Winegrape ideas from reading the literature

**Misc**

Ferguson et al 2014 – estimated day of bud-burst, initial hardiness and maximum hardiness were all positively correlated. More hardy varieties in winter then tend to budburst earlier in the spring.

If I have enough data, I would like to look at the variation due to root stock and clone. What capacity is there for retaining an variety but still adaptive planting?

**Climate Modelling**

I could frame a question around predicting species’/varaiety’s niches? Thsi might be more ecological? About how difficult it is based on a one or a few climate variables. Focus on suposed increases in where wine can be grown in teh north because winter temperatures are getting higher, but what about teh influence of increasing heatwaves, drought and false springs? Also how does considering within species variation change teh answer? Buit what if better adapted varieties cant reach new areas? Also how much can we infer about changes in summer heat/drought from changes in winter temperatures? Do places generally increase winter and summer temperatures teh same amount? Does something weird happen in spring? Might there be more extreme fluctuations in climate?

Are more cold tolerant species more or less sensitive to heat/drought? Maybe some tradeoff? This will matter when considering new areas to grow grapes.

What about the potential affects of lack of chilling in warmer winegrape regions? See Luedeling et al 2009 about this problem in trees

**False Springs**

Could I get at which varieties are going to be less vulnerable to false springs?

How much of a problem will false springs be? Will they be more of a problem for areas that are only just getting warm enough for planting? Will this cause problems if you need to plant a very hardy vine but then it is more susceptible to false springs? \***\**need more research on false spring modelling*\***\*

Most damage to crops occurs during spring frosts or autumn heat waves (Charrier et al). SO this is where my model need s to be most accurate?

Phenology - Do I see evidence that more cold hardy varieties budburst earlier? (see Ferguson et al 2014). If so these varieties may be MORE cold vulnerable in spring than less hardy varieties

**Trait Plasticity**

Does the same vine reach the same hardiness each year, conditional on temperature? Does the same variety or clone? How plastic is cold hardiness?

What about how variable varieties are between sites? If I take teh same varieties, and look at how they differ relatively at different sites, will some varieties differ more? I.e. be more plastic? Or are acc/deacc rates unchanging?

**How does winter hardiness correlate with other important things?**

What would i expect it to correlate with? What is an important thing?

\* heat and/or drought tolerance. Will new areas really become available because of warmer winter temperatures, or will these areas become to extreem during teh summer?

\* Wine quality/verasion timing/phenology

\* yield

\* where does cold hardiness fit into syndromes?

\*what trade-offs are there physiologically in becoming and maintain cold hardiness?

Ferguson et al 2014 – more variation in Hc max than Hc initial between varieties. Doesn't that suggest that some varieties must get hardier quicker? How does that work physiologically, and what are the costs of this? Does microclimate affect the rate of change of hardiness in relation to temperature? Or will Riesling always get (for example) 1 degree more cold tolerant for a unit of chilling wheras Merlot only 0.5 degrees of cold tolerance? If rate does change, would I expect more variation for a hardier grape? If the rate is invariable I would expect less between site variation (if micro climates are taken into consideration).

**Modelling**

Processed based modelling – can I think of a simpler one that would still work?

Should I focus on maximum hardiness or the rate of deac/acc? (related to potential risk of False Springs vs very cold periods midwinter). Charier et al mentioned that it has been observed that maximum hardiness achieved in winter is not dependent on environment (need to take another look at this).

The Feguson 2011 model was not good at predicting late winter/spring hardiness. It tended to overestimate hardiness a lot because the model didnt understand the physiological changes taking place as vines get ready for budburst. The 2014 Ferguson model estimated hardiness based on phenological stage for the spring temperatures, and that seemed to work better. They said that LTE values derived from the lab were not correct for buds that were not dormant – something to do with water chemistry I think?

Maybe have a model that has two different rate periods, one before spring bud physiological changes move to budburst, and one after this point. But how would i estimate this pivot date?

Maybe i could include as logistic component to my regression (like Fegusson et al 2011) to stop harciness increasing linearly when it’s really cold?

Lenz et al 2016 - in trees, budburst happened a certain number of days after the last time temperatures went below the freezing tolerance of new leaves.

Could I just include a modle estimating chilling requirement and budburst (i.e. Caffera and Eccel 2010) and include that as teh dates when i expect rates of change of hardiness to change?

**Physiology/ mechanisms**

Energy is necessary to drive acclimation and sugars play an essential role in freezing tolerance, the

resiliency of photosynthesis under stress conditions and how photosynthates are utilized (growth vs acclimation) also need to be better understood (Gusta and Wisniewskib 2012). Coudl there be a growth cost to being more cold hardy? Do more cold hardy vines produce smaller yeilds?

Proteins work in concert with sugars to establish cold tollerance. If plants havent got enouph sugars (carbohydrates) from the growing season then they cant be cold hardy ( Gusta and Wisniewskib 2012).

There is a model based on carbohydrate amounts in cells that models cold hardiness in Walnut trees

What are teh physiological differences between a more and a less cold hardy vine variety?

Lots of references in Lenz et al 2016 about how budbreake is closely related to loss of winter hardiness. Expect more cold tolerant leaves to mean earlier budbreak because the risk of frost is lower. Is that why ,ore cold hardy vines budbreak earlier? Or do they budbreak earlier for other reasons? Are the leaves of more generally cold hardy varieties more cold hardy too?

Lenz et al 2016 – suggest freezing resistance is rather fixed trait in trees. Freezing resistance was very similar amoung distinct populations of teh same species. SO its easier to adjust leaf-out date than how cold hardy your leaves are.