

Field Performance of GRAD® Cool Climate-Adapted Rootstocks:

In early November 2015, 1,100 'Te Kauwhata Hermitage / Stonecroft' Syrah mass selection vines on GRAD® 44-53 and GRAD® 106-8 rootstocks were received from Stanmore Farm Nursery and planted in hard highly sodic soil on an elevated (260 metres a.s.l.) north facing site 40 metres above the Amuri Basin, at Hawarden in North Canterbury.

The sub-soil here is extremely stony and its pH ranges from around 7 at 30cm to 7.8 or more at 2 metres depth. Because of sheet-erosion dangers on the slope, the vine rows were not ripped, but instead individual planting holes were augered for each vine to a depth of 2 metres using a 30cm diameter auger. Vine spacings are 2 x 1m, 5,000 vines per hectare.

Aside from the topsoil, soil fertility is low, and trace element deficiencies, particularly of Zinc, occur due to the low soil pH. Dressings of Gypsum, and fertigation with Calcium Thiosulphate are being applied on an ongoing basis to drive down the very high Sodium levels in the sub-soil and allow trace elements and Magnesium to become more vine-available.

Despite its hardness and high sandstone gravel levels (ranging in size from pea gravel to football sized stones), the hillside soil is notoriously free draining and moisture retention is moderately low. In addition, throughout 2015-2016 the Hawarden region was in serious drought and remained so until late March 2017, with soil moisture deficit levels of -130mm in summer and early autumn according to NIWA.

Vine Establishment:

The first thing that stood out in this planting on GRAD® 44-53 and GRAD® 106-8 was the rate of vine establishment and the amount of growth achieved by the vines in their first year, despite our *not using any fertigation* and notwithstanding the poor subsoil fertility. Although neither 44-53 or 106-8 are rated as vigorous rootstocks (both are no more vigorous than Couderc 3309), *they are clearly very highly efficient at transporting water and nutrients to their scion*, and under steady irrigation (maintained at field capacity) during their first growing season, most of the 1,100 Syrah vines got to the high fruiting wire (1.5 metres on the downward shoot positioned single curtain trellis) by January, and thereafter established *up to 4 metres of growth along the fruit wire*. No fertigation was used: this is all growth due to the high nutrient and water -transport efficiency of the vines' stocks.

Only vines in a section of extremely sodic soil with a pH around 7.8 did not give exceptional growth, their restriction being due to marked Zinc deficiency because of the extremely harsh sub-soil in their section of the block.

Cane diameters of 9-10cm were typical in most vines otherwise, with long initial shoot growth but nevertheless well moderated 8 – 10cm internodes. Excavations to determine root growth showed that both the GRAD® 44-53 and GRAD® 106-8 stocks plunged their roots into the augered-out planting holes and in autumn we found roots at a meter or more already.

Root spreading across the initial 30cm upper soil layer was not evident, despite this section being markedly looser than the soil below 30cm depth, and despite our maintaining all season long an entirely bare, weed-free, top soil zone right across the planted area. This demonstrates a very sharp contrast with Riparia X Ruperstris (e.g., Couderc 3309, Schwarzmann) and straight Riparia stocks (like Riparia Gloire) which are genetically disposed to exploit this shallower zone and to branch their roots liberally within it. Freedom from weed competition would only encourage these stocks even more to follow their shallow-rooted disposition, but by comparison the GRAD® 44-53 and GRAD® 106-8 stocks plunged their roots below it. This creates relative immunity to dry topsoil and dry shallow sub-soil conditions.

We have since discovered however, that *even for dry-grown vines weed control remains important*. This is because dry-growing relies on intermittent rainfall to (ideally) meet the vines' water needs, and our observations in the second growing season, just passed, have showed that where weeds were allowed to grow (e.g., broad clover cover) they intercept the rainfall robbing the vines of their only water source beyond what, if any, remained stored in the subsoil. Stronger vines with deeper GRAD® 44-53 and GRAD® 106-8 root systems were less affected by weed cover, but when faced with an entire summer of soil moisture deficits of -100mm to -130mm, getting water from the occasional fall of rain into the sub-soil is vitally important, and we found that weed cover prevents this.

This was an unanticipated finding: *deep roots alone won't prevent eventual drought stress if soils are truly dried right out and all rainfall on the soil is intercepted before it can get down to the vines' roots.*

Management in the Vines' Second Season:

With so many vines well extended on the fruit wire with 9-10cm diameter cane diameter and internodes in the first 3 metres averaging around 8.5 cm, it was decided that to maintain vine balance and restrict the vigour of these close-planted Syrah vines, we would lay down up to 10 buds of fruiting cane on the well-established two year old vines in winter of 2016.

Two budding for the second season was not considered at all appropriate therefore, except for a tiny handful of strugglers (all of which have gone on well in their second season, aided only by intermittent individual vine watering by hand). Around 95% of the two year old vines were pruned onto the high fruit wire therefore to carry a moderate first crop.

Final bud numbers (10 fruiting shoots being the budgeted maximum) were decided according to trunk and cane diameter and cane bud quality. The majority of vines had 10 fruiting buds laid down.

From budburst onward, all the vines were dry grown — i.e., were not irrigated — in the 2016-17 season until and unless vine stress markedly affected them. By late January, with a district soil moisture deficit of -110mm to -120mm, vines in the weaker rows (where very highly sodic sub-soil continued to impact on them as the drought grew worse) were given moderate 'recovery' irrigation for the next month (until veraison). Their already modest fruit load was also deliberately reduced as necessary. This affected around 35% of the total planting, but because these vines were the least strong in the block and had therefore been pruned very conservatively, their recovery from what was in fact three months of severe soil moisture deficit was relatively straightforward — and in fact it soon markedly exceeded our expectations.



Above: Dry-grown 2 year old Syrah 'Stoncroft Hermitage m/s' on GRAD® 44-53 at Hawarden, 24th February 2017

Drought recovery: much stronger than anticipated:

We found that as the GRAD[®] 44-53 and GRAD[®] 106-8 stocks supporting the most stressed and weakest vines took up the moderate ‘restoration’ level irrigation water provided, the Syrah — contrary to what we expected — resumed shoot growth, with these vines steadily putting on 30cm to 50 cm of shoot extension. (Water *only* was applied; no fertigation was provided.) This surprising and significant burst of growth delayed veraison of course, and it became evident that having ‘hit the wall’ under severe drought stress, these smaller vines nevertheless needed significantly less water, and for a shorter period, than we had allowed for.

Our expectations about their recovery were of course based on experience with Ripara X Ruperstris (e.g., Couderc 3309, Schwarzmann) and straight Riparia stocks (like Riparia Gloire) which actually suffer *damage* and severe and sustained restriction under severe drought.

To find instead that the Syrah resumed growing vigorously (10cm internodes, with sustained new growth for a further month) was a shock. In a nutshell: *what we thought was a realistic recovery irrigation level was actually too generous for GRAD[®] 44-53 and GRAD[®] 106-8 stocks.* A much more modest irrigation ‘rescue’ volume, and for a shorter time, was all that was needed, and this is something we will have to refine in subsequent seasons.

The stressed Syrah vines’ recovery was thus *remarkable*. Ripara X Ruperstris and straight Riparia stocks would have *collapsed for the balance of the season*. Not only would there have been no ripening of their fruit, but they would also have been markedly impaired going into the following season (e.g., with reduced carbohydrate storage and weakened shoots and buds). By comparison, we found that the GRAD[®] 44-53 and GRAD[®] 106-8 stocks strongly supported their scion’s recovery, putting on good ‘come back’ growth in the face of severe and sustained prior water deficit. Admittedly, this wasn’t ideal from a ripening point of view, but it does demonstrate how *these stocks have a very significantly greater ability to restore their scion’s health and condition for the following season.*

The balance (65%) of the block simply did not even wilt (as Syrah will do under water stress) as the district soil moisture deficit progressed to -120mm by mid-March. So long as they got a little nor-west rainfall now and then (subject to the absence of weeds) they kept on keeping on! (The high level of wind shelter in this block greatly assisted this, too, but there is no escaping the fundamental truth that the vines were in very dry soil and were got by through the summer on nothing but intermittent rain and shelter-moderated controlled evaporation *alone*.)

In summary then, two year old close-planted Syrah carrying around 800gm of first crop and having had no irrigation whatsoever from 1st May 2016 onward remained in excellent condition right up to late March 2017 despite three months of severe drought and not a drop of irrigation water. The GRAD[®] 44-53 and GRAD[®] 106-8 stocks stood their first fruiting season’s dry-growing test *exceptionally well*.

Late in March the first of two tropical Cyclones dumped heavy rain on much of the country, and by the time the second of these weather phenomena had finished in mid-April, the Hawarden block’s soil moisture (along with that of every other block in North Canterbury) was at field capacity. Accumulated rainfall of around 200mm was recorded in the Hawarden area from late March to mid-April, so our dry-growing experiment was drastically curtailed by this. Nevertheless, the results right through an exceptionally dry summer were exceptional; no Riparia X Rupestris or straight Riparia stock would have survived such conditions.

Autumn vine condition:

This autumn we faced quite the opposite conditions from autumn 2016 of course: very wet soil and sustained cold conditions were the mark of 2017’s autumn in North Canterbury. Nevertheless the cool-climate adaptation of the GRAD[®] 44-53 and GRAD[®] 106-8 stocks very much showed itself: *the Syrah on GRAD[®] 44-53 and GRAD[®] 106-8 stocks at Hawarden kept their canopies and held good healthy green leaves until mid-May* when senescence finally and gradually began. By comparison, block after block of vines on Riparia X Rupestris and straight Riparia stocks in the North Canterbury area (Waipara, Omihi, Waikari, and Hawarden) were driven into disastrous early senescence and failed to offer any hope of properly ripening their fruit.

These stocks will not tolerate sustained cold autumn conditions and low autumn soil temperatures, and by late March and early April their canopies failed disastrously; early and rapid senescence was the result. By stark

contrast, the Hawarden Syrah on GRAD[®] 44-53 and GRAD[®] 106-8 stocks carried healthy green canopy until mid May, and then a frost a week or so later finally shut the vines down for the season.

With the Hawarden Syrah virtually the only vines left in the district still photosynthesising with a healthy green canopy through April and May, we harvested a modest crop of rain-affected but *physiologically ripe* Syrah. The rest of North Canterbury got very little or nothing of virtually all varieties. Their vines canopies were finished for the season by late March or early April.

Pruning 2017:

At pruning, I found the dry-growing typically gave 12 good buds per row metre (two buds above the expected management average for this close-planted block) to lay down for the 2017-18 crop.

Typical internodes on the Syrah are 8cm — and this is in a very sheltered block so the measured growth is not due to wind stress. Impact from the autumn heavy rains shows only at about the 1.2 metre point on the vines' canes *if* and where they have returned to vegetative growth in the exceptionally cool and wet autumn conditions. Typical cane diameter is 8mm to 10mm.

This close-planted block was deliberately intended to be dry-grown for the production of Syrah with small berries for elevated dry extract and early physiological ripeness. The use of GRAD[®] 44-53 and GRAD[®] 106-8 stocks was critical to this management plan. In their first two years they have performed outstandingly, and further expansion of the block is ongoing using the same stocks.