PERSEPHONE

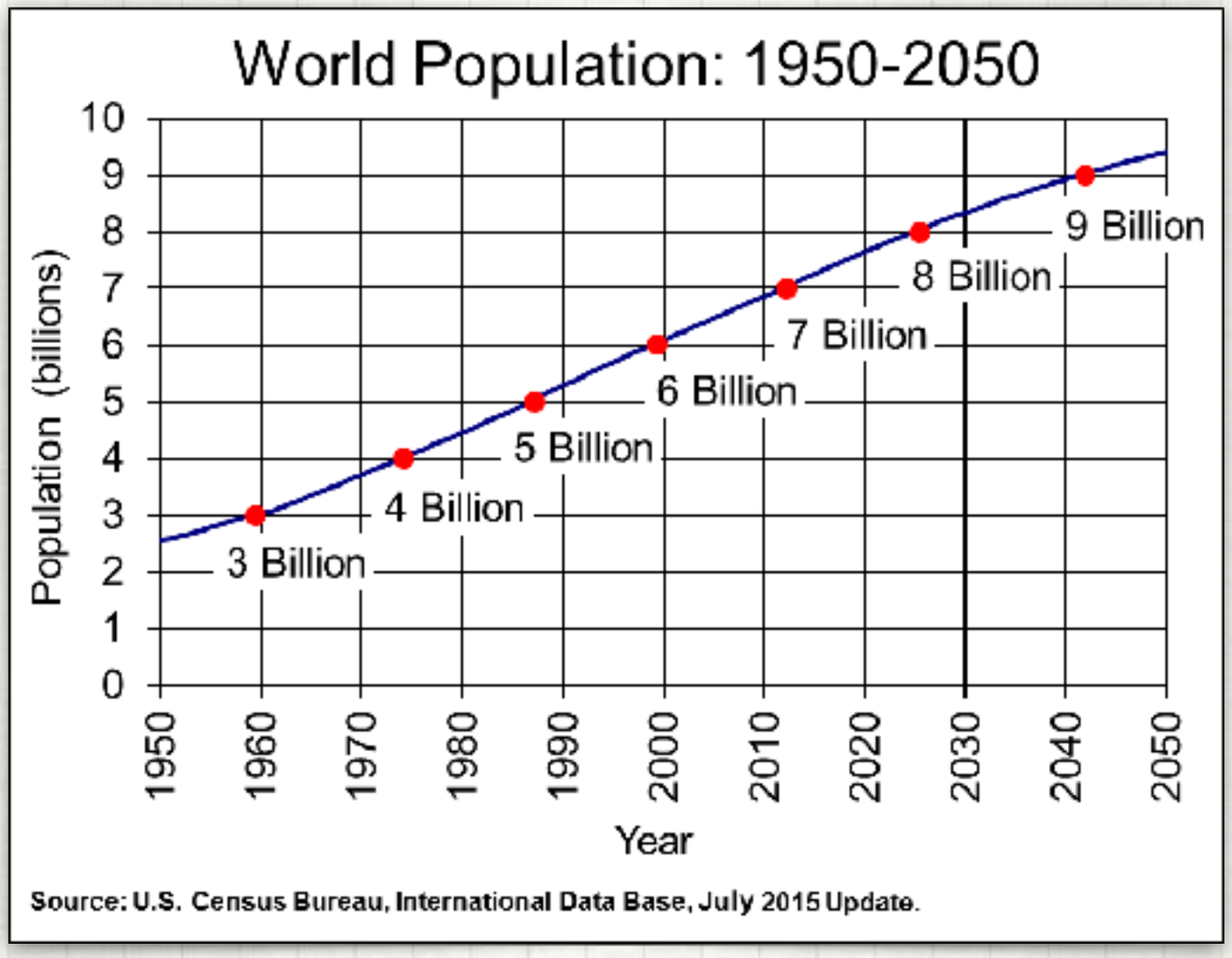
[PER-SEF-UH-NEE]

CROP YIELD FORECASTING WITH MACHINE LEARNING

by **Eric Hsieh**
hsieh.ching.han@gmail.com
linkedin.com/in/erichsieh1

WHY: POTENTIAL FOOD SECURITY CRISIS

- World population:
  +2.3 billion by **2050**
- Arable land/person:
  0.38 hectare (**1970**)
  0.23 hectare (**2000**)
  0.15 hectare (**2050**)
- Extreme climate is the new normal



TASK:

CAN WE QUANTIFY THE IMPACT OF **CLIMATE CHANGE** ON **CROP YIELD** WITH **MACHINE LEARNING ALGORITHMS**?

METHOD: REGRESSION WITH HISTORICAL RECORD

- **U.S.** has rich microclimates; lots of data on how different weather impacts different crop yields
- Data: **weather** (features) vs. **field crop yield** (response variables)
- Weather + crop yield linked by **location + time**
- **10 states**
- Time: **1960-2014**

ML MODELS:

- **18 models** (18 crops)
- Categorical variables are important (ex. irrigated vs non-irrigated, fuel-use vs none-fuel-use)
- **Random Forest Regression** (cross-validated):
  - Adjusted R^2 (wheat): **0.93**
  - Adjusted R^2 (corn): **0.9**
  - Adjusted R^2 (soybeans): **0.81**

INSIGHTS: KEY WEATHER FEATURES (CORN)

- #1: **DT90**: annual average of days/month with maximum temperature greater than or equal to 90.0 F
  (unit: days)
- #2: **TPCP**: average monthly precipitation
  (unit: inches)
- #3: **AMT**: annual mean temperature
  (unit: Fahrenheit)

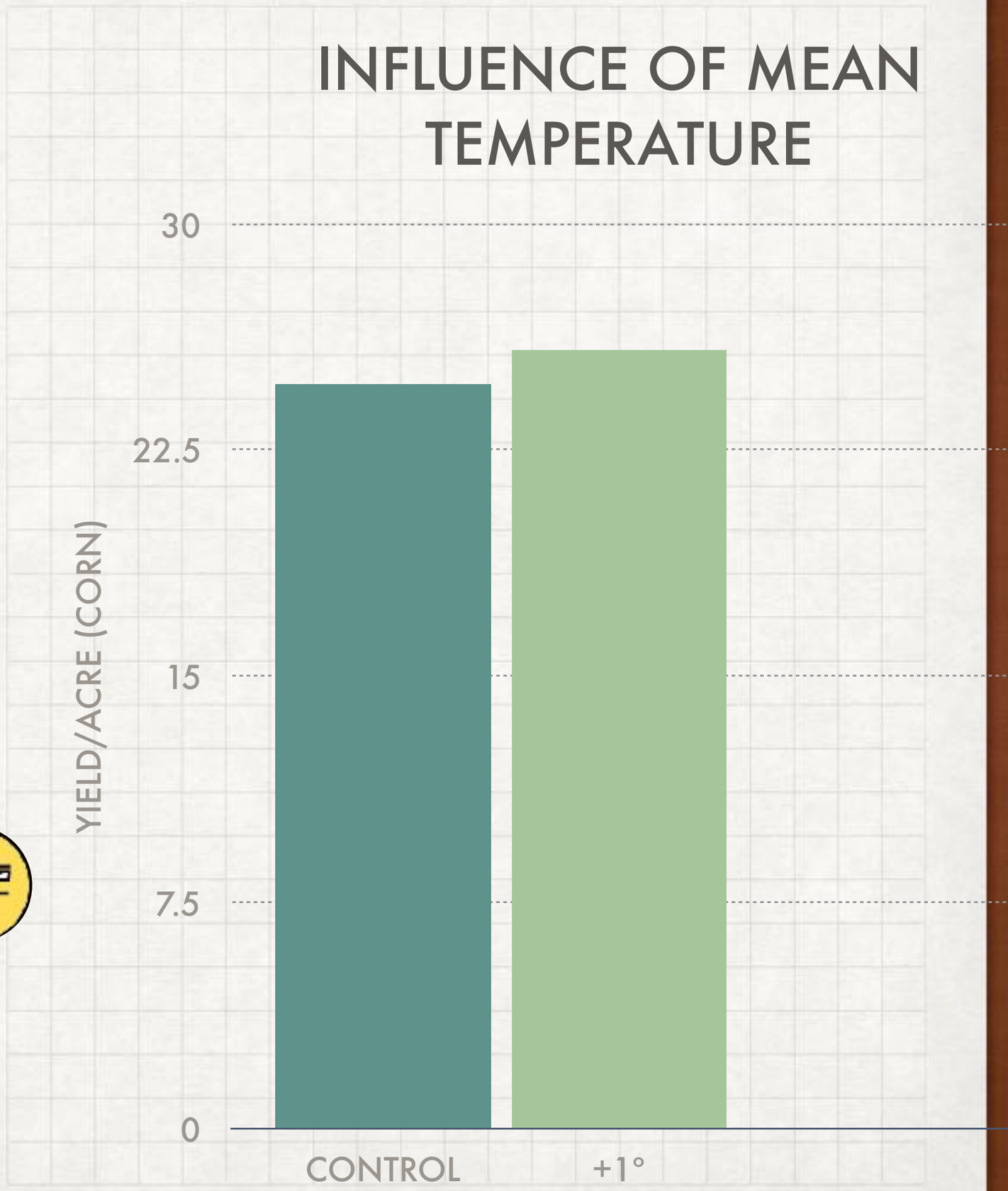
FEATURE #1:
ON CORN

+1° F MEAN TEMPERATURE

↓

+4.4% YIELD/ACRE

P-VALUE: 0.034



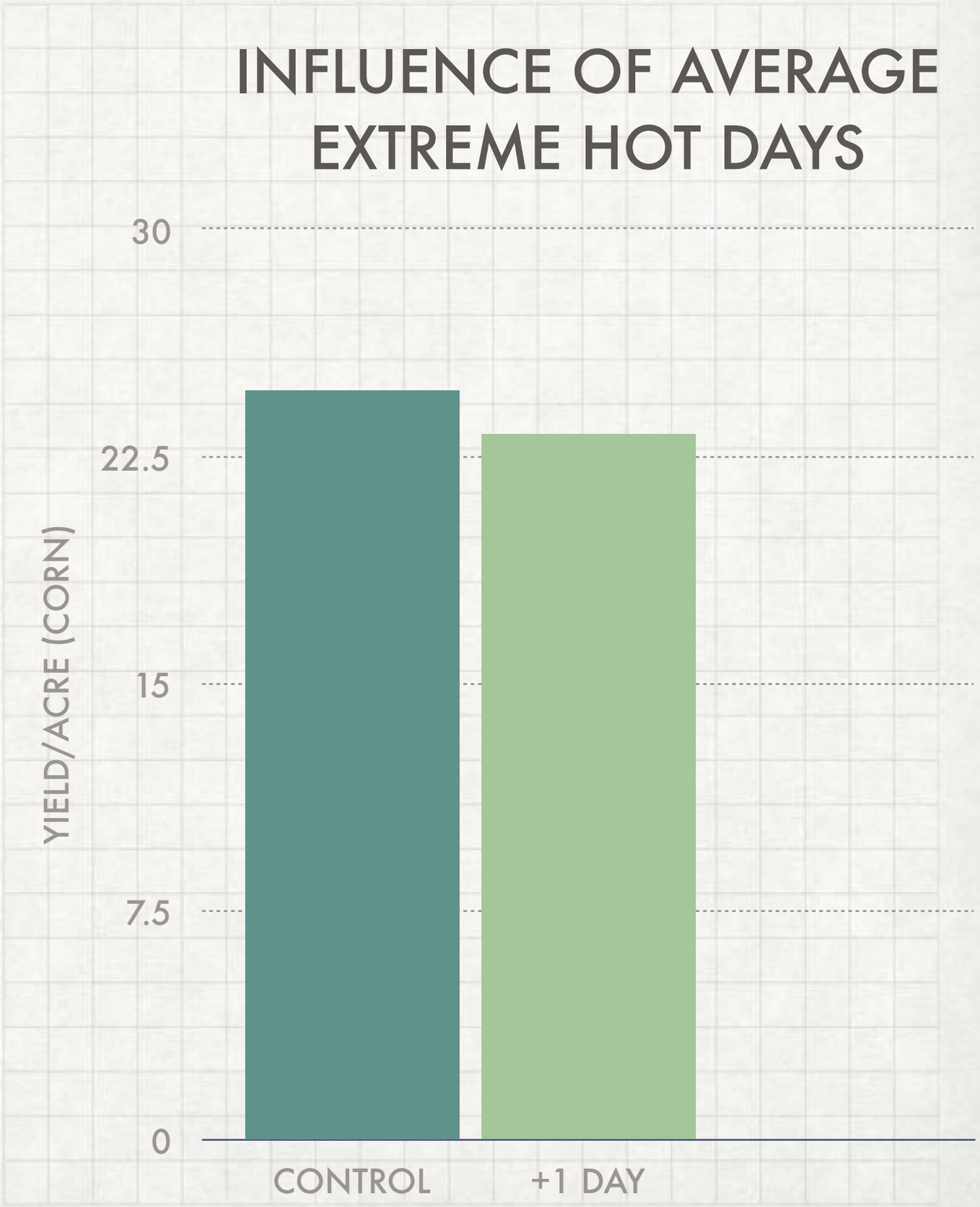
FEATURE #2:
ON CORN

+1 DAY
AVERAGE NUMBER OF DAYS IN MONTH WITH MAXIMUM TEMPERATURE GREATER THAN 90.0° F

↓

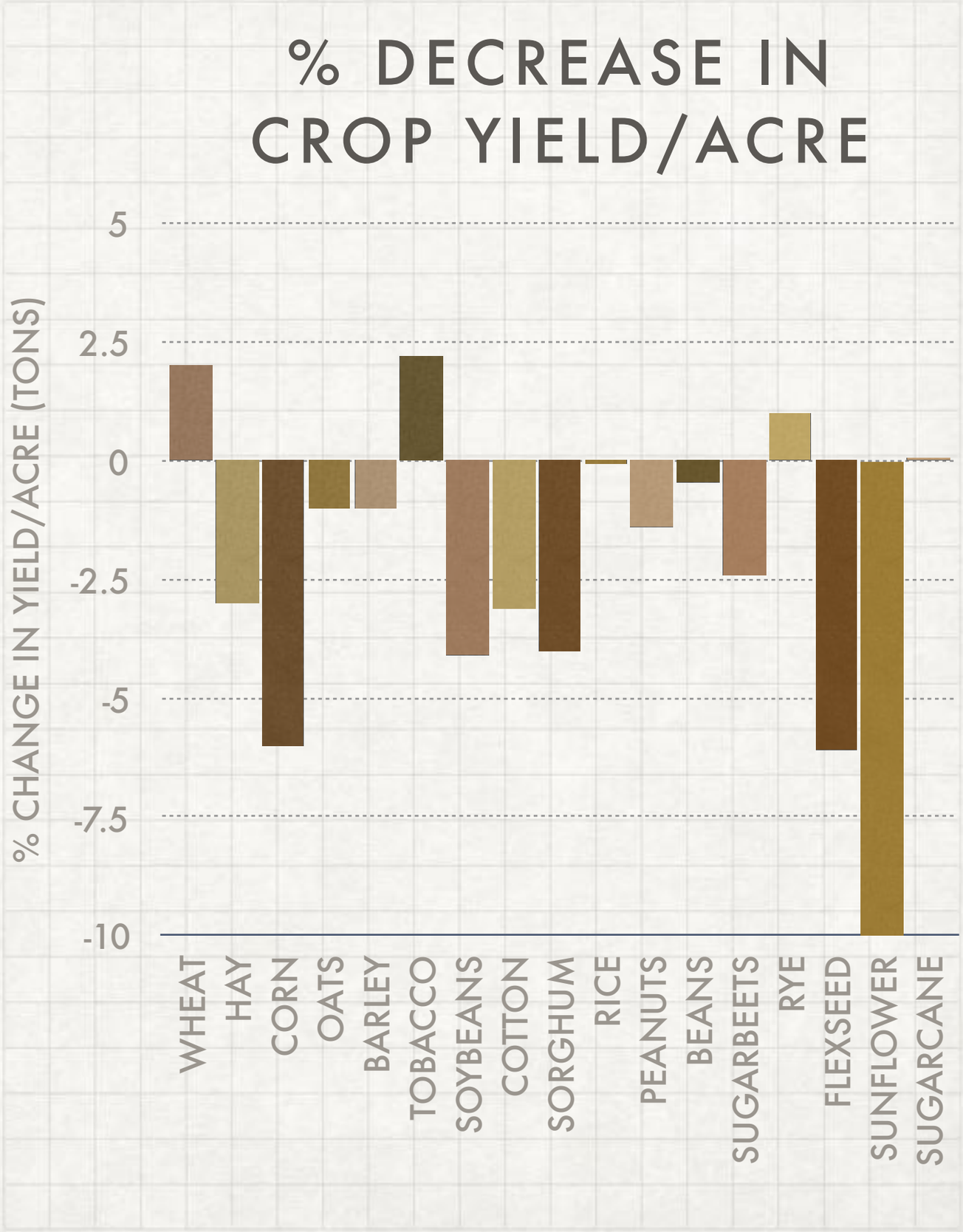
-5.95% YIELD/ACRE

P-VALUE: 0.000



WITH +1 AVERAGE EXTREMELY HOT DAY, HOW WILL CROP YIELD CHANGE (MEASURED IN $)?

TOTAL ECONOMIC IMPACT: -$1.6 BILLION PER YEAR



FUTURE:

- Use different metrics
- Model all **50 states**
- More feature engineering
- Model on other products (ex. **peaches**)
- **Crop recommender**

THANK YOU!

QUESTIONS?

Eric Hsieh

hsieh.ching.han@gmail.com

linkedin.com/in/erichsieh1