITA/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/STOT//ALTAR 84/ALD/3/PATKA_7/YAZI_1	SDWN	515525	6140463	55	MS	R
364	88	AMRIA/10/TARRO_1/2*YUAN_1//AJAIA_13/YAZI/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515129	6140467	45	HS	S

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
365	89	NASSIRA/4/DUKEM_1//PATKA_7/YAZI_1/3/PATKA_7/YAZI_1	SDWN	515142	6140475	20	S	MS
366	90	NASSIRA/10/TARRO_1/2*YUAN_1//AJAIA_13/YAZI/9/ USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515147	6137203	220	MR	R
367	91	NASSIRA/10/TARRO_1/2*YUAN_1//AJAIA_13/YAZI/9/ USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	515147	6137206	223	R	MR
368	92	PH896-21/5/BRAK_2/AJAIA_2//SOLGA_8/3/CANELO_8// SORA/2*PLATA_12/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/ GUIL//GREEN/6/HUBEI//SOOTY_9/RASCON_37/3/ 2*SOOTY_9/RASCON_37/4/SOOTY_9/RASCON_37	SDWN	527295	6420066	45	MR	MS
369	93	BELLAROI/5/1A.1D 5+1-06/3*MOJO//RCOL/4/ARMENT// SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	526840	6420916	142	MS	S
370	94	WID22202/5/MINIMUS/COMB DUCK_2//CHAM_3/3/RCOL/ 4/SOMAT_4/INTER_8/6/SOMAT_4/INTER_8/5/AJAIA_16// HORA/JRO/3/GAN/4/ZAR	SDWN	527303	6420930	68	S	HS
371	95	WID22202/5/TOSKA_26/RASCON_37//SNITAN/4/ARMENT// SRN_3/NIGRIS_4/3/CANELO_9.1/6/SOMAT_3/GREEN_22/ 4/GODRIN/GUTROS//DUKEM/3/THKNEE_11	SDWN	527306	6420075	47	S	MR
372	96	WID22209/5/RASCON_33/TISOMA_2/3/CANELO_8//SORA/ 2*PLATA_12/4/SOMAT_4/INTER_8/7/CHEN_1/TEZ/3/GUIL// CIT71/CII/4/SORA/PLATA_12/5/STOT//ALTAR 84/ALD/ 6/SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	527311	6420077	43	MR	MS
373	97	WID22209/5/RASCON_33/TISOMA_2/3/CANELO_8//SORA/ 2*PLATA_12/4/SOMAT_4/INTER_8/7/CHEN_1/TEZ/3/ GUIL//CIT71/CII/4/SORA/PLATA_12/5/STOT//ALTAR 84/ALD/6/SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	527311	6420078	44	S	MS
374	98	WID22209/7/AINZEN_1/3/SN TURK MI83-84 503/LOTUS_4// MUSK_4/6/CMH82A.1062/3/GERARDO VZ 394//SBA81/PLC/ 4/AAZ_1/CREX/5/HUI//CIT71/CII/11/LABUD/NIGRIS_3// GAN/3/AJAIA_13/YAZI/10/PLATA_10/6/MQUE/4/USDA573// QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/	SDWN	527313	6420938	45	MR	R
375	99	WID22209/7/AINZEN_1/3/SN TURK MI83-84 503/LOTUS_4// MUSK_4/6/CMH82A.1062/3/GERARDO VZ 394//SBA81/PLC/ 4/AAZ_1/CREX/5/HUI//CIT71/CII/11/LABUD/NIGRIS_3// GAN/3/AJAIA_13/YAZI/10/PLATA_10/6/MQUE/4/USDA573// QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/	SDWN	527313	6420939	46	S	MR
376	100	WID22209/6/ARLIN/2*ACO89/3/BOOMER_33//AUK/OSTE/5/ ROLA_5/3/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)// PLATA_13/4/MALMUK_1/SERRATOR_1/11/PLATA_10/6/ MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/ PLATA_13/8/RAFI97/9/MALMUK_1/SERRATOR_1/10/JUPARE C 2001	SDWN	527315	6420941	21	MR	S
377	101	SOMAT_4/INTER_8//COSMODUR/7/AINZEN_1/6/ CMH82A.1062/3/GERARDO VZ 394//SBA81/PLC/4/ AAZ_1/CREX/5/HUI//CIT71/CII	SDWN	521585	6420978	21	S	MR
378	102	VANRRIKSE_6.2//1A-1D 2+12-5/3*WB881/3/COSMODUR/ 5/SOMAT_4/SILVER_1/3/FOCHA_1/ALAS//4*FOCHA_1/4/ SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	521587	6420979	40	MR	MR

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
379	103	VANRRIKSE_6.2//1A-1D 2+12-5/3*WB881/3/COSMODUR/5/SOMAT_4/SILVER_1/3/FOCHA_1/ALAS//4*FOCHA_1/4/SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	521587	6420090	39	MR	MS
380	104	PRECO/10/TARRO_1/2*YUAN_1//AJAIA_13/YAZI/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9/11/CNDO/PRIMADUR//HAI-OU_17/3/SNITAN/4/JUPARE C 2001/5/CNDO/PRIMADUR//HAI-OU_17/3/SNITAN	SDWN	521610	6421001	115	MR	MR
381	105	ZENIT/5/SORA/2*PLATA_12//RASCON_37/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/6/MINIMUS_4/GRO_2/3/PROZANA/ARLIN//MUSK_6/5/SULA/RBCE_2/3/HUI//CIT71/CII/4/RYPS27_3/SKARV_3	SDWN	521621	6421007	58	MR	MR
382	106	DUILLIO/4/DUKEM_1//PATKA_7/YAZI_1/3/PATKA_7/YAZI_1/8/RISSA/GAN//POHO_1/3/PLATA_3//CREX/ALLA/7/EUDO//CHEN_1/TEZ/3/TANTLO_1/5/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/6/MOJO/KITTI	SDWN	521624	6419945	119	MR	MS
383	107	MERIDIANO/5/MINIMUS/COMB DUCK_2//CHAM_3/3/GREEN_19/4/SORA/2*PLATA_12//SOMAT_3/6/BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21	SDWN	521636	6421019	36	MS	MR
384	108	MERIDIANO/5/MINIMUS/COMB DUCK_2//CHAM_3/3/GREEN_19/4/SORA/2*PLATA_12//SOMAT_3/6/BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21	SDWN	521636	6421020	37	S	MS
385	109	SIMETO/3/SORA/2*PLATA_12//SRN_3/NIGRIS_4/5/TOSKA_26/RASCON_37//SNITAN/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	521637	6421022	58	MR	MS
386	110	CRECALE/5/BRAK_2/AJAIA_2//SOLGA_8/3/CANELO_8//SORA/2*PLATA_12/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/6/CNDO/PRIMADUR//HAI-OU_17/3/SNITAN/4/JUPARE C 2001/5/CNDO/PRIMADUR//HAI-OU_17/3/SNITAN	SDWN	527344	6420108	27	R	R
387	111	SARAGOYA/10/RCOL/THKNEE_2/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9/11/PLATA_6/GREEN_17//RCOL/3/RYPS27_3/SKARV_3	SDWN	527355	6421059	29	MS	MS
388	112	SARAGOYA/11/BRAK_2/AJAIA_2//SOLGA_8/3/FOSKAL_1/PELA_2//BRAK_2/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/12/SNITAN/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/5/SNITAN	SDWN	527357	6421060	16	S	MR
389	113	SARAGOYA/4/GRO_2/YUAN_1//ARLIN/2*ACO89/3/JUPARE C 2001/5/SOMAT_4/INTER_8/3/RASCON_21/KNAR_3//PLATA_8/4/CNDO/PRIMADUR//HAI-OU_17/3/SNITAN	SDWN	527358	6420110	32	S	MS
390	114	PRECO/6/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/POD_9/4/RASCON_37/TARRO_2//RASCON_37/5/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/7/1A.1D 5+1-06/3*MOJO//RCOL/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	527469	6421062	67	R	MR
391	115	BUSHEN_4/2*GREEN_18//NORMANNO/4/BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21	SDWN	527568	6421069	17		

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
392	116	OROBEL//BUSHEN_4/2*GREEN_18/8/GEDIZ/FGO//GTA/3/SRN_1/4/TOTUS/5/ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/2*TC60//JO69/6/SOMBRA_20/7/JUPARE C 2001	SDWN	527580	6421072	51	MR	MR
393	117	ATIL/KARALIS/5/SOMAT_3/GREEN_22/4/GODRIN/GUTROS//DUKEM/3/THKNEE_11	SDWN	527583	6421075	28	R	MS
394	118	SNITAN*2/RBC/10/RCOL/THKNEE_2/9/USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/HUI/YAV79/8/POD_9	SDWN	521251	6421078	32	S	HS
395	119	JUPARE C 2001*2/KHAPLI/5/PLATA_6/GREEN_17//SNITAN/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	521258	6421082	16	S	MS
396	120	JUPARE C 2001*2/RBC/8/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/TARRO_1/4/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/6/CHEN_1/TEZ/3/GUIL//CIT71/CII/4/SORA/PLATA_12/5/STOT//ALTAR 84/ALD/7/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	521263	6421089	57	MR	MS
397	121	SOOTY_9/RASCON_37//STORLOM/5/SOMAT_4/SILVER_1/3/FOCHA_1/ALAS//4*FOCHA_1/4/SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	521297	6419949	27	R	MR
398	122	SOOTY_9/RASCON_37//GUAYACAN INIA/11/BOOMER_33/ZAR/3/BRAK_2/AJAIA_2//SOLGA_8/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	521313	6421096	48	S	MR
399	123	SOOTY_9/RASCON_37//GUAYACAN INIA/11/BOOMER_33/ZAR/3/BRAK_2/AJAIA_2//SOLGA_8/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	521313	6419950	47	MS	MR
400	124	SOOTY_9/RASCON_37//JUPARE C 2001/3/SOOTY_9/RASCON_37//CAMAYO	SDWN	521330	6420126	36		R
401	125	SOOTY_9/RASCON_37//JUPARE C 2001/3/SOOTY_9/RASCON_37//GUAYACAN INIA	SDWN	521331	6420127	65	R	MR
402	126	SOOTY_9/RASCON_37//JUPARE C 2001/3/SOOTY_9/RASCON_37//GUAYACAN INIA	SDWN	521331	6420128	66	MS	MS
403	127	SOOTY_9/RASCON_37//JUPARE C 2001/3/SOOTY_9/RASCON_37//GUAYACAN INIA	SDWN	521331	6421105	68	S	S
404	128	SOOTY_9/RASCON_37//JUPARE C 2001/3/SOOTY_9/RASCON_37//SOMAT_3.1	SDWN	521332	6421106	33	S	MS
405	129	SOOTY_9/RASCON_37//GUAYACAN INIA/3/SOOTY_9/RASCON_37//STORLOM	SDWN	521344	6420132	15	S	MS
406	130	SNITAN*2/RBC/5/SULA/AAZ_5//CHEN/ALTAR 84/3/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/6/PLATA_6/GREEN_17/3/CHEN/AUK//BISU/5/PLATA_3//CREX/ALLA/3/SOMBRA_20/4/SILVER_14/MOEWE	SDWN	527360	6420134	75	S	MS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
407	131	JUPARE C 2001*2/IM/5/PLATA_6/GREEN_17//SNITAN/4/ YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/6/ SORA/2*PLATA_12//SOMAT_3/3/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13	SDWN	527364	6421112	46	S	S
408	132	JUPARE C 2001*2/IM/4/AAZ/MORUS_1//RCOL/3/SOMAT_3/ PHAX_1//TILO_1/LOTUS_4/5/HYDRANASSA30/SILVER_5// LYMNO_8/3/PATKA_7/YAZI_1/4/YAZI_1/AKAKI_4// SOMAT_3/3/AUK/GUIL//GREEN	SDWN	527366	6420136	44	S	MS
409	133	JUPARE C 2001*2/IM/6/ADAMAR_15//ALBIA_1/ALTAR 84/3/SNITAN/4/SOMAT_4/INTER_8/5/SOOTY_9/RASCON_37/ 7/GUAYACAN INIA/KUCUK/4/ARMENT//SRN_3/NIGRIS_4/ 3/CANELO_9.1	SDWN	527367	6420138	35	MS	MS
410	134	JUPARE C 2001*2/KHAPLI/6/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/SOMBRA_20/4/ SNITAN/5/SOMAT_4/INTER_8/7/SORA/2*PLATA_12// SOMAT_3/3/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)// PLATA_13	SDWN	527371	6421119	128	MS	S
411	135	P91.272.3.1/3*MEXI75//2*JUPARE C 2001/6/ARLIN/2*ACO89/3/ BOOMER_33//AUK/OSTE/5/ROLA_5/3/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/4/MALMUK_1/ SERRATOR_1/7/SOMAT_4/SILVER_1/4/STORLOM/3/ RASCON_37/TARRO_2//RASCON_37/5/PATKA_4/PLATA_16	SDWN	527377	6421128	23		MR
412	136	P91.272.3.1/3*MEXI75//2*JUPARE C 2001/4/BCRIS/BICUM// LLARETA INIA/3/DUKEM_12/2*RASCON_21/5/1A.1D 5+1-06/3*MOJO//RCOL/4/ARMENT//SRN_3/NIGRIS_4/3/ CANELO_9.1	SDWN	527379	6421134	94	S	R
413	137	P91.272.3.1/3*MEXI75//2*JUPARE C 2001/5/BRAK_2/AJAIA_2// SOLGA_8/3/CANELO_8//SORA/2*PLATA_12/4/YAZI_1/ AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/7/AINZEN_1/3/SN TURK MI83-84 503/LOTUS_4//MUSK_4/6/CMH82A.1062/3/ GERARDO VZ 394//SBA81/PLC/4/AAZ_1/CREX/5/HUI//CIT	SDWN	527381	6420142	14	HS	S
414	138	P91.272.3.1/3*MEXI75//2*JUPARE C 2001/5/CMH79A.1147/ HUI//CMH82.801/3/GRVAND_2/MCK_2/4/SOMAT_4/INTER_8/6/ 1A.1D 5+1-06/3*MOJO//RCOL/4/ARMENT//SRN_3/NIGRIS_4/3/ CANELO_9.1	SDWN	527383	6420145	122	S	MR
415	139	SOOTY_9/RASCON_37//SOMAT_3.1/5/GUAYACAN INIA/ KUCUK/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/ 8/AVTA/ALTAR 84/5/CHEN/ALTAR 84/3/HUI/POC//BUB/ RUFO/4/FNFOOT/6/SORA/2*PLATA_12//SOMAT_3/7/ SOOTY_9/RASCON_37	SDWN	527390	6421146	55	MS	MS
416	140	SOOTY_9/RASCON_37//CAMAYO/5/RASCON_33/TISOMA_2/ 3/CANELO_8//SORA/2*PLATA_12/4/SOMAT_4/INTER_8/6/ GUAYACAN INIA/KUCUK/4/ARMENT//SRN_3/NIGRIS_4/3/ CANELO_9.1	SDWN	527401	6421169	88	MR	MR
417	141	SOOTY_9/RASCON_37//STORLOM/5/TOSKA_26/RASCON_37// SNITAN/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/6/ RISSA/GAN//POHO_1/3/PLATA_3//CREX/ALLA*2/4/ ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	527409	6421183	87	HS	MS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
418	142	SOOTY_9/RASCON_37//LLARETA INIA/7/AINZEN_1/3/SN TURK MI83-84 503/LOTUS_4//MUSK_4/6/CMH82A.1062/3/ GERARDO VZ 394//SBA81/PLC/4/AAZ_1/CREX/5/HUI// CIT71/CII/8/HUBEI//3*SOOTY_9/RASCON_37/3/SOOTY_9/ RASCON_37	SDWN	527414	6421188	31		
419	143	SOOTY_9/RASCON_37//LLARETA INIA/10/ALTAR 84/ CMH82A.1062//ALTAR 84/3/YAZI_10/4/SNITAN/9/USDA595/ 3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENTE/7/ HUI/YAV79/8/POD_9/11/SILK_3/DIPPER_6/3/ACO89/ DUKEM_4//5*ACO89/4/PLATA_7/ILBOR_1//SOMAT_3	SDWN	527418	6420155	32	S	S
420	144	SOOTY_9/RASCON_37//GUAYACAN INIA/4/BCRIS/BICUM// LLARETA INIA/3/DUKEM_12/2*RASCON_21/7/CHEN_1/ TEZ/3/GUIL//CIT71/CII/4/SORA/PLATA_12/5/STOT//ALTAR 84/ALD/6/SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	527421	6421198	82		
421	145	SOOTY_9/RASCON_37//JUPARE C 2001/6/PLATA_6/ GREEN_17/3/CHEN/AUK//BISU/5/PLATA_3//CREX/ALLA/3/ SOMBRA_20/4/SILVER_14/MOEWE/7/TARRO_1/2*YUAN_1// AJAIA_13/YAZI/3/SOMAT_3/PHAX_1//TILO_1/LOTUS_4/ 4/CANELO_8//SORA/2*PLATA_12	SDWN	527432	6421219	28	MR	MR
422	146	SOOTY_9/RASCON_37//JUPARE C 2001/5/THKNEE_11/ SNITAN/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL// GREEN/8/GREEN_2/HIMAN_12//SHIP_1/7/ECO/ CMH76A.722//BIT/3/ALTAR 84/4/AJAIA_2/5/KJOVE_1/6/ MALMUK_1/SERRATOR_1	SDWN	527437	6420163	59	HS	S
423	147	SOOTY_9/RASCON_37//JUPARE C 2001/3/SOOTY_9/ RASCON_37//LLARETA INIA/4/SOOTY_9/RASCON_37// CAMAYO/3/SOOTY_9/RASCON_37//SOMAT_3.1	SDWN	527635	6420170	43	S	S
424	148	SOOTY_9/RASCON_37//SOMAT_3.1/3/SOOTY_9/RASCON_37// STORLOM/4/SOOTY_9/RASCON_37//GUAYACAN INIA/3/SOOTY_9/RASCON_37//LLARETA INIA	SDWN	527636	6420173	57	S	HS
425	149	SOOTY_9/RASCON_37//SOMAT_3.1/3/SOOTY_9/RASCON_37// STORLOM/4/SOOTY_9/RASCON_37//GUAYACAN INIA/3/SOOTY_9/RASCON_37//LLARETA INIA	SDWN	527636	6421230	60	S	S
426	150	RASCON_22/RASCON_21//MOJO_2/3/GUANAY/4/RCOL/5/ SORA/2*PLATA_12//SOMAT_3/8/SOMAT_4/INTER_8/6/ CHEN_1/TEZ/3/GUIL//CIT71/CII/4/SORA/PLATA_12/5/STOT// ALTAR 84/ALD/7/DON87/TARRO_1	SDWN	521378	6421270	121	S	S
427	151	ZHONG ZUO/2*GREEN_3//SORA/2*PLATA_12/10/PLATA_10/ 6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/ PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/ RUFO/4/FNFOOT/11/SORA/2*PLATA_12//SOMAT_3/3/ AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13	SDWN	521393	6419974	165	S	MR
428	152	ZHONG ZUO/2*GREEN_3//SORA/2*PLATA_12/10/PLATA_10/ 6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/ PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/ RUFO/4/FNFOOT/11/SORA/2*PLATA_12//SOMAT_3/3/ AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13	SDWN	521393	6421283	175	R	R

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
429	153	ZHONG ZUO/2*GREEN_3//SORA/2*PLATA_12/10/PLATA_10/ 6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/ PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/ RUFO/4/FNFOOT/11/RISSA/GAN//POHO_1/3/PLATA_3// CREX/ALLA/4/JUPARE C 2001/5/ARMENT//SRN_3/ NIGRIS_4/3/CA	SDWN	521396	6421295	93	S	MS
430	154	SOMAT_4/INTER_8/6/CHEN_1/TEZ/3/GUIL//CIT71/CII/4/ SORA/PLATA_12/5/STOT//ALTAR 84/ALD/7/DON87/ TARRO_1/8/ARLIN/2*ACO89/3/BOOMER_33//AUK/OSTE/5/ ROLA_5/3/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)// PLATA_13/4/MALMUK_1/SERRATOR_1	SDWN	521448	6421311	47	S	MS
431	155	ROLA_5/3/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)// PLATA_13/4/MALMUK_1/SERRATOR_1/5/KHP*2/D31708// BOOMER_33/3/PLATA_3//CREX/ALLA/8/SRN_3/AJAIA_15// PICON/3/GREEN/6/CMH82A.1062/3/GERARDO VZ 394//SBA81/ PLC/4/AAZ_1/CREX/5/HUI//CIT71/CII/7/SOMAT_4/INTER_8	SDWN	526433	6420218	48	MS	S
432	156	LABUD/NIGRIS_3//GAN/3/AJAIA_13/YAZI/10/PLATA_10/ 6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/ PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC// BUB/RUFO/4/FNFOOT/11/SOMAT_4/SILVER_1/3/FOCHA_1/ ALAS//4*FOCHA_1/4/SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	526435	6420219	75	HS	MS
433	157	LABUD/NIGRIS_3//GAN/3/AJAIA_13/YAZI/10/PLATA_10/ 6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/ PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC// BUB/RUFO/4/FNFOOT/11/SORA/2*PLATA_12//SOMAT_3/4/ STORLOM/3/RASCON_37/TARRO_2//RASCON_37/5/ CADO/BOOMER_33	SDWN	526438	6421352	90	MS	MS
434	158	SOMAT_4/INTER_8/5/CREX//BOY/YAV_1/3/PLATA_6/4/ PORRON_11/6/MINIMUS_6/PLATA_16//IMMER/3/SORA/ 2*PLATA_12/7/RASCON_22/RASCON_21//MOJO_2/3/ GUANAY/4/RCOL/5/SORA/2*PLATA_12//SOMAT_3	SDWN	526447	6421363	154	MS	MR
435	159	SOMAT_4/INTER_8/5/CREX//BOY/YAV_1/3/PLATA_6/4/ PORRON_11/6/MINIMUS_6/PLATA_16//IMMER/3/SORA/ 2*PLATA_12/7/RASCON_22/RASCON_21//MOJO_2/3/ GUANAY/4/RCOL/5/SORA/2*PLATA_12//SOMAT_3	SDWN	526447	6421364	155	MR	R
436	160	SOMAT_4/INTER_8/5/CREX//BOY/YAV_1/3/PLATA_6/4/ PORRON_11/6/MINIMUS_6/PLATA_16//IMMER/3/SORA/ 2*PLATA_12/7/RASCON_22/RASCON_21//MOJO_2/3/ GUANAY/4/RCOL/5/SORA/2*PLATA_12//SOMAT_3	SDWN	526447	6421365	156	MS	MS
437	161	SOMAT_4/INTER_8/5/CREX//BOY/YAV_1/3/PLATA_6/4/ PORRON_11/6/MINIMUS_6/PLATA_16//IMMER/3/SORA/ 2*PLATA_12/7/RASCON_22/RASCON_21//MOJO_2/3/ GUANAY/4/RCOL/5/SORA/2*PLATA_12//SOMAT_3	SDWN	526447	6421366	157	MR	MR
438	162	BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/ 5/1A.1D 5+1-06/3*MOJO//RCOL/4/ARMENT//SRN_3/ NIGRIS_4/3/CANELO_9.1	SDWN	526464	6420228	55	MR	HS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
439	163	BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/6/LHNKE/HCN//PATA_2/3/CAMAYO/5/CREX//BOY/YAV_1/3/PLATA_6/4/PORRON_11	SDWN	526469	6421385	31	S	S
440	164	BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/5/SILK_3/DIPPER_6/3/ACO89/DUKEM_4//5*ACO89/4/PLATA_7/ILBOR_1//SOMAT_3	SDWN	526474	6419995	89	MS	S
441	165	BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/5/SRN_2//YAVAUS/HUI/3/RASCON_19/4/SOMAT_3/PHAX_1//TILO_1/LOTUS_4	SDWN	526475	6420236	45	HS	MS
442	166	BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/4/SORA/2*PLATA_12//SOMAT_3/3/AJAIA_12/F3LOCAL(SEL.ETHIO.135.85)//PLATA_13	SDWN	526538	6421431	94	S	MS
443	167	BCRIS/BICUM//LLARETA INIA/3/DUKEM_12/2*RASCON_21/5/RISSA/GAN//POHO_1/3/PLATA_3//CREX/ALLA*2/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	526539	6421441	107	R	S
444	168	HUBEI//SOOTY_9/RASCON_37/3/2*SOOTY_9/RASCON_37/4/SOOTY_9/RASCON_37/5/GUAYACAN INIA/KUCUK/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	526555	6421457	57	R	MR
445	169	CNDO/PRIMADUR//HAI-OU_17/3/SNITAN/4/JUPARE C 2001/5/CNDO/PRIMADUR//HAI-OU_17/3/SNITAN/6/RISSA/GAN//POHO_1/3/PLATA_3//CREX/ALLA*2/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	526580	6420016	29	MS	MS
446	170	BOOMER_33/ZAR/3/BRAK_2/AJAIA_2//SOLGA_8/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/ARTICO/AJAIA_3//HUALITA/3/FULVOUS_1/MFOWL_13/4/TECA96/TILO_1/12/SORA/2*PLATA_12//	SDWN	527531	6420256	67	MR	MR
447	171	KIRKI_1/HIMAN_9/4/LIS_8/FILLO_6/3/FUUT//HORA/JOR/5/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/6/ADAMAR_15//ALBIA_1/ALTAR 84/3/SNITAN/4/SOMAT_4/INTER_8/5/SOOTY_9/RASCON_37/7/1A.1D 5+1-06/3*MOJO//RCOL/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1	SDWN	527534	6421497	105	R	R
448	172	MÂALI/5/LOTUS_5/SORD_1/3/CANELO_8//SORA/2*PLATA_12/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	521203	6421550	39	MR	R
449	173	MÂALI/5/LOTUS_5/SORD_1/3/CANELO_8//SORA/2*PLATA_12/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN	SDWN	521203	6421551	40	S	MS
450	174	MÂALI/3/RCOL/GUANAY*2//SOMAT_3/GREEN_22	SDWN	521206	6421558	70	HS	MR
451	175	STOT//ALTAR 84/ALD/3/PATKA_7/YAZI_1/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/5/NASR 99	SDWN	521660	6421581	89	S	MS
452	176	STOT//ALTAR 84/ALD/3/PATKA_7/YAZI_1/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/5/NASR 99	SDWN	521660	6421583	91	S	S
453	177	ARTICO/AJAIA_3//HUALITA/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/ALTAR 84//FD8419-126-1-2/RAZZAK/3/KRF-DW/BALADIA HAMRA	SDWN	527498	6421627	136	MR	R

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
454	178	ALTAR 84//FD8419-126-1-2/RAZZAK/3/KRF-DW/BALADIA HAMRA/5/BRAK_2/AJAIA_2//SOLGA_8/3/CANELO_8// SORA/2*PLATA_12/4/YAZI_1/AKAKI_4//SOMAT_3/3/AUK/ GUIL//GREEN/10/NASR 99/9/SOMAT_3/PHAX_1//TILO_1/ LOTUS_4/7/YEL/BAR/3/GARZA/AFN//CRA/5/DOM//CRA*2/ GS/3/SCOT/4/H	SDWN	527609	6421683	310	MR	MS
455	179	MÂALI/6/MUSK_1//ACO89/FNFOOT_2/4/MUSK_4/3/PLATA_3// CREX/ALLA/5/OLUS*2/ILBOR//PATKA_7/YAZI_1/10/ALTAR 84//FD8419-126-1-2/RAZZAK/3/KRF-DW/BALADIA HAMRA/ 9/ALTAR 84/860137//YAZI_1/4/LIS_8/FILLO_6/3/FUUT//HORA/ JOR/8/GEDIZ/FGO//GTA/3/SRN_1/4/TOTUS/5/ENTE/M	SDWN	527618	6421704	156	S	S
456	180	TGBB/CANDEF//LALA/GUIL/3/BONVAL/4/TILO_1/ LOTUS_4/5/TILO_1/LOTUS_4	SDWN	478331	5550875	27	MR	MR
457	181	BELLAROI/6/RASCON_22/RASCON_21//MOJO_2/3/ GUANAY/4/RCOL/5/SORA/2*PLATA_12//SOMAT_3/8/ PLATA_3//CREX/ALLA/3/YAZI_10/4/JUPARE C 2001/7/ CHEN_11/POC//TANTLO/5/ENTE/MEXI_2//HUI/4/YAV_1/3/ LD357E/2*TC60//JO69/6/MINIMUS/COMB DUCK_2//CHAM_3	SDWN	538221	6634315	95	MR	MR
458	182	WID22209/5/PLATA_6/GREEN_17//SNITAN/4/YAZI_1/ AKAKI_4//SOMAT_3/3/AUK/GUIL//GREEN/6/YAV79/ 4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/5/MINIMUS/ COMB DUCK_2//CHAM_3/3/GREEN_19	SDWN	538237	6634331	62	S	MS
459	183	BELLAROI/5/HUBEI//SOOTY_9/RASCON_37/3/2*SOOTY_9/ RASCON_37/4/SOOTY_9/RASCON_37/6/RASCON_22/ RASCON_21//MOJO_2/3/GUANAY/4/RCOL/5/SORA/ 2*PLATA_12//SOMAT_3	SDWN	531811	6634381	90	S	MR
460	184	TOPDUR/SAAT_923020.2/3/VANRRIKSE_6.2//1A-1D 2+12-5/3*WB881/4/SOOTY_9/RASCON_37//GUAYACAN INIA	SDWN	531888	6634481	79	MS	MR
461	185	SARAGOYA/5/GUANAY/SHIP_1/4/ARMENT//SRN_3/ NIGRIS_4/3/CANELO_9.1/9/STR/4/JO69/3/JO69/CRA//CIT71/ 5/ALTAR 84/AOS/6/ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/ 2*TC60//JO69/7/SOMAT_4/INTER_8/8/INTER_8/SILVER_2	SDWN	531910	6634531	87	HS	HS
462	186	AZN1/3/STJR_3//DRA_2/BCR/11/CANELO_9.1/SNITAN/10/ PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/ AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	537483	6634627	116	HS	MR
463	187	TOPDY_18/FOCHA_1//ALTAR 84/3/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/4/SOMAT_3/ GREEN_22/6/LHNKE/HCN//PATA_2/3/SOMAT_4/ INTER_8/5/CREX//BOY/YAV_1/3/PLATA_6/4/PORRON_11	SDWN	531190	6634786	143	MS	S
464	188	ALTAR 84/860137//YAZI_1/4/LIS_8/FILLO_6/3/FUUT//HORA/ JOR/8/GEDIZ/FGO//GTA/3/SRN_1/4/TOTUS/5/ENTE/MEXI_2// HUI/4/YAV_1/3/LD357E/2*TC60//JO69/6/SOMBRA_20/7/ JUPARE C 2001/9/SOMAT_4/INTER_8/6/CHEN_1/TEZ/3/ GUIL//CIT71/CII/4/SORA/PLATA_12/5/STOT//ALTAR 84/A	SDWN	531199	6634819	122	S	MR
465	189	CAMAYO/2*KUCUK/3/SOOTY_9/RASCON_37//GUAYACAN INIA	SDWN	531204	6634824	82	MS	R

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
466	190	CHEN_1/TEZ/3/GUIL//CIT71/CII/4/SORA/ PLATA_12/5/STOT//ALTAR 84/ALD/6/SOMAT_3/ PHAX_1//TILO_1/LOTUS_4/7/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/4/ CHEN_1/TEZ/3/GUIL//CIT71/CII/5/SORA/ 2*PLATA_12//SOMAT_3	SDWN	531225	6634847	73	S	MS
467	191	CHEN_1/TEZ/3/GUIL//CIT71/CII/4/SORA/PLATA_12/5/STOT// ALTAR 84/ALD/6/SOMAT_3/PHAX_1//TILO_1/LOTUS_4/7/ LABUD/NIGRIS_3//GAN/3/AJAIA_13/YAZI/4/SORA/ 2*PLATA_12//SOMAT_3	SDWN	531226	6634850	44	S	MS
468	192	TADIZ/3/SOMAT_3/PHAX_1//TILO_1/LOTUS_4/8/SRN/GOTE/ 4/SHWA/MALD//AAZ/3/SRN/5/CARC/CALI/6/BRAK_2/ AJAIA_2//SOLGA_8/7/SOMAT_4//AJAIA_13/YAZI	SDWN	531375	6635074	52	HS	MS
469	193	SILK_3/DIPPER_6/3/ACO89/DUKEM_4//5*ACO89/4/PLATA_7/ ILBOR_1//SOMAT_3/9/CBC 509 CHILE/6/ECO/CMH76A.722// BIT/3/ALTAR 84/4/AJAIA_2/5/KJOVE_1/7/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/8/SOOTY_9/ RASCON_37//WODUCK/CHAM_3	SDWN	537773	6635087	34	S	MR
470	194	1A.1D 5+1-06/3*MOJO//RCOL/4/ARMENT//SRN_3/NIGRIS_4/ 3/CANELO_9.1/11/SOOTY_9/RASCON_37/3/SOOTY_9/ TARRO_1//AJAIA_2/10/PLATA_10/6/MQUE/4/USDA573//QFN/ AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/ 9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	537793	6635117	61	MR	MR
471	195	SOMAT_4/INTER_8/5/AJAIA_16//HORA/JRO/3/GAN/4/ZAR/ 9/GEDIZ/FGO//GTA/3/SRN_1/4/TOTUS/5/ENTE/MEXI_2// HUI/4/YAV_1/3/LD357E/2*TC60//JO69/6/SOMBRA_20/7/ JUPARE C 2001/8/CS/TH.CU//GLEN/3/GEN/4/MYNA/ VUL/5/2*DON87/6/2*BUSCA_3	SDWN	537838	6635188	81	MR	MS
472	196	SOMAT_4/INTER_8/5/AJAIA_16//HORA/JRO/3/GAN/4/ZAR/ 11/CANELO_9.1/SNITAN/10/PLATA_10/6/MQUE/4/USDA573// QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/ 9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	537840	6635194	123	HS	MS
473	197	SOMAT_4/INTER_8/5/AJAIA_16//HORA/JRO/3/GAN/4/ZAR/ 11/CANELO_9.1/SNITAN/10/PLATA_10/6/MQUE/4/USDA573// QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/ 9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT	SDWN	537840	6635198	127	S	HS
474	198	SILK_3/DIPPER_6/3/ACO89/DUKEM_4//5*ACO89/4/PLATA_7/ ILBOR_1//SOMAT_3/6/GUANAY//TILO_1/LOTUS_4/5/ OSU-3880005/3/STOT//ALTAR 84/ALD/4/KUCUK_2	SDWN	537861	6635221	39	MS	MS
475	199	SOMAT_4/INTER_8/3/RASCON_21/KNAR_3//PLATA_8/4/ CNDO/PRIMADUR//HAI-OU_17/3/SNITAN/9/GEDIZ/FGO// GTA/3/SRN_1/4/TOTUS/5/ENTE/MEXI_2//HUI/4/YAV_1/3/ LD357E/2*TC60//JO69/6/SOMBRA_20/7/JUPARE C 2001/8/CS/TH.CU//GLEN/3/GEN/4/MYNA/VUL/5/ 2*DON87/6/2*BUSCA_3	SDWN	537883	6635238	86	MR	MR

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
476	200	SOMAT_4/INTER_8/3/RASCON_21/KNAR_3//PLATA_8/4/ CNDO/PRIMADUR//HAI-OU_17/3/SNITAN/9/GEDIZ/FGO// GTA/3/SRN_1/4/TOTUS/5/ENTE/MEXI_2//HUI/4/YAV_1/3/ LD357E/2*TC60//JO69/6/SOMBRA_20/7/JUPARE C 2001/8/CS/TH.CU//GLEN/3/GEN/4/MYNA/VUL/5/ 2*DON87/6/2*BUSCA_3	SDWN	537883	6635242	90	MS	MR
477	201	D86135/ACO89//PORRON_4/3/SNITAN/10/PLATA_10/6/MQUE/ 4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/ 8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/ FNFOOT/11/CANELO_8//SORA/2*PLATA_12/12/TADIZ/9/ USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ARDENT	SDWN	537893	6635270	79	S	MR
478	202	D86135/ACO89//PORRON_4/3/SNITAN/10/PLATA_10/6/MQUE/ 4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/ 8/THKNEE_11/9/CHEN/ALTAR 84/3/HUI/POC//BUB/RUFO/4/ FNFOOT/11/CANELO_8//SORA/2*PLATA_12/12/DACK/KIWI// OSTE/3/CHEN84_1/4/MEXI75/5/NIGRIS_4/6/LLARETA INI	SDWN	537896	6635277	45	MR	MS
479	203	TARRO_1/2*YUAN_1//AJAIA_13/YAZI/3/SOMAT_3/PHAX_1// TILO_1/LOTUS_4/4/CANELO_8//SORA/2*PLATA_12/7/ CMH83.2578/4/D88059//WARD/YAV79/3/ACO89/5/2*SOOTY_9/ RASCON_37/6/1A.1D 5+1-06/3*MOJO/3/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13	SDWN	537901	6635290	86	MS	S
480	204	WDRAIL_1/TOSKA_26//PLATA_6/GREEN_17/3/SORA/ 2*PLATA_12//SOMAT_3/4/SORA/2*PLATA_12//RASCON_37/6/ YAV79/4/ARMENT//SRN_3/NIGRIS_4/3/CANELO_9.1/5/ MINIMUS/COMB DUCK_2//CHAM_3/3/GREEN_19	SDWN	537950	6635343	117	MR	R
481	205	CNDO/VEE//CELTA/3/PATA_2/6/ARAM_7//CREX/ALLA/ 5/ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/2*TC60//JO69/9/ USDA595/3/D67.3/RABI//CRA/4/ALO/5/HUI/YAV_1/6/ ARDENTE/7/HUI/YAV79/8/POD_9/11/SOOTY_9/RASCON_37// WODUCK/CHAM_3/10/PLATA_10/6/MQUE/4/USDA573// QFN/AA_7/3/ALB	SDWN	537986	6635403	64	S	MS
482	206	1A.1D 5+1-06/2*WB881//1A.1D 5+1-06/3*MOJO/3/SOOTY_9/ RASCON_37/10/PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/ 3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/THKNEE_11/9/CHEN/ ALTAR 84/3/HUI/POC//BUB/RUFO/4/FNFOOT/11/SOMAT_3/ PHAX_1//TILO_1/LOTUS_4/3/GUANAY/5/NETTA_4/ DUKEM_12/	SDWN	537996	6635413	34	HS	MR
483	207	CMH74A.630/SX//TSI/3/GUANAY/4/2*D86135/ACO89// PORRON_4/5/SOOTY_9/RASCON_37/3/SOOTY_9/ TARRO_1//AJAIA_2/7/SNITAN/5/AJAIA_12/ F3LOCAL(SEL.ETHIO.135.85)//PLATA_13/3/ SOMAT_3/4/SOOTY_9/RASCON_37/6/SNITAN	SDWN	537998	6635414	67	MS	MR
484	208	CBC 501 CHILE/GUANAY/3/ISLOM_1/DUKEM_2//TARRO_3/ 4/SOMAT_3/PHAX_1//TILO_1/LOTUS_4/5/SOOTY_9/ RASCON_37//WODUCK/CHAM_3/3/SOMAT_3/PHAX_1// TILO_1/LOTUS_4	SDWN	538013	6635437	55	HS	MS

Table S1. (Continued.)

Entry	Sub-entry	Cross name	Nursery	CID	GID	SID	RR-GR	
							Pt	Pn
485	*Pn-Check*	CROC_1/AE.SQUARROSA(224)//OPATA						MR
486	*Pn-Check*	CROC_1/AE.SQUARROSA(224)//OPATA						MR
487	*Pn-Check*	SERI						HS
488	*Pn-Check*	GATCHER						HS
489	*Pt-Check*	CROC_1/AE.SQUARROSA(224)//OPATA					MR	
490	*Pt-Check*	GATCHER					S	
491	*Pt-Check*	GS5017					MR	
492	*Pt-Check*	SERI					HS	

Abbreviations stand for: resistant (R), moderately resistant (MR), moderately susceptible (MS), susceptible (S), and highly susceptible (HS), (n = 6).