Supplementary Materials S1: A low and constant pressure sucrose injection method

A continuous low-pressure injection system was designed in which a separate feeding bottle was used for each vine, allowing replication at the level of individual vines (Figure SIa). Sucrose injection was monitored at increasing pressures from 30 kPa to > 100 kPa. Sap bleeding was observed at cut ends of root and shoot with pressure at 100 kPa or higher in pot-grown grapevine. Similarly, sap bleeding was observed at 140 kPa or higher in field grown grapevine during winter (dormant) (Figure SIb). A constant pressure of 69 kPa (10 psi) was adopted to avoid this leakage of injected sucrose solution. Xylem saps collected during budburst time were analysed for sucrose, glucose and fructose. The concentration of soluble sugars in xylem sap was 321 ± 80 µM (mean ± sd, n = 4).

An injection hole of 6 mm diameter and approximately 30 mm depth was adopted. The diameter was suited to the available fittings and held the pressure applied up to 100 kPa. The brass coupler was inserted to 10 mm of depth and the remaining 20 mm of depth served as a reservoir to provide the solution into the xylem apoplast. Zamora and Escobar (2000) reported that 6 and 4 mm diameter injectors performed better for tree injection than a 3 mm diameter injector.

Injection of a range of sucrose concentrations (2.5% to 10% w/v) were trialled in pot grown vines, with leaf burning symptoms associated with higher sucrose concentrations; i.e., 10% w/v in grapevine (Figure SIc). Concentrations of 2.5% and 5% w/v sucrose resulted in decreased photosynthetic rates, but there was no visible sign of leaf damage. The 5% w/v sucrose concentration was chosen for use in the field trial.

Figure SI. Preliminary exercise on low pressure injection system for stem injection system for stem injection.: (a) three potted vines injected under a common pressure manifold but with separate fluids; (b) sap bleeding from cut ends and twisted cane in field grown (dormant) vines (inset—arrow to droplets) following injection over 140 kPa; (c) leaf drying visually observed with 10% w/v sucrose.

The vine trunk was drilled 10–30 cm above the graft union to 30 mm depth with a 6 mm diameter bit, while constantly wetting the cut surface. The holes were drilled parallel to the ground surface using a Ryobi 12V 1.3Ah drill driver (Bunnings, Australia). A two-end brass coupler (outer diameter 6.35 mm, 0.31 x 0.31 mm inner tube diameter, equal union; IFS standard brass No. 401, IFS, Australia) was then inserted into the drill hole without delay and connected with a bolt and delivery tubing. The coupler was compatible with a 3 mm diameter flexible pneumatic tube (Dixon, Australia; working pressure rated to 150 psi). This stem

coupling mechanism was adopted for all further work. After injection periods ended, injection drill holes and trunk core sampling holes were plugged with 6 mm wooden dowels and tree sealant (Ryset tree wound sealant, Forestry Tools, Australia) was applied externally.

A 2HP 21 L ProjectAir (Bunnings, Australia) gas compressor was fitted with two regulators and was used to deliver compressed air via pneumatic tubing (6 mm outer diameter) to each vine 'feed' bottle (Figure SII). The autoclaved 2.5 L brown glass 'feed' bottle filled with 2 L of sucrose solution prepared in the laboratory. Bottles were covered with aluminium foil to prevent the direct exposure of the solution to light. A tubing inlet was fitted above the level of solution and used to pressurise the bottle. An outlet port had tubing extending to the bottom of the bottle, with tubing continuing to the injection port on the vine. Drill tool and the trunk surface were sterilized by using 70% ethanol before injecting the trunk. Pressure was optimised at 69 kPa for grapevine (Figure SII).

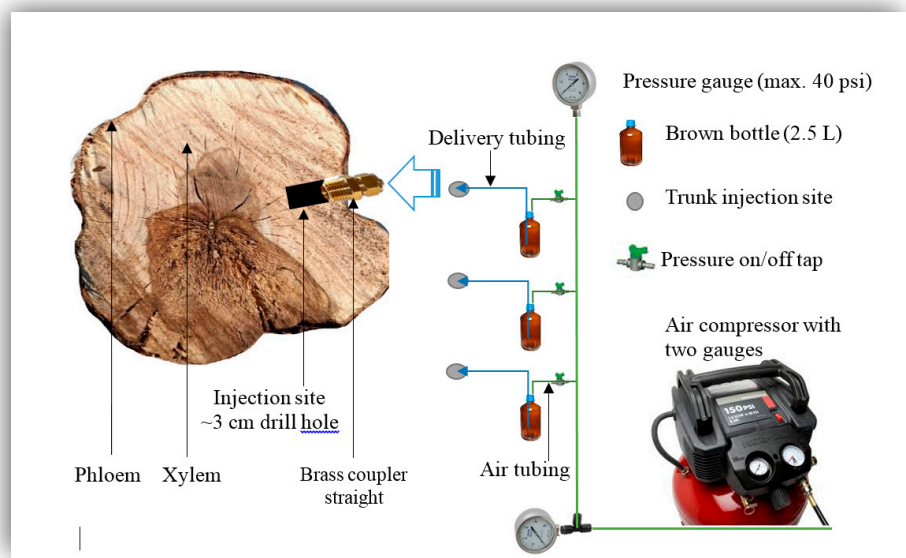

Figure SII. A low-pressure stem injection method involving a compressor delivering air at 69 kPa to 2.5 L bottles containing 5% w/v sucrose, with pressurised solution delivered to grapevine trunks. Note necrotic tissue in trunk cross section.

The initial liquid level of each bottle was marked with white permanent marker and solution was added to maintain this level. An isolation tap allowed handling of individual bottles without affecting pressure of the whole pressure system. Top up volumes for each vine were measured by cylinder and recorded. Once the volume targeted to inject was achieved, the vine bottle was isolated from the pressure source.

Vines in the field with the experiemental set-up, and illustrative volumes of injected liquid are illustrated in Figures SIII and SIV, respectively. Table S1 shows amounts of sucrose solution injected to individual vines, during the first and second injection in each year.

Figure SIII. Cane pruned vines on a five-wire sloping T-trellis system with above ground drip irrigation and sucrose injection started after budburst (7 August 2015).

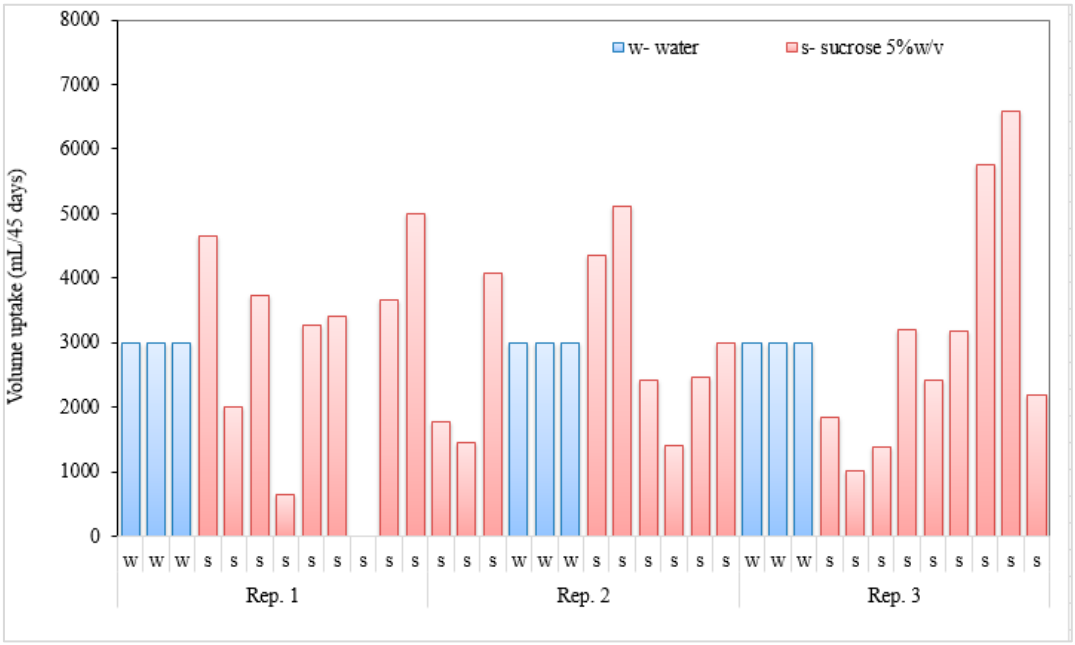

Figure SIV. Volume of liquid injected per vine during 45 days in the budburst to flowering period, 2014, for water (w) and sucrose (s) injection treatments. Water injection was halted at 3000 mL (9 non-injected control vines are not shown).

Table S1. Amount in ml of 5% sucrose solution injected into each vine over the duration after injection.

Days after first injection					Days after second injection			
Year	Vine #	1-3 d	4-10 d	11-20 d	2-3 d	4-10 d	11-22 d	Sum ml
2014	9	200	125	50	900	1770	370	3415
2014	11	900	450	120	150	1535	510	3665
2014	12	400	225	25	750	1670	1920	4990
2014	22	550	150	35	700	1600	1310	4345
2014	23	500	200	50	875	1780	1700	5105
2014	24	450	150	70	675	930	150	2425
2014	42	550	175	20	900	1355	190	3190
2014	43	650	175	0	850	1720	2360	5755
2014	44	800	275	375	850	1660	2630	6590
2015	9	450	50	100	328	152	120	1200
2015	11	1350	650	150	722	345	83	3300
2015	12	700	100	0	569	81	0	1450
2015	22	200	100	200	150	60	140	850
2015	23	1000	100	0	545	55	0	1700
2015	24	600	200	0	329	49	2	1180
2015	42	150	50	0	338	22	90	650
2015	43	1050	350	200	361	176	13	2150
2015	44	500	200	200	780	180	240	2100