



2023 Disease Evaluations and Agronomic Traits of Advanced Peanut Breeding Lines

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Overview

- A total of 28 breeding lines and reference cultivars were evaluated at the Caddo Research Station for agronomic characteristics and soilborne diseases (Sclerotinia blight and pod rot).
- The six-entry runner trial included Lariat, FloRun '107', Southwest Runner, ACI 509, IPG517 and one USDA-ARS breeding line. The 14-entry Spanish/Valencia trial tested four Spanish and one small-seeded runner breeding line from USDA-ARS, six Valencia breeding lines from New Mexico State University, and cultivars IPG 1288, OLé, and TAMVal OL14. The Virginia trial evaluated eight entries: Jupiter, Comrade, Bailey II, Emery and four breeding lines from USDA-ARS.
- The 28-entry disease trial was planted on June 21 and dug 136 days after planting (Nov. 3), accumulating 2,823 growing degree days (GDD) in Fahrenheit. The season was marked by above-average temperatures for August and September (both 3 degrees above the 15-year mean). Compared to the 15-year average for rainfall, June and July experienced more, while August and September had less. Moderate to moderately high levels of Sclerotinia blight were observed in the runner and Virginia genotypes, but little pod rot was observed in this trial. The field also had high levels of parasitic nematodes.
- Moderately low levels of pod rot were present in the Virginia pod rot nursery. Jupiter and the susceptible genotype PI 378012 had 21% and 28% pod rot, respectively.

A major goal of the ARS peanut research program in Stillwater is to develop and release high-oleic peanut cultivars for the Southwest with improved yield, disease resistance and seed characteristics. In 2023, we evaluated commercial and advanced breeding lines of runner, Spanish/Valencia and Virginia peanuts in small plots at Oklahoma State University's Caddo Research Station in Fort Cobb. The objectives of these field studies were:

1. To compare advanced breeding lines to commercially available cultivars for resistance to Sclerotinia blight and agronomic characteristics, such as yield, seed, and pod qualities.
2. To evaluate a selection of Virginia entries for pod rot resistance in a field where soilborne levels of the pathogens causing peanut pod rot were promoted by planting susceptible genotypes the previous year.

Methods for Evaluating Advanced Breeding Lines and Cultivars

A total of 28 breeding lines and reference cultivars (6 runner, 14 Spanish/Valencia and 8 Virginia market types) were evaluated. Runner and Virginia peanut market types were each grown and evaluated separately, but Spanish and Valencia entries were combined in the same field and analyzed together. All advanced breeding lines were high oleic. Each entry was planted at a density of 5 seeds/ft in plots consisting of two 15-foot-long rows with 36-inch-wide beds. A randomized complete block design was used by dividing the field into four sections (blocks) to account for potential disease gradients and environmental variables. All plots were planted approximately one month later than normal (June 21) to ensure green foliage was available for late-season development of Sclerotinia blight. All plots were inverted on Nov. 3, 136 days after planting, and threshed on Nov. 6, 2023.

Additional water was applied to all plots 14 times (total 9.95”) between June 30 and Oct. 4, using a center pivot system. Each row in the two-row plots was inoculated with 0.5 grams of *Sclerotinia minor* sclerotia on Sept. 12. Fields were managed for weeds, foliar diseases and southern blight (caused by *Agroathelia rolfsii*) following Extension recommendations but were not managed for Sclerotinia blight, pod rot or nematodes. Entries were evaluated for Sclerotinia on Oct. 13. Disease incidence was measured by counting the number of 6-inch sections within each plot that had symptoms of Sclerotinia blight. On Aug. 21 and Oct. 10, approximately 20 soil cores were collected near the taproots from the four plots planted with Jupiter for nematode counts. All plots were examined for pod rot on the same day the plants were inverted.

Peanut grades were determined following USDA-Agricultural Marketing Service guidelines, using two 200-gram samples from each plot. Two 500-gram samples per plot were used to determine pod sizes in the Virginia entries. Yield was adjusted by factoring in the area lost by plots in the path of the center pivot wheels. Data were analyzed using one-way ANOVA in PROC GLIMMIX of SAS (ver. 9.4).

The Type I error rate for pairwise comparisons of breeding lines and cultivars was controlled at $\alpha = 0.05$ using the ADJUST=TUKEY option. Crop value for each market type was calculated using the following 2023 contract prices per ton: \$650, runner; \$950, Valencia; \$700, Spanish; and \$725, Virginia.

The pod rot nursery was planted on June 21 to reduce the number of volunteers, and plots were dug and rated for pod rot on Oct. 17.

Summary of 2023 Field Conditions

A total of 2,823 growing degree days in Fahrenheit accumulated for the 2023 disease trial. The season was characterized by above-average temperatures for August and September (+3F from 15-year mean), above-average rainfall for June and July, and below-average rainfall for August and September (Table 1). Cooler evening temperatures in October favored the development of Sclerotinia blight. Little southern blight and pod rot were observed. The nematology lab at Oklahoma State University found 331 ring and 20 root-knot nematodes per 100 cc (=3.4 oz.) of soil in the Aug. 21 samples. By Oct. 10, there was an average of 910 ring and 1,050 root-knot nematodes per 100 cc of soil (Kelli Black and Nathan Walker, pers. communication) – numbers considered to be very high levels of infestation for both nematodes.

Performance of the Six Runner Market-type Entries

- Runner entries with the highest yield ($\geq 4,584$ lbs. per acre) and crop values ($\geq \$1,049$ per acre) were Southwest Runner, ARSOK R109-1 and Lariat (Table 2). Average seed grade varied among entries from 61% to 72%.
- Moderately high levels of Sclerotinia blight were observed in mid-October, and the most resistant entries included Southwest Runner (<1%), Lariat (9%) and ARSOK R109-1 (12%).
- Three-year averages were calculated for four entries (Table 3), but plots from 2021 and 2022 were in the field 30 and 12 days longer, respectively, than in 2023. Lariat, Southwest Runner and ARSOK R109-1 had similar yields. Seed grade for Lariat was higher than FloRun '107' and Southwest Runner but not significantly different than R109-1. Southwest Runner had more resistance to Sclerotinia blight than FloRun '107' and R109-1 but was similar to Lariat in resistance.

Performance of the 14 Spanish/Valencia Market-type Entries

- OLé and ARS small-seeded runner breeding line ARSOK R58B had the highest numerical yields (4,811 and 4,244 pounds per acre, respectively; Table 4). Yields among Valencia market-type entries were statistically similar.
- Crop value was highest for all Valencia market type entries except NM310 due to the higher contract price for Valencia. Within the Valencia entries, NM16-17 had the highest numerical yield (4,039 lbs/A), and IPG 1288 had the best grade at 72%.
- OLé had the highest yield of the entire Spanish/Valencia trial at 4,811 lbs/A. The small-seeded runner, ARSOK R58B, was among the highest yielding (4,244 lbs/A) and had the best grade at 74%.
- Minimal Sclerotinia blight (<2%) was observed except in IPG 1288 which had 38% disease.
- OLé had the highest numerical yield among the seven entries evaluated for the past three years (Table 5). Few differences in seed grade were observed, and the entries had little Sclerotinia blight.

Performance of the Nine Virginia Market-type Entries

- Among the Virginia entries, ARSOK V99 had the highest crop value (\$1,120/A; Table 6) and the highest numerical yield (4,537 lbs/A).
- Average seed grade was relatively low, ranging from 65% to 68% but did not differ significantly among entries. ARSOK entries V98, V99 and V103-1 had the lowest levels of Sclerotinia blight (<11%), while Emery was the most diseased (39%).
- Entries differed significantly in number of pods per ounce (Table 6) and pod size distribution (Figure 1). ARSOK V103-3 (81%) and Comrade (75%) had the largest percentage of super jumbo pods by weight.
- Over the past three years, ARSOK V99 had the highest numerical yield (4,400 lbs/A) and the least amount of Sclerotinia blight (6%; Table 7). Seed grade was highest in Comrade and ARSOK V99 (69 and 68%, respectively).

Pod Rot Nursery

In 2023, moderately low levels of pod rot were observed in the pod rot nursery (Table 8). The susceptible control PI 378012 and Jupiter had above 20% pod rot. Comrade had intermediate levels of disease (11%), and all other entries had 5% or less pod rot.

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Table 1. Monthly rainfall and average air temperature from Mesonet for 2023 field season at the Caddo Research Station in Fort Cobb.¹

Month	Air Temperature (°F)				Rainfall (inches)		Total
	Avg. Max.	Avg. Low	Daily Mean	Dep. 15-Yearly Avg.	Total	Dep. 15-Yearly Avg.	Degree Days (°F)
June	88 (92)	66 (71)	77 (81)	-3	6.7 (2.0)	+3.05	354 (166)
July ²	93	70	81	-1	5.2	+2.23	514
August ²	96	69	82	+3 ³	0.6	-1.98	471
September ²	89	64	76	+3	1.5	-1.36	307
October	75	49	61	0	2.8	-0.29	93

¹ All plots planted June 21 and dug Nov. 3. June data for entire month and after planting (in parentheses).
² Incomplete Mesonet records. August departure from 15-year average temperature from Hinton due to extensive incomplete records for Fort Cobb.

Table 2. Crop value, yield, grade, Sclerotinia blight and shelling characteristics in advanced runner breeding lines and commercial cultivars planted at the Caddo Research Station in Fort Cobb on June 21, 2023.¹

Entry	Revenue (\$/A) ²	Yield (lbs/A)	Grade ³	SM ⁴	100-seed (g)	VDK (%) ⁵	Hull (%)
SW Runner	1089a	4746a	70.6ab	0.4d	57.7c	0.4	27.3ab
ARSOK R109-1	1080a	4628a	71.7a	12.2b-d	66.3ab	0.2	24.3c
Lariat	1049a	4584a	70.4ab	9.2cd	69.7a	0.2	24.6c
FloRun '107'	851b	3778b	69.4bc	54.4a	63.8b	0.6	26.5b
IPG 517	736c	3357b	67.5c	30.0b	62.5b	0.2	28.6a
ACI 509	695c	3088b	69.4bc	20.4bc	55.8c	0.5	25.8bc

¹ Entries sorted by highest to lowest contract revenue per acre. Runners were dug Nov. 3 (136 days after planting; 2,823 growing degree days in Fahrenheit). Numbers with the same lowercase letter within columns are not significantly different ($\alpha = 0.05$). No differences among entries if letters absent in column.
² Based on a contract price per ton of \$650 for runners. Calculations do not include deductions for excess splits or damaged and other kernels.
³ Grade = % total sound mature kernels + sound splits.
⁴ Incidence of Sclerotinia blight rated on Oct. 13.
⁵ VDK, visibly damaged kernels.

Table 3. Three-year averages for Sclerotinia blight, yield (pounds per acre) and seed grade in runner advanced breeding lines and commercial cultivars at the Caddo Research Station in Fort Cobb (2021-2023).¹

Entry	2021-2023			2023			2022			2021		
	Yield	GRD ²	SM ³	Yield	GRD	SM	Yield	GRD	SM	Yield	GRD	SM
Runner				136 DAP/2823 GDD ⁴			148 DAP/3203 GDD			166 DAP/3409 GDD		
Lariat	4509a	72a	13bc	4584a	70ab	9b	5324a	71a	25c	3618	75a	4b
FloRun '107'	3599b	69c	53a	3778b	69b	54a	3775b	66b	88a	3183	70b	16a
SW Runner	4510a	69bc	4c	4746a	71ab	0b	4925a	68ab	10c	3860	69b	0b
ARSOK R109-1	4394a	71ab	26b	4628a	72a	12b	5215a	71a	50b	3340	72ab	16a

¹ Numbers with the same lowercase letter within columns are not significantly different ($\alpha = 0.05$).
² Grade = % total sound mature kernels + sound splits.
³ SM, % incidence of Sclerotinia blight. Sclerotinia blight-susceptible (FloRun '107) and resistant (Southwest Runner) controls.
⁴ Days after planting (DAP) when dug; peanut growing degree days (GDD) heat units in Fahrenheit calculated by Mesonet. Planting and digging dates: 2023, June 21 and Nov. 3; 2022, June 6 and Oct. 31; 2021, May 14 and Oct. 26.

Table 4. Crop value, yield, grade, Sclerotinia blight and shelling characteristics in advanced Spanish/Valencia breeding lines and commercial cultivars planted at the Caddo Research Station in Fort Cobb on June 21, 2023.¹

Entry	Market Type	Revenue (\$/A) ²	Yield (lbs/A)	Grade ³	SM ⁴	100-seed (g)	VDK (%) ⁵	Hull (%)
NM16-17	Valencia	1351a	4039bc	70.4bc	0b	53.5cd	0.7ab	27.6ab
NM16-42	Valencia	1317ab	3951bc	70.2b-d	0b	53.3cd	0.7ab	27.2bc
NMPR25	Valencia	1282a-c	3891bc	69.4b-d	0.8b	52.7cd	0.5ab	28.2ab
TAMVal OL14	Valencia	1281a-c	3889bc	69.3b-d	0b	57.3ab	1.2a	28.2ab
IPG 1288	Valencia ⁶	1255a-d	3656bc	72.2ab	38.3a	59.0a	0.7ab	24.9cd
NM-KC25	Valencia	1251a-d	3743bc	70.4bc	1.7b	54.1b-d	0.8ab	27.8ab
NM-M6	Valencia	1190b-e	3596bc	69.7b-d	0b	53.0cd	0.6ab	28.3ab
OLé	Valencia	1183c-e	4811a	70.3b-d	0b	44.2e	0.5ab	27.1bc
NM310	Valencia	1127d-f	3527c	67.3d	0b	51.6d	0.7ab	29.8a
ARSOK R58B	Spanish ⁶	1093e-g	4244ab	73.6a	0.8b	56.2a-c	0.4b	24.8d
ARSOK S105-4E	Spanish	1008f-h	4167a-c	69.2cd	0b	54.3b-d	0.6ab	28.3ab
ARSOK S105-3E	Spanish	988gh	4011bc	70.4bc	1.3b	54.7b-d	0.5ab	27.5b
ARSOK S104-3E	Spanish	979gh	3993bc	70.2b-d	0b	52.8cd	0.5ab	27.9ab
ARSOK S104-2E	Spanish	947h	3867bc	70.0b-d	0b	51.9d	0.5ab	27.8ab

¹ Entries sorted by highest to lowest contract revenue per acre. Peanuts were dug Nov. 3 (136 days after planting; 2,823 growing degree days in Fahrenheit). Numbers with the same lowercase letter within columns are not significantly different ($\alpha = 0.05$). No differences among entries if letters absent in column.

² Based on a contract price per ton of \$700/ton for Spanish and \$950/ton for Valencia. Calculations do not include deductions for excess splits or damaged and other kernels.

³ Grade = % total sound mature kernels + sound splits.

⁴ Incidence of Sclerotinia blight rated on Oct. 13.

⁵ VDK, visibly damaged kernels.

⁶ IPG 1288, red-seeded runner; ARSOK R58B, small-seeded runner.

Table 5. Three-year averages for Sclerotinia blight, yield (pounds per acre) and seed grade in Spanish advanced breeding lines and commercial cultivars at the Caddo Research Station in Fort Cobb (2021-2023).¹

Entry	2021-2023			2023			2022			2021		
	Yield	GRD ²	SM ³	Yield	GRD	SM	Yield	GRD	SM	Yield	GRD	SM
Runner				136 DAP/2823 GDD ⁴			148 DAP/3203 GDD			166 DAP/3409 GDD		
OLé	4084a	70ab	1b	4811a	70	0	4804	69	3b	2614	70a-c	—
ARSOK S104-2E	3584bc	71a	3ab	3867b	70	0	4586	70	5ab	2299	74a	—
ARSOK S104-3E	3658a-c	69ab	5ab	3993b	70	0	4574	67	10ab	2408	71ab	—
ARSOK S105-3E	3794a-c	69ab	2ab	4011b	70	1	4753	66	4b	2589	70a-c	—
ARSOK S105-4E	3866ab	69ab	3ab	4167b	69	0	4913	68	5ab	2517	71ab	—
NM16-17	3363c	68b	4ab	4039b	70	0	3908	65	8ab	2178	66c	—
NM16-42	3487bc	69ab	9a	3951b	70	0	4054	68	18a	2456	69bc	—

¹ Numbers with the same lowercase letter within columns are not significantly different ($\alpha = 0.05$).

² Grade = % total sound mature kernels + sound splits.

³ SM, % incidence of Sclerotinia blight. No Sclerotinia ratings taken in 2021 in the Spanish/Valencia trial due to low levels of disease.

⁴ Days after planting (DAP) when dug; peanut growing degree days (GDD) heat units in Fahrenheit calculated by Mesonet. Planting and digging dates: 2023, June 21 and Nov. 3; 2022, June 6 and Oct. 31; 2021, May 14 and Oct. 26.

Table 6. Crop value, yield, grade, Sclerotinia blight, pod and shelling characteristics in advanced Virginia breeding lines and commercial cultivars planted at the Caddo Research Station in Fort Cobb on June 21, 2023.¹

Entry	Revenue (\$/A) ²	Yield (lbs/A)	Grade ³	SM ⁴	100-seed (g)	VDK (%) ⁵	Hull (%)	Super Jumbo (%)	Jumbo (no./oz) ²	Fancy (no./oz) ²
ARSOK V99	1120a	4537a	68.1	5.0b	83.0cd	0.8	30.0b	12.7a	14.7bc	19.7d-f
Comrade	1009b	4103ab	67.8	23.3ab	98.1a	0.5	30.8ab	10.0d	15.3b	23.5bc
Jupiter	974b	4092ab	65.6	21.1ab	88.8b	0.7	32.9ab	11.3bc	14.0cd	21.0cd
ARSOK V103-3	969b	4014a-c	66.5	25.8ab	89.5b	1.1	31.5ab	11.9ab	17.7a	26.9a
ARSOK V98	962b	4026a-c	65.9	4.6b	88.1bc	0.7	32.6ab	11.0c	12.9d	17.6ef
ARSOK V103-1	920bc	3921a-c	64.8	10.7b	90.2b	0.9	33.4a	11.8ab	17.1a	25.6ab
Bailey II	846c	3531bc	66.1	22.9ab	82.1d	0.7	31.8ab	11.4bc	12.9d	16.9f
Emery	825c	3395c	67.1	38.8a	86.6b-d	0.5	31.4ab	11.2bc	14.1c	20.7c-e

¹ Entries sorted by highest to lowest contract revenue per acre. Peanuts were dug Nov. 3 (136 days after planting; 2,823 growing degree days in Fahrenheit). Numbers with the same lowercase letter within columns are not significantly different ($\alpha = 0.05$). No differences among entries if letters absent in column.

² Based on contract price of \$650/ton. Calculations do not include deductions for excess splits or damaged and other kernels.

³ Grade = % total sound mature kernels + sound splits.

⁴ Incidence of Sclerotinia blight rated on Oct. 13.

⁵ VDK, visibly damaged kernels.

⁶ Number of pods per ounce for pods riding slotted screens sized for super jumbo (40/64 x 3" slots), jumbo (37/64 x 3"), fancy (32/64 x 3")

Figure 1. Percent pod size distribution by weight among Virginia entries in 2021 and 2022 disease trials. Pods were sorted using slotted screens sized for super jumbo (40/64 x 3" slots), jumbo (37/64 x 3") and fancy (32/64 x 3"). Pass-through pods fit through 32/64 x 3" screen.

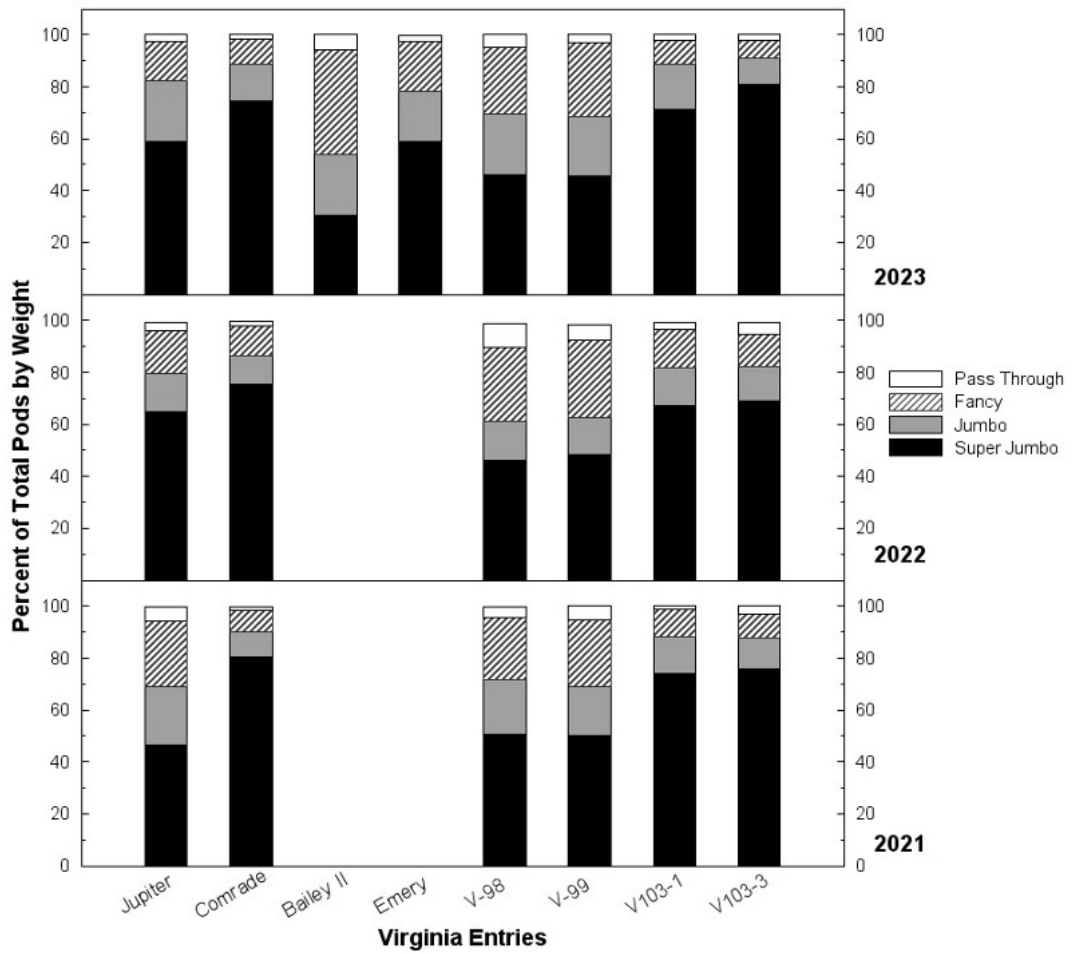


Table 7. Three-year averages for Sclerotinia blight, yield (pounds per acre), and seed grade in Virginia advanced breeding lines and commercial cultivars at the Caddo Research Station in Fort Cobb (2021-2023).¹

Entry	2021-2023			2023			2022			2021		
	Yield	GRD ²	SM ³	Yield	GRD	SM	Yield	GRD	SM	Yield	GRD	SM
Virginia				136 DAP/2823 GDD ⁴			148 DAP/3203 GDD			166 DAP/3409 GDD		
Jupiter	4007ab	64c	34a	4092	66	21ab	4711	61c	58a	3219ab	64c	23a
Comrade	3985ab	69a	31a	4103	68	23ab	4852	67a	62a	3001ab	72a	8ab
ARSOK V98	3911ab	67a-c	10b	4014	66	5b	5106	64ab	21bc	2614b	69a-c	5b
ARSOK V99	4400a	68a	6b	4537	68	5b	5034	65ab	6c	3630a	70ab	8ab
ARSOK V103-1	3957ab	67ab	30a	3921	65	26a	4925	64a-c	46ab	3025ab	71ab	17ab
ARSOK V103-3	3794b	65bc	19ab	4026	66	11ab	4501	62bc	25bc	2856ab	66bc	24a

¹ Entries are sorted from highest to lowest two-year average yield. Numbers with the same lowercase letter within columns for each market type are not significantly different ($\alpha = 0.05$). No differences among entries if letters absent in column.
² Grade = % total sound mature kernels + sound splits.
³ SM, % incidence of Sclerotinia blight.
⁴ Days after planting (DAP) when dug; peanut growing degree day (GDD) heat units in Fahrenheit calculated by Mesonet. Planting and digging dates: 2023, June 21 and Nov. 3; 2022, June 6 and Oct. 31; 2021, May 14 and Oct. 26.

Table 8. Pod rot in Virginia entries planted in the 2023 pod rot nursery and 2021 cultivar/advanced breeding line trial at the Caddo Research Station, Fort Cobb.¹

Entry	Pod Rot %	
	2023 Pod Rot Nursery	2021 Cultivar/Breeding Lines
Bailey II	5.3c	—
Comrade	11.3bc	31.3ab
Emery	1.3c	—
Jupiter	20.5ab	43.8a
ARSOK V99	4.0c	20.5bc
ARSOK V103-1	1.3c	10.5c
ARSOK V103-3	2.3c	4.0c
PI 365553 (resistant)	1.0c	—
PI 378012 (susceptible)	27.5a	—

¹ 2023 pod rot nursery planted on June 17; 2021 plots planted on May 14. Numbers with the same lowercase letter within columns for each market type are not significantly different ($\alpha = 0.05$).

² Percentage of pods with symptoms of pod rot estimated within 3 days after digging.

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