Wind Injury of Anjou Pear

J. T. A. PROCTOR, Associate Professor, Department of Horticultural Science, University of Guelph, Guelph, Ontario, Canada N1G 2W1

ABSTRACT

Proctor, J. T. A. 1982. Wind injury of Anjou pear. Plant Disease 66:1169-1170.

Marginal blackening of terminal leaves, necrosis of stipules, and blackening of stems were observed on trees of Anjou pear, *Pyrus communis*, from orchards in exposed location and on greenhouse-grown trees after exposure to wind at 3 m/sec in a wind tunnel. Similar injury could not be induced readily on Bartlett and was not observed in the orchard on Bartlett, Bosc, Clapp, or Flemish Beauty. Maximum net photosynthesis of the uninjured leaves of Anjou was about 0.7 mg CO_2/m^2 per second; rates for injured leaves depended on the extent of the injury and were as low as 0.3 mg CO_2/m^2 per second. Rates of dark respiration and transpiration were higher in injured leaves than in uninjured leaves.

Additional key words: Beurre d'Anjou

Anjou is the second most common pear (*Pyrus communis* L.) cultivar grown in the United States and Canada, accounting for 18.5% of total pear production (5). Total area and production of Anjou, particularly in the northwestern United States, have increased in the last 10 yr (5). For many years we have received inquiries about, and samples of, injured Anjou pear leaves. An explanation for the relatively high incidence of leaf injury in some years, particularly in this cultivar early in the growing season, has been sought. Because of the extent of the injury we have tried to establish its nature and the factors that might cause and influence it.

MATERIALS AND METHODS

Two-year-old trees of Anjou and Bartlett pear on seedling rootstocks were purchased in early spring 1981 from a commercial nursery and either held dormant in cold storage (3 ± 2 C, 50 ± 5% relative humidity) or placed in a greenhouse (23 ± 3 C day, 18 ± 2 C night). If placed in a greenhouse, they were first planted in 30-cm-diameter plastic pots containing 1:1:1 peat, perlite, soil (v/v/v) and headed back to 30 cm above the bud union. After about 6 wk, when two or three shoots each of about 30 cm had grown, some of the trees were moved to a wind tunnel.

This research was supported in part by the Ontario Ministry of Agriculture and Food and in part by Grant A6697 of the Natural Sciences and Engineering Research Council of Canada.

Accepted for publication 22 April 1982.

The publication costs of this article were defrayed in part by page charge payment. This article must therefore be hereby marked *"advertisement"* in accordance with 18 U.S.C. § 1734 solely to indicate this fact.

0191-2917/82/12116902/$03.00/0

The overall length of the tunnel was 18 m with a working section 1.2 × 1.2 m and 12.2 m long. The airflow was obtained by an axial flow fan and regulated by an Amplispeed Regutron (Electric Machinery Mfg. Company, Minneapolis, MN). The required air velocity in the wind tunnel, obtained by setting the command voltage on the remote speed potentiometer, could be between 0.6 and 16.8 m/sec. It was measured with an Alnor thermo-anemometer (Alnor Instrument Company, Niles, IL) inserted through an access hole in the side of the tunnel. General access to the tunnel was through four removable Plexiglas side windows. The top of the tunnel also had similar windows so that during exposure of plants to different wind velocities they were illuminated by a 400-W, high-pressure sodium-discharge lamp mounted in a commercial ballast reflector above a window. Light intensity monitored by an L1-190S quantum sensor attached to a Lambda L1-185 radiometer was 400 $\mu E/m^2$ per second immediately under the window. Because the top of the foliage usually came close to the window, it was exposed to 300–400 $\mu E\ m^2$/per second. Plants were placed in the wind tunnel 1 day before the wind treatments and on the next day were exposed to wind at 3 m/sec from 0900 to 1600 EST. After exposure, they were returned to the greenhouse.

Net photosynthetic rates and transpiration were determined in the laboratory on intact, fully expanded midshoot leaves of potted plants following the method used by Proctor et al (7). Leaf temperature during the measurements was 22 ± 2 C. Light was supplied to the entire plant by a 400-W, high-pressure sodium-discharge lamp.

RESULTS AND DISCUSSION

Symptoms. The most common leaf injury on orchard samples and wind tunnel trees was marginal terminal leaf blackening (Fig. 1). In severe cases, cracks perpendicular to the leaf margin appeared in the blackened area. The upper surface of mildly injured areas was golden yellow, but the undersurface showed blackening. This suggests that injury to the two surfaces of the laminae arose independently.

Injury varied with the leaf position on a shoot. Generally on a shoot of 12 leaves, the two or three young, unfolding leaves were severely blackened; the oldest four leaves at the base of the shoot were not injured, whereas the five or six midshoot leaves showed extensive injury. One group of four trees exposed to wind at 3 m/sec in the tunnel had an average of 20% leaf area injured for all midshoot leaves. All symptoms of injury occurred on these leaves. Generally, leaves between 50 and 100% expansion in the center of the shoot have greater net photosynthesis than younger and older leaves on the same shoot (4). These metabolically active leaves are obviously sensitive to wind injury. Injury to Bartlett in the wind tunnel was slight. After 1 mo, greenhouse-grown trees exposed to wind started to grow again but were obviously stressed. Injury to leaf growth early in the season could have severe effects on young, newly planted trees and mature trees.

Fig. 1. (A) Marginal blackening of leaf apexes of greenhouse-grown Anjou pear plants 6 days after exposure to wind at 3 m/sec in a wind tunnel. **(B)** Severe, overall leaf blackening and leaf tip necrosis.

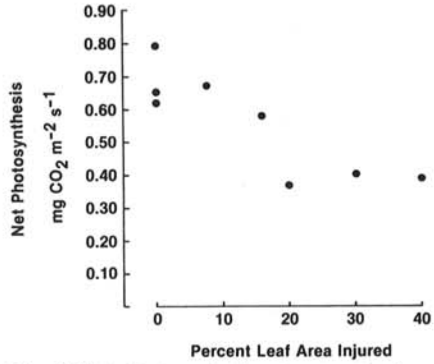

Fig. 2. Net photosynthetic rate at saturating light intensity of fully expanded, midshoot Anjou pear leaves injured to different degrees by wind. The data can be fitted to a straight line having the equation: net photosynthesis = 0.68–0.009 percent leaf area injured, $r = -0.86$.

If stipules had persisted to the time of exposure to wind, they were usually severely blackened and then abscised. Injury to the stem usually occurred in the internodal area and was characterized by blackening and accumulation of wax around the periphery of the injury. It is suggested that this injury is caused by the abrasive action of one stem rubbing repeatedly on another. This action probably also results in the observed displacement of surface waxes.

Injured leaves similar to those described above were observed in commercial orchards and nurseries in different years, but not every year, on trees of Anjou but not on Bartlett, Bosc, or Flemish Beauty. Colleagues discounted the observed injury as resulting from the usual pear pests. First injury was usually readily apparent in early June, shortly after full bloom; it also occurred during June but by middle to late August was not obvious because many of the injured leaves had abscised prematurely. All orchards where injury was seen were both exposed and located close to large bodies of water—lakes Erie or Ontario. Injury was particularly severe on Anjou when it was found on the side of the orchard that faced the prevailing wind. These items suggest a role of wind and/or low air temperatures.

Brown et al (1) report that prevailing mean daily wind speeds in the vicinity of these orchards and nurseries is about 5 m/sec in April, declining to about 3 m/sec in July. Hence, during the period the leaf injury was observed, the wind speeds exceeded that which caused injury to greenhouse-grown trees within 2 hr in a wind tunnel. Although the conditions are not identical, the injury to the leaves in the orchard and that induced in the wind tunnel were similar, which suggests that wind is the cause in the orchard.

Gaseous exchange. Light response curves for healthy Anjou pear leaves followed the expected rectangular hyperbola characteristic of apple leaves (8) and of Bartlett pear leaves (3). Maximum net photosynthesis (Pn) rate was about 0.60 mg CO_2/m^2 per second and light-saturated at about 800 $\mu E/m^2$ per second. At this saturating light intensity, photosynthesis had a broad temperature optimum between 22 and 32 C, a sharp decline to 35 C, and a gradual decline to about 0.30 mg CO_2/m^2 per second at 7 C.

The light response curves for wind-injured leaves were similar to those of healthy leaves except that Pn rates were lower at each light intensity and in the dark. Respiration of injured leaves was about 0.06 mg CO_2/m^2 per second, compared with 0.04 for healthy leaves. At saturating light intensity, Pn rate was reduced as the amount of leaf area injured increased (Fig. 2). Leaf transpiration also increased from about 37 mg of H_2O/m^2 per second for uninjured leaves to about 56 mg of H_2O/m^2 per second for leaves with 20% leaf injury. These rates are not as high as those of Kriedemann and Canterford (3) but are similar to those for apple (2,7).

Anjou is also the most sensitive pear cultivar to other external agents. For instance, vegetative buds, particularly terminal, of Anjou pear are more sensitive to oil dips than are buds of Bartlett, Comice, Bosc, and Seckel (6); leaves of Anjou are more likely to exhibit injury from frost, *Pseudomonas syringae*, and chemical sprays than are those of other cultivars (P. B. Lombard, *personal communication*).

The reasons for the greater sensitivity of Anjou leaves are not known. It is suspected that surface waxes are involved. Possibly they are thinner or differently distributed on Anjou, or are more easily disrupted by the damaging agents noted above. Such speculations need resolution. In the meantime, growers should recognize the sensitivity of Anjou to wind, and when they use this cultivar in their orchards they should ensure that it is protected from cold, prevailing winds in the spring and early summer.

ACKNOWLEDGMENTS

I am indebted to Dean Louttit for technical assistance, to Professor J. R. Ogilvie, Director of the School of Engineering, University of Guelph, for use of the wind tunnel, and to Professor Porter Lombard, Oregon State University, for various comments about Anjou pear.

LITERATURE CITED

1. Brown, D. M., McKay, G. A., and Chapman, L. J. 1968. The climate of Southern Ontario. Climatological Studies, No. 5. Can. Dep. Transp. Meteorol. Branch. 50 pp.
2. Ferree, D. C., and Hall, F. R. 1981. Influence of physical stress on photosynthesis and transpiration of apple leaves. J. Am. Soc. Hortic. Sci. 106:348-351.
3. Kriedemann, P. E., and Canterford, R. L. 1981. The photosynthetic activity of pear leaves (*Pyrus communis* L.). Aust. J. Biol. Sci. 24:197-205.
4. Leopold, A. C., and Kriedemann, P. E. 1975. Plant Growth and Development. 2nd ed. McGraw-Hill Book Co., New York.
5. Lombard, P., Hull, J., Jr., and Westwood, M. N. 1980. Pear cultivars of North America. Fruit Var. J. 34:74-83.
6. Lombard, P. B., Westigard, P. H., Zwick, R. W., Mellenthin, M. W., and Martin, G. C. 1981. Effects of pre-bloom oil applications on pear fruit set and the possible mode of action. HortScience 16:54-55.
7. Proctor, J. T. A., Blackburn, W. J., Bodnar, J. M., and Watson, R. L. 1982. Analysis of the efforts of the spotted tentiform leafminer (*Phyllonorycter blancardella* F.) on the photosynthetic characteristics of apple leaves. Can. J. Bot. In press.
8. Proctor, J. T. A., Watson, R. L., and Landsberg, J. J. 1976. The carbon budget of a young apple tree. J. Am. Soc. Hortic. Sci. 101:579-582.