GENETIC GAIN AND SUSTAINABILITY

ROY G CANTRELL

RGCANTRELL@MAC.COM

SEPTEMBER 24 2017
COTTON SUSTAINABILITY

• Important for the future profitability and competitiveness of cotton in the marketplace against MMF.

• NCC, CI, CCI, & Cotton Board is assessing key technologies and trends that will impact the future sustainability of cotton production systems.

• I will focus on land use efficiency (LUE) where steady progress has been made and is not appreciated as a key driver of sustainability, especially in the next 30yr
  • Increasing yields from genetic gain and grower mgmt (and GXM)
LUE IS A COMMONLY USED KPI

- LUE = acres to produce a lb of lint†

† Can use TSC instead of lint.
LUE FOR 2 PERIODS OF US COTTON PRODUCTION†

- **1930-1939** mean area 31,223,000 mill acres harvest (13.2 M bales), mean lint yld/acre = 212 lb/ac,
  - LUE = 0.0047 acres to prod lb lint
- **2007-2016** mean area 10,018,800 mill acres harvest (16.7 M bales), mean lint yld/acre = 832 lb/ac,
  - LUE = 0.0012 acres to prod lb lint

~4X Increase in LUE for cotton

† Source: USDA-AMS.
MANY POSITIVE FACTORS HAVE IMPROVED COTTON YIELD

• BW eradication
• Mechanization
• Pest management (weeds & insects)
• Fertility management
• Irrigation technologies & efficiencies
• Genetic improvements from breeding (genetic gain)
GENETIC GAIN OR IMPROVEMENTS ON THE FARM IMPACTED BY MANY FACTORS
FOCUS ON 2 MOST IMPORTANT

- Genetic gain in breeding program
  - Estimated in commercial breeding program at appropriate test stage relative to a GG check (proprietary)
  - Important benchmark or metric for commercial breeding program

- Variety turnover or refresh rate
  - Large amount of GG is “left on the table” by cotton growers
    - Risk management
    - Lack of “data” on new products
    - Seed availability (Inventory & supply chain management) from seed companies
    - Reluctance to give up proven older varieties
THIS WILL ALL CHANGE DRAMATICALLY OVER THE NEXT 30YR AND IMPACT LUE AND COTTON SUSTAINABILITY

- Genetic gain in breeding program
  - Impact of new breeding technologies (GWS, Genome Editing, HTP, Data Science, Predictive Analytics & etc)
- Variety turnover or refresh rate
  - Precision product placement & data science
  - Improved seed production/processing technologies by seed companies
  - Inventory management/data science
How will genetic gain from breeding impact sustainability over the next 30yr? Basically, what is US yield in 2050?

Model (3 eras)
- 2020-2029\(^\dagger\) 2% annual genetic gain from breeding, 5yr variety refresh rate
- 2030-2039 2.5% annual genetic gain from breeding, 4yr variety refresh rate
- 2040-2050 3.0% annual genetic gain from breeding, 3yr variety refresh rate

\(^\dagger\) Set Base US Yield in 2020 = 880 lb/a
GAINS FROM BREEDING OVER THE NEXT 30YR

- Average rate of gain over 30yr period ~ 6 lb lint/ac
- Predicted average lint yield in 2050 is 1077 lb/ac
- Doesn’t include gains from other technologies other than those that protect yield
- No yield plateau in this period
GAINS IN COTTON SUSTAINABILITY THROUGH BREEDING BY 2050

• 1930-1939 mean area 31,223,000 mill acres harvest (13.2 M bales), mean lint yld/acre = 212 lb/ac,
  • LUE = 0.0047 acres to produce lb lint

• 2007-2016 mean area 10,018,800 mill acres harvest (16.7 M bales), mean lint yld/acre = 832 lb/ac,
  • LUE = 0.0012 acres to produce lb lint

• 2050 area 8,000,000 mill acres harvest (17.2 M bales), mean lint yld/acre = 1077 lb/ac,
  • LUE = 0.0009 acres to produce lb lint

25% increase in LUE by 2050
SUMMARY

• Cotton breeding technologies will contribute significantly to cotton sustainability over the next 30yr
• Rate of gain expected to steepen w/ implementation of new technologies
• Metrics going forward (how to track)
  • Realized annual gain from new varieties
  • Variety refresh rate
ACKNOWLEDGEMENT

Cotton Incorporated Project 17-040
QUESTIONS