HOP (*Humulus lupulus*)
Downy mildew; *Pseudoperonospora humuli*
Hop mosaic virus (HpMV)

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Response of hop cultivars to major diseases, 2013.

A quarter acre hop yard was established at the Ohio Agricultural Research and Development Center, Horticultural Research Unit 2 in Wooster, OH on Wooster to examine the feasibility of hop production within the state. The field was disked and leveled, raised beds were prepared, and landscape fabric was laid over the beds on 6 May. Hop cultivars (Cascade, Centennial, Columbus, Galena, Mt. Hood, Nugget, Sterling, Willamette) were transplanted into silt loam soil on 8 May. The experiment was established using a randomized complete block design with four replications. Plants were spaced 3 ft apart on 10 ft centers under a 17 ft trellis with two strings per plant, and two bines were trained per string. The field was hand watered and hand weeded as necessary. Incidence and severity of downy mildew and Hop mosaic virus (HpMV) was determined on 27 Sep, 4 and 11 Oct. The severity of the diseases on foliage was evaluated using a scale of 0-100% foliage affected. Plant height was estimated visually using a scale of 1-3 (1=1-20 in.; 2=21-40 in.; 3=>40 in.) on 27 Sep, and 4 and 11 Oct. Average maximum temperatures for 8-31 May, Jun, Jul, Aug, Sep, and 1-11 Oct were 73.8, 78.5, 81.5, 80.2, 74.4 and 74.1ºF; average minimum temperatures were 49.7, 58.1, 63.1, 58.4, 51.9 and 52.6ºF; and total rainfall amounts were 2.0, 5.0, 6.6, 2.0, 2.9 and 2.3-in., respectively. Analysis of variance was performed using the general linear models procedure with SAS statistical software and means were separated using Fisher's least significant difference test.

Downy mildew and HpMV appeared naturally. Downy mildew disease pressure was low and HpMV pressure was moderate in this trial. There were significant differences among cultivars in incidence and severity of downy mildew and HpMV. Downy mildew incidence and severity on 11 Oct and season-long disease progress (AUDPC) were highest in hop cultivars 'Columbus' and 'Cascade'. 'Galena' also exhibited significantly higher downy mildew incidence on Oct 11 than asymptomatic cultivars 'Centennial', 'Mt. Hood', 'Nugget', 'Sterling' and 'Willamette'. HpMV incidence, severity and disease progress were highest in 'Sterling' and low to moderate in 'Galena' and 'Cascade'. Few or no symptoms were observed in 'Columbus', 'Centennial', 'Mt. Hood', 'Nugget' and 'Willamette'. Cultivars also differed significantly in height.

Cultivar	Plant height[z]	Downy mildew[y]			HpMV		
		Severity (%) (11 Oct)	Incidence (%) (11 Oct)	AUDPC[x]	Severity (%) (11 Oct)	Incidence (%) (11 Oct)	AUDPC[y]
Cascade	2.3 abc[w]	11.9 a	60.0 a	122.5 a	27.5 b	51.3 b	347.8 b
Centennial	2.8 ab	0.0 b	0.0 c	0.0 b	0.0 d	0.0 c	0.0 d
Columbus	1.8 c	13.1 a	71.3 a	137.8 a	1.1 cd	27.5 bc	14.4 d
Galena	1.8 c	2.5 b	22.5 b	19.3 b	13.8 c	48.8 b	179.4 c
Mt. Hood	2.0 bc	0.0 b	0.0 c	0.0 b	0.5 d	25.0 bc	7.0 d
Nugget	3.0 a	0.0 b	0.0 c	0.0 b	0.3 d	6.3 c	3.5 d
Sterling	1.5 c	0.0 b	0.0 c	0.0 b	63.8 a	100.0 a	761.3 a
Willamette	2.3 abc	0.0 b	0.0 c	0.0 b	0.0 d	0.0 c	0.0 d
P value	0.0231	≤0.0001	≤0.0001	≤0.0001	≤0.0001	≤0.0001	≤0.0001

[z] Plant height was estimated visually using a scale of 1-3 (1=1-20 in.; 2=21-40 in.; 3=>40 in.)

[y]Downy mildew and HpMV disease ratings and area under the disease progress curves (AUDPC) were based on percent foliage affected.

[x]AUDPC values were calculated according to the formula: $\sum([(x_i+x_{i-1})/2](t_i-t_{i-1}))$ where x_i is the rating at each evaluation time and (t_i-t_{i-1}) is the number of days between evaluations.

[w]Values are the means of four replicate plots; means followed by the same letter within a column are not significantly different at P≤0.05. Means were separated using Fisher's least significant difference test.