SUGAR BEET (*Beta vulgaris* ssp. *vulgaris*)
SEA BEET (*Beta vulgaris* ssp. *maritima*)
Rhizoctonia crown and root rot;
Rhizoctonia solani

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Rhizoctonia crown and root rot resistance evaluation of *Beta* PIs in Fort Collins, CO, 2014.

Twenty-nine beet (*Beta vulgaris* subsp. *vulgaris* and *Beta vulgaris* subsp. *maritima* (L.) Arcang) accessions from the *Beta* collection of the USDA-Agricultural Research Service National Plant Germplasm System were screened for resistance to Rhizoctonia crown and root rot, at the Colorado State University ARDEC facility in Fort Collins, CO. There were two highly resistant germplasms, one resistant germplasm, and one susceptible germplasm used as controls. The 2014 *Rhizoctonia* screening nursery was a randomized complete-block design with five replicates in one-row plots (76 cm row spacing) 3.7 m long. The soil is a Fort Collins loam (0 to 1% slope, pH 7.2). The field had been planted to hard red winter wheat in 2012, and Grazex BMR 737 (a sorghum/sudangrass hybrid) in 2013. In 2014, the field was fertilized (60 lbs N $acre^{-1}$ and 30 lbs P_2O_5 $acre^{-1}$) and bedded on the 22 May. Sugar beet seed was planted on 29 May to moisture and irrigated as needed with an overhead linear irrigation system. The herbicide Betamix (2 oz $acre^{-1}$; 8% phenmedipham, 8% desmedipham [v/v] and 84% inert ingredients) was applied on 12 and 19 Jun. The field was hand weeded and thinned on 28 Jun and 19 Jul. An inoculum of dry, ground, hulless-barley grain, infested with *Rhizoctonia solani* isolate R-9 (AG-2-2), was applied to the crown of the plants on 21 Jul (at the 8-12 leaf growth stage) at a rate of 6.01 g m^{-1} of row. A Gandy® electrically driven applicator was used to apply the inoculum and the field was cultivated afterwards to place soil onto the plant crowns. Roots were harvested on 16 Sep with a single row lifter (pulled and cleaned by hand), and each root was rated for rot on a scale of 0 (no disease) to 7 (dead plant, leaves necrotic with root completely rotted) (Plant Dis. Rep. 63:518–522). Average disease severity per plot (DI) was determined with the DI treated as a continuous variable for each replicate of each entry. Analyses of variance (PROC GLIMMIX) were performed on disease indices, percent of healthy roots (classes 0 and 1 combined) and percent of the roots in classes 0 through 3 (harvestable roots). Data in classes 0-1 and 0-3 were transformed using arcsine square root to normalize the data for analyses (AP 0-1 and AP 0-3, respectively). Additionally, an analysis of variance (PROC MIXED) was performed on DI and Dunnett's one-tailed t-test ($p = 0.05$) was used to compare all entries to the highly resistant control (FC709-2) and the most susceptible plant introduction accession (PI 590719) for DI.

At harvest there was moderate Rhizoctonia root rot and other diseases were not evident. There were significant differences among entries for all three variables (PROC GLIMMIX). The DI was 1.5 in the highly resistant control and 7.0 in the most susceptible entry. Two entries, PI 560340 and PI 560339, for which DI<3.3 in the table, were not significantly different from the highly resistant control (Dunnett's one tailed t-test for DI, $p = 0.05$). All entries below Ames 2652 (DI>4.4) in the table were not significantly different (Dunnett's one tailed t-test for DI, $p = 0.05$) from the most susceptible entry (DI = 7.0). The eight entries with DI > 4.5 and > 3.2 had moderate resistance. The two entries with the highest resistance (PI 560339, PI 560340) were released from the USDA-ARS Salinas breeding program. PI 560339 was released for resistance to virus yellows, Erwinia (reclassified as Pectobacterium betavasculorum), powdery mildew (Erysiphe polygoni), and improvement for percent sucrose. PI 560340 was released for resistance to rhizomania and Rhizoctonia crown and root rot. All accessions significantly more resistant than PI 590719 will be retested and, if the resistance is confirmed, entered into the USDA-ARS Rhizoctonia root rot-resistance breeding program at Fort Collins, CO to develop sugar beet germplasm with increased resistance to Rhizoctonia root rot. These results will be accessible to interested parties through the USDA-ARS, NPGS GRIN database (http://www.ars-grin.gov/npgs/index.html).

ID	Subspecies[z]	Origin	Alternate ID	DI[y]	%0-1[x]	%0-3[w]	AP0-3[v]	AP0-3[v]
PI 599668	*vulgaris*	*Highly Resistant Control FC709-2*		*1.5*	*71*	*96*	*57.9*	*82.3*
PI 590754	*vulgaris*	*Highly Resistant Control FC705/1*		*1.8*	*53*	*93*	*47.5*	*80.1*
PI 590656	*vulgaris*	*Resistant control FC703*		*1.9*	*53*	*88*	*47.0*	*72.0*
PI 560340	*vulgaris*	United States	C94	2.8	26	64	30.3	56.2
PI 560339	*vulgaris*	United States	C93	3.2	31	61	30.5	54.7
PI 372276	*vulgaris*	Poland	300/71	3.3	21	53	23.8	46.4
PI 504274	*maritima*	France	Wild beet	3.7	29	50	29.6	42.0
PI 590694	*vulgaris*	United States	SP78564-0	3.7	19	44	22.7	38.2
PI 507848	*vulgaris*	Hungary	IDBBNR 5565	3.8	15	47	22.3	43.4
PI 614828	*vulgaris*	United States	AT3994-4	4.0	15	28	18.1	27.8
PI 560338	*vulgaris*	United States	C47R	4.2	7	36	12.0	33.2
PI 604553	*maritima*	China	IDBBNR 10024	4.4	3	26	6.7	29.4
Ames 2652	*vulgaris*	United States	IDBBNR 4794	4.5	8	24	10.6	26.0
Ames 8300	*vulgaris*	United Kingdom	IDBBNR 9517	4.5	11	37	17.2	37.3
19941025	*vulgaris*	*Susceptible Control - FC901/C817*		*4.6*	*16*	*24*	*20.8*	*28.3*
PI 507851	*vulgaris*	Hungary	IDBBNR 5568	4.8	7	17	9.7	21.7
PI 590743	*vulgaris*	United States	SLC 19	4.9	2	16	4.2	20.8
PI 590667	*vulgaris*	United States	SP76745-0	4.9	11	15	14.3	19.6
Ames 10836	*vulgaris*	China	Tian Si Stock	5.0	6	13	6.5	13.4
PI 546431	*maritima*	Greece	IDBBNR 5619	5.1	0	29	0.0	28.5
PI 546447	*maritima*	France	IDBBNR 5628	5.3	8	21	10.9	23.8
PI 470091	*vulgaris*	United Kingdom	IDBBNR 5522	5.3	1	9	2.9	16.0
PI 604552	*maritima*	Italy	IDBBNR 9480	5.3	5	26	6.0	24.6
PI 504221	*maritima*	Italy	Wild beet	5.4	0	21	0.0	18.8
PI 663876	*maritima*	United States	C23BM	5.6	3	12	4.8	15.8
PI 590697	*vulgaris*	United States	SP70756-0	5.7	2	9	3.4	13.7
PI 614829	*vulgaris*	United States	552	5.8	2	8	3.4	10.8
PI 527307	vulgaris	United States	F1009	5.8	3	9	4.4	15.7
PI 590652	vulgaris	United States	8420	6.1	3	8	5.6	13.0
PI 546443	maritima	Greece	IDBBNR 5624	6.1	0	15	0.0	14.5
Ames 2662	vulgaris	United States	IDBBNR 4804	6.8	0	0	0.0	0.0
PI 540589	maritima	France	WB 843	6.9	0	0	0.0	0.0
PI 590719	vulgaris	United States	EL40	7.0	0	0	0.0	0.0
			Trial Mean	*4.6*	*13*	*29*	*14.2*	*28.3*

[z]All entries that are *Beta vulgaris* subspecies *vulgaris* (including the control entries) are cultivated, those of *B. v.* ssp. *maritima* (sea beet) are wild.

[y]DI = Mean Disease Index, which is based on a scale of 0 (=healthy) to 7 (= plant dead) for individual roots to give a plot mean and averaged over five replicates.

[x]Mean Percent of healthy roots (disease classes 0 and 1 combined) averaged over five replicates.

[w]Mean Percent of diseased roots likely to be taken for processing (disease classes 0 through 3 combined) averaged over five replicates.

[v]AP indicates value after percentages were transformed to arcsine-square roots to normalize the data for analyzes

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