Distillate Flower Abscission of Walnut—‘Serr’, ‘Sunland’, ‘Howard’, and ‘Chandler’

P.B. Catlin and E.A. Olsson

Department of Pomology, University of California, Davis, CA 95616

Additional index words. *Juglans regia*, rootstock, flowering index

Abstract. Distillate flower abscission (PFA) was measured for four cultivars of walnut (*Juglans regia* L.): ‘Serr’, ‘Sunland’, ‘Howard’, and ‘Chandler’. Mean PFA for ‘Serr’ over 7 years was greater than for the other cultivars and there were no differences among any of the latter. The high PFA potential of ‘Serr’, shown here and earlier, was not expressed in ‘Sunland’, even though both cultivars have one common parent. There was no association of PFA with either of two rootstock. Flowering index did not differ among cultivars and was not related to PFA.

Distillate flower abscission (PFA) of Persian (English) walnut can seriously reduce yield (Catlin et al., 1987). Flowers are affected shortly after anthesis after becoming receptive to pollination and fertilization (Catlin and Polito, 1989). Ovary enlargement stops at 3 to 4 mm diameter and abscission occurs 1 to 2 weeks later. PFA is not due to lack of pollination and fertilization. Separation occurs between the peduncle and the vegetative axis so that all pistils (commonly two) on a reproductive shoot are lost. We have recorded levels of PFA in excess of 90%.

Nine years of orchard-based monitoring of PFA failed to identify causes (Catlin et al., 1987). No association could be made with any known physiological, cultural, pathological, or entomological influence. Competition for resources, commonly thought to be responsible for high levels of post-anthesis abscission of tree fruits and nuts (Stephenson, 1981), did not appear to be involved in PFA. PFA differs substantially with planting site and can vary with year at specific sites.

PFA differs also with cultivar. ‘Serr’ is more seriously affected than other cultivars. Based on concurrent flower emergence and on a common site, ‘Serr’ experienced higher PFA than ‘Chico’ and ‘Ashley’ in 3 successive years (Catlin et al., 1987). Less rigorous evaluations suggested that ‘Early Ehrhardt’, ‘Tehama’, ‘Hartley’, and ‘Franquette’ were less affected than ‘Serr’. PFA of ‘Serr’ and ‘Pedro’ also appears to occur in France (E.

Germain and M.-P. Latorse, personal communication).

‘Serr’, ‘Pedro’, and ‘Tehama’ are among the 10 cultivars introduced in 1968 from the Univ. of California, Davis, walnut breeding program (Serr and Forde, 1968). ‘Sunland’, ‘Chandler’, and ‘Howard’ are later releases from this program (Ramos et al., 1984). There has been concern about the potential for PFA in these cultivars, particularly in the case of ‘Sunland’, which has one parent in common with ‘Serr’. In 1988, questions regarding flowering characteristics of ‘Chandler’ were raised because of extremely low yields with certain trees or orchards. This report compares PFA of ‘Serr’, ‘Sunland’, ‘Chandler’, and ‘Howard’.

Procedures used to measure PFA have been described by Catlin et al. (1987). Briefly, numbered tags were attached to extending spurs or shoots on sample limbs when pistillate flowers first became visible. Inspection of shoots and tagging was repeated at 3- to 4-day intervals throughout the approximately 3 weeks of flower emergence. Sample branches from each of two trees were ≈ 5 to 8 cm in diameter at the base and had 100 or more buds. The same limbs on each tree were used in all years. All trees were in the Univ. of California selection block in Davis. Trees were 9 to 11 years old when first monitored for PFA.

During the latter half of the flower emergence period, pistil size was estimated for all tagged shoots each time branches were inspected. These repeated estimates allowed identification of pistils that had stopped enlarging, as well as those that continued to grow beyond the critical 3- to 4-mm-diameter stage. All pistils that stopped growth later abscised. The number of growing points that did not produce reproductive structures also was recorded to provide degree of fruit-

fulness of shoots (flowering index) (Lombard et al., 1988). Trees were equally divided between Northern California black walnut [*J. hindsii* (Jeps.) Rehder] and Paradox rootstock.

The initial statistical analysis used a repeated measures analysis of variance with an orthogonal polynomial decomposition (Steel and Torrie, 1980). A logit transformation was used on the dependent variable (proportion of either abscission or fruitfulness) to stabilize the variances. Since the orthogonal polynomial decomposition did not reveal a smooth trend over time, separate comparisons between cultivars were done for each year. All of these comparisons used Tukey’s highest significant difference method (Steel and Torrie, 1980).

Levels of PFA recorded for ‘Serr’, ‘Sunland’, ‘Howard’, and ‘Chandler’ in 1980 through 1986 are given in Table 1. Mean PFA for ‘Serr’ over 7 years was higher than for the other three cultivars and there was no difference among any of the latter.

In the first 3 years, PFA for ‘Serr’ was moderately low but still higher than with the other cultivars, except ‘Howard’ in 1980. PFA increased with ‘Serr’ in 1983 to nearly 70% and fluctuated between 60% and 80% in subsequent years. The change from moderate levels in 1980 to 1982 to substantially higher amounts in all later years is unexplained. Large increases in PFA occurred in some other plots from one year to another (Catlin et al., 1987).

PFA for ‘Sunland’, ‘Howard’, and, except in 1985, ‘Chandler’ was $\approx 20\%$ or less in all years of observation. The substantial increase in PFA to $>40\%$ in 1985 with ‘Chandler’ is unexplained. Adjacent ‘Howard’ trees experienced higher than usual abscission for this cultivar in that year. Catlin et al. (1987) suggested earlier that soil environment-root physiology interactions might be related to incidence of PFA. If so, localized conditions may have been sufficiently adverse in 1985 to increase abscission in otherwise low-expression cultivars.

Because all cultivars were equally divided between Northern California black walnut and Paradox rootstock, the possibility of a rootstock effect on PFA was examined. The 7-year mean PFA with all cultivars combined was 9.4% and 8.7% for Paradox and black walnut, respectively ($P < 0.79$). The absence of a rootstock effect is in agreement with earlier results (Catlin et al., 1987).

Catlin et al. (1987) have shown previously that PFA is not related to degree of fruitfulness (flowering index) of sample branches. Similar results were obtained here ($P < 0.66$), where the 7-year average fruitfulness of limbs was 93% for ‘Sunland’, ‘Howard’, and ‘Chandler’. Average fruitfulness of ‘Serr’ was 77%, which was not significantly different

Received for publication 6 Nov. 1989. Partial support was received from the Walnut Marketing Board. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

Table 1. Pistillate flower abscission for four walnut cultivars, 1980-1986.

Cultivar	Abscission (%) ^z							Mean 7 years
	Year							
	1980	1981	1982	1983	1984	1985	1986	
Serr	29 a	41 a	27 a	68 a	80 a	62 a	71 a	54 a
Sunland	0 c	6 b	16 ab	3 c	6 bc	11 b	10 b	5 b
Howard	22 a	8 b	12 b	3 c	4 c	18 b	4 b	8 b
Chandler	9 b	14 b	13 ab	11 b	21 b	42 ab	12 b	16 b

^aMeans within columns followed by same letter are not significantly different at $P = 0.05$ according to Tukey's highest significant difference method.

from that of the other cultivars.

Yield data were not obtained. 'Sunland', 'Howard', and 'Chandler' expressed low and fairly constant PFA (except 'Chandler' in 1985) and high fruitfulness over 7 years. If it can be assumed that this combination resulted in regular high nut yields, then an effect of crop load on either PFA or flowering index did not exist. Observations of mature nut loads on trees supports the assumption about yields. Previous results also failed to show a relationship between yield and PFA (Catlin et al., 1987).

It was concluded earlier that PFA differs with location or planting site and that high abscission occurred each year at some sites (Catlin et al., 1987). The performance of 'Serr' during 1983 to 1986 indicated the likelihood of a site favoring a high incidence of PFA. 'Chandler' and 'Howard' were planted adjacent to each other and 12 to 20 m from 'Serr'. 'Sunland' trees were in the same planting, but 105 m from 'Serr'. There were no known soil differences in this planting. Lower PFA with 'Chandler', 'Howard', and 'Sunland' planted under apparently the same soil and aerial environments as was 'Serr' indicated a lower PFA potential for the former three cultivars. There was no indication that the common parent of 'Serr' and 'Sunland' might cause high PFA potential with 'Sunland'. Even though yields of 'Chandler' have been disappointing in some orchards, this cultivar does not appear to have expressed high PFA potential under the conditions prevailing here. Low yields of 'Chandler' have recently been associated with inadequate pollination (P.B.C., unpublished data).

proach. 2nd ed. McGraw Hill, New York.
Stephenson, A.G. 1981. Flower and fruit abor-

tion: Proximate causes and ultimate functions.
Annu. Rev. Ecol. Systematic 12:253-279.

Literature Cited

- Catlin, P.B. and V.S. Polito. 1989. Cell and tissue damage associated with distillate flower abscission of Persian walnut. *HortScience* 24:1003-1005.
- Catlin, P.B., D.E. Ramos, G.S. Sibbett, W.H. Olson, and E.A. Olsson. 1987. Distillate flower abscission of the Persian walnut. *HortScience* 22:201-205.
- Lombard, P.B., N.W. Callan, F.G. Dennis, Jr., N.E. Looney, G.C. Martin, A.R. Renquest, and E.A. Mielke. 1988. Towards a standardized nomenclature, procedures, values, and units in determining fruit and nut tree yield performance. *HortScience* 23:813-817.
- Ramos, D., G. McGranahan, and L. Hendricks. 1984. Walnuts. *Fruit Var. J.* 38:112-120.
- Serr, E.F. and H.I. Forde. 1968. Ten new walnut varieties released. *Calif. Agr.* 22(4):8-10.
- Steel, R.G.D. and J.H. Torrie. 1980. Principles and procedures of statistics. A biometrical ap-