

Evaluation of Lettuce Cultivars for Resistance to Fusarium Wilt in 2003

Michael E. Matheron, Barry R. Tickes, Martin Porchas, Charles A. Sanchez, Louis G. Didier and Kevin P. Ford

Abstract

In the 2001-2002 production season, Fusarium wilt was observed for the first time in six different lettuce fields in the Gila and Dome Valley production areas of Yuma County, Arizona. The disease was found in 11 additional sites during 2002-2003. Fusarium wilt presents a serious threat to the health of the lettuce industry in Arizona. The only effective means of controlling Fusarium wilt of lettuce at this time is to avoid infested fields. On the other hand, Fusarium wilt in other crops, such as tomatoes and melons, is controlled effectively by planting cultivars resistant to the pathogen. The relative resistance of lettuce cultivars grown in the Arizona desert production region is unknown; therefore, a cultivar evaluation trial was established in a field known to contain the wilt pathogen, Fusarium oxysporum f.sp. lactucae. Tested cultivars were grouped into three different planting dates: Sep 7, Oct 17 and Dec 6, 2002. A majority of the cultivars within each planting date were those that would be planted in the desert at that time. Fusarium wilt was severe in the early planting of lettuce (Sep 7), moderate in the second planting (Oct 17) and very mild in the third planting (Dec 6). Disease severity was low in some lettuce cultivars in the second planting and most cultivars in the third planting. Among the types of lettuce tested, head lettuce was usually least resistant whereas romaine was most resistant. The data presented in this report are preliminary findings, subject to confirmation in another study planned for the next lettuce production season.

Introduction

In the fall of 2001, a new disease was observed in six different lettuce fields in the Gila and Dome Valley production areas of Yuma County, Arizona. Symptoms included wilting, yellowing of leaves and a red-brown to black discoloration of internal taproot and crown tissue. Affected plants were stunted and often died. This wilt disease affected lettuce plants of all ages, from seedling to mature plant. A *Fusarium* species was consistently recovered from discolored internal taproot and crown tissue.

Fusarium wilt is new to Arizona lettuce fields; however, the disease was first discovered on this crop in Japan in 1955. The first discovery of Fusarium wilt of lettuce in the United States occurred during 1990 in Fresno County near Huron, California. Most recently, the disease was reported in Italy in 2002. Researchers in Japan named the pathogen *Fusarium oxysporum* f.sp. *lactucae*. This fungus is a soil-borne pathogen that can remain viable in soil for many years.

A research paper published in 1993 by Hubbard and Gerik (1) is the current primary source of information concerning the disease cycle and epidemiology of *Fusarium* wilt of lettuce. Hubbard and Gerik determined in the laboratory that the fungus can grow between 46 and 89EF, with optimum growth at 82EF. Lettuce was not susceptible to any of the *Fusarium* wilt pathogens from other crops, including tomatoes and melons. Likewise, no other hosts have been found for *Fusarium oxysporum* f.sp. *lactucae*. In seedling inoculation experiments, the researchers found that the lettuce cultivars Autumn Gold, Empire, Excell, Salinas, Vanguard, Vanguard 75, Vanmax, Viva and Winterset were susceptible to the disease in varying degrees, with Salinas demonstrating the most disease tolerance.

Fusarium wilt presents a serious threat to the health of the lettuce industry in Arizona. The only effective means of controlling *Fusarium* wilt of lettuce at this time is to avoid infested fields. On the other hand, an effective method of managing *Fusarium* wilt in other crops, such as tomatoes and melons, is to plant cultivars resistant to the pathogen. In the long term, development of lettuce cultivars with resistance to *Fusarium oxysporum* f.sp. *lactucae* would be highly desirable. In the short term, we need to evaluate existing lettuce cultivars for their relative susceptibility to the disease. This evaluation process was initiated this past lettuce production season by establishing a replicated planting of lettuce cultivars in a field known to contain *Fusarium oxysporum* f.sp. *lactucae*.

Materials and Methods

A large field trial was established on a commercial lettuce field farmed by Coronation Peak Ranches in Wellton, Arizona. Plots were planted and managed using current commercial practices. Each of the four replicate plots for each head lettuce cultivar contained 600 lettuce plants for a total of 2,400 plants evaluated per cultivar. For romaine and leaf lettuce cultivars, replicate plots each contained 300 plants for a total of 1,200 plants evaluated per cultivar. Tested cultivars were grouped into three different planting dates: Sep 7, Oct 17 and Dec 6, 2002. A majority of the cultivars within each planting date were those that would be planted in the desert at that time. The remainder of the cultivars were included for comparison of disease on the same cultivar within different planting dates or for evaluation of cultivars not grown commercially in the desert. Termination dates for each planting and the number of cultivars of each lettuce type within each planting are listed in Table 1. Disease evaluations were performed three times during crop development in each planting. Only the final disease rating at crop maturity is presented in this report. Each plant within a plot was determined to be diseased if the plant was dead or stunted and displayed the typical wilting and yellowing symptoms of *Fusarium* wilt of lettuce.

Table 1

Planting number	Planting date	Maturity date	Days to maturity	Number of cultivars tested of each lettuce type.				
				Head	Romaine	Green leaf	Red leaf	Butter
1	Sep 7	Nov 8	62	41	15	3	4	2
2	Oct 17	Jan 11	86	40	9	4	3	1
3	Dec 6	Mar 22	107	40	4	1	1	1

Results and Discussion

The complete list of tested lettuce cultivars and their respective disease assessments at crop maturity are presented in Table 2. Several cultivars were present in two and occasionally in all three plantings, which allowed for comparison of disease intensity among different planting dates. Among virtually all tested cultivars of lettuce, the severity of disease in the first planting was much higher than that observed in the second planting, which in turn was higher than that observed in the third planting. One possible reason for the differences in severity of *Fusarium* wilt among planting dates was soil temperature. The average daily soil temperature at the 4-inch depth ranged from 65 to 85EF, 55 to 74EF, and 48 to 64EF for the first, second and third plantings, respectively. In all three plantings, differences in disease severity were detected among the different types of lettuce, with head lettuce being most susceptible whereas romaine demonstrated the highest level of tolerance. Observed disease tolerance for specific

cultivars was dependent on disease pressure. Of the 11 head lettuce cultivars tested in both the first (high disease pressure) and second (moderate disease pressure) plantings, the lowest disease rating was a 32% loss in the first planting, whereas three head lettuce cultivars had disease ratings at or below 4% in the second planting. Similar results were observed for romaine, green leaf and red leaf lettuce.

Fusarium wilt was first recognized in the Yuma area during the 2001-2002 season, when *Fusarium oxysporum* f.sp. *lactucae* was recovered from diseased head lettuce plants in six different fields. During the just completed 2002-2003 season, the pathogen was recovered from 11 additional head lettuce plantings. Disease was detected in these fields from October through December; therefore, head lettuce fields in production during this time that exhibited no evidence of Fusarium wilt can be assumed to be free of the pathogen. On the other hand, lettuce fields in production during January through March and showing no evidence of Fusarium wilt still may harbor the pathogen, since disease development during this time is greatly reduced and could easily be overlooked.

Preliminary recommendations. Keeping in mind that the data presented in this report are preliminary findings and subject to confirmation by further studies, there are some initial recommendations that can be made concerning the management of Fusarium wilt of lettuce.

1. Every effort should be made to prevent the spread of contaminated soil from known locations of *Fusarium oxysporum* f.sp. *lactucae* to “clean” fields by workers and equipment. These precautions should be maintained even when crops other than lettuce are grown in infested fields.
2. Avoidance. The best way to avoid Fusarium wilt on lettuce is to not plant this crop on sites known to contain the pathogen.
3. Based on the preliminary data presented in this report, one could choose a late planting date (early December) and select a cultivar that sustained little to no disease at this planting time.
4. For the vast majority of lettuce production fields where *Fusarium oxysporum* f.sp. *lactucae* is not known to occur, maintain vigilance to prevent the introduction of the pathogen into fields and use normal criteria for cultivar and planting time selection.

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Reference

Hubbard, J.C., and Gerik, J.S. 1993. A new wilt disease of lettuce incited by *Fusarium oxysporum* f.sp. *lactucum* forma specialis nov. Plant Dis. 77:750-754.

Table 2. Comparative susceptibility of lettuce cultivars to Fusarium wilt.

Cultivar	Lettuce Type	Producer	% of plants dead or diseased		
			First planting	Second planting	Third planting
Acacia	Head	Synergene	100	-----	-----
Annie	Head	Seminis	100	-----	-----
AZ 90	Head	Central Valley	-----	67	-----
AZ 2000	Head	Central Valley	-----	-----	10
Beacon	Head	Paragon	100	72	-----
Big Green COS	Romaine	Synergene	-----	-----	0
Big Star	Greenleaf	Synergene	-----	0.8	-----
Big Sur	Head	Synergene	-----	-----	0
BOS 9021	Romaine	Orsetti	10	-----	-----
Bubba	Head	Seminis	-----	50	-----
Buccaneer	Head	Central Valley	92	1	0
Cavalier	Head	Progeny	100	-----	-----
Cibola	Head	Paragon	-----	62	-----
Clemente	Romaine	Seminis	14	0.8	-----
Climax	Head	Jim McCreight, USDA	-----	-----	0.1
Coastal Star	Romaine	Coastal	32	2	-----
Cochise 47	Head	Central Valley	-----	59	-----
Colossus	Head	Shamrock	-----	16	-----
Conquistador	Romaine	Seminis	13	0	-----
Coolgreen	Head	Harris Moran	-----	-----	5
Coolguard	Head	Pybas Seeds	-----	41	-----
Connick	Butter	Sun Seeds	-----	66	0.3
Costa Rica #4	Romaine	Jim McCreight	-----	-----	0
Coyote	Head	Seminis	-----	16	-----
Crusader	Head	Progeny	95	-----	0.2
Daneberg 66	Head	Progeny	-----	-----	0.2
Darkland COS	Romaine	Central Valley	20	0.7	-----
Del Oro	Head	Seminis	-----	38	-----
Del Rio	Head	Seminis	-----	6	0
Desert Heat	Head	Central Valley	100	47	11
Desert Queen	Head	Seminis	86	-----	-----
Desert Spring	Head	Seminis	-----	-----	3
Desert Storm	Head	Harris Moran	100	-----	-----
DF 7	Romaine	Pybas	13	0.2	-----
Diamond	Head	Coastal	-----	-----	0
Diamond Back	Head	Central Valley	100	-----	0
Domingos 67	Head	Progeny	-----	-----	0.1

Table 2 (continued). Comparative susceptibility of lettuce cultivars to Fusarium wilt.

Cultivar	Lettuce Type	Producer	% of plants dead or diseased		
			First planting	Second planting	Third planting
Durango	Head	Coastal	-----	-----	0
Emperor	Head	Harris Moran	100	-----	-----
Encanto	Butter	Synergene	66	-----	-----
EXP 411	Cos/head	Paragon	18	-----	-----
EXP 7542	Head	Paragon	100	-----	-----
EXP 9145	Head	Paragon	100	-----	-----
Fallgreen	Head	Harris Moran	100	-----	-----
Fiorette	Head	Rijk Zwaan	-----	-----	0
Fresheart	Romaine	Orsetti	18	-----	-----
Fortuna	Head	Synergene	100	-----	-----
Gabilan 1315	Head	Paragon	-----	-----	18
Grand Max	Head	Progeny	98	-----	-----
Green Forest	Romaine	Central Valley	26	-----	-----
Green Lightning	Head	Progeny	-----	-----	0.2
Green Pack	Head	Central Valley	70	3	-----
Green Towers	Romaine	Harris Moran	19	-----	-----
Grizzly	Head	Seminis	-----	30	-----
Headmaster	Head	Progeny	-----	-----	0
Heatmaster	Head	3 Star	100	-----	-----
HMX 1527	Head	Harris Moran	-----	-----	4
HMX 1528	Head	Harris Moran	-----	-----	4
Honcho II	Head	Seminis	-----	47	-----
Husky	Head	3 Star	100	16	0.5
Icon	Head	Progeny	-----	-----	0.4
Jackal	Head	Seminis	-----	-----	0.2
Javelina	Head	Seminis	98	-----	-----
Kahuna	Head	Synergene	100	-----	-----
King Louie	Romaine	Paragon	7	0.9	-----
Kofa	Head	Synergene	-----	40	-----
Laguna Fresca	Head	Central Valley	100	-----	-----
La Quinta	Head	3 Star	82	-----	-----
Lighthouse	Head	Paragon	100	66	-----
Marin	Greenleaf	Orsetti	89	0.8	-----
Milestone	Head	Paragon	100	-----	-----
Mohawk	Head	Seminis	100	-----	-----
Monarch	Head	Paragon	100	-----	-----
Monolith	Head	Shamrock	-----	28	-----

Table 2 (continued). Comparative susceptibility of lettuce cultivars to Fusarium wilt.

Cultivar	Lettuce Type	Producer	% of plants dead or diseased		
			First planting	Second planting	Third planting
North Star	Greenleaf	Paragon	27	2	-----
Optima	Butter	Vilmorin	86	-----	-----
Palma	Head	Central Valley	100	-----	-----
Paragon PIC	Romaine	Paragon	24	1	-----
Patriot	Head	J. McCreight	-----	-----	0.5
PIC	Romaine	Pybas	29	-----	-----
PRO 1839	Head	Progeny	-----	-----	0
PX 843	Head	Progeny	97	-----	-----
PYB 251	Head	Pybas	-----	-----	8
Raider	Head	Seminis	93	-----	-----
RC 74	Head	Paragon	-----	67	-----
Red Fox	Red leaf	Central Valley	50	2	-----
Red Tide	Red leaf	Seminis	100	88	10
Rivergreen	Head	J. McCreight	-----	-----	0
Robusto	Romaine	Paragon	22	0.9	-----
Sahara	Head	Seminis	100	-----	-----
Salinas 88	Head	J. McCreight	-----	0.8	-----
Sharpshooter	Head	Seminis	32	2	0
Silverado	Head	Coastal	-----	-----	0
Sniper	Head	Seminis	85	4	0
Slugger	Romaine	Coastal	5	0.4	0
Snowbird	Head	3 Star	100	16	0.8
Spector	Head	Seminis	82	-----	-----
Spring Pac	Head	Synergene	-----	-----	0
Sunbelt	Romaine	Central Valley	-----	0.4	0
Sun Devil	Head	Progeny	93	-----	-----
Supercoach	Head	Progeny	-----	40	-----
Syn 352	Head	Synergene	-----	40	-----
Target	Head	Seminis	-----	-----	0.1
Telluride	Head	Coastal	-----	-----	0
Toronto	Head	Rijk Zwaan	-----	-----	0
Tradition	Head	Pybas	100	10	2
Tres Equis	Head	Synergene	98	-----	-----
Triton	Romaine	Harris Moran	16	-----	-----
Two Star	Greenleaf	Orsetti	85	3	0
Valley Green	Head	Harris Moran	100	-----	-----
Valley Queen	Head	Paragon	100	38	-----

Table 2 (continued). Comparative susceptibility of lettuce cultivars to Fusarium wilt.

Cultivar	Lettuce Type	Producer	% of plants dead or diseased		
			First planting	Second planting	Third planting
Valley Queen +T-22	Head	Paragon	-----	32	-----
Vulcan	Red leaf	Sakata	20	3	-----
Vanguard 75	Head	Jim McCreight, USDA	-----	49	-----
Van Max	Head	Pybas	-----	48	10
Van Mor	Head	Harris Moran	-----	54	-----
Wellton	Head	Paragon	100	-----	-----
Westlands	Head	Orsetti	-----	52	-----
Western Red	Red leaf	Orsetti	39	-----	-----
Wintergold	Head	Progeny	-----	30	-----
Winterhaven	Head	Orsetti	-----	60	-----
Winterhaven BOS	Head	Orsetti	-----	58	-----
Winterking	Head	Paragon	-----	46	-----
Wolverine	Head	Seminis	-----	4	-----
Yuma	Head	Harris Moran	-----	46	-----
# 106	Head	Paragon	-----	-----	6
# 203	Head	Paragon	-----	-----	0.2
3SS106	Head	3 Star	-----	-----	3
Least Significant Difference; LSD ($P = 0.05$)			5.3	9.3	3.0
Values differing by more than the least significant difference are significantly different from each other according to the Duncan-Waller K-ratio test.					