

2021 Fusarium Screens - SUMMARY (Tulare County Site)

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

February 18, 2022 copy

COMMERCIAL SEED COMPANY ENTRIES

Project Principal Investigator: R.B. Hutmacher (University of California) - cell: (559) 260-8957

Cooperators: M. Ulloa (USDA-ARS); M.P. Keeley, T. Frigulti, J. Angeles (UCCE, UCD); Cooperator Grower in Tulare County; M. Ellis (CA State Univ Fresno)

Funding provided by: CA Cotton Alliance, CA Cotton Growers and Ginners Assoc., Cotton Incorporated; University of CA-ANR and UC Davis Plant Sci Dept; USDA-ARS; facilities and equipment by Tulare County grower

2021 Fusarium Screen - Summary - University of CA - commercial entries - R.B. Hutmacher

page 1 of 6

A9:A35A15AA9:A35 Entry Name	2021 Entry #	Type of Cotton known, or based on leaf & flower characteristics (P-Pima; U-Upland H-Hybrid)	Whole Plot Foliar FOV rating		Single Plant Foliar rating		Root Vasc. Stain Rating		Cotyledon Vasc. Stain Rating		Plant height (inches)		Verticillium Incidence in evaluated plots percent	Plant Survival Percent	
			mean	stdev	mean	stdev	mean	stdev	mean	stdev	mean	stdev		mean	stdev
DP 347 RF	647	Pima	0.67	0.58	0.20	0.41	0.93	0.80	0.00	0.00	29	4	0	92.6	1.5
DP 359 RF	648	Pima	0.67	0.58	0.47	0.52	1.07	0.88	0.07	0.26	32	4	0	93.1	4.4
DP 20R022 R2P	649	Pima	0.33	0.58	0.13	0.35	0.80	0.86	0.00	0.00	31	2	0	90.1	1.9
DP 1646 B2XF	650	Upland	1.00	0.00	0.47	0.52	1.47	1.06	0.00	0.00	29	6	27	90.7	4.2
DP 2020 B3XF	651	Upland	1.00	1.00	0.40	0.63	1.20	1.01	0.20	0.41	28	4	20	83.8	4.6
DP 2012 B3XF	652	Upland	1.00	1.00	0.53	0.74	1.47	1.25	0.20	0.41	34	3	13	79.2	2.5
DP 2055 B3XF	653	Upland	1.00	0.00	0.53	0.52	1.73	1.10	0.93	0.80	35	2	53	87.1	3.6
DP 2141 NR B3XF	654	Upland	1.00	0.00	0.33	0.49	1.27	1.10	0.53	0.64	29	2	33	84.5	5.5
DP 2143 NR B3XF	655	Upland	1.00	0.00	0.53	0.52	0.87	0.92	0.20	0.41	28	3	27	89.4	3.2
PHY 881 RF	634	Pima	0.67	0.58	0.33	0.49	1.07	0.59	0.53	0.74	31	3	13	90.9	2.2
PHY 807 RF	635	Pima	0.67	0.58	0.20	0.41	0.80	0.86	0.07	0.26	29	3	13	93.6	1.3
PHY 1180-A101-02RF	636	Pima	0.67	0.58	0.47	0.52	0.93	0.70	0.33	0.49	31	2	7	94.4	2.9
PHY 1180-A103-02RF	637	Pima	0.67	0.58	0.20	0.41	0.60	0.74	0.00	0.00	27	4	13	93.4	2
PHY 1180-A105-02RF	638	Pima	1.25	0.50	0.80	0.77	1.27	0.96	0.33	0.49	33	2	13	91.5	3.0
PHY 764 WRF	639	Upland	1.00	0.00	0.53	0.52	1.80	0.86	0.20	0.41	35	3	27	91.3	4.5
PHY 332 W3FE	640	Upland	0.67	0.58	0.20	0.41	1.40	0.83	0.53	0.74	30	4	33	89.8	4.7

2021 Fusarium Screens - SUMMARY (Tulare County Site)

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

February 18, 2022 copy

COMMERCIAL SEED COMPANY ENTRIES

Project Principal Investigator: R.B. Hutmacher (University of California) - cell: (559) 260-8957

Cooperators: M. Ulloa (USDA-ARS); M.P. Keeley, T. Frigulti, J. Angeles (UCCE, UCD); Cooperator Grower in Tulare County; M. Ellis (CA State Univ Fresno)

Funding provided by: CA Cotton Alliance, CA Cotton Growers and Ginners Assoc., Cotton Incorporated; University of CA-ANR and UC Davis Plant Sci Dept; USDA-ARS; facilities and equipment by Tulare County grower

2021 Fusarium Screen - Summary - University of CA - commercial entries - R.B. Hutmacher

page 2 of 6

A9:A35A15AA9:A35 Entry Name	2021 Entry #	Type of Cotton known, or based on leaf & flower characteristics (P-Pima; U-Upland H-Hybrid)	Whole Plot Foliar FOV rating		Single Plant Foliar rating		Root Vasc. Stain Rating		Cotyledon Vasc. Stain Rating		Plant height (inches)		Verticillium Incidence in evaluated plots percent	Plant Survival Percent	
			mean	stdev	mean	stdev	mean	stdev	mean	stdev	mean	stdev		mean	stdev
PHY 350 W3FE	641	Upland	1.33	0.58	0.53	0.64	1.27	0.96	0.07	0.26	31	4	27	88.4	2.1
PHY 400 W3FE	642	Upland	1.00	0.00	0.27	0.46	1.47	0.99	0.53	0.83	32	3	40	88.5	3.3
PHY 443 W3FE	643	Upland	0.67	1.15	0.27	0.70	1.40	0.83	0.53	0.74	33	2	20	91.9	4.4
PHY 480 W3FE	644	Upland	1.00	0.00	0.27	0.46	1.47	1.19	0.53	0.74	29	5	33	90.2	2.4
PHY 580 W3FE	645	Upland	1.00	0.00	0.33	0.49	1.27	0.96	0.00	0.00	31	2	13	87.5	5.0
PX 4808 W3FE	646	Upland	1.00	0.00	0.27	0.46	1.40	1.06	0.47	0.64	28	4	33	90.3	5.5
HA 1432	633	Hybrid (Gowan)	1.00	0.00	0.47	0.52	1.40	1.06	0.27	0.46	38	2	27	83.9	4.7
FM 1830 GLT	630	Upland	0.53	0.50	0.44	0.50	1.40	0.73	0.02	0.07	29	1	29	90.2	3.1
FM 1730 GLTP	659	Upland	1.00	0.00	0.20	0.41	1.60	0.99	0.47	0.64	30	3	47	87.3	3.0
FM 2398 GLTP	660	Upland	1.00	0.00	0.47	0.52	1.33	0.98	0.20	0.41	27	4	27	90.2	5.2
FM 1621 GL	667	Upland	1.00	0.00	0.33	0.49	1.53	0.83	0.47	0.64	30	2	27	90.7	6.0
FM 2202 GL	668	Upland	1.00	0.00	0.53	0.52	1.27	0.88	0.20	0.41	34	4	20	89.5	3.3
FM 2498 GLT	670	Upland	1.00	0.00	0.53	0.52	1.33	0.98	0.00	0.00	31	2	27	88.8	5.5
BX 2295 B3XF	663	Upland	1.00	0.00	0.47	0.52	1.07	0.88	0.27	0.59	30	5	27	87.4	3.30
BX 2296 B3XF	664	Upland	1.33	0.58	0.40	0.51	1.33	1.05	0.13	0.35	29	3	20	87.4	1.5
BX 2297 B3XF	665	Upland	1.00	0.00	0.40	0.51	1.07	0.96	0.13	0.35	33	3	27	85.9	7.5

2021 Fusarium Screens - SUMMARY (Tulare County Site)

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

February 18, 2022 copy

COMMERCIAL SEED COMPANY ENTRIES

Project Principal Investigator: R.B. Hutmacher (University of California) - cell: (559) 260-8957

Cooperators: M. Ulloa (USDA-ARS); M.P. Keeley, T. Frigulti, J. Angeles (UCCE, UCD); Cooperator Grower in Tulare County; M. Ellis (CA State Univ Fresno)

Funding provided by: CA Cotton Alliance, CA Cotton Growers and Ginners Assoc., Cotton Incorporated; University of CA-ANR and UC Davis Plant Sci Dept; USDA-ARS; facilities and equipment by Tulare County grower

2021 Fusarium Screen - Summary - University of CA - commercial entries - R.B. Hutmacher

page 3 of 6

Entry Name	2021 Entry #	Type of Cotton <i>known, or based on leaf & flower characteristics</i> (P-Pima; U-Upland H-Hybrid)	Whole Plot Foliar FOV rating		Single Plant Foliar rating		Root Vasc. Stain Rating		Cotyledon Vasc. Stain Rating		Plant height (inches)		Verticillium Incidence in evaluated plots <i>percent</i>	Plant Survival Percent	
			<i>mean</i>	<i>stdev</i>	<i>mean</i>	<i>stdev</i>	<i>mean</i>	<i>stdev</i>	<i>mean</i>	<i>stdev</i>	<i>mean</i>	<i>stdev</i>		<i>mean</i>	<i>stdev</i>
ST 4550 GLTP	632	Upland	1.50	0.71	0.90	0.57	1.50	0.97	0.00	0.00	31	2	20	89.9	1
ST 5091 B3XF	656	Upland	1.00	0.00	0.47	0.52	1.53	1.19	0.27	0.46	33	5	33	90	4.4
ST 4993 B3XF	657	Upland	1.00	0.00	0.60	0.51	1.20	0.86	0.13	0.35	30	3	20	86.7	5.8
ST 4990 B3XF	658	Upland	0.67	0.58	0.33	0.49	1.33	0.90	0.07	0.26	33	5	27	92.5	4.3
ST 5600 B2XF	661	Upland	1.00	0.00	0.60	0.51	1.07	0.96	0.20	0.41	29	6	27	89.5	2.3
ST 5707 B2XF	662	Upland	0.67	0.58	0.40	0.51	1.47	1.30	0.00	0.00	32	3	20	91.9	4.5
ST 4550 GLTP	669	Upland	1.00	1.00	0.33	0.62	1.40	1.18	0.13	0.35	28	1	13	88	5.7
NG 4936 B3XF	631	Upland	1.67	0.58	0.73	0.80	1.67	1.11	0.00	0.00	27	4	27	88.5	7
DG 3215 B3XF	601	Upland	1.00	0.00	0.47	0.52	1.20	0.77	0.07	0.26	30	3	27	82.5	5.2
DGX 13852B B3XF	602	Upland	0.50	0.71	0.20	0.42	1.20	0.79	0.20	0.42	27	5	30	79.7	11.3
DGX 13852D B3XF	603	Upland	1.00	0.00	0.27	0.46	1.47	1.06	0.20	0.41	29	2	27	91.1	3.6
DGX 18502631C B3XF	604	Upland	1.00	0.00	0.60	0.51	1.73	1.03	0.53	0.83	26	4	40	88.8	4
DGX 1404D B3XF	605	Upland	1.00	0.00	0.27	0.46	1.07	0.70	0.00	0.00	29	2	20	86.6	2.3
DGX 1420B B3XF	606	Upland	1.00	1.00	0.67	0.82	1.73	1.28	0.53	0.74	27	4	40	88.7	5.00
DGX 1425C B3XF	607	Upland	0.67	0.58	0.33	0.49	1.33	0.82	0.00	0.00	30	1	33	89.9	4.5
DGX 1427C B3XF	608	Upland	1.00	0.00	0.47	0.52	1.20	0.94	0.13	0.35	26	4	20	85.5	5.4

2021 Fusarium Screens - SUMMARY (Tulare County Site)

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

February 18, 2022 copy

COMMERCIAL SEED COMPANY ENTRIES

Project Principal Investigator: R.B. Hutmacher (University of California) - cell: (559) 260-8957

Cooperators: M. Ulloa (USDA-ARS); M.P. Keeley, T. Frigulti, J. Angeles (UCCE, UCD); Cooperator Grower in Tulare County; M. Ellis (CA State Univ Fresno)

Funding provided by: CA Cotton Alliance, CA Cotton Growers and Ginners Assoc., Cotton Incorporated; University of CA-ANR and UC Davis Plant Sci Dept; USDA-ARS; facilities and equipment by Tulare County grower

2021 Fusarium Screen - Summary - University of CA - commercial entries - R.B. Hutmacher

page 4 of 6

Entry Name	2021 Entry #	Type of Cotton known, or based on leaf & flower characteristics (P-Pima; U-Upland H-Hybrid)	Whole Plot Foliar FOV rating		Single Plant Foliar rating		Root Vasc. Stain Rating		Cotyledon Vasc. Stain Rating		Plant height (inches)		Verticillium Incidence in evaluated plots percent	Plant Survival Percent	
			mean	stdev	mean	stdev	mean	stdev	mean	stdev	mean	stdev		mean	stdev
DGX 1428C B3XF	609	Upland	1.33	0.58	0.73	0.80	1.80	1.21	0.67	0.82	28	3	47	85.5	7.8
DGX N44-98 B3XF	610	Upland	0.67	0.58	0.27	0.46	1.27	0.96	0.07	0.26	31	4	20	88.4	1.3
DGX 19WS737-1F3B B3XF	611	Upland	0.67	0.58	0.27	0.46	1.00	0.85	0.13	0.35	30	2	33	88.2	6
DGX 1207C B3XF	612	Upland	1.00	0.33	0.60	0.51	1.87	0.99	0.53	0.83	25	4	33	77.8	8.2
DGX 14002-1 GLTP	613	Upland	0.67	0.58	0.07	0.26	0.93	0.88	0.20	0.56	28	3	33	84.9	2.7
DGX 14002-10 GLTP	614	Upland	0.67	0.58	0.20	0.41	1.53	1.13	0.20	0.41	30	1	27	90.6	1.8
DGX 14003-30 GLTP	615	Upland	1.00	0.00	0.33	0.49	1.87	0.83	0.60	0.83	25	5	47	91.6	3
DGX 14003-33 GLTP	616	Upland	0.67	0.58	0.20	0.41	0.93	0.88	0.13	0.35	30	3	13	89.5	2.9
DGX 14003-36 GLTP	617	Upland	0.67	0.58	0.33	0.49	1.47	0.83	0.20	0.56	28	3	27	87.6	9.1
DGX 14003-50 GLTP	618	Upland	1.00	1.00	0.33	0.49	1.20	0.86	0.00	0.00	30	5	20	86.4	6.8
DGX 14003-54 GLTP	619	Upland	1.67	0.58	0.87	0.83	1.60	0.99	0.73	0.80	29	2	27	86.5	4.9
DGX 14004-7 GLTP	620	Upland	1.50	0.71	0.70	0.82	1.40	0.97	0.50	0.53	26	3	40	88	3.7
DGX 14004-8 GLTP	621	Upland	0.67	0.58	0.33	0.49	1.20	0.94	0.00	0.00	29	4	33	85.6	2.6
DG 3387 B3XF	622	Upland	1.00	0.00	0.33	0.49	1.53	0.99	0.07	0.26	25	5	27	90.1	3.0
DG 3422 B3XF	623	Upland	1.33	0.58	0.53	0.64	1.60	1.12	0.27	0.46	30	3	13	92.1	4.5
DG 3799 B3XF	624	Upland	1.00	0.00	0.33	0.49	1.40	0.74	0.33	0.72	27	4	33	86.2	2.7

2021 Fusarium Screens - SUMMARY (Tulare County Site)

UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

February 18, 2022 copy

COMMERCIAL SEED COMPANY ENTRIES

Project Principal Investigator: R.B. Hutmacher (University of California) - cell: (559) 260-8957

Cooperators: M. Ulloa (USDA-ARS); M.P. Keeley, T. Frigulti, J. Angeles (UCCE, UCD); Cooperator Grower in Tulare County; M. Ellis (CA State Univ Fresno)

Funding provided by: CA Cotton Alliance, CA Cotton Growers and Ginners Assoc., Cotton Incorporated; University of CA-ANR and UC Davis Plant Sci Dept; USDA-ARS; facilities and equipment by Tulare County grower

2021 Fusarium Screen - Summary - University of CA - commercial entries - R.B. Hutmacher

page 5 of 6

Entry Name	2021 Entry #	Type of Cotton known, or based on leaf & flower characteristics (P-Pima; U-Upland H-Hybrid)	Whole Plot Foliar FOV rating		Single Plant Foliar rating		Root Vasc. Stain Rating		Cotyledon Vasc. Stain Rating		Plant height (inches)		Verticillium Incidence in evaluated plots percent	Plant Survival Percent	
			mean	stdev	mean	stdev	mean	stdev	mean	stdev	mean	stdev		mean	stdev
DG 3469 B3XF	625	Upland	1.33	0.58	0.73	0.70	1.33	1.11	0.33	0.49	30	4	27	89.7	4.8
DG H929 B3XF	626	Upland	1.00	1.00	0.47	0.64	1.40	1.06	0.00	0.00	28	3	27	89.4	4.3
DG H959 B3XF	627	Upland	1.33	0.58	0.60	0.74	1.53	1.06	0.40	0.51	26	5	40	87.2	6.2
DG 1464 GLTP	628	Upland	0.67	1.15	0.20	0.56	1.33	0.98	0.20	0.41	31	3	13	91.3	5.2
DG 3520 B3XF	629	Upland	1.33	0.58	0.53	0.64	1.40	1.06	0.07	0.26	29	2	20	84.6	7.6
Mons 109-C7		<i>Pima-susceptible check</i>	3.50	1.73	1.25	1.02	2.70	0.66	1.05	0.83	11	5	15	28.8	11.5
BX 2192		<i>Upland check</i>	0.83	0.41	0.20	0.41	1.45	0.89	0.35	0.49	26	4	35	86.3	9.6
DP 340		<i>Pima-susceptible check</i>	2.25	0.50	1.55	1.10	2.40	0.75	0.50	0.69	14	4	10	24.4	13.5
FM 2498 GLT		<i>Upland check</i>	0.67	0.58	0.13	0.35	1.33	0.72	0.40	0.51	30	3	33	93.3	9.5
PHY 764 WRF		<i>Upland - Acala type check</i>	1.20	0.45	0.56	0.65	1.88	0.78	0.96	1.02	32	4	24	95.8	4.7

NOTES: The screening site was a naturally-infested field site where presence of the race 4 Fusarium pathogen had been confirmed in prior pathology studies. Averages and standard deviations of data are shown. This has been a multi-year test site with a moderate infestation of Race 4 Fusarium (Hutmacher assessment), and observed symptoms were less severe than in 2020 at the same research site. For screening purposes for FOV-4 resistance, at this site & this year we consider Vascular Root Staining numbers of 1.2 or lower as having some potential for useful levels of resistance, worth considering for more field screening or greenhouse evaluations under FOV-4 pressure. Three randomized replicate plots were utilized at the test Site for all cultivars, while 4 to 6 reps of check varieties were planted and dispersed through the test plot area. Whole plot ratings were evaluated the full plot length, while for other plant ratings (foliar, root and stem vascular ratings, etc., a minimum of five plants were evaluated within each field replication.

In general, we consider the data shown in the column "Root Vascular Staining" as the most useful information for assessments of relative damage from and relative resistance to the FOV-4 pathogen. At this site, plant survival percent has not been particularly useful in separating cultivars for FOV-4 response severity, other than to show the very low survival % in the susceptible Pima checks (DP-340 and Mons 109-C7) From our observations, foliar damage symptoms are often not a clear indicator of plant infection or disease severity. Vascular staining at the cotyledon node is less consistent than tap root vascular staining. Plant height values at the time of field screenings are just measured as relative indicators of impacts on plant vigor and size of plants at the timing of screening evaluations. "Verticillium Incidence" rating evaluations were done as cuts through stems at main stem nodes 5-7, with plants counted as "+" for verticillium wilt if exhibited streaky (not continuous) vascular staining at that location in stems.

Foliar Damage/Disease Severity Index scale : 0 = no symptoms; 1 = epinasty and slight dwarfing; 2 = 1 to 30% of leaves chlorotic; 3 = 31 to 80% of leaves chlorotic and severe stunting; 4 = 81 to 100% of leaves chlorotic; and 5 = plant death.

Root Vascular Staining Index scale : 0 = no vascular root staining evident, 1 = light vascular root staining evident as spotty areas; 2 = more continuous than 1, but light colored staining covering an area between one quarter and one half of the stem crosssection; 3 = moderate brown/black staining evident in a band encircling most of the stem cross section; 4 = brown/black staining evident across most vascular tissue in stem cross section, and 5 = plant severely damaged or plant death with staining seen throughout a cross-section of root tissue (Ulloa et al. 2006, 2009a).

COMMENTS ON THE FUSARIUM RACE 4 FIELD SITUATION AT THE TRIAL LOCATION: (Tulare County) versus situations elsewhere in San Joaquin Valley:

Feb-22

Evaluations by Dr. Margaret Ellis of CA State University Fresno have found two *Fusarium oxysporum* f. sp. *vasinfectum* race 4 (FOV4) strains (genotypes), identified as "null" (N) and "true" (T) genotypes of the FOV-4 pathogen at the field screening site in Tulare County.

Many cotton plants at the Tulare County screening site in 2021 also displayed a moderate incidence of Verticillium wilt in susceptible cultivars (noted in screen information).

The screening information for Verticillium wilt only identifies the % of evaluated plants also showing evidence of Verticillium wilt, and does not signify severity of injury.

In grower fields in recent years, the FOV4-null genotype was most frequently isolated from cotton in fields in samples collected from Merced County sites, while the

FOV4-true genotype was more frequently identified in samples collected across all counties where samples were evaluated (Merced, Kings, Fresno, Kern, Tulare).

The FOV4-true and a third genotype FOV4-MT have been reported in Texas by Isakeit (Texas A&M Univ. and others). Dr. Ellis of CA State Univ. Fresno has indicated that she has not to date found the FOV4-MT genotype from evaluations done on California SJV plant samples.