IMPROVING YIELD STABILITY USING VARIETY MIXTURES IN NORTH CAROLINA: FIRST YEAR RESULTS

Guy D. Collins,
North Carolina State University
Rocky Mount, NC
Keith L. Edmisten,
Blake L. Szilvay
North Carolina State University
Raleigh, NC

Abstract

Variety selection continues to be one of the most important decisions that growers make in a given year. Yield stability, or the frequency in which a variety performs at or near the top across environments, has become one of the most effective tools for evaluating variety stability. However, even the varieties with the highest degree of stability are not the top performers in every environment. In many cases, a variety with the highest stability characteristics may only be the top performer in 50 to 60 percent of trials. This leads growers to question if variety mixtures might improve overall stability characteristics, reduce the chances of significant losses in potential revenue in cases where weather patterns cause a top performing variety to rank lower than predicted, or improve the chances of capturing acceptable yields in dryland environments where rain events during the growing season are highly unpredictable. To the last point, many fields in N.C. are rainfed environments that can result in high yields (1200 to 1500 lbs/A) if seasonal rains are timely and adequate, but can also result in low yields (400 to 800 lbs/A) if seasonal rainfall is infrequent or insufficient. The N.C. On-Farm Cotton Variety Evaluation Program has clearly illustrated that some varieties are more competitive when planted in high-yield environments whereas others are more competitive in low-yield environments. Without irrigation, the yield environment is highly unpredictable, therefore growers question whether mixtures of varieties that are competitive in either high or low-yield environments would improve yield stability across environments, or at least minimize the chances of significant losses if the environment doesn't suit the variety chosen for that field. The objectives of this research were to 1.) To investigate the effects of variety mixtures on yield stability, 2.) To evaluate mixtures of varieties that are known to perform competitively in vastly different types of environments (low-yield, drought-stressed versus high-yield, non-stressed environments), and 3.) To evaluate mixtures of varieties that are known to perform well across a broad range of environments. We hypothesized that variety mixtures may improve yields in some environments, and that yield improvements may occur for some varieties but not others.

Replicated trials were conducted in North Carolina during 2017 at five research stations: Lewiston, Plymouth, Rocky Mount, Goldsboro, and Sandhills. Varieties and mixtures were chosen based on past performance in the NC On-Farm Cotton Variety Evaluation Program as seen in the tables below, and current marketability. Varieties included PHY 312 WRF (competitive in low-yield environments), ST 4848 GLT (competitive in high-yield environments), NG 3522 B2XF and DP 1646 B2XF (both competitive across environments in a year with frequent rainfall), and DP 1538 B2XF (competitive across environments in a dry year). Binary mixtures of PHY 312 WRF and ST 4848 GLT were compared to each alone to evaluate stability of varieties that only perform well in vastly different environments, where rainfall is unpredictable. Binary mixtures of DP 1538 B2XF and DP 1646 B2XF were compared to each alone to evaluate stability among varieties that are known to perform well regardless of the environment. Lastly, equal proportions of the four aforementioned varieties plus NG 3522 B2XF where compared to each variety alone, to evaluate stability when several competitive varieties are mixed. Data were subjected to ANOVA and means were separated using the LSD test at $p \leq 0.1$ in ARM 2017 software.

PHY 312 WRF has been shown to perform competitively in low-yield environments whereas ST 4848 GLT performs competitively in high-yield environments. In most areas of NC, 2017 was a high-yielding year. Binary mixtures of PHY 312 WRF and ST 4848 GLT improved yield compared to the lower-yielding of the two, in two out of six environments, and improved average yield and yield ranking across the six environments. Conversely, the mixture reduced yield in a similar manner when compared to the higher-yielding variety of the two. DP 1538 B2XF (consistent performer in a dry year) and DP 1646 B2XF (consistent performer in a wet year) have been shown to be top performers across a broad range of environments. Binary mixtures of the two improved yield compared to the lower-yielding of the two, only in one environment. Average yield of the mixture across environments was greater than the lower-yielding variety, however, average yield ranking was not improved. When five varieties were mixed

in equal proportions, yield of the mixture was greater than one or more varieties in three out of six environments. Average yield and yield ranking was approximately in the middle range of all varieties planted independently. In two of the three environments where an effect was observed, the mixture resulted in lower yields than one or more varieties. We concluded that variety mixtures can improve yields compared to some varieties, but can reduce yields compared to others. Additionally, improvements in yield stability were more clearly observed when varieties planted alone are competitive in vastly difference environments (wet/high-yield versus dry/low-yield environments). When more than two varieties are mixed, the magnitude of yield improvements and reductions become greater. Stability can be improved through mixtures, but only when one of the varieties planted alone was a poor choice and yielded lower than the mixture, across environments. Ideas for future research include conducting similar research in a broader range of environments (dry years), and investigating variety mixtures in controlled irrigated environments where high yields are more predictable.

Acknowledgements

The authors extend a special thanks to the NC Cotton Producers Association and Cotton Incorporated for their continued support of this and other agronomic research for cotton at N.C. State University.