Influence of Wind Speed on Gas Exchange of Field-grown 'Cabernet Sauvignon' Grapevines on the Texas High Plains

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Air temperature, humidity, and wind speed can vary from day to day and from hour to hour in west Texas. Leaf transpiration, stomatal conductance (rate of water loss through stomata), and photosynthetic rate are influenced by climatic conditions. Because of variable climatic conditions found in the region, producers need to understand how wind speed may influence important plant physiological process (stomatal conductance, photosynthesis, etc.) and which grape varieties may be best suited to climates found on the Texas High Plains. Therefore, response of grapevine physiological processes to wind speed was evaluated. This research investigated leaf gas exchange (stomatal conductance) of *Vitis vinifera* 'Cabernet Sauvignon' vines subjected to variable wind speeds in a High Plains vineyard.

Materials and Methods

Research was conducted at the Texas AgriLife Research and Extension Center vineyard in Lubbock, Texas. The vineyard was planted in 2006 (20 varieties grafted to 110R rootstock) to investigate varietal adaptation to climate. Throughout the day on three dates (18, 30 September and 7 October 2008) three 'Cabernet Sauvignon' vines (grafted to 110R rootstocks) were exposed to increased wind speeds (using electric leaf blowers) and three vines were exposed to ambient wind speed (control vines). Leaf stomatal conductance was measured with a LI-COR 1600 Portable Steady State Porometer on four leaves from each vine. Prior to measuring stomatal conductance, a hand held anemometer was used to estimate wind speed at leaf level. Vineyard climatic data was recorded with an onsite weather station.

Results

Wind speed data (Figure 1) indicate daily extremes of wind speed during 2008 (May through September). Daily maximum wind speed was greatest 19 June when wind speed reached 43 mph. In addition, during this time period there were 89 days when maximum daily wind speed was greater than 20 mph and 24 days when daily maximum wind speed was greater than 30 mph. Daily measurements (only 7 October data shown) indicate leaf level wind speed had a significant effect on leaf stomatal conductance (Figures 2 and 3). Each day stomatal conductance was measured, differences were found between leaves exposed to ambient wind speed and leaves exposed to increased wind speed. Even after blowers were turned off, stomatal conductance was greater for leaves not exposed to high wind speed (Figure 2).

Discussion

Although data is very preliminary, exposing 'Cabernet Sauvignon' leaves to increased wind speed appears to reduce leaf stomatal conductance. Additional data from a separate 2008 study on the same vines indicate stomatal conductance and photosynthetic rate are very closely related (Figure 4). These data indicate as stomatal conductance is reduced photosynthetic rate decreases (Figure 4). Results therefore indicate that as leaves of 'Cabernet Sauvignon' vines are exposed to increasing wind speed, vine stomatal conductance (and therefore photosynthetic rate) would also be reduced.

Applications of Research

Gas exchange plays an important role in all aspects of vine and berry development. Vine growth and productivity are dependent upon assimilation of carbon dioxide (photosynthesis) and release of gases (water vapor and oxygen) during the photosynthetic process. Climatic factors which limit gas exchange (temperature, precipitation, wind, etc.) also limit vine and berry development. In regions with pronounced

prevailing winds, producers need to be aware of limitations climatic factors place on vineyard production and take steps to maximize productivity. Varieties should be grown that are adapted to local climate. Research will continue to investigate varietal differences in gas exchange in response to wind speed. In addition, producers should consider cultural management factors such as row orientation, row spacing, and windbreaks to lesson effects wind has on vine gas exchange.

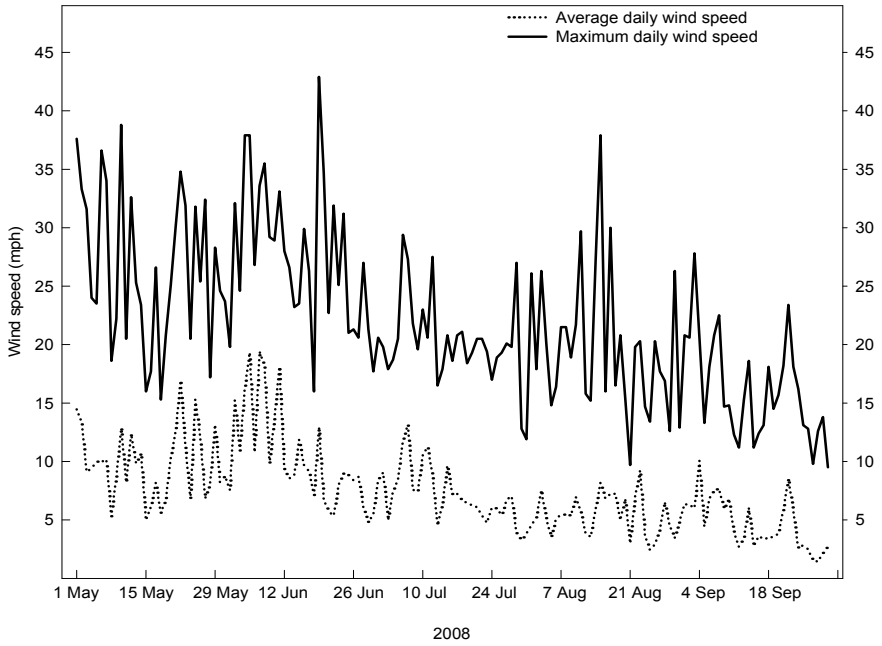

Figure 1. Daily average and maximum wind speed data (May through September) for Texas AgriLife research vineyard (2008).

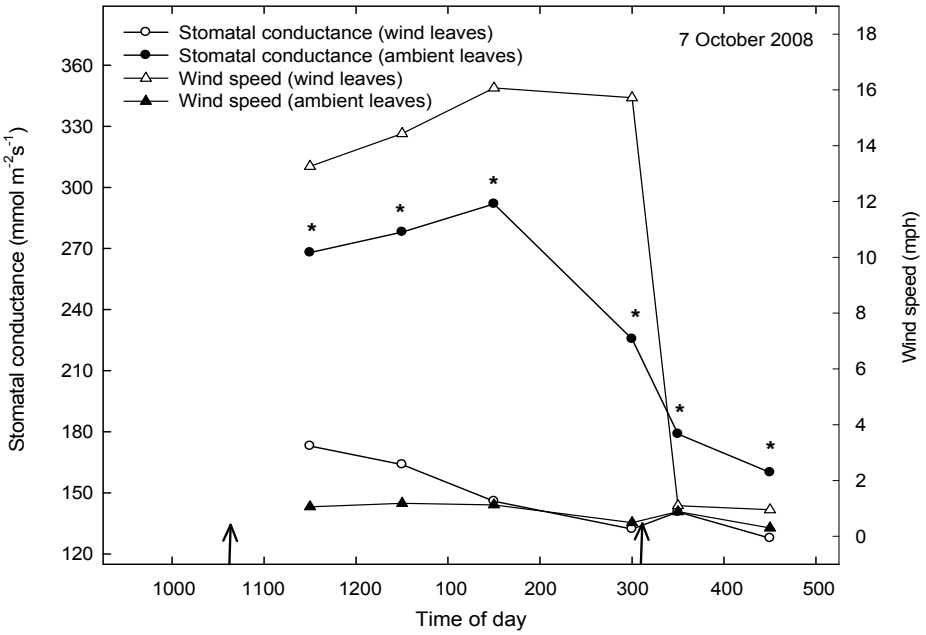

Figure 2. Daily stomatal conductance of field grown 'Cabernet Sauvignon' vines subjected to variable wind speeds. An asterisk above a symbol indicates significant effects of wind speed on stomatal conductance ($P \leq 0.05$). Each symbol represents the mean of 12 measurements. Arrows indicate when leaf blowers were turned on (morning) and when leaf blowers were turned off (afternoon).

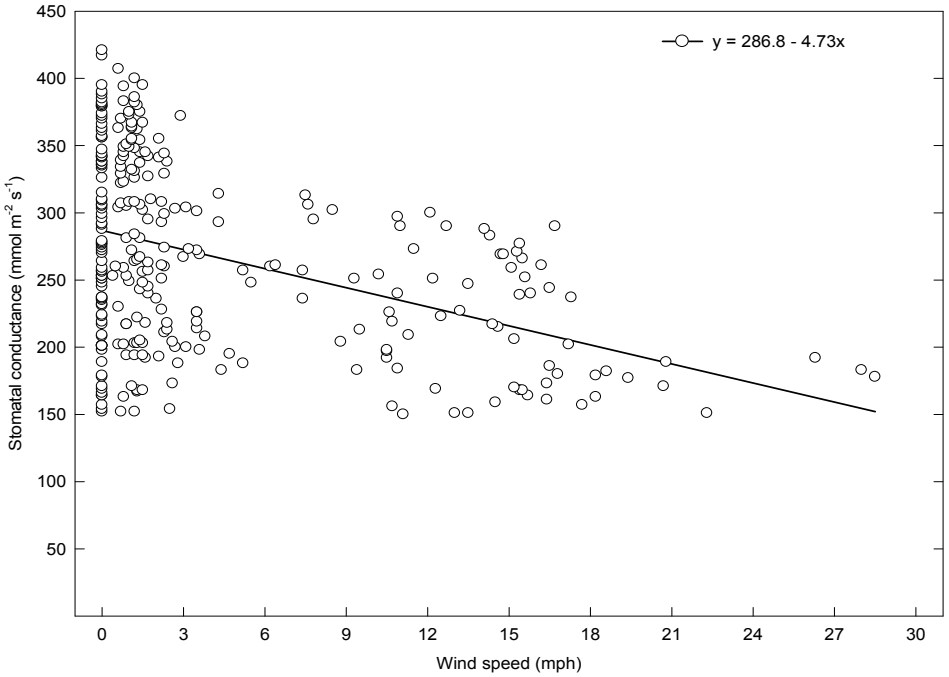

Figure 3. Actual and predicted values for effect of wind speed on stomatal conductance of field grown 'Cabernet Sauvignon' grapevines subject to variable wind speed (data from 18, 30 September and 7 October 2008).

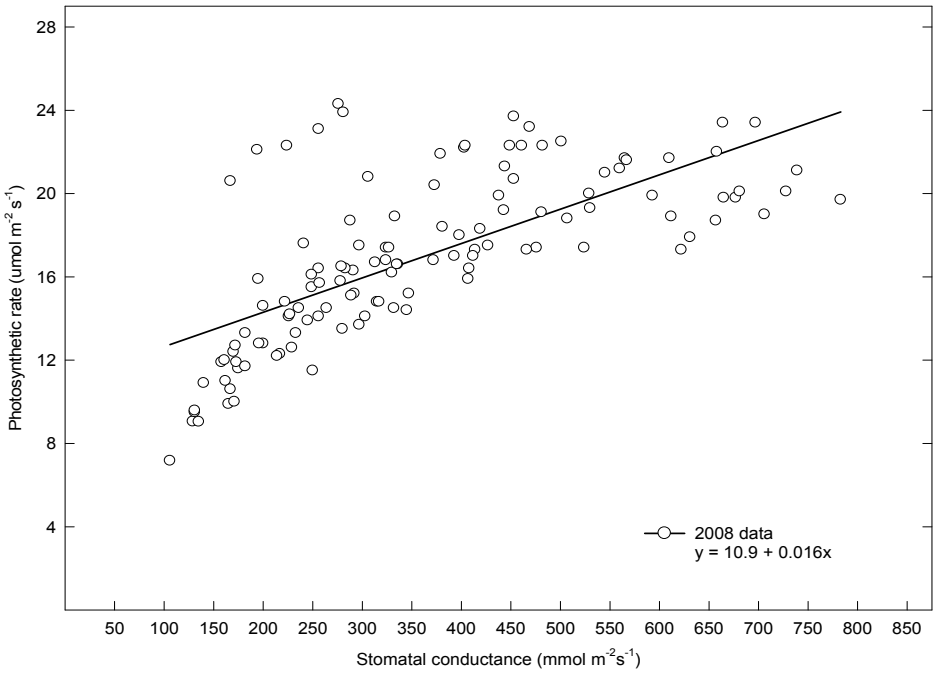

Figure 4. Actual and predicted values for effect of stomatal conductance on photosynthetic rate of field grown 'Cabernet Sauvignon' grapevines. Measurements from data taken seven days (3, 10, 12, 19, 26 June, 5, 7 August 2008).