CALIFORNIA FRESH CARROT ADVISORY BOARD
Research Report
March, 2018 to February, 2019

Project Title:	Identification of gene sources for resistance to root-knot nematodes attacking carrots in California
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Root-knot nematodes (*Meloidogyne* spp.) are a major problem to carrot production because their root infection causes galling and forking distortion of the taproot, rendering the carrots unmarketable. They are especially prevalent in the loam to sandy soils used for carrot production in California. In an approach to find alternative management strategies to soil fumigation treatments, our goal is to characterize carrot germplasm with genetic resistance and tolerance to root-knot nematodes, and to provide advanced lines that will enable carrot breeders to develop resistant cultivars suitable for California fresh market production. In collaboration with Dr. Phil Simon, USDA, Wisconsin, different sources of resistance and tolerance are being advanced and combined to provide carrot cultivars with a broad-based protection against the spectrum of root-knot nematode species. Emphasis is being placed on the high resistance to *M. incognita*, *M. javanica*, and *M. arenaria* in Brasilia sources, high resistance in several non-Brasilia resistance sources, and moderate to high tolerance and resistance to the northern root-knot nematode *M. hapla* in various resistance sources. Genetic characterization and combining abilities of different resistance sources are being investigated through crossing, progeny screening, and molecular marker analysis in allelism tests. New combinations among the resistance sources show excellent promise for developing broad-based root-knot nematode resistant carrots.

Our field screening of carrot breeding lines for nematode resistance also includes materials from seed companies, and we are fostering their collaborative involvement in the field trial assessments. Some of the most advanced nematode resistant selections have been seed-increased by seed companies to provide seed quantities large enough to perform small-scale field testing in commercial fields. An important feature in the process of selecting and advancing field and greenhouse screened materials is leaf tissue sampling for DNA extraction and marker analysis at the time of resistance evaluation. Field and greenhouse selected roots were shipped to Dr. Simon in Wisconsin for selfing or crossing, following vernalization in cold storage for several weeks either before or after shipping.

Another component of our research is to determine how broadly effective the different carrot resistance sources are to multiple isolates of the aforementioned primary root-knot nematode species. We have been testing a collection of about 50 nematode isolates on a panel of eleven resistant carrot sources under controlled greenhouse screening assays.

Field screening of inbred lines and resistant progeny selections:

Kearney REC trials: Field screenings of advanced lines including inbred crosses developed by Dr. Simon were made in 2018 at the UC Kearney Research and Extension Center (KREC), Parlier, Fresno County. Carrot lines together with known resistant and susceptible control lines were tested on two field sites, one infested with *M. incognita* (MI) and a second with *M. javanica* (MJ). The *M. incognita* population (isolate project 77) at the KREC site is originally from Tulare Co. in the San Joaquin Valley, California, and representative of *M. incognita* infestations in carrot growing areas of the state. The complete screening results from 1,344 plots on the two sites are summarized in Table 1. Tests were made in 3-foot plots as in previous years, planted on 5/8/2018 and harvested for evaluation on 8/30-31/2018. Infection was good to excellent and fairly uniform in both MI and MJ trials, based on infection levels in the susceptible Imperator-58 controls, which were planted every 5th plot. The mean control score in the MI trial was 5.85 (range 4 to 9), slightly lower than in the 2017 South Coast REC trial. The mean control score in the MJ trial was 6.56 (range of 4 to 9), higher than the 2017 South Coast REC trial. Crop rotation at the KREC sites, where a field block of 44 rows is used for trials every 4 years, has improved the infection levels and uniformity, and also minimized problems associated with other diseases. The 3-year crop cycle before the 2018 test year was sorghum followed by a susceptible legume followed by susceptible tomato.

The root symptom evaluations were based on a 0 to 8 scale for amount of taproot galling and galling of fibrous roots, plus a score of 9 if roots were completely rotted. Plots with a score of 0 were fully resistant. Plots with scores of 1 to 2 were mostly resistant with evidence of possible segregation. Plots with a score of 5 had > 50% susceptible roots, but often some resistant roots could be selected from the plot. Plots with a score of 7 were fully susceptible, and a plot with a score of 8 was susceptible mixed with some rot, mostly from infection by *Sclerotium rolfsii*. A score of 9 was given to plots that were completely lost to rot. Rot was evident in some plots in the 2018 trials, especially in some of the susceptible Imperator 58 control plots. This was more the case in the *M. javanica* (MJ) trial, where 16 out of 162 control plots had a score of 9. The greater loss to rot was likely due in part to the more severe nematode infection in the MJ trial. Only 2 of the 162 control plots in the MI trial were lost to rot (scores of 9). There were also more test (non-control) plots with poor stands (coded ps) in the MJ trial (about 100 plots, twice that observed in the MI trial), also due in part to root rot. Both trials were very effective in distinguishing resistant and susceptible entries, and a substantial percentage of entries were resistant (scores of 2 or lower), indicating resistance held up well to the high infection levels and high temperature. Several temperature records were broken during the 2018 summer at Kearney, including the number of consecutive days with daily high temperatures over 100 F.

Horticultural quality overall was quite good given the harsh conditions (nematode infection level and high temperature), enabling selection for both nematode resistance and quality (root shape, length and color, etc.). Selection for resistance and quality was made in about 10 % of the plots, primarily in the MI trial.

1,344 test plots in total were planted in the two main field trials (MI and MJ). In each trial, 649 USDA breeding material entries from Phil Simon, 162 susceptible Imperator 58 control plots, and 23 industry submissions (not including industry dedicated rows for breeding material) were planted. Entries were replicated once in each trial. In addition to the main trials, 4 rows consisting of 280 plots (70 plots/row) were allocated to industry in each trial for nematode screening and selection for resistance. For consistency, industry plantings followed the protocol used in the main trials with a susceptible control every 5th plot along each row. Entries in the industry-dedicated rows were replicated twice.

A field day was held during the harvest evaluations on 8/31/2018, highlighted by the *M. incognita* trial, and attended by seed company and carrot industry personnel.

Main Nursery trials: Data from the field trials are presented in Table 1. Data on the 23 industry submissions were reported directly to the respective industry partners. Each trial included 52 entries that are derived from selections made in 2017 at the South Coast REC nematode trials (entries 101 through 153) and 285 entries derived from selections made in 2016 at Kearney (entries 202 through 486); these are listed in **Section 1 (under Arlington production)**. Also listed in section 1 are entries derived from selections made from USDA plant introductions (PI's) tested at the Coachella Valley Research Station (CVARS) in 2017 and at UCR in a greenhouse test (entries 152 to 201). Also listed in section 1 are entries derived from selections made at UCR in a greenhouse *M. hapla* test of a segregating Homs population (entries 175 to 187) and a greenhouse multi-isolate *M. hapla* test conducted in 2016 (entries 492 to 518).

Entries in **Section 1** (from 101 to 153) that are derived from selections from both MI and MJ trials conducted at South Coast REC in 2017 include F1 hybrids to more advanced (up to F6) material. Of the 52 entries, 37 or 71 % had scores of 2 or less. Many were highly resistant with scores of 0 in both trials. The high percentage of very resistant entries indicated that selection in 2017 under intense nematode pressure was very effective. Sources of resistance include Brasilia (BR or B), Homs (HM or H), Scarlet Fancy x Favorite (SFF or S), Western Red (WR or W), and Ping Ding (PD or P) singly or in various combinations. Older inbreds like Nb8483 and newer inbreds including Npw2191, Nb3271, and Nb1386, are highly resistant and are being utilized in crosses. Of interest was the observation of effective resistance in some hybrids with SC, including entries 116, 132, 134, 137 and 141 (PD and WR are the resistance sources), and entry 119 (SFF is the resistance source).

Although many of the entries derived from USDA PI selections at CVARS were not very resistant in the 2018 trials, there were some with good resistance, including PI 169484 (root source CV076, entries 167 and 168) and PI 272258 (root source CV259, entry 169). Progeny from a greenhouse test indicated segregation for resistance to *M. incognita*. Progeny from the greenhouse test were included in **Section 1** (entries 191 through 196).

Entries in **Section 1** (from 202 through 486) derived from selections made at Kearney in 2016 ranged from F2 to F9 with a few F x F (generation column). Of the 285 entries, 190 (67%) had scores of 2 or less. Some of these entries had also been tested at South Coast

REC in 2017. Many of the entries were highly resistant (scores of 0) to both MI and MJ. A resistance source that appears quite often in the entries is (8483 x 9256). 8483 is an inbred derived from Brasilia 1252 x 6274. An F3 population of (8483 x 9256) had been greenhouse tested at UCR in 2009 and again in 2014 and resistant roots sent to Wisconsin (see also Table 2). Resistant roots from the 2009 test were caged together to produce Sem 274-1 (Table 2), which was used in the multi-isolate tests at UCR in 2014-2018 and has been genotyped. Another source that appears frequently in the entries is [HM x (B x 6)] or [(B x 6) x HM]. B x 6 = Brasilia 1252 x 6274, and HM = Homs. A high percentage of the entries in this group with either (8483 x 9256) or [HM x (B x 6)] or both in the pedigree were highly resistant in the trials. Many of the newer inbreds in Section 1 (entries 438 thru 486) were also highly resistant, including Nh0252B, Nb1386B, Nb1391B, Npw2191B, among others.

Good horticultural quality was seen in some entries that were also resistant, including entries 109, 236, and 621 (pedigree = [(HM x B x 6) x 9359B]), 363 (pedigree = H x B), 451 (pedigree = Nb1391B), and 676 (pedigree = Nbh2306B). The entries with an N designation are nematode resistant inbreds, where Nb has resistance derived from Brasilia 1252 and Nbh has resistance derived from Brasilia and Homs.

Entries 492 to 518 (Section 1) are derived from selections made in the multi-*M. hapla* isolate greenhouse trial conducted in 2016. *M. hapla* resistant selections were made in 2 sources of Homs (H1 and H2), Homs x (Br1252 x 6274) or H x B, and F5 derived from a cross of Br1091 x Homs. Overall, H1 was fixed for very good resistance to *M. hapla* in the 2016 greenhouse trial after selections made in 2014. Although these entries were derived from selections for resistance to *M. hapla*, most were also highly resistant to MI and MJ in the 2018 field trials. Of the 27 entries, 26 or 96% of the entries had scores of 2 or lower, and 12 of the entries had scores of 0 in both trials.

Section 2 of Table 1 (entries 535 to 601) are primarily inbreds, including some older inbreds like Nb8542B, Nb8503, Nb3999B, and Nb6526B and were highly resistant in the 2018 trials, as in previous years. These (Nb) inbreds carry resistance derived from BR1252. NB3999, NB4001, NB4002, NB6526, and NB8503 were released in 2014 to provide germplasm for developing improved hybrids and breeding populations. Other inbreds tested in the trials and listed in Section 2 carry resistance derived from SFF (NS5154B), and Homs (NH2168B, NH8502B), and are highly resistant. NS5154 and NH2168 were also released in 2014.

Section 3 of Table 1 consists of earlier production material, either not tested previously in the nematode field trials (602 to 611) or derived from selections made in years other than 2017. Entries 615 to 626 and 749 to 772 were derived from selections made in the trials at Kearney in 2015 and are overall very resistant, with 28 out of 36 (78%) highlighted as resistant.

Section 4 of Table 1 (entries 627 to 721) consists of hybrids made of resistant x susceptible inbreds or resistant x resistant inbreds in single or 3-way crosses. Resistant inbreds used in the hybrid crosses included some that are older (e.g., Nb8483, Nb3999,

Nb8524, Nb6526) and others that are more recent (e.g., Nb1386, Nb2195, Nb9297) including some with multiple resistances in the pedigree (e.g., Nbh2306, Npw2191). In most cases, single-cross hybrids with resistance in only one of the parents (e.g., entries 687 or 689, crosses with Nb9297) were more susceptible, whereas crosses with both parents resistant (entry 688, Nb9297 crossed with Nb2205) were resistant. In 3-way hybrids, those with resistance in all parents were also resistant in the trials (e.g., 667, a 3-way using Nb8524, Nb8483, and Nb9297). There were some 3-way hybrids with resistance in 2 of the 3 parents that also expressed high resistance (e.g., 630, or 634 to 637, or 651), involving resistant x susceptible in the initial cross and then x resistant in the final cross. This was not the case in 3-ways of (resistant by resistant) x susceptible (e.g., 627) or (susceptible x susceptible) x resistant (e.g., 628, 629). This confirms our observations from previous trials, that resistance needs to be in both parents in hybrid crosses.

As in previous years, selection for resistance and quality were made on entries in both MI and MJ field trials. Selected roots were shipped to Wisconsin to be vernalized and planted in the 2018-2019-winter nursery for crossing and (or) seed production.

Greenhouse evaluations:

Greenhouse trials were conducted with two objectives. One focus was to continue the screening of a carrot genotype resistance panel with multiple root-knot nematode isolates, in order to determine how broadly effective are the identified resistance sources to the main root-knot nematode species attacking carrots (section 1). A second focus was a continuation of controlled screening of populations segregating for nematode resistance (section 2), in attempts to define the trait loci and to develop markers for the loci for use in the breeding programs.

1. Multi-isolate screening of 11 resistant carrot genotypes and 1 susceptible control (Imperator 58) was continued to look at possible variability among root-knot nematode isolates on different sources of resistance. The focus in 2018 was to complete the isolate screens with repeat screens for some isolates, with a focus on *M. hapla*. Excellent resistance to *M. hapla* was conformed, and is effective across the majority of *M. hapla* isolates.

2. Several tests were conducted on segregating carrot populations that are being used for genotyping and genetic analysis (Table 2).
    a. In the first test, 335 plants of USDA PI 272258 were inoculated with *M. incognita*, and segregated for resistance with a range of scores from 1 (resistant) to 8 (highly susceptible. Progeny of the most resistant pot-tested plants were screened at Kearney in 2018 (Table 1) and indicated that the resistance is effective against both *M. incognita* and *M. javanica*. A separate pot test with *M. hapla* also indicated this line segregates for resistance to *M. hapla*, with some plants scoring 0 or 1. Progeny of single roots from the initial pot test and roots selected from the 2017 CVARS trial were also greenhouse-tested with *M. incognita* (Table 2, populations 135172, etc.). All 501 plants in these tests were leaf sampled and roots

sent to Wisconsin for seed production and (or) crossing. Leaf samples were used for DNA extraction for use in genotyping (GBS).

b. Additional tests with *M. incognita* were conducted on two other new lines that appeared to segregate in an initial pot test and were quite resistant in the 2017 field test. 72 plants of PI 171643 segregated for resistance to *M. incognita* with a range of scores from 3 to 8. 63 plants of PI 222249 also segregated for resistance to *M. incognita* with a range of scores from 3.5 to 7. Both sets of plants were leaf sampled for genotyping and roots sent to Wisconsin.

c. Also listed in **Table 2** are other populations that have been tested since 2011 for use in genetic analysis. With the exception of Homs (population 87298), the other populations listed in the table are derived from Brasilia 1252 x 6274 with the intention of understanding the genetics of resistance to *M. incognita* of Brasilia 1252. Population source 95644, which is an F2 derived from a cross of FN2-9 x 8503, would be expected to segregate for *Mj-1* together with other genes controlling resistance to *M. incognita*. Sem 274-1, 80080 and the group of UCR populations are fixed (homozygous) for resistance to *M. javanica* and hence are fixed for the gene *Mj-1*. These populations therefore segregate for resistance to *M. incognita* with *Mj-1* fixed in the background. All populations listed in Table 2 have been leaf sampled for DNA extraction. Populations 87298 (Homs), Sem 274-1, and UCR 2 and UCR 5 have been genotyped. A preliminary analysis of UCR 2 and UCR 5 data indicates 2 QTL and a possible weak 3rd QTL are responsible for the segregation of resistance to *M. incognita* derived from Brasilia 1252. Analysis of genotype data from SEM 274-1 will be used to corroborate those QTL. Genotype data from Homs population 87298 will be used to map the trait determinant that segregates for *M. hapla* resistance.

Please also refer to the report by Dr. Phil Simon (Carrot Breeding to Develop and Introduce Improved Cultivars).

Table 1. Root-knot nematode carrot resistance field trials

conducted in 2018 at U.C. Kearney Research and Extension Center.

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
	Arlington 2017-18 Production							
101	7808, Flavor x (SFF x (8483x9256))	F4	J103	135002	4		4	
102	**(Nb8483B x 9256B) x (Bx6 x HM)**	**F5**	**i117**	**135003**	**1**		**1**	
103	**(Nb8483B x 9256B) x (Bx6 x HM)**	**F5**	**i117**	**135004**	**2**		**0**	
104	HM x (Bx6)	F3M2S	J122	135007	3	5.5	3	7
105	**(FN2-9 x 2302) x (WR x PD)**	**F4S**	**i128**	**135010**	**1**		**1**	
106	(FN2-9 x 2302) x ((Bx6)x(PD x PI))	F3MS	J129	135012	4		3.5	
107	**(HM x NF) x 0569B**	**F5**	**i130**	**135013**	**1.5**		**2**	
108	**(HM x NF) x 0569B**	**F5**	**i130**	**135015**	**1**	**7**	**1**	**8**
109	**(HM x Bx6) x 9359B**	**F5**	**J132**	**135020**	**1.5**		**1**	
110	(PD x WR) x 9782B	F4M	i143	135024M	1		3.5	
111	**7262B x HM**	**F2M2S**	**i158**	**135027**	**0**		**1**	
112	((Bx6)x(PDxPI)) x (8483Bx9256B)	F2MS2	i161	135030	0	8	3.5	7
113	**PD x PI326011**	**F1M2SMS2etc.**	**i173**	**135032**	**1**		**2**	
114	**(PD x PI326011) x WR**	**F5MS2**	**i184**	**135033#1**	**1.5**		**0**	
115	**(PD x PI326011) x WR**	**F5MS2**	**i184**	**135033#2**	**1**		**1.5**	
116	**SC x ((PD x PI236011) x WR)**	**F1**	**i405**	**135097cg033**	**1**	**5.5**	**1**	**7**
117	**HM x (Bx6)**	**F3MS2**	**i188**	**135034**	**0**		**1**	
118	**SFF**	**F1XMS3M2S4**	**i199**	**135036**	**2**		**2**	
119	**SC x SFF**	**F1**	**i397**	**135084cg036**	**1**		**2**	
120	(Snts x EFM) x HM x (Bx6)	F6	i204	135038	0	6	4	6
121	(Bx6 x HM) x (8483B x 9256B)	F3MS2	J212	135039	1		2.5	
122	**[HMx(Bx6)x(SntsxEFM)]x[8483et**	**F2**	**i219**	**135042**	**0**		**2**	
123	**(PD x PI326011) x WR**	**F3MSMSMS2**	**i225**	**135043**	**0**		**1**	
124	SC x ((PD x PI236011) x WR))	F1	i405	135102cg043	2.5	5.5	2 (ps)	6.5
125	**HM x SFF**	**F4MS2**	**i226**	**135044**	**1**		**1**	
126	**WR x PD**	**F3M2S5**	**i227**	**135046**	**1**		**2**	
127	**HM x SFF**	**F4MSM**	**i229**	**135047**	**1**		**1**	
128	HM x SFF	F4MS2	i229	135048	0	7	2.5	9
129	SC x (HM x SFF)	F1	i405	135102cg048	0		3	
130	**(8483B x 9256B) x HM**	**F3MS3**	**i245**	**135051**	**0 (ps)**		**0 (ps)**	
131	**(PD x PI326011) x WR**	**F3MSMSMS3**	**i249**	**135052**	**0**		**0**	
132	**SC x ((PD x PI236011) x WR)**	**F1**	**i405**	**135100cg052**	**0**	**5.5**	**0**	**6**
133	**(PD x PI326011) x WR**	**F3MSMSMS2**	**i251**	**135053**	**0**		**1.5**	
134	**SC x ((PD x PI236011) x WR)**	**F1**	**i405**	**135107cg107**	**1**		**1**	
135	Nb8483B 9256B	F4MS2MS	i258	135055	2		2.5	
136	PD x WR	F3MS2M3	i265	135057	1	6	2.5	9
137	**SC x (PD x WR)**	**F1**	**i405**	**135104cg057**	**1.5**		**2**	
138	**HM x (Bx6)**	**F2MS6**	**i280**	**135058**	**1**		**1**	
139	**(Nb8483B x 9256B) x HM**	**F2MS3**	**i345**	**135067**	**0**		**0**	
140	**WR x PD**	**F3M2S4**	**i350**	**135068**	**1**	**4.5**	**1**	**7**
141	**SC x (WR x PD)**	**F1**	**i405**	**135108cg068**	**1**		**1**	
142	**Nb1386B**	**F4MS3**	**i385**	**135078**	**1**		**0**	
143	Npw2191B	F3M2SMS2	i396	135083	0		3.5	
144	**SC x Npw2191**	**BC2**	**i397**	**135086cg083**	**1**	**4.5**	**1**	**8**
145	Nb8524B	F3M6SM2	i443	135112	1		3	
146	**"HxB" = Homs x (Br1252 x 6274)**	**F5M2S2**	**i449**	**135114**	**1**		**2**	
147	**HM x (Bx6)**	**F5MS3**	**i502**	**135120**	**1.5**		**1**	
148	**(HM x NF) x 0569B**	**F4**	**i516**	**135126**	**1**	**5.5**	**1 (ps)**	**5.5**
149	**(8483B x 9256B) x (Bx6 x Homs)**	**F4**	**i528**	**135130**	**0**		**0**	
150	**R5647B**	**?**	**i663**	**135135**	**1**		**1**	
151	**Nb3271B**	**?**	**i700**	**135137**	**0**		**1.5**	
152	PI 169484/'2357'	S	CV076	135147	4.5	6	5	4.5
153	SC x PI 169484	F1	i405	135106cg147	3.5		1	
154	PI 169484/'2357'	S	CV076	135148	2		6.5	
155	PI 169484/'2357'	S	CV076	135150	4.5		6	
156	PI 163238/'Gajar'	M	CV054	135152M	2	6	5	6
157	Ames 29084/'19'	S	CV022	135154	5		3	
158	PI 169485/'2416'	S	CV077	135156	5	6	6.5	5

Table 1. Arlington production continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
159	PI 169485/'2416'	S	CV077	135157	6		6	
160	PI 176558/'9235'	S	CV110	135163	6.5		4	
161	PI 179275/'4966'	S	CV126	135164	3		5	
162	PI 179275/'4966'	S	CV126	135165#1	6	7	5	5
163	PI 179275/'4966'	S	CV126	135165#2	5		3	
164	PI 179275/'4966'	S	CV126	135166	3 (seg)		4	
165	PI 179275/'4966'	S	CV126	135167	5.5		3.5	
166	PI 179277/'9883'	S	CV126	134168	5.5	8	2	5.5
167	**PI 169484/'2357'**	**S**	**CV076**	**135169**	**0**		**1**	
168	**PI 169484/'2357'**	**S**	**CV076**	**135170**	**1**		**2**	
169	**PI 272258/'Cape Market'**	**S**	**CV259**	**135172**	**1**		**1(ps)**	
170	PI 272258/'Cape Market'	M	CV259	135173M	1	7	4	8
171	PI 272258/'Cape Market'	S	CV259	135174#1	3		3	
172	PI 272258/'Cape Market'	S	CV259	135174#2	1.5		4	
173	Nb8483B 9256B	F3MS	Sem057(UCR)	135178	0		3	
174	**Nb8483B 9256B**	**F3MS**	**Sem252(UCR**	**135182**	**0**	**7**	**0**	**7**
175	Homs	M4SMS2	H058 (UCR)	135189#1	2.5		3	
176	Homs	M4SMS2	H076 (UCR)	135189#2	3		2	
177	Homs	M4SMS2	H088 (UCR)	135190#1	1		2.5	
178	Homs	M4SMS2	H103 (UCR)	135190#2	1.5	7	4.5	7
179	**Homs**	**M4SMS2**	**H109 (UCR)**	**135191#1**	**1**		**1.5**	
180	**Homs**	**M4SMS2**	**H145 (UCR)**	**135191#2**	**1**		**1**	
181	Homs	M4SMS2	H001 (UCR)	135193#1	1		3(ps)	
182	**Homs**	**M4SMS2**	**H024 (UCR)**	**135193#2**	**1.5**	**6.5**	**2**	**5**
183	**Homs**	**M4SMS2**	**H032 (UCR)**	**135194**	**1**		**1**	
184	Homs	M4SMS2	H142 (UCR)	135197#1	2.5		0	
185	**Homs**	**M4SMS2**	**H160 (UCR)**	**135197#2**	**1**		**1**	
186	Homs	M4SMS2	H007 (UCR)	135198	1.5	7	3	9
187	**Homs**	**M4SMS2**	**H119 (UCR)**	**135199**	**1.5**		**1**	
188	PI 226309/'Primary 61 Chapingo'	S	195-2 (UCR)	136584	2		4	
189	PI 232073/'Cape Market'	S	203-1A (UCR)	136585	2		6	
190	PI 232073/'Cape Market'	S	203-7 (UCR)	136589	1(ps)	6.5	5	6
191	PI 272258/'Cape Market'	S	259-3 (UCR)	136595	1		4	
192	PI 272258/'Cape Market'	S	259-4 (UCR)	136596	2		4	
193	PI 272258/'Cape Market'	S	259-5 (UCR)	136597	2		3	
194	**PI 272258/'Cape Market'**	**S**	**259-7 (UCR**	**136598**	**0 (ps)**	**7**	**0 (ps)**	**8**
195	**PI 272258/'Cape Market'**	**S**	**259-10 (UCR)**	**136600**	**0**		**0**	
196	PI 272258/'Cape Market'	S	259-11 (UCR)	136601	4.5		5	
197	PI 288461/'336'	S	300-1 (UCR)	136602	3		4	
198	PI 288461/'336'	S	300-7 (UCR)	136603	2	6	3	5
199	PI 294637/'Baladi'	S	316-1 (UCR)	136604	3.5		3	
200	PI 294637/'Baladi'	S	316-2 (UCR)	136605	3		3	
201	PI 652258/'Pusa Yamadagni'	S	653-5 (UCR)	136607	5.5		2	
202	(SFFx(8483x9256)) x 7808, Flavor	F3	16K mj101	129001	3	7	1	9
203	(SFFx(8483x9256)) x 7808, Flavor	F3	16K mj101	129002	4.5		3	
204	7808B, Flavor x (SFFx(8483x9256))	F3	16K i102	129003	3		3	
205	7808B, Flavor x (SFFx(8483x9256))	F3	16K mj104	129005#1	NS		NS	
206	**7808B, Flavor x (SFFx(8483x9256**	**F3**	**16K mj104**	**129005#2**	**1**	**7**	**1.5**	**6**
207	**7808B, Flavor x (SFFx(8483x9256**	**F3**	**16K mj104**	**129006**	**2**		**1**	
208	**6526x((5280x(Turkishx7262))xH**	**F4**	**16K i106**	**129007**	**0**		**1**	
209	(HM x SFF) x L0556B	F4	16K i109	129009#1	3		1	
210	(HM x SFF) x L0556B	F4	16K i109	129009#2	4.5	7	4	8
211	**[(Bx6xHM)x(8483Bx9256B)]x232**	**F x F**	**16K i111**	**129011cg548**	**2**		**1**	
212	(Bx6 x HM) x (8483B x 9256B)	F4	16K i111	129012	2.5		1	
213	**(Bx6 x HM) x (8483B x 9256B**	**F3M**	**16K i111**	**129013M**	**0**		**0**	
214	(Bx6 x HM) x (8483B x 9256B)	F4	16K mj111	129014	0		2.5	
215	**(Bx6 x HM) x (8483B x 9256B**	**F4**	**16K mj111**	**129015**	**2**	**7**	**2**	**6**
216	**(Bx6 x HM) x (8483B x 9256B**	**F4**	**16K mj111**	**129016**	**1**		**1**	
217	(Nb8483B x 9256B) x (Bx6 x HM)	F4	16K i115	129017	0		3.5	
218	**(Nb8483B x 9256B) x (Bx6 x HM)**	**F4**	**16K i115**	**129022**	**0**		**1(ps)**	
219	**(Nb8483B x 9256B) x (Bx6 x HM)**	**F4**	**16K i117**	**129023**	**0**		**1**	

Table 1. Arligton production continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
220	(Nb8483B x 9256B) x (Bx6 x HM)	F3M	16Ki117	129024M	0	7	0 (ps)	7
221	(HM x (Bx6)) x FS	F5	16Ki121	129026#1	1		0 (ps)	
222	(HM x (Bx6)) x FS	F5	16Ki121	129026#2	0		0 (ps)	
223	HM x (B x 6)	F3M2	16Ki125	129027to033	1		0	
224	D.c. Z020 x Nb8524B	F3M2	16Ki133	129035cg036	2.5	7	4.5	8
225	D.c. Z020 x Nb8524B	F3M2	16Ki133	129036cg035	1.5		2	
226	Nb9324B x Nb4216B	F2	16Ki244	129037	3		6	
227	Nb9324B x Nb4216B	F2	16Ki244	129038	1		1	
228	(FN2-9 x 2302) x (WR x PD)	F4	16Ki252	129049#1	1	6	4	5.5
229	(FN2-9 x 2302) x (WR x PD)	F4	16Ki252	129049#2	1		4	
230	(FN2-9x2302)x((Bx6)x(PDxPI))	F3M	16Kmj247	129043M	3		4	
231	(HM x NF) x 0569B	F4	16Ki250	129046	2.5		3	
232	[(FN2-9x2302)x(WRxPD)]xL0568B	F x F	16Kmj255	129051cg544	3 (ps)	6	1 (ps)	5.5
233	(FN2-9 x 2302) x (WR x PD)	F4	16Kmj255	129052	0		3.5	
234	(HM x Bx6) x 9359B	F4	16Ki260	129053#1	0		5	
235	(HM x Bx6) x 9359B	F4	16Ki260	129053#2	0		1	
236	(HM x Bx6) x 9359B	F4	16Ki260	129054#1	1.5	6.5	1	5
237	(HM x Bx6) x 9359B	F4	16Ki260	129054#2	0		1.5	
238	(HM x Bx6) x 9359B	F2MS	16Kmj262	129055	1		2	
239	(HM x Bx6) x 9359B	F2MS	16Kmj262	129056#1	0		0 (ps)	
240	(HM x Bx6) x 9359B	F2MS	16Kmj262	129056#2	0	5.5	2	8
241	(Bx6 x HM) x (8483B x 9256B	F2MS	16Ki267	129057#2	0		1	
242	(Bx6 x HM) x (8483B x 9256B)	F2MS	16Kmj267	129059	3 (ps)		0	
243	(PD x WR) x 9782B	F4	16Ki269	129060	1		3	
244	(PD x WR) x 9782B	F4	16Ki269	129061	1	5	4	7
245	SFF x (SFF x HM)	F4	16Ki276	129062#2	1		0 (ps)	
246	SFF x (SFF x HM)	F4	16Ki276	129063	0 (ps)		0	
247	SFF x (SFF x HM)	F4	16Kmj276	129064	0		0 (ps)	
248	(8483B x 9256B) x (Bx6 x Homs)	F4	16Ki279	129066#1	1	5	1	7
249	(8483B x 9256B) x (Bx6 x Homs)	F4	16Ki279	129066#2	0		1	
250	(8483B x 9256B) x (Bx6 x Homs)	F4	16Ki279	129067#1	0		0	
251	(8483B x 9256B) x (Bx6 x Homs)	F4	16Ki279	129067#2	0		0	
252	(8483B x 9256B) x (Bx6 x Homs)	F4	16Ki279	129068	1	5	0	5.5
253	(8483B x 9256B) x (Bx6 x Homs)	F4	16Kmj279	129069	0		0	
254	7262B x HM	F2MS	16Ki286	129077#1	0		0	
255	7262B x HM	F2MS	16Ki286	129077#2	1		0	
256	7262B x HM	F2M2	16Ki286	129078M	0	6	3	6.5
257	7262B x HM	F4	16Kmj287	129079	NS		NS	
258	7262B x HM	F4	16Kmj287	129080	0		1	
259	((Bx6)x(PDxPI)) x (8483B x 9256	F2MS	16Kmj289	129081#1	0		1	
260	((Bx6)x(PDxPI)) x (8483B x 9256	F2MS	16Kmj289	129082	0	6	1	4
261	((Bx6)x(PDxPI)) x (8483B x 9256	F2MS	16Ki291	129083	0		1	
262	((Bx6)x(PDxPI)) x (8483B x 9256	F2MS	16Ki291	129084	0		1.5	
263	NF x HM	F5	16Ki297	129087	1		NS	
264	(PD x PI326011) x WR	F3MS2MS	16Ki299	129088	0	7	3.5	4
265	(PD x PI326011) x WR	F3MS2MS	16Ki299	129089	1		1	
266	(PD x PI326011) x WR	F3MS2MS	16Kmj299	129091	2.5		3	
267	PD x PI326011	F1M2SMS2M2S	16Ki311	129093#1	1		2	
268	PD x PI326011	F1M2SMS2M2S	16Ki311	129093#2	1.5	5.5	0	7
269	PD x PI326011	F1M2SMS2M2S	16Kmj311	129094	0		2	
270	PD x PI326011	F1M2SMS2M2S	16Kmj311	129095#1	0		1.5	6
271	PD x PI326011	F1M2SMS2M2S2	16Kmj311	129095#2	1		3	
272	SFF	F2MS8	16Kmj316	129096	0	6	1	
273	8483B x 9256B	F8	16Ki319	129098#2	1 (ps)		0	
274	8483B x 9256B	F8	16Kmj319	129100#1	0		0	5
275	8483B x 9256B	F8	16Kmj319	129101#1	0		0 (ps)	
276	8483B x 9256B	F8	16Kmj319	129101#2	0	7	0	
277	(PD x PI326011) x WR	F5M2	16Ki322	129102M	1		1	
278	(PD x PI326011) x WR	F5MS	16Ki322	129103	0		2	7
279	(PD x PI326011) x WR	F5MS	16Kmj322	129104	0		3	
280	(PD x PI326011) x WR	F5MS	16Kmj322	129105	1	7	2.5	
281	HM x (B x 6)	F3MS	16Ki328	129106#1	1		1	
282	HM x (B x 6)	F3MS	16Ki328	129106#2	0		1	6.5

Table 1. Arligton production continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
283	HM x (B x 6)	F3MS	16Ki328	129107#1	0		0	
284	HM x (B x 6)	F3MS	16Ki328	129107#2	1	6	2	
285	HM x (B x 6)	F3MS	16Kmj328	129108#1	0		1	
286	HM x (B x 6)	F3MS	16Kmj328	129108#2	0		2	6.5
287	HM x (B x 6)	F3MS	16Kmj328	129109#1	0		0	
288	HM x (B x 6)	F3MS	16Kmj328	129109#2	0	5	3	
289	(FN2-9 x 2302) x HM	F4MS	16Ki336	129111#1	0		1.5	
290	(FN2-9 x 2302) x HM	F4MS	16Ki336	129111#2	1 (ps)		0 (ps)	7
291	(FN2-9 x 2302) x HM	F4M2	16Kmj336	129112M	0		0	
292	SFF	F1XMS3M2S3	16Kmj341	129114#1	0	4.5	2	
293	SFF	F1XMS3M2S3	16Kmj341	129114#2	0		1.5	
294	(Snts x EFM) x HM x (B x6)	F4M	16Ki346	129118M	0		2	7
295	(Snts x EFM) x HM x (B x6)	F5	16Ki346	129119#1	0		1	
296	(Snts x EFM) x HM x (B x6)	F5	16Ki346	129119#2	0	6.5	3.5	
297	(Snts x EFM) x HM x (B x6)	F5	16Kmj346	129120	0		2	
298	(Snts x EFM) x HM x (B x6)	F5	16Kmj346	129121	1		3.5	8
299	(HM x Bx6) x 9359B	F3MS	16Kmj353	129123	2		1	
300	(HM x Bx6) x 9359B	F5	16Ki354	129124	0	6	3.5	
301	(HM x Bx6) x 9359B	F5	16Ki354	129125#1	1		1	
302	(HM x Bx6) x 9359B	F5	16Ki354	129125#2	2		0	8
303	(Bx6 x HM) x (8483B x 9256B	F3MS	16Ki359	129126	0		1	
304	(Bx6 x HM) x (8483B x 9256B	F3MS	16Kmj360	129128	0	6.5	2 (ps)	
305	[(Bx6 x HM) x (8483x9256)] x SF	F x F	16Kmj360	129129cg18	0		1.5	
306	(Bx6 x HM) x (8483B x 9256B)	F3MS	16Kmj360	129129#2	0		3	7
307	Nb8483B x 9256B	F9	16Kmj367	129132	0		1.5	
308	Nb8483B x 9256B	F9	16Kmj367	129133#1	1.5	6.5	0 (ps)	
309	Nb8483B x 9256B	F9	16Kmj367	129133#2	0		0	
310	Nb8483B x 9256B	F7MS	16Ki369	129134#1	0		1	6.5
311	Nb8483B x 9256B	F7MS	16Ki369	129134#2	0		0	
312	(Nb8483B x 9256B) x 2327	F x F	16Ki369	129135cg54	0	5	1	
313	[HM x (Bx6) x (Snts x EFM)] x [Nb8483B x 9256B) x HM]	M, F x F	16Ki373, etc.	129136-139 cg12914?	1		2.5	
314	(Nb8483B x 9256B) x HM	F2MS3	16Kmj379	129144	3		2	6.5
315	(PD x PI326011) x WR	F3MSMSM2	16Ki386	129145M	1.5		2	
316	(PD x PI326011) x WR	F3MSMSMS	16Ki386	129146	1.5	5	0	
317	(PD x PI326011) x WR	F3MSMSM2	16Kmj386	129147M	1		1	
318	(PD x PI326011) x WR	F3MSMSMS	16Kmj386	129148#1	1		1	7
319	(PD x PI326011) x WR	F3MSMSMS	16Kmj386	129148#2	2		1	
320	HM x SFF	F4MS	16Kmj393	129151	1	6	3	
321	WR x PD	F3M2S4	16Kmj398	129155#2	1		1 (ps)	
322	HM x SFF	F4MS	16Kmj389	129156#1	1.5		1	7
323	HM x SFF	F4MS	16Kmj389	129156#2	1		3	
324	(HM x SFF) x 0571B	F2MS	16Kmj401	129157#1	0	5.5	0	
325	(HM x SFF) x 0571B	F2M2	16Kmj401	129158M	0		1.5	
326	HM x (Bx6) x (Snts x EFM)	F4MS	16Kmj409	129159#1	2		1	
327	HM x (Bx6) x (Snts x EFM)	F4MS	16Kmj409	129160	1		1 (ps)	
328	HM x (Bx6) x (Snts x EFM)	F4MS	16Kmj409	129161#1	1	7	2	7
329	HM x (Bx6) x (Snts x EFM)	F4MS	16Kmj409	129161#2	0		2 (ps)	
330	HM x (Bx6) x (Snts x EFM)	F5M	16Ki411	129162M	2 (ps)		NS	
331	HM x (Bx6) x (Snts x EFM)	F5M	16Ki411	129163M	0 (ps)		NS	
332	(8483B x 9256B) x HM	F3M3	16Kmj416	129164#1M	0	7	1	7
333	(8483B x 9256B) x HM	F3M2S	16Kmj416	129164#2	0		1	
334	(8483B x 9256B) x HM	F3M2S	16Kmj416	129165	0		1	
335	(8483B x 9256B) x HM	F3M3	16Kmj420	129166M	0		0	
336	(8483B x 9256B) x HM	F3M2S	16Kmj420	129167#1	NS	5	NS	7
337	(8483B x 9256B) x HM	F3M2S	16Kmj420	129167#2	0 (ps)		0 (ps)	
338	(8483B x 9256B) x HM	F3MS2	16Ki421	129168#1	0		0	
339	(8483B x 9256B) x HM	F3MS2	16Ki421	129168#2	0		0 (ps)	
340	(8483B x 9256B) x HM	F3MS2	16Ki421	129169#1	0	4.5	1	7
341	(8483B x 9256B) x HM	F3MS2	16Ki421	129169#2	0 (ps)		1 (ps)	
342	(PD x PI326011) x WR	F3MSMSMS	16Ki429	129170	0		1	
343	(PD x PI326011) x WR	F3MSMSMS	16Ki429	129171	2		2	

Table 1. Arlington production continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
344	(PD x PI326011) x WR	F3MSMSMS	16Kmj 429	129173	1	7	2	7
345	WR x PD	F3M2SMS	16Ki 431	129174	0		2	
346	HM x (B x 6)	F5MSMS	16Ki 446	129176#1	0		0	
347	HM x (B x 6)	F5MSMS	16Ki 446	129176#2	0		1	
348	SFF	F2MS8	16Ki 462	129178#2	2	5.5	1	7
349	SFF	F2MS8	16Ki 462	129179	0 (ps)		1 (ps)	
350	Nb8483B x 9256B	F4MS2M	16Ki 469	129181M	1		3.5	
351	L9786B x HM	F4M	16Ki 542	129189M	1.5		3	
352	SFF x HM	F5MS	16Ki 555	129194	1.5	5	2.5	7
353	PD x WR	F3MS2M2	16Ki 560	129196M	0		4	
354	PD x WR	F3MS2MS	16Ki 560	129197#1	1		3	
355	PD x WR	F3MS2MS	16Ki 560	129197#2	1 (ps)		0 (ps)	
356	PD x WR	F3MS2MS	16Ki 560	129198#1	2	4.5	4	7
357	(SFF x HM) x L3726B	F x F	16Ki 565	129200cg131	0		4.5	
358	SFF x HM	F4M2S	16Ki 565	129200#2	0		3	
359	HM x (B x 6)	F2MS5	16Kmj 656	129211	1		0	
360	H2 = Moms 2	XMXMS2M2S4	16Ki 687	129213#1	0	7	1	7
361	H2 = Moms 2	XMXMS2M2S4	16Ki 687	129213#2	0		1	
362	H2 = Moms 2	XMXMS2M2S4	16Ki 687	129214#1	0		0	
363	H x B = Homs x (BR1252x627	F5MS3	16Ki 705	129216	1		1	
364	Npw2191B	F3MS	16Ki 726	129217	0	6.5	1.5	6
365	Npw2191B	F3MS	16Ki 726	129218	2		3.5	
366	Npw2191B	F3MS	16Kmj 726	129219	0		2	
367	Npw2191B	F3MS	16Kmj 726	129220	1		2.5	
368	(PD x PI326011) x WR	F3MS3	16Kmj 729	129221	2	6	2.5	6
369	(PD x PI326011) x WR	F3MS2M	16Kmj 729	129222M	0		3	
370	(PD x PI326011) x WR	F3MS3	16Kmj 729	129223	1		1	
371	(PD x PI326011) x WR	F3MS3	16Ki 731	129226	2		3	
372	PD x PI326011	F1M2SMS2M2SI	16Ki 742	129229M	1	5	1	5
373	PD x PI326011	F1M2SMS2M2SI	16Kmj 742	129231M	1		1.5	
374	(8483B x 9256B) x HM	F2MS	16Ki 749	129234#2	0		1	
375	(8483B x 9256B) x HM	F2MS	16Kmj 749	129236#1	NS		NS	
376	SFF x HM	F4MS	16Ki 753	129237#1	0	5.5	0 (ps)	5
377	SFF x HM	F4MS	16Ki 753	129238#1	0		0	
378	SFF x HM	F4MS	16Ki 753	129238#2	0		0	
379	PD x PI326011	F1M2SMS2M2SI	16Ki 757	129241	0		1	
380	PD x PI326011	F1M2SMS2M2SI	16Ki 757	129242	2	6	1.5	4
381	PD x PI326011	F1M2SMS2M2SI	16Ki 757	129243	0		1	
382	HM x SFF	F4	16Ki 763	129245	1	7	1.5	6.5
383	SFF	F2MS4	16Ki 783	129246#2	0		0	
384	SFF	F2MS4	16Ki 783	129247	1		4	
385	[Nb8524Bx(FN2-9x2302)]xL9782B	F x F	16Ki 812	129251cg553	3		2.5	
386	Nb8524B x (FN2-9 x 2322)	F4	16Kmj 812	129252#1	0 (ps)	7	3 (ps)	4.5
387	Nb8524B x (FN2-9 x 2322)	F4	16Kmj 812	129252#2	NS		NS	
388	Nb8524B x (FN2-9 x 2322)	F4	16Kmj 812	129253#2	3		2 (ps)	
389	(Nb8483B x 9256B) x HM	F4	16Ki 813	129254#1	0		2	
390	(Nb8483B x 9256B) x HM	F4	16Ki 813	129255	0	5	2	6
391	PD x WR	F3MS3	16Ki 816	129257	1		1	
392	PD x WR	F3MS3	16Ki 816	129259	2		3	
393	PD x WR	F3MS3	16Kmj 816	129260#1	2		2	
394	PD x WR	F3MS3	16Kmj 816	129260#2	0	4	2	8
395	PD x WR	F3MS3	16Kmj 816	129261	1		3.5	
396	PD x WR	F3MS2M	16Kmj 816	129262M	0		3.5	
397	P6139B x 2226B	F2	16Ki 823	129263	5		6.5	
398	P6139B x 2226B	F2	16Ki 823	129265	5 (ps)	6	7	6
399	(Bx6 x HM) x (8483B x 9256B)	F4	16Ki 824	129266#1	0		2.5	
400	L9786B x HM	F5	16Ki 829	129268#1	0		2	
401	L9786B x HM	F5	16Ki 829	129268#2	0		1	
402	L9786B x HM	F5	16Ki 829	129269#1	0	4	1	6.5
403	L9786B x HM	F5	16Ki 829	129269#2	0 (ps)		3 (ps)	
404	L9786B x HM	F5	16Ki 830	129270	0		1	
405	L9786B x HM	F4M	16Ki 830	129271M	0		2	

Table 1. Arlington production continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
406	PD x WR	F3MS4	16Ki 831	129272	NS		0 (ps)	
407	PD x WR	F3MS3M	16Ki 831	129273M	0	6.5	1	8
408	PD x WR	F3MS4	16Kmj 831	129276	0		2	
409	(Nb8483B x 9256B) x HM	F2MS2	16Ki 832	129277#1	0		1	
410	(Nb8483B x 9256B) x HM	F2MS2	16Ki 832	129277#2	1		3	
411	(Nb8483B x 9256B) x HM	F2MS2	16Ki 832	129278#1	0	7	1	6
412	(Nb8483B x 9256B) x HM	F2MS2	16Ki 832	129278#2	0		0	
413	(PD x PI326011) x WR	F3MSMS2	16Ki 834	129279	2		3	
414	(PD x PI326011) x WR	F3MSMS2	16Ki 834	129280#1	1.5		2	
415	(PD x PI326011) x WR	F3MSMS2	16Ki 834	129280#2	0	5.5	2	6
416	(PD x PI326011) x WR	F3MSMS2	16Ki 834	129281	0		3	
417	WR x PD	F3M2S3	16Ki 837	129283	0		1	
418	HM x (Bx6) x (Snts x EFM)	F5	16Ki 841	129284	3		2	
419	HM x (Bx6) x (Snts x EFM)	F5	16Ki 841	129285	0	5	3 (ps)	7
420	HM x (Bx6) x (Snts x EFM)	F5	16Ki 841	129286	2		2 (ps)	
421	HM x (Bx6) x (Snts x EFM)	F5	16Kmj 841	129288#1	0 (ps)		3 (ps)	
422	HM x (Bx6) x (Snts x EFM)	F5	16Kmj 841	129288#2	NS		NS	
423	(8483B x 9256B) x HM	F5	16Kmj 842	129289#1	0	6	2 (ps)	6.5
424	(8483B x 9256B) x HM	F5	16Kmj 842	129289#2	0		1	
425	PD x WR	F3MS4	16Ki 843	129292	0		2	
426	SFF	F1XMS2MS5	16Kmj 844	129294#1	0		4	
427	SFF	F1XMS2MS5	16Kmj 844	129294#2	1	5	1	6.5
428	SFF	F1XMS2MS5	16Kmj 844	129295	0		1	
429	(PD x PI326011) x WR	F3MSMSM	16Ki 845	129296M	1		4	
430	(PD x PI326011) x WR	F3MSMS2	16Ki 845	129297	0		2	
431	(PD x PI326011) x WR	F3MSMS2	16Kmj 845	129298#1	0	7	3 (ps)	7
432	(PD x PI326011) x WR	F3MSMS2	16Kmj 845	129298#2	0		1 (ps)	
433	(PD x PI326011) x WR	F3MSMS2	16Kmj 845	129299	0		0 (ps)	
434	(Nb4001 x Nb4002) x (HM x (Bx6))	BC1	16Ki 203	129306cg302	2		3	
435	Nb8483B x Nb9256B	F3MS	16Ki 217	129311#1	3	8	4	6
436	Nb8483B x Nb9256B	F3MS	16Ki 217	129311#2	2		4	
437	Western Red	? + MS	16Ki 151	129315	3.5		NS	
438	Nh0252B	M4SMSMS	16Ki 152	129318	0		0	
439	Nh0252B	M4SMSMS	16Ki 152	129319	1		1	
440	Nb1386B	F4MSMS	16Ki 477	129321#1	0	6.5	2 (ps)	5.5
441	Nb1386B	F4MSMS	16Ki 477	129321#2	0		0	
442	Nb1386B	F4MSMS	16Ki 477	129324	1		1 (ps)	
443	Nb1386B	F4MS2M	16Ki 479	129326M	3 (ps)		0 (ps)	
444	Nb1386B	F4MS2	16Ki 793	129327#1	0	6	1	6.5
445	Nb1386B	F4MS2	16Ki 793	129328#1	2 (ps)		NS	
446	Nb1386B	F4MS2	16Ki 793	129328#2	2 (ps)		2	
447	Nb1386B	F4MS2	16Kmj 793	129329	3.5		1	
448	Nb1386B	F4MSM	16Kmj 793	129330M	1	5.5	1	7
449	Nb1391B	F4M3S	16Ki 580	129331#1	0		0	
450	Nb1391B	F4M3S	16Ki 580	129331#2	1		0	
451	Nb1391B	F4M3S	16Ki 580	129332#1	2		0	
452	Nb1391B	F4M3S	16Ki 580	129332#2	3	5	0	8
453	Nb1391B	F6	16Ki 796	129333#1	1		0 (ps)	
454	Nb1391B	F6	16Ki 796	129334	2		2	
455	Nb2159B	F2MSMS5M2S	16Ki 158	129337	0		4	
456	Npw2191B	F3M2SMS	16Ki 486	129341cg34	2	4.5	0	7
457	(Nb8483 x Nbh2306) x Npw2	BC1	16Ki 221	129342cg34	0		1.5	
458	Nb2222B	F5MS3	16Ki 139	129343cg34	1.5(ps)		2	
459	Npw2191B	F3M2SMS	16Kmj 590	129347#2	2		2	
460	Npw2191B	F3M2SMS	16Kmj 590	129348	0	4	1	8
461	Nbh2306B	F9	16Ki 140	129349cg35	0		2	
462	(SC x Nb6509B) x Nbh2306B	BC2	16Ki 141	129351cg34	0		0	
463	(SC x Nb6509B) x Nbh2306B	BC2	16Kmj 141	129354cg35	0		1.5	
464	Nbh2306B	F7MS	16Ki 494	129356	4	6	1	7
465	Nbh2306B	F9	16Ki 496	129360cg353	4		1	
466	(SC x Nb6509B) x Nbh2306B	BC2	16Kmj 141	129353cg36	1		0	
467	Nbh2306B	F9	16Kmj 511	129366	2		3	

Table 1. Arlington production continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
468	**Nb3271B**	**F2MSMS3M2S2**	**16Ki 142**	**129367cg37**	**2**	**5**	**1.5**	**6**
469	Nb3271A	BC3	16Ki 161	129370cg367	3		1	
470	**Nb3284B**	**F7**	**16Ki 598**	**129371**	**NS**		**0 (ps)**	
471	Nb4001B	F3M4S	16Ki 168	129374	3 (ps)		0 (ps)	
472	(SC x Nb9297) x Nb4001	BC1	16Ki 167	129376cg373	3	9	4.5	5
473	Nb4001B	F3M4S	16Ki 168	129373cg376	3		6	
474	Nb4002B	F3M4S	16Ki 171	129379cg383	1		3.5	
475	Npw4217B	F3M2S	16Ki 146	129386	2		3	
476	Ns4450B	F2M2S2	16Ki 147	129390	2.5	6.5	4.5	5
477	**Ns4450B**	**F2M2S2**	**16Ki 147**	**129392**	**1 (ps)**		**NS**	
478	Npw4458B	F3MSM2S	16Ki 856	129393	1.5		3	
479	**Npw5182B**	**F5MS**	**16Ki 240**	**129401**	**1**		**0**	
480	(Nb4001 x Nb8483) x Nb6526	BC1	16Ki 178	129405cg407	0	7	3 (ps)	9
481	**Nb6526B**	**F4M5SMS2MS2**	**16Kmj 602**	**129406**	**0 (ps)**		**0**	
482	**Nb6526B**	**F4M5SMS2MS2**	**16Kmj 602**	**129407cg40**	**1**		**1**	
483	**Nb6526B**	**F4M5SMSM2S**	**16Ki 625**	**129408**	**0**		**1**	
484	**Nb8524B**	**F3M6S2**	**16Kmj 605**	**129416**	**0**	**7**	**0**	**5**
485	Nb8524B	F3M6S2	16Kmj 605	129417	4 (ps)		3 (ps)	
486	Nb9297B	F3MS3	16Kmj 528	129424	3 (ps)		0 (ps)	
487	(PDx(Bx6)xWR) x PNp0191B	F2	60934	129517	4		3.5	
488	(PDx(Bx6)xWR) x PNp0191B	F2	60934	129518	5.5	5	4.5	5
489	(PDx(Bx6)xWR) x PNp0191B	F2	60934	129521plt1	4		3.5	
490	(PDx(Bx6)xWR) x PNp0191B	F2	60934	129521plt2	2		6	
491	(PDx(Bx6)xWR) x PNp0191B	F2	60934	129522	3.5		5	
	492 thru 518 derived from resistant selections out of UCR multi-isolate hapla test in 2016							
492	**H x B = Homs x (BR1252x627**	**F3M2S**	**Iso 17 R2**	**131369**	**0**	**6**	**1 (ps)**	**5**
493	**H1 = Homs 1**	**M4SMSMS**	**Iso 17 R2**	**131367**	**0**		**0**	
494	**H1 = Homs 1**	**M4SMSMS**	**Iso 17 R4**	**131372**	**0**	**6**	**0**	**5.5**
495	**H1 = Homs 1**	**M4SMSMS**	**Iso 30 R2**	**131375**	**0**		**0**	
496	**H x B = Homs x (BR1252x627**	**F5M2S**	**Iso 32 R2**	**131385**	**0**		**0**	
497	**H1 = Homs 1**	**M4SMSMS**	**Iso 32 R3**	**131386**	**0**		**0**	
498	**H x B = Homs x (BR1252x627**	**F5M2S**	**Iso 32 R3**	**131388**	**0**	**5**	**1**	**4**
499	**H1 = Homs 1**	**M4SMSMS**	**Iso 32 R4**	**131389**	**0**		**1**	
500	**H1 = Homs 1**	**M4SMSMS**	**Iso 33 R2**	**131391**	**0 (ps)**		**NS**	
501	**H2 = Homs 2**	**XMXMS2M2SMS**	**Iso 33 R2**	**131392**	**0**		**0 (ps)**	
502	**H x B = Homs x (BR1252x627**	**F5M2S**	**Iso 33 R2**	**131393**	**0**	**7**	**0**	**5**
503	**H1 = Homs 1**	**M4SMSMS**	**Iso 33 R4**	**131396**	**0**		**0**	
504	**H x B = Homs x (BR1252x627**	**F5M2S**	**Iso 33 R4**	**131398**	**1 (ps)**		**1**	
505	**H1 = Homs 1**	**M4SMSMS**	**Iso 35 R4**	**131403**	**1**		**1**	
506	**H x B = Homs x (BR1252x627**	**F5M2S**	**Iso 35 R4**	**131404**	**0**	**7**	**0**	**8**
507	**H2 = Homs 2**	**XMXMS2M2SMS**	**Iso 36 R2**	**131407**	**1.5**		**0**	
508	**H2 = Homs 2**	**XMXMS2M2SMS**	**Iso 36 R3**	**131410**	**0**		**0**	
509	**H2 = Homs 2**	**XMXMS2M2SMS**	**Iso 36 R4**	**131412**	**1**		**1**	
510	**H x B = Homs x (BR1252x627**	**F5M2S**	**Iso 36 R4**	**131413**	**0**	**5.5**	**0**	**9**
511	**H1 = Homs 1**	**M4SMSMS**	**Iso 37 R1**	**131414**	**0**		**2**	
512	**H x B = Homs x (BR1252x627**	**F5M2S**	**Iso 38 R1**	**131418**	**0 (ps)**		**0 (ps)**	
513	**F5 = BR 1091 x Homs**	**F6**	**Iso 38 R2**	**131419**	**NS**		**0 (ps)**	
514	H x B = Homs x (BR1252x6274)	F5M2S	Iso 38 R3	131422	1	6.5	3.5	6
515	**H1 = Homs 1**	**M4SMSMS**	**Iso 38 R4**	**131423**	**0**		**2**	
516	**H1 = Homs 1**	**M4SMSMS**	**Iso 39 R1**	**131425**	**0**		**1**	
517	**H2 = Homs 2**	**XMXMS2M2SMS**	**Iso 39 R2**	**131428**	**1**		**0**	
518	**H x B = Homs x (BR1252x627**	**F5M2S**	**Iso 39 R3**	**131430**	**0**	**6**	**1**	**6.5**
519	Ns5154 x 2289B	F2	6006	127022	6		4.5	
520	Ns5154 x 2289B	F2	6006	127024	7		4	
521	2566B x (NF x HM)	F2	6007	127026	6		4.5	
522	2566B x (NF x HM)	F2	6007	127028	5	7	5	9
523	L0566B x (PD x WR)	F2	6009	127030	3		0	
524	L0566B x (PD x WR)	F2	6011	127038	2 (ps)		4	
525	**(SFF x HM) x Nb8542B**	**F2**	**6012**	**127042**	**2**		**1**	
526	(SFF x HM) x Nb8542B	F2	6012	127044	1.5	5	3	7
527	Nb8542B x (SFF x HM)	F2	6013	127046	1		3	
528	**Nb8542B x (SFF x HM)**	**F2**	**6013**	**127048**	**0**		**1**	

Table 1. Arlington production continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
529	Ns5154 x 2289B	F1M	7003	132616M	6		4 (ps)	
530	Ns5154 x 2289B	F1M	7003	132618M	5	6	3.5	7
531	Ns5154 x 2289B	F3	7047	132740	3.5		4	
532	2566B x (NF x HM)	F3	7049	132746	5		4	
533	2566B x (NF x HM)	F3	7049	132748	4.5		4.5	
534	Nb9324B x Nb4216B	F3	7074	132806	3	6	5	7

Inbreds

535	W133B			Goldman	4 (ps)		3.5(ps)	
536	W204C			Goldman	NS		NS	
537	W255B			Goldman	NS		NS	
538	W259B			Goldman	0 (ps)		NS	
539	W266C			Goldman	NS	5	NS	8
540	WAY268C			Goldman	4		3.5(ps)	
541	WAY271B			Goldman	3 (ps)		4 (ps)	
542	WAY272C			Goldman	NS		NS	
543	WAY273C			Goldman	4 (ps)	5	NS	5
544	WAY274B			Goldman	NS		NS	
545	W276B			Goldman	NS		NS	
546	W277B			Goldman	2 (ps)		NS	
547	W278B			Goldman	4 (ps)	6	1 (ps)	8
548	W279B			Goldman	4 (ps)		NS	
549	W280B			Goldman	6 (ps)		5 (ps)	
550	W281C			Goldman	NS		3 (ps)	
551	W284B			Goldman	NS		NS	
552	W285B			Goldman	NS	6.5	1 (ps)	8
553	W286C			Goldman	NS		NS	
554	W287B			Goldman	NS		NS	
555	W289B			Goldman	3 (ps)		NS	
556	**Ns5154B**	**S3**	**60956**	**129557**	**0**	**7**	**1**	**7**
557	Nb8483B	M	6969	131531-536	4		1	
558	**Nb8542B**	**F3M7**	**6982**	**131538-539**	**0 (ps)**		**0**	
559	Nb8542A	BC5	6983	131541-542	3		0	
560	Nb3999B			85858, etc.	3	6	1 (ps)	8
561	**Nh2168B**			**90865-70**	**0**		**1**	
562	**Nh2168B**			**85838**	**0**		**1 (ps)**	
563	**Nh2168B**			**90865-70**	**1**		**1.5**	
564	**Nb8503**			**85864, etc.**	**0 (ps)**	**8**	**0 (ps)**	**8**
565	Nb3999B			B115-1	3		1	
566	Uberlandia			ECHO etc.	4.5		4.5	
567	2nd gen. Uberlandia			ECHO etc.	3		3	
568	Improved Uberlandia			ECHO etc.	NS	5.5	NS	7
569	Improved Uberlandia			ECHO etc.	4		5	
570	**HM**	**XMXS3M3**		**S304-1**	**1 (ps)**		**2**	
571	HM = Nh0252B	M4SMSM		S278-1	2		4	
572	**HM x (Bx6)**	**F5M**		**S267-1**	**1.5**	**6.5**	**1.5**	**8**
573	PD x PI326011	F1X3SM		B309-1	2		4	
574	(PD x PI 326011) x WR			S303-1	1		3	
575	**Nb2159A**	**BC4**		**I004-1**	**1.5**		**NS**	
576	Nb2159B	F2MSMS4M2		I105-2	3	7	5	7
577	Nb2159B			N151721	3.5		4.5	
578	Nb2159A			N151722	4.5		2	
579	**Nb3271B**			**N151761**	**0**		**0**	
580	**Nb3271A**			**N151762**	**0**	**6**	**0**	**6**
581	**Nb6526B**	**F4M5SMSM**		**B105-1**	**2**		**1**	
582	**Nb6526B**	**F4M5SMSM**		**I104-2**	**0**		**0 (ps)**	
583	**(Nb4001 x Nb8483) x Nb6526**	**F1**		**I104-1**	**1**		**1**	
584	**Nb6526B**	**F4M5SMSM**		**S277-1**	**1**	**6**	**0**	**9**
585	**Nb8503B**	**F3MSM2SM3**		**B121-1**	**2**		**2**	
586	Nb8483B	F3MSM3SM		B106-1	3.5		1	
587	**Nh8502B**	**XMXMSM**		**B113-1**	**0**		**0**	

Table 1. Inbreds continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
588	Nb8503B	F3MSM3		B114-1	0	6.5	0	9
589	Nb9296B	F3M		B116-1	0		2 (ps)	
590	Nb8524B	F3M6		V104068-2	4		2 (ps)	
591	Nb8542B	F3M6		V104070-2	0		1	
592	Nb8542A	BC4		V104071-2	1	5.5	1	6
593	Nb8483 x 9256	F4M		B307-1	1		1	
594	Nb8483 x 9256	F4M		B308-1	0		1	
595	Nb8483 x 9256	F3M		S274-1	0		1	
596	Nb8483 x 9256	F3M		S274-1	0	5.5	0	8
597	Nb8483 x 9256	F3M		S275-1	0		0	
598	Nb2159B	?		N17164-1	2		3	
599	Nb2159A	BC2		N17164-2	2.5		4	
600	Nb8503	F3MSM4		B116-1	0	6	0	6.5
601	Nb3999B	F3MSM2		B115-1	2		2	

Earlier productions

602	(HM x SFF) x L0571B	F3M	6064	127218	2.5(ps)		4	
603	HM x (Bx6)	F3M2	6133	127392	1		3	
604	PD x WR	F3M	6170	127420	0	4	2	5.5
605	Nb8483 s 9256	F4M2S	6190	127424	1		0	
606	(HM x Bx6) x L9359B	F4	6198	127432	1		0	
607	HM x (Bx6)	F5MS2	6208	127460	1	4.5	0	6
608	(FN2-9 x 2302) x (WR x PD)	F4	6248	127522	1.5		3 (ps)	
609	Various Reds x (Reds x 7262)	F1MSM	6324	127634	6		6 (ps)	
610	(HM x SFF) x L0556B	F3	5063	121196	2		3	
611	HM x (Bx6)	F4	5155	121420	1	4.5	3	6
612	Homs	XMXMS	3N196	74078	0 (ps)		4 (ps)	
613	Homs	XMXMS	3N196	74080	1 (ps)		4.5(ps)	
614	HM = Nh0252B	M4SMSM		S278-1	1		0	
615	(HM x NF) x 0569B	F3	15KI107	124318	1	4	1	8
616	(FN2-9 x 2302) x (WR x PD)	F2M	15KJ109	124324	0		1	
617	(FN2-9 x 2302) x (WR x PD)	F3	15KJ110	124326	0		4	
618	(HM x Bx6) x 9359B	F2M	15KI112	124331	1		4	
619	(HM x Bx6) x 9359B	F2M	15KI112	124333	1.5	5	2	5
620	(HM x Bx6) x 9359B	F3	15KI112	124336	1		3.5	
621	(HM x Bx6) x 9359B	F2M	15KI113	124339	0		2	
622	(HM x Bx6) x 9359B	F3	15KI113	124341	0		3	
623	(HM x Bx6) x 9359B	F3	15KI113	124342	1	4.5	1 (ps)	5
624	(8483B x 9256B) x (B x 6 x Homs	F3	15KI125	124361	0		0 (ps)	
625	((Bx6) x (PDxPI)) x (8483 x 9256	F3	15KI133	124372	1		0	
626	SFF	F1XMS3M2S2	15KI236	124463	1		1	
749	((Bx6) x (PDxPI)) x (8483x92	F2M	15KI133	124373	1		1	
750	HM x (Bx6)	F2MS4M	15KJ369	124626M	0		1.5	
751	HM x (Bx6)	F2MS4M	15KJ369	124627M	1	5	0	5
752	Nb8483 s 9256	F4MSM	15KI415	124651M	0		NS	
753	Nb8483 s 9256	F4MS2	15KI415	124652	1		1 (ps)	
754	Nb8483 s 9256	F4MSM	15KJ415	124653M	1.5		2.5	
755	Nb8483 s 9256	F4MSM	15KJ415	124654M	1	6	1	4
756	PD x WR	F3MS2M	15KJ492	124769M	1		2	
757	SFF x HM	F4M2	15KI506	124771M	0		1.5	
758	SFF x HM	F4M2	15KI506	124773M	1		3 (ps)	
759	(PD x PI326011) x WR	F3MSM2	15KI509	124776M	0	5.5	1	4
760	Nb8503B x (FN2-9 x 2302)	F3M	15KI461	124731M	0		2.5	
761	Nb8503B x (FN2-9 x 2302)	F3M	15KI461	124733M	0 (ps)		0	
762	L9786B x HM	F3M	15KI469	124741M	0		1	
763	L9786B x HM	F3M	15KJ469	124743M	0	4	1	4.5
764	L9786B x HM	F3M	15KJ469	124744M	0		2	
765	(Nb8483B x 9256B) x HM	F3M	15KI474	124746M	0		0 (ps)	
766	(Nb8483B x 9256B) x HM	F4	15KI474	124747	0		0	
767	SFF x HM	F5M	15KJ485	124761M	0	4.5	1	5
768	SFF x HM	F5M	15KJ485	124762M	0		2.5	

Table 1. Earlier prod. continue

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
769	**Nb8483 s 9256**	**F4M3**	**15KI537**	**124799M**	**0**		**0 (ps)**	
770	**Nb8483 s 9256**	**F4M3**	**15KJ537**	**124801M**	**0**		**0**	
771	**Nb8483 s 9256**	**F4M3**	**15KJ537**	**124802M**	**1**	**5.5**	**0 (ps)**	**9**
772	Nb8524B	F3M7	15KJ597	124848M	NS		NS	
		Hybrids						
627	(Nb8483 x Nbh2306) x L0567	F1	6555	503-12	2	5	4	5.5
628	(L1406 x L0567) x Nb1175	F1	6546	510-2	3		6	
629	(L9785 x L0567) x Nb1175	F1	6548	510-3	2.5		5	
630	**(Nb13932 x L0569) x Nb1175**	**F1**	**6549**	**510-4**	**2**		**2**	
631	(L1406 x L1401) x Nb1175	F1	6552	510-5	3	4	6	5.5
632	(9785 x L2576) x Nb1175	F1	6556	510-7	3		4.5	
633	**Nb1386B**			**512-1**	**1**		**1**	
634	**(Nb8483 x 42156) x Nb1386**	**F1**	**6560**	**512-2**	**0**		**2**	
635	**(3035 x Nb3999) x Nb1386**	**F1**	**6580**	**512-3**	**2**	**4**	**1**	**6**
636	**(SC x Nb3999) x Nb1386**	**F1**	**6582**	**512-4**	**0**		**1**	
637	**(SC x Nb9324) x Nb1386**	**F1**	**6584**	**512-6**	**0**		**1**	
638	**(Nb4001 x Nb6526) x Nb1386**	**F1**	**6585**	**512-7**	**0**		**1**	
639	(SC x Nb8542) x Nb1386	F1	6586	512-8	3	4	2.5	5
640	(L9785 x L0567) x Nb1386	F1	6548	512-9	0		3 (ps)	
641	Npw2191B	F3M2SM2	6436	518-1	2		3.5	
642	**(Nb8483AxNbh2306B) x Npw219**	**F1**	**6555**	**518-2**	**1**		**0**	
643	**(Nb8483AxNbh4216B) x Npw219**	**F1**	**6560**	**518-3**	**ND**	**4**	**1.5**	**9**
644	**(Nb8524 x Nb8483) x Npw219**	**F1**	**6583**	**518-4**	**1**		**0 (ps)**	
645	(Nb4001 x Nb6526) x Npw2191B	F1	6585	518-5	1		3 (ps)	
646	(SC x Nb8542) x Npw2191B	F1	6586	518-6	3.5		1	
647	**Nb2195B**	**F4MSM**	**6440**	**519-1**	**2**	**4**	**0**	**9**
648	**(Nb8483 x Nbh2306) x Nb219**	**F1**	**6555**	**519-2**	**2**		**1**	
649	**(Nb8483A x Nb4216) x Nb219**	**F1**	**6560**	**519-3**	**1**		**1**	
650	(Nb8483 x Nb4216) x Nb2205	F1	6560	521-3	2.5		1	
651	**(3035 x Nb3999) x Nb2205**	**F1**	**6580**	**521-4**	**1**	**6**	**1**	**6**
652	**((SCxNb8495B)xNb3999) x Nb22**	**F1**	**6582**	**521-5**	**1**		**2 (ps)**	
653	(Nb8483A x Nbh2306B) x Nb220	F1	6555	521-2	2		4	
654	(Nb8524 x Nb8483) x Nb2205	F1	6583	521-6	2		3	
655	**(SC x Nb9324) x Nb2205**	**F1**	**6584**	**521-7**	**0**	**5**	**1.5**	**9**
656	(Nb4001 x Nb6526) x Nb2205	F1	6585	521-8	4		2 (ps)	
657	**(SC x Nb8542) x Nb2205**	**F1**	**6586**	**521-9**	**2**		**NS**	
658	(Nb1393 x L0569) x L2577	F1	6549	535-9	1		4.5	
659	(Nb1393 x L0567) x 5133	F1	6545	543-2	1 (ps)	9	3.5	9
660	(Nb1393 x L0569) x 5133	F1	6549	543-5	1 (ps)		4 (ps)	
661	(Nb1393 x L0569) x L5134	F1	6549	544-5	2		3	
662	**Nb6526B**	**F4M5SMS2M2**	**6482**	**568-1**	**1**		**0 (ps)**	
663	(Nb8483 x Nb4216) x Nb6526	F1	6560	568-5	3		3 (ps)	
664	(3035 x Nb3999) x Nb6526	F1	6580	568-6	3.5	5	0 (ps)	9
665	**Nb9297B**	**F3M3**	**6497**	**575-1**	**0**		**NS**	
666	**(SC x Npw2191) x Nb9297**	**F1**	**6437**	**575-3**	**1**		**0**	
667	**(Nb8524 x Nb8483) x Nb9297**	**F1**	**6583**	**575-4**	**1.5**		**1**	
668	**(Nb8483 x Nbh2306) x Nb932**	**F1**	**6555**	**576-4**	**1**	**4.5**	**1 (ps)**	**8**
669	(Nb8483A x Nb4216) x Nb9324	F1	6560	576-5	4		1	
670	**((SC x Nb8495) x Nb3999)xNb93**	**F1**	**6582**	**576-6**	**1**		**1**	
671	(3035A x Nb3999B) x Nb9324	F1	6580	576-7	1		2.5	
672	(Nb8524 x Nb8483) x Nb9324	F1	6583	576-8	3	6	3	5
673	(SC x Nb9324) x Nb9324	F1	6584	576-9	3.5		4	
674	(SC x Nb8542) x Nb9324	F1	6586	576-11	5		4	
674	Nb2159B	F2MSMS4M3	6899	608-1	2		3	
676	**Nbh2306B**	**F7M**	**6214**	**612-1**	**1**	**5.5**	**1**	**9**
677	Nb3271B	F2MSMS3M2SM	6930	622-1	1		2.5	
678	Nb3271A	BC3	6933	622-2	4.5		7	
679	Nb6526B	F4M5SMSM2	6967	661-1	4		1	
680	Nb6167B	F4M	6167	642-1	2	4.5	2.5	5.5
681	(SC x L2577) x Nb6167B	F1	7031	642-2	1		4 (ps)	

Table 1. Hybrids continued

Plot ID	Pedigree	Generation	Root Source	Seed Source	MI scores Plot	MI scores Check	MJ scores Plot	MJ scores Check
682	(SC x L4168) x Nb6167B	F1	7033	642-3	4		6.5	
683	((Nb1393xL0569(xL4168)xN6167	F1	7035	642-4	2.5		4	
684	((L1406xL1401)xL4168)xNb6167	F1	7036	642-5	4	6	3.5(ps)	5
685	**Nb2205A x Nb6526B**	**F1**	**6919**	**661-3**	**1**		**1**	
686	(Nb4001 x Nb4002) x Nb6526B	F1	6948	661-4	2		3	
687	1138A x Nb9297B	F1	6688	669-2	2		3.5	
688	**Nb2205A x Nb9297B**	**F1**	**6917**	**669-5**	**1**	**6**	**1**	**6.5**
689	2144A x Nb9297B	F1	6692	669-6	2		3.5	
690	(2126A x Nb9297B) x 2144B	F1	7988	708-4	2		4	
691	(Nb8483A x Nb4216) x 2144B	F1	8011	708-5	4		3.5	
692	**Nb3271B**	**F2MSMS3M2**	**8296**	**716-1**	**1**	**4.5**	**2**	**6**
693	Nb3271A	BC1	8299	716-2	0		3	
694	(Nb8483A x Nb4216) x Nb3271B	F1	8011	716-3	1		3.5	
695	(Nb8483A x Nbh2306B) x 6116B	F1	7990	730-4	1.5		5	
696	(Nb8483A x Nb4216) x 6116B	F1	8011	730-5	3	7	6	5.5
697	(Nb8483A x Nbh2306B) x F7120E	F1	7990	749-2	3 (ps)		5 (ps)	
698	(2126A x Nb9297B) x F7142B	F1	7988	750-4	3		4.5	
699	(Nb8483A x Nbh2306B) x F7142E	F1	7990	750-5	2		NS	
700	6274A x F7142B	F1	7561	750-6	5.5	6	6.5	7
701	(Nb2205A x Nb9297B) x F7737B	F1	8035	765-5	3.5		1	
702	(Nb8483A x Nb4216) x F7723B	F1	8011	764-6	4		5	
703	(Nb8483A x Nbh2306B) x F7738E	F1	7990	766-3	2		3	
704	(5280A x Nbh2306B) x F7738B	F1	8014	766-5	4	5	5	5
705	(2126A x L3303B) x Npbw7261B	F1	7986	788-3	4		4.5	
706	(2144A x Nb9297B) x Npbw7261I	F1	8010	788-4	3.5		4 (ps)	
707	(5280AxNbh2306B) x Npbw7261I	F1	8014	788-5	2.5		3	
708	**(Nb2205A x Nb9297B) x Npbw72(**	**F1**	**8035**	**788-6**	**1**	**5**	**1.5**	**6**
709	(L1406A x L0567B) x Nbh2306B	F1	7974	789-2	1		3.5	
710	Nbh2306B	F8M	7199	790-1	3		3	
711	L1408A x Nbh2306B	F1	7370	790-2	4		4.5	
712	(L7550A x L1408B) x Nbh2306B	F1	7978	790-3	1	6.5	4	5
713	(L9785A x L2576B) x Nbh2306B	F1	7975	790-4	3.5		3.5	
714	(L1406A x L0567B) x Nbh2306B	F1	7971	790-5	3		3.5	
715	(L9793A x L3726B) x Nbh2306B	F1	7987	790-6	2		4	
716	Nbh2306B	F8M	7200	791-1	0	5.5	3 (ps)	5
717	L1408A x Nbh2306B	F1	7370	791-2	4		2.5	
718	(L7550A x L1408B) x Nbh2306B	F1	7978	791-3	1		3.5	
719	(L9785A x L2576B) x Nbh2306B	F1	7975	791-4	2	6	3	6
720	(L1406A x L0567B) x Nbh2306B	F1	7971	791-5	3		2	
721	(L9793A x L3726B) x Nbh2306B	F1	7987	791-6	3		3	
722	Imperial Cuts (Standard baby)			Integra	3		2.5(ps)	
723	Propeel (Standard baby)			Seminis	4.5	5	4.5	6
724	Upper Cut (Standard baby)			Nunhems	4		5.5	
725	Maverick (Standard cello)			Nunhems	4.5		5 (ps)	

Key:

MI - Meloidogyne incognita
MJ - Meloidogyne javanica
Score - 0 to 9 scale; 0=resistant, 9=susceptible
NS - No stand
ND - Data not included in this table
ps - poor stand

Nb - Inbreds with Brasilia resistance
Nbh - Inbreds with Brasilia + Homs resistance
Npw - Inbreds with PingDing + Western Red resistance
Nh - Inbreds with Homs resistance
Ns - Inbreds with SFF resistance

Resistance sources in pedigrees :

(B x 6) - Brasilia 1252 x 6274
Br 1091 - Brasilia 1091
HM - Homs
NF (or SN) - Nantes Fancy
PD - Ping Ding
SFF - Scarlet Fancy x Favourite
WR - Western Red

Shaded are resistant (scores of 2 or less) to MI and MJ

Table 2 - Segregating carrot populations tested with *Meloidogyne* in the greenhouse for genotyping and genetic analysis

Population	Year tested	Pedigree	Generation	# plants tested	Nematode sp./isolate
USDA item # 85	2018	PI 171643	N/A	72	incognita/Beltran
USDA item # 176	2018	PI 222249	N/A	63	incognita/Beltran
USDA item # 259	2018	PI 272258	N/A	335	incognita/Beltran
135172	2018	PI 272258	S	14	incognita/Beltran
135174 #1	2018	PI 272258	S	22	incognita/Beltran
135174 #2	2018	PI 272258	S	20	incognita/Beltran
136595 to 136601	2018	PI 272258	S	110	incognita/Beltran
(87298)	2017	Homs	M4SMS	174	hapla/S. Brdo
(Sem 274-1	2017	Br x 6274 (8483 x 9256)	F3M	257	incognita/Pr. 77
80080	2014	Br x 6274 (8483 x 9256)	F3	84	incognita/Beltran
95644	2014	FN2-9 x 8503	F2	180	incognita/Beltran
(UCR 2)	2011-2013	Br x 6274 (3999B)	F3MS	345	incognita/Beltran
UCR 4				104	
(UCR 5)				165	
UCR 9				48	
UCR 12				136	
UCR 26				11	
UCR 28				7	
UCR 29				158	
UCR 31				222	
UCR 35				109	
UCR 40				81	
UCR 43				17	
UCR 44				18	
UCR 47				223	

Highlighted populations have been genotyped