

Effect of Topically Applied 'Sevillano' Pollen on Normal-seeded and Parthenocarpic "Shotberry" Fruit Set of 'Manzanillo' Olive

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Summary. The 'Manzanillo' olive (*Olea europaea* L.) is widely grown in California, because olive processors prefer its uniform size and quality for their canned product. Although it is self-compatible, 10% of a planting should be committed to a pollinizer cultivar to promote optimal production of seeded 'Manzanillo' fruit and minimal occurrence of worthless parthenocarpic "shotberries." As fruits of pollinizer cultivars are of substantially less value and more difficult to manage within a 'Manzanillo' planting, less commitment of land for pollination purposes would be desirable. Here we show that topical applications of supplemental olive pollen can be a feasible alternative to commitment of land to olive pollinizer cultivars within a 'Manzanillo' planting.

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The 'Manzanillo' olive is the preferred cultivar in California for processing into "ripe" olives and is planted widely within the state. When planted singly in solid blocks, especially in locations isolated from other olive cultivars, inconsistent production occurs. Poor crops of normal-seeded fruit, accompanied by an abundance of the parthenocarpic and commercially useless fruit called "shotberries," often are produced.

Pollen source can influence production of normal and shotberry 'Manzanillo' olives (Griggs et al., 1975). Although 'Manzanillo' is self-compatible, the number of seeded fruit increased and the number of shotberries declined when pollen of other olive cultivars fertilized 'Manzanillo' flowers. In those experiments, pollen from 'Barouni' and 'Sevillano' best improved the production of seeded 'Manzanillo' fruit and reduced the incidence of shotberries. Pollen from 'Mission' and 'Ascolano' were less effective, while self-pollinated 'Manzanillo' flowers produced the most shotberries and the lowest number of seeded fruit. These results suggest that some degree of self-incompatibility may occur within 'Manzanillo'.

Cross-pollination of 'Manzanillo' is recommended to increase production. Ideally, 'Manzanillo' plantings should include $\approx 10\%$ of another cultivar, preferably 'Sevillano' or 'Barouni', for optimal production. The pollinizer trees should be planted in rows across the direction of prevailing wind to disseminate the pollen and promote cross-pollination.

Growers would rather not commit 10% of their acreage to pollinizers for 'Manzanillo'. The market for other cultivars, especially 'Barouni' and 'Sevillano', is limited, and grower returns can be substantially lower. Moreover, mixing trees of cultivars complicates management; e.g., harvest timing usually varies and cultivars can have different pest control requirements. Provision for cross-pollination for 'Manzanillo' without land commitment would be of value to the olive industry.

Here we report results of an experiment designed to determine the feasibility for topical application of supplemental 'Sevillano' pollen to promote production of normal fruit and reduce the incidence of shotberries in 'Manzanillo'.

Methods

The experiment was conducted during 1989 and 1990 in a mature 232-acre (92.8 ha) block of 'Manzanillo' olives managed by the S & J Farming Co., Madera, Calif. We selected a block having a chronic history of poor annual production, including an abundance of shotberries. This block had special features; unlike more productive blocks on the ranch, where every 10th row was planted to 'Sevillano' for cross-pollination, this one block included only 'Ascolano' as the pollinizer. Due to poor performance of 'Manzanillo' in this block, 'Ascolano' was regrafted to 'Sevillano' the initial year of our study. No 'Sevillano' bloom developed on the new grafts that year, and flowers were removed before bloom in the 2nd year. Thus, within the plot, only 'Manzanillo' pollen was present during the test years.

Thirteen rows of 50 'Manzanillo' trees each, planted 30×30 ft (9.2×9.2 m) east-west across the direction of prevailing wind, were selected for the experiment. Four times during the bloom, 30 g/acre ($75 \text{ g}\cdot\text{ha}^{-1}$) of undiluted 'Sevillano' pollen was applied supplementally to the northern and two southernmost rows of the experimental plot; rows 2 through 11 did not receive direct supplemental pollen applications. Applications were made at the beginning of bloom, two times during midbloom, and a final application was made at $\approx 50\%$ petal fall. A total of 120 g of 'Sevillano' pollen was applied per treated acre ($300 \text{ g}\cdot\text{ha}^{-1}$) each year of the experiment. The supplemental pollen was "dusted" onto the trees by metering it through a modified leaf blower mounted on an all-terrain vehicle traveling ≈ 15 mph ($24 \text{ km}\cdot\text{h}^{-1}$) down the designated rows.

We determined normal-seeded and shotberry fruit production on individual trees in 10 transects (replications) at five-tree intervals traversing the 13 experimental rows. The transects were oriented from north to south across the east-west rows. Each year before bloom, but when inflorescences could be distinguished, we selected ten 1-year-old flowering shoots on each tree (five on the north and five on the south side) in each transect for observation. Selected shoots were 18 to 24 inches (0.46 to 0.62 m) and contained between 10 and 20 inflorescences. The inflorescences were

counted back from the terminal, a tag was placed at that point, and the number of inflorescences was recorded on the tag. The same transects and observation trees were used each year of the experiment.

Two months following bloom, seeded and shotberry fruits were determined on each tagged shoot. Seeded and shotberry fruit per inflorescence were calculated for each observation tree in each row, a total of 130 trees. The resulting data were tested by analysis of variance and Scheffe's post hoc test (Abstat, 1987) to determine the effect of distance from the topically applied pollen source on seeded and shotberry fruit production.

The 'Sevillano' pollen used in the experiment was obtained from commercial sources each year. Its viability was determined before treatment using the fluorescein diacetate (FDA) test (Pinney and Polito, 1989) and was found to be 46.9% and 54.5% for 1989 and 1990, respectively. Such viability is consistent with that reported for olive pollen in other studies (Fernandez-Escobar and Martin, 1986; Fernandez-Escobar et al., 1983; Griggs et al., 1975; Pinney and Polito, 1989).

Results

Normal-seeded 'Manzanillo' fruit set decreased and incidence of shotberry fruits increased with distance from topical applications of supplemental 'Sevillano' pollen (Fig. 1).

1989. Normal fruit set ranged from a high of 0.34 fruit per inflorescence in rows where pollen was applied to a low of 0.06 fruit per inflorescence 90 ft (27.7 m) away from the single row and 210 ft (64.6 m) from the two rows dusted with pollen. Shotberries were highest 120 ft (36.9 m) from the nearest pollen application and lowest in rows where pollen was applied (Fig. 4). Highly significant reductions ($P < 0.01$) in seeded fruit occurred at distances >60 ft (18.5 m), and increases in parthenocarpic shotberries were observed at distances >120 ft (36.9 m) from the topically applied supplemental 'Sevillano' pollen (Table 1).

1990. Set of normal-seeded fruit was higher in 1990 than in 1989. Seeded fruit per inflorescence ranged from 0.49 in the single row where pollen was applied to a low of 0.14 per inflorescence 120 ft (36.9 m) away and 170 ft (52.3 m) from the two artificially pollinated rows. Shotberries

were highest 150 ft (46.2 m) from the nearest pollen application and lowest in the row where 'Sevillano' pollen was applied topically (Fig. 4). A highly significant reduction ($P < 0.01$) in mean normal fruit and a highly significant increase in shotberries per inflorescence occurred at distances >90 ft (27.7 m) from the topical application of supplemental pollen (Table 1).

Discussion

Cross-pollination is known to improve seeded fruit set and reduce incidence of worthless shotberries in

'Manzanillo' olive (Griggs et al., 1975). The work reported here clearly demonstrates that topical applications of pollen can be a feasible substitute for the commitment of land to a pollinizer cultivar. In our experiments, set of normal-seeded 'Manzanillo' fruit significantly increased while incidence of shotberries significantly decreased in those trees close to topically applied supplemental 'Sevillano' pollen.

Olive is an evergreen species in which a dense canopy of leaves can impede dissemination of wind-borne pollen. In this work, seeded fruit set

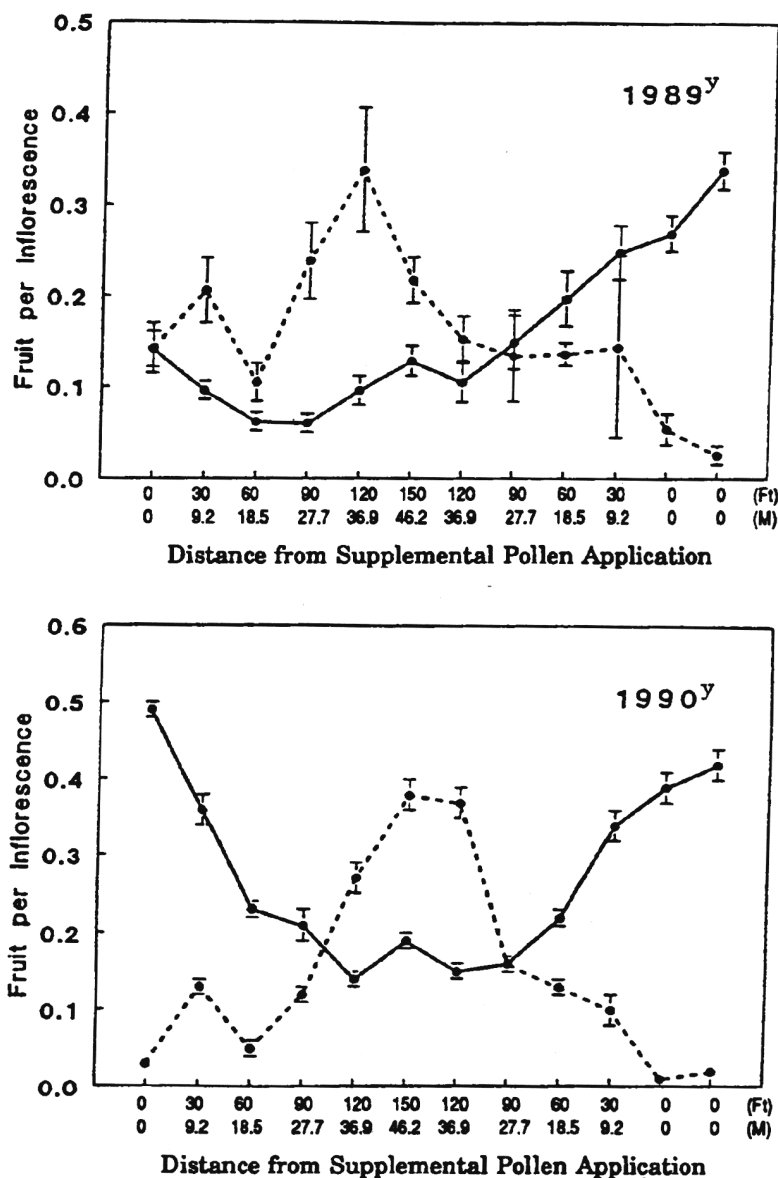


Fig. 1. Number of normal and shotberry fruit per inflorescence of 'Manzanillo' olive across north-south transect after four topical applications of 'Sevillano' pollen to each end of the transects in 1989 and 1990. Solid lines indicate seeded fruit; dotted lines indicate shotberry fruit. Each data point represents mean fruit per inflorescence for 10 inflorescences from each of 10 tree replications per row. Bars represent two times the standard error of the mean.

Table 1. Mean normal and parthenocarpic shotberry fruits per inflorescence for 1989 and 1990.

Distance (ft) from pollen application	N ^a	Seeded fruit/ inflorescence ^b		Parthenocarpic shotberry fruit/ inflorescence ^b	
		1989	1990	1989	1990
0	3	0.25 a	0.39 a	0.07 a	0.02 a
30	2	0.17 ab	0.35 ab	0.17 ab	0.11 a
60	2	0.13 b	0.23 bc	0.07 a	0.09 a
90	2	0.11 b	0.19 c	0.19 ab	0.14 a
120	2	0.10 b	0.14 c	0.25 b	0.34 b
150	2	0.13 b	0.17 c	0.12 b	0.38 b

^aWithin columns, values with different letters are significantly different at $P < 0.01$.

^bNumber of data rows at each distance.

was significantly reduced at distances 260 to 90 ft (18.5 to 27.7 m) from the pollen source, and shotberries significantly increased at distances >120 ft (36.9 m). These data suggest supplemental pollen should be applied at intervals not exceeding 60 ft (18.5 m), i.e., every third middle in an orchard having a 30-ft row spacing.

We applied 30 g/acre of undiluted pollen four times during the bloom at a cost of about \$110 per acre. Further work is needed to establish the

required rate of pollen per acre and the frequency of topical application for optimal results. The topical applications of supplemental pollen to other olive cultivars needs study.

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