

Susceptibility of storage onion cultivars to iris yellow spot in the Columbia Basin of Washington, 2004.

A storage onion cultivar trial was planted near Quincy, WA on 30 Mar 04 to evaluate the performance of 46 cultivars in the semi-arid Columbia Basin of central Washington. The trial was surrounded by a furrow-irrigated commercial onion bulb crop of the cultivar Tamara. A Stanhay belt planter (Stanhay Webb Ltd., Lincs, England) was used to plant coated seed of each cultivar. Each plot consisted of two double rows 30 ft long and spaced 22 in. apart on a 34 in. raised bed, with seed 4 in. apart within rows. A 5 ft alley separated plots at each end. The plots were arranged in a randomized complete block design with three replications. The crop was maintained by the grower using standard cultural practices for fertilization (160-170-60-30-2 lb/A of N-P-K-S-B applied over the season), irrigation, and disease, pest, and weed control. Incidence of plants with iris yellow spot symptoms was rated on 11 Aug for the center 5 ft of each plot. At the same time, iris yellow spot severity on each plant was rated as mild (1-2 small lesions), moderate (3-5 lesions), and severe (>5 lesions with the youngest leaves turning necrotic from coalescing lesions). Bulbs were lifted on 4 Sep and topped and harvested by hand on 23 Sep. The number and weight of bulbs were determined for colossal (>4.00 in.), jumbo (3.00-4.00 in.), medium (2.25-3.00 in.), and small (<2.25 in.) bulb sizes. Total marketable yield was calculated as the sum of colossal, jumbo, medium, and small bulbs. Total precipitation and mean temperature for Mar, Apr, May, Jun, Jul, Aug, and Sep were 0 in. and 46.9°F, 0.01 in. and 53.1°F, 0 in. and 58.4°F, 0 in. and 66.5°F, 0 in. and 74.7°F, 0.03 in. and 73.0°F, and 0 in. and 60.6°F, respectively.

Hail damage occurred at approximately the three-leaf growth stage, but seedlings outgrew the mechanical injury. Iris yellow spot was severe at this site by late Jul. Similarly, severe outbreaks of iris yellow spot were observed in several other furrow-irrigated onion bulb and seed crops within 10 miles of this site, reflecting the rapid increase in incidence and severity of the disease since it was first observed in Washington in 2002. A distinct gradient in incidence and severity of iris yellow spot was observed across the trial in Aug and Sep, with the highest incidence in plots of the first replication located approximately 200 ft from the southeast corner of the field, and the lowest incidence in the third replication near the northeast corner of the field. This gradient suggested primary infection was probably from viruliferous thrips migrating into the crop from adjacent vegetation (radish seed crop to the south, apple orchard to the southeast, or surrounding native vegetation), with limited secondary movement of viruliferous thrips within the crop. All 46 cultivars were susceptible to IYSV with a mean incidence ranging from 58% for Tioga to 97% for EX 15122. The mean incidence of plants with symptoms of IYSV infection was <70% for only five of the 46 cultivars (BGS 196, Golden Spike, PX 5299, T-433, and Tioga), three of which had no plants with severe symptoms (Golden Spike, PX 5299, and T-433). In contrast, 13 cultivars had >90% of the plants with symptoms of IYSV infection (Bandolero, BGS 194, Copra, EX 15122, Flamenco, Genesis, OLYH 02N2, Redwing, Sabroso, SWO 4001, SX 7004, T-817, and Vaquero), and all 13 cultivars had some plants with severe symptoms. The means ± standard deviations of the incidence of plants with mild, moderate, and severe symptoms were 39 ± 11, 37 ± 12, and 7 ± 8%, respectively. Significant differences in yield were observed among cultivars, with significant negative correlations between total incidence of plants with iris yellow spot symptoms and total marketable yield ($r = -0.43$ at $P = 0.0029$) as well as percentage jumbo bulbs ($r = -0.41$ at $P = 0.0046$). Similarly, the mean incidence of moderate and severe symptoms was significantly negatively correlated with total yield ($r = -0.36$ at $P = 0.0142$ and $r = -0.40$ at $P = 0.0053$, respectively) and percentage jumbo bulbs ($r = -0.40$ at $P = 0.0053$, $r = -0.44$ at $P = 0.0025$). Accounting for inherent differences in yield among cultivars by using cultivar as a covariate, the regression relationship between total marketable yield and incidence of iris yellow spot was:

$$\text{Mean marketable yield (t/A)} = 33.45 + \beta_0(\text{cultivar}) - 0.11 X_1 - 0.14 X_2 - 0.12 X_3 \quad (R^2 = 0.88, \text{CV} = 12.1\%),$$

where $X_1, X_2,$ and $X_3 =$ % plants with mild, moderate, and severe iris yellow spot symptoms, respectively, and where β_0 ranged from -5.83 (for Copra) to + 33.03 (for Rancho).

In summary, IYSV had a similar significant negative impact on total yield (t/A) and bulb size (% jumbo bulbs) for the 46 cultivars evaluated under the conditions of this furrow-irrigated trial in a semi-arid climate, but cultivars differed significantly in the total incidence of plants with iris yellow spot symptoms and the incidence of plants with mild, moderate, or severe symptoms. The results of this trial may assist growers in selecting cultivars with some resistance to iris yellow spot for planting in areas with a recent history of severe outbreaks of this disease. However, empirical evidence indicates iris yellow spot is significantly less severe in crops grown under overhead (wheel-line, hand-line, or center pivot) irrigation compared to furrow- or drip-irrigation. The results may also be of assistance in breeding onion cultivars for resistance to iris yellow spot.

Seed company and cultivar	Marketable yield					% Plants with iris yellow spot symptoms				$\beta_0(\text{cultivar})^z$
	Total (t/A)	% Bulbs by size				Total	Severity of symptoms			
		Colossal	Jumbo	Medium	Small		Mild	Moderate	Severe	
American Takii										
Milestone	28.9	0.0	10.9	73.5	11.3	87.9	37.5	42.0	8.5	6.37 NS
T-433	49.5	0.5	67.8	21.7	4.0	66.0	48.2	17.8	0.0	23.79 **
T-439	40.9	0.0	39.0	55.2	3.7	78.8	47.8	30.4	0.6	16.97 **

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T-817	22.8	0.0	0.0	79.3	20.7	95.2	23.9	52.9	18.4	1.51 NS
9003 G	34.7	0.0	32.6	56.2	6.2	73.8	35.1	31.1	7.6	10.38 **
Bejo Seeds, Inc.										
Copra	16.0	0.0	13.6	68.6	15.4	94.4	48.0	41.7	4.8	-5.83 NS
Daytona	38.2	0.0	45.9	34.2	17.6	87.4	57.5	29.9	0.0	15.18 **
Gunnison	33.9	0.0	22.2	57.5	15.2	76.0	41.3	31.0	3.7	9.70 *
Redwing	35.3	0.0	36.0	54.2	8.6	90.4	35.1	48.4	6.8	13.28 **
Tamara	32.4	0.0	19.2	68.8	12.0	88.6	34.7	45.9	8.0	10.10 **
BGS 194	36.1	0.0	27.8	64.9	5.5	93.8	52.7	37.7	3.4	14.05 **
BGS 196	44.8	0.0	34.8	54.9	8.8	68.8	47.4	20.8	0.6	19.49 **
BGS 199	44.9	0.6	39.0	53.1	4.0	75.9	50.1	25.1	0.6	20.55 **
Crookham Co.										
Genesis	21.7	0.0	5.4	59.5	33.1	92.8	16.8	46.1	30.0	0.15 NS
Harmony	54.8	1.7	62.4	27.8	2.2	82.7	48.4	30.5	3.9	31.38 **
OLYH 02N2 ..	21.7	0.0	0.0	53.4	46.6	90.7	21.3	56.6	12.7	0.05 NS
Global Genetics										
Varsity	36.9	0.0	36.8	54.9	7.0	89.0	28.0	46.5	14.5	14.74 **
SWO 4001	36.7	0.0	27.4	55.9	12.1	94.0	26.6	47.5	20.0	15.23 **
SWO 6001	47.3	1.1	46.2	36.5	14.4	76.4	32.0	39.3	5.1	23.40 **
SWO 6011	38.1	6.1	55.6	29.6	5.3	75.8	52.5	23.3	0.0	13.65 **
Nippon Norin										
Tenshin	22.2	0.0	6.5	65.3	27.4	81.2	41.4	31.9	7.9	-1.29 NS
RE-E	28.1	0.0	6.8	72.5	19.5	77.0	49.6	27.4	0.0	3.92 NS
W-10	23.5	0.0	9.1	65.1	21.4	81.7	49.7	29.8	2.2	-0.08 NS
W-20	23.4	0.0	7.0	60.2	28.7	79.9	34.6	41.2	4.1	0.00 NS
Seminis										
Vegetable Seeds										
Golden Spike..	47.5	0.0	56.6	34.8	6.8	69.7	54.0	15.7	0.0	22.09 **
Pinnacle	41.8	0.0	47.4	43.2	7.7	86.9	37.4	47.6	1.9	19.28 **
Red Zepplin ...	29.6	0.0	17.1	58.1	20.9	89.8	29.4	45.5	14.9	7.48 *
Seahawk	33.1	0.0	24.8	50.8	22.1	77.0	25.0	46.6	5.4	9.50 *
Tioga	44.0	0.0	34.7	52.9	9.4	58.4	35.1	21.6	1.7	17.62 **
EX 15122	38.5	0.0	28.4	53.7	15.1	96.8	27.5	42.3	26.9	17.24 **
PX 2599	55.3	4.4	81.4	12.7	1.6	72.6	57.2	15.4	0.0	30.28 **
PX 5299	48.2	0.6	61.6	24.6	8.8	64.0	56.7	7.3	0.0	21.92 **
SVR 5646	46.8	0.0	51.9	44.7	1.8	82.2	39.1	35.1	8.0	23.47 **
SVR 5819	47.9	0.5	53.2	41.3	5.0	77.8	44.9	30.2	2.7	23.86 **
SVR 7004	38.1	0.0	24.2	66.5	7.7	72.9	46.9	26.0	0.0	13.43 **
SVR 7106	40.2	0.0	36.2	51.3	7.2	89.0	35.4	49.7	3.9	18.00 **
Nunhems										
Bandolero	28.6	0.0	15.9	57.1	25.8	96.8	28.8	42.7	25.3	7.34 NS
Flamenco	23.7	0.0	4.8	62.0	30.3	90.5	44.7	35.4	10.4	1.35 NS
Granero	48.8	1.2	56.0	38.1	4.7	81.9	44.3	36.3	1.4	25.45 **
Ranchero	55.7	10.6	57.6	25.1	5.5	85.6	34.1	46.7	4.8	33.03 **
Sabroso	32.0	0.0	17.4	61.9	20.6	93.4	33.0	46.2	14.2	10.29 **
Salsa	35.1	0.0	35.4	48.1	8.8	89.6	25.1	51.9	12.6	13.11 **
Tesoro	35.4	0.0	31.7	56.4	9.4	77.8	46.4	31.4	0.0	11.41 **
Vaquero	46.5	0.6	49.1	34.8	11.4	92.9	27.1	56.1	9.8	25.05 **
SX 7002	42.7	0.0	53.4	37.4	6.7	84.4	30.6	40.4	13.4	19.83 **
SX 7004	46.8	0.0	50.1	41.2	8.7	94.9	29.6	56.1	9.1	25.51 **
LSD ^y	6.33	1.99	16.96	17.74	12.39	16.46	22.96	21.28	15.63	

^z $\beta_0(\text{cultivar})$ = covariate for each cultivar in the regression relationship: $Y = 33.45 + \beta_0(\text{cultivar}) - 0.11X_1 - 0.14X_2 - 0.12X_3$, where Y = total marketable yield (t/A), and X_1 , X_2 , and X_3 = % plants with mild, moderate, and severe iris yellow spot symptoms, respectively. NS, *, and ** = non-significantly, significantly ($0.01 < P \leq 0.05$), and highly significantly ($P \leq 0.01$) different from 0.

^y LSD = Fisher's protected least significant difference ($P \leq 0.05$).