Ten Years of the Maize Nested Association Mapping Population

For example, flowering time in maize is controlled by many common, small effect QTL, none of which affect flowering time by more than 1.5 d (Buckler et al., 2009). However, in self-pollinated species like rice (Oryza sativa), sorghum (Sorghum bicolor), and Arabidopsis (Arabidopsis thaliana), much of the variation for flowering is controlled by a few QTL with large effects (Huang et al., 2012; Salomé et al., 2011; Li et al., 2011). Similar contrasting architectures were observed for leaf structure in maize compared to the self-pollinated species rice, Arabidopsis, and barley (Hordeum vulgare) (Turner et al., 2005; Takahashi et al., 2009; Koornneef et al., 2004). The distinct patterns of genetic architecture of maize complex traits relative to inbreeding species may be related to differences in the evolutionary strategies of selfing and outcrossing species. Selection may favor

small effect sizes in outcrossing species, in which the sum of small effects keeps the individual

phenotypes closer to the population mean (Wallace et al., 2014; Buckler et al., 2009). In

outcrossing species, the two parental genomes are shuffled and recombined at every generation,

and large effect loci may not be passed on to progeny. Polygenic trait architectures may also have

helped maize adapt to diverse environments, where the effects of selection are spread across

numerous segregating loci (Flood and Hancock, 2017). Selection might have also favored

independence of traits over pleiotropy, as certain combinations of phenotypes may be favorable in

some environments but not others (Wallace et al., 2014).

Preston and Fjellheim 2020

Parrish & Fike 2005

II. E. Phenology & Temperature Relations

Switchgrass displays distinct developmental patterns in response to accumulated temperature and to day length, but these relationships are greatly affected by genotype x environment interactions.

The rate of growth of switchgrass is thought to be dependent on temperature, with minimal growth occurring below a putative base temperature (BT). A BT of 10 C for vegetative and reproductive development is commonly used for growth models (Mitchell et al 1997; Sanderson and Wolf, 1995a). [Li has used a BT of 13 C and hopefully has a citation for that – I asked her for it 2020-05-27]. BT vary by cultivar and are as low as 2.8 C for northern cultivars and 6.5 C for southern cultivars (Madakadze et al 2003).

However, BT requirements for greenup may be higher, or there may be a photoperiod or vernalization mechanism rather than a temperature threshold *per se* for triggering spring growth (Parrish and Fike 2005).

A relationship between vegetative morphology and GDD has been shown in environments from Texas USA to Quebec Canada; but the nature of the relationship changes quantitatively and qualitatively with cultivar and location (Madakadze et al 1998c; Sanderson and Wolf, 1995a, 1995b).

While the rate and extent of vegetative development is closely related to GDD, reproductive development is more tied to day-of-the-year, or photoperiod. Switchgrass is a short-day plant; it flowers when exposed to shortening days of a specific length (Benedict, 1940).

[so what is daylength of flowering for each plant\_id \* site – and is it the same across sites for individual plant\_ids? Or different? If the same, this is the driver; if different, something else is the driver.]

For genome paper

As noted previously, switchgrass exhibits tremendous diversity in form – so much so that some populations would appear to be well on the way to evolutionary divergence from one another (Parrish and Fike 2005).

Parrish DJ, Fike JH. 2005. The Biology and Agronomy of Switchgrass for Biofuels. Critical Reviews in Plant Sciences 24:423-459.