Guar Production in Texas & SW Oklahoma

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Updated October 2019

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Why Guar? Why Now?

- Guar gum is highly valuable and sought after as an ingredient from small quantities in numerous food products to large scale uses in oil field services (e.g., a component of frac fluids)
  - Desirable viscosity, a carrier for materials into deep wells, “cleans out” relative well (no residues remaining)

About this information…

- The information provided is a collection of field observations, limited research, and the input from several farmers and processor staff
- It is generally relevant for the Texas South Plains and Rolling plains, but it generally applicable as well in southwest Oklahoma and eastern New Mexico (info. is also generally relevant for the Texas Coastal Bend and Lower Rio Grande Valley where there has been limited production in the past).
- Guar is not well adapted to humid regions of Central Texas, for example, the I-35 corridor due to higher humidity and rainfall which fosters much more disease pressure than normally observed in the HP & RP.

The Value of U.S. Guar Gum Imports

- According to the USDA Agricultural Marketing Service, in 2011 in the Port of Houston (Texas) guar gum imports were ~225,000 metric tons (80% of U.S. total).
- At historical guar gum prices of $2 to $3/lb., this translates to an import value of $1.0-1.5 billion
- This represents about 2.3 million acres of production (at 800 lbs./acre, which is an average yield in the U.S., but double the average yield in India).

Yes, Guar! Yes, Now!

- Uses range from a company needing a few tons to make tens of thousands of tons of food ingredients or finished food products, to an industry estimate of as much as 20,000 lbs. of guar gum to frac one oil well.
  - Can enough guar be produced for the oilfield industry? One frac job could require 80 acres of guar production (750 lbs./A)
  - FTS International, Ft. Worth, uses 1,700 tons of guar gum (2012) a month (3-4X current annual U.S. production)
  - In the past Caremoli USA has used up to 20 million lbs. of guar gum as a food ingredient (~90,000 acres at 750 lbs./A)
  - Halliburton, mid-2012, guar gum was 30% of material cost to frac a well (this during a time of severely inflated prices for foreign guar gum)

Guar Materials

Samples courtesy West Texas Guar

Guar Markets

- Much of the guar consumed in the U.S. is imported from India and Pakistan as ‘splits’—the endosperm (which contains the valuable gum); the seed coat and embryo have been removed.
- As a rule of thumb for basic understanding, the seed components are:
  - Embryo, 45%
  - Seed coat, 15%
  - Endosperm, containing the gum, 40%
- Figure about 28% of raw seed weight is net extractable gum

Guar Markets

- International market for guar and guar gum drives you nuts! There is no rhyme or reason to pricing or availability. A manipulated market.
- Some companies suggest the gum quality of imported guar is better than U.S. production
- Is this fact or perception?
  - Texas Tech Univ. research suggest quality can be comparable
  - Guar grades/quality for fracking vs. guar for food—fracking guar actually has higher standards (need to hydrate quickly under high pressure and temperature)

Guar Markets

- U.S. companies need a stable supply, and appear more willing to pay the needed cost.
- Due to volatility in the international market (which is controlled and does not necessarily reflect market conditions), interest rises in investing/establishing U.S. production when prices are high
- What about food vs. industrial use debate?
  - Blue Bell ice cream—the 2012 run-up in guar prices amounts to ~10-12 cents higher ingredient cost per half gallon carton which costs $5-6

Guar Economics

- Guar is a crop that has minimal input costs to grow. Therefore the gross returns (which seem low), must be evaluated in light of actual (low) production costs.
- Historically, guar is not a crop of choice if a producer must service a high debt load.
- Guar production budgets @ http://southplainsprofit.tamu.edu

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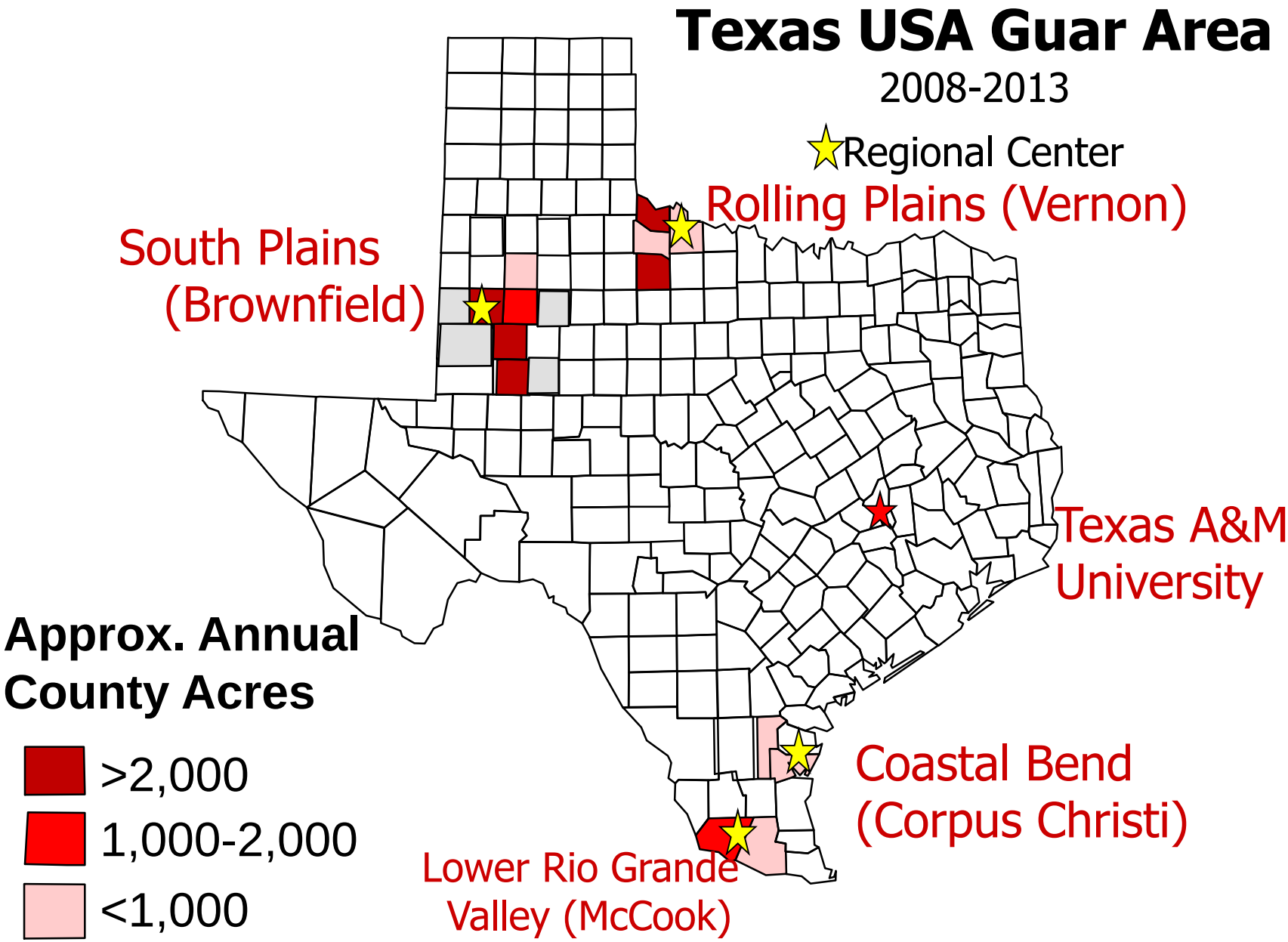
Texas USA Guar Area
2008-2013
Regional Center
Rolling Plains (Vernon)
South Plains (Brownfield)
Texas A&M University
Coastal Bend (Corpus Christi)
Lower Rio Grande Valley (McCook)
Approx. Annual County Acres
>2,000
1,000-2,000
<1,000

Guar Buyer/Processor: TX, OK, NM

- Guar Resources, Brownfield, TX
  - Purchased assets of West Texas Guar, whose contracted production 2009-2013 ranged from about 10,000 to 120,000 acres (latter included guar replanted after failed cotton); ~30,000 acres in 2018 & 25,000 acres in 2019.
  - (806) 637-4662, www.guarresources.com
  - **New splitting and powder equipment installed in 2016**
  - Annual processing capacity is about 50 million lbs. of grain (about 60,000 acres of average production)
  - Compared to previous markets, half or more of Guar Resources 2019 market is for higher value uses in food, industrial applications, consumer products.

2019 Contracting (TX, OK, NM)

- Guar Resources, Brownfield, TX
- Price is $0.165/lb. ($0.185/lb. if delivered to Brownfield, TX) (this is somewhat below historical prices prior to 2011) but the current price is also above what the market would otherwise pay due to dirt cheap guar gum prices (on the world market, near $1/lb.)

Volatility of Seed Price for Farmers

- 2013 price was the highest ever, $0.45/lb. for standard Grade #1 (though offered *after* extreme guar prices in 2012 had returned to more historic levels by early 2013)
- Phone calls and e-mails: "With the high cost of guar gum, why isn't guar production contracting at least $0.50/lb., even $1.00/lb.?
- The late 2012 crash in guar gum prices might be why!!! Prices even lower now—volatile!
  - In late spring/early summer 2012 guar gum was as high as $12/lb. Then by mid-September 2012 guar gum prices were back down to about $3.50 per lb., then $2.00/lb. in Fall 2013, and <$1.50 lb. in late 2014/early 2015

Guar & Crop Insurance

- Currently no meaningful crop insurance (not a program crop)
  - A viable private crop insurance product was potentially in place for 2014, but the West Texas Guar bankruptcy ended any meaningful crop production for 2014-2015
- Lending agencies may not loan money on guar without crop insurance
- Currently only NAP insurance is available, and it may be not economical to justify purchase
- As of October 2019 USDA Risk Management Agency's Specialty Crop Program has designated guar for contract research of program crop insurance for guar, which could lead to a three-year pilot program

The (Undeserved) Perception of Guar:

"Low-Input/Stepchild Crop" (USA)

"Poor Man's Crop" (India)

Key Guar Considerations

- Indeterminant, annual legume
- Good for rotations with cotton, sorghum, etc. (1970's at Texas A&M AgriLife—Vernon: 15% lint yield increase the following year; subsequent data from the Texas A&M AgriLife Research station at Chillicothe suggest a lower yield benefit)
- As drought tolerant—if not more—than any other crop in Texas (sesame would be similar)
- Low risk

Guar

- With sesame, the most drought tolerant crop in the Texas Rolling & South Plains and Southwest Oklahoma
- Low input crop
- No insects or disease treated in production since ~1998
- Target planting date: mid-May to about July 1
  - Rolling Plains or High Plains; much of the guar is planted late in this window, and we believe this may curtail yield some years (cool September weather can hasten loss of leaves)
- Harvest generally November-December in the Southwest U.S. (but use of harvest aid could hasten harvest a month or more)
- How quickly can new crop guar gum be available? Could potentially hit market in December if facilities can process quickly (earlier with harvest aid)

Yield Potential

- Dryland: 400-1,100 lbs./A (typical range)
  - Getting an initial stand is important; once the stand is established then guar is highly likely to make a crop even in drought years
  - Key long-time WTG growers—experience is valuable!—averaged 800 to 1,000 lbs./A since 1999
- Limited irrigation (3-6”): 800-1,400 lbs./A
- Full irrigation? Not recommended
  - Guar’s relative performance to other crops is best in dryland settings, especially when droughty as long as the crop is established, but guar may not take advantage of irrigation as well as numerous other crops.
  - Industry yield goals, West Texas/Rolling Plains: ~900 lbs./A dryland; ~1,500 lbs./A irrigated

Varieties

- 1980-1983, at numerous Vernon-area locations:
  - Lewis ~100 lbs./A more than Kinman
  - Lewis ~200 lbs./A more than Esser
- Kinman, Lewis (less branching, more pods on main stem), Matador (Texas Tech Univ., 2005), and Santa Cruz are most common varieties--All are acceptable; see contractor; ‘Judd 69’ is an apparent hand selection that has been increased, and some growers like it.
- Breeding program can make rapid improvements, especially if newer techniques are coupled with ready assessment of gum quantity and quality

Dryland Guar Yields AGCARES, 2001-2002

- Dry years, but deep moisture available
- Kinman and Lewis yields (averaged)--
  - 2001: 549 lbs./A
  - 2002: 829 lbs./A

Where is Guar Best Suited?

- Grows adequately under a wide range of soil conditions
  - Clayey soils are not recommended
- Performs best on medium- and sandy textured soils
- Dryland pivot corners
- Fields without heavy weed pressure
- Humid environments are not desirable
  - Alternaria, bacterial blight, other diseases begin to take their toll
  - Indi and Paki varieties are exposed to humidity during the monsoon seasons, may handle disease potential better?

Herbicide

- Trifluralin (Treflan, etc.; liquid '4EC' formulation, 43.0% a.i.)—a foundation for weed control in guar
  - Pre-plant soil incorporated:
    - Course-textured soils (sand, loamy sand, sandy loam), 0.5 qt./A;
    - Medium, 0.75 qt./A
    - Fine, 0.75 qt./A
    - All soils with 2-5% organic matter, 0.75 qt./A
- Clethodim (Select Max, etc.; 12.6% a.i.) for over-the-top grass control after guar emergence (post-emerge)
  - Annual grasses, 9-16 fl. oz./A
  - Perennial grasses, 12-32 fl. oz./A
  - NIS at 0.25%, but no AMS
  - 30-day post-harvest interval (PHI)

Herbicide

- Aim (carfentrazone) is labeled for hooded sprayers in guar

- Texas A&M AgriLife submitted information for 2,4-DB approval to the EPA IR-4 specialty crop program for possible labeling as a post-emerge over-the-top broadleaf weed control option. No decision was made (or seemed necessary since guar acreage disappeared in 2014 & 2015)
  - Proposed label is for 1.0 pint per acre applied up to 6” tall or 6 weeks, whichever comes first.

Rhizobium Inoculation

- I have the same frustration as you: poor to no nodulation
- West Texas research (Dawson Co.):
  - Guar seedbox powder (an inferior product), and now no longer commercially available
  - Concentrated peanut liquid Lift as advised by company (*Bradyrhizobium*)
  - Nothing! No increase in nodulation.
  - Some ‘seed inoculants’ used in guar (e.g., Sono Ag., Plainview, TX) have *Rhizobium*, (‘Micronoc’ powder; also a liquid) and other biologicals that may be specific to guar

Rhizobium Inoculation

- AGCARES, Dawson Co., 2002
- Seedbox inoculant, planted June 28
- Temperature (4 PM):
  - Air, 93 F
  - Soil surface, 130 F
  - Seed depth, 1.25” deep, 104 F
  - 2” depth, 90 F
  - This kind of temperature in the soil surface kills the inoculum
  - Guar seedlings are not able to emerge from deep plantings very well, are poor at breaking crusts, thus planting deep to avoid surface soil temperatures is problematic

Rhizobium Inoculation

- INTX Microbials (now Verdesian) was the most recent U.S. manufacturer that still had a *Rhizobium* inoculant with guar included on the label (prior to 2010, many minor and other 'pulse' crops on same label).
- Micronoc, Sono Ag., Plainview, TX; a combination *Rhizobia/seed* inoculant (advance notice needed for liquid), does include a nodule strain isolated from guar
- Seedbox powders historically are poor at nodulation
- Visjon Biologicals, Wichita Falls, TX, is a potential key partner in developing an improved *Rhizobium* product (most likely granular) for guar

Rhizobium nodules on guar roots

Seeding

- ~5 lbs./A dryland, ~8 lbs./A irrigated; higher seeding rates (~10 lbs./A) may increase stem node length at the soil line, like in soybean, and ease harvest
  - Old TX Rolling Plains research reported that 2 to 10 lbs. seed/A produced no difference in yield
- Listed ground, 4-8” tall beds, can help harvest
- 70˚ F for optimum establishment at planting
  - This is about as warm a soil as needed for any crop

Fertility Results

- AGCARES, Dawson Co., TX
- Being a legume ("guar is a soil builder"—NOT; it has to be nodulated); Nitrogen should not be a consideration
- Two-year results on dryland guar: no measurable yield response to 30 lbs./A P_2O_5

- India: most common micronutrient deficiency is Zinc

Insects and Disease

- None treated for yet in West Texas in 1998-2019
  - Alternaria, bacterial blight (‘Monument’ is susceptible)
- Guar midge (infects bud)--not the same insect as sorghum midge but is the alfalfa midge
  - Infrequent issue, but sprayed for in Hardeman Co. in 2012

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Insects and Disease

- Of two Texas Tech variety releases in about 2005, one variety, ‘Monument’ is very susceptible to disease—not recommended (though some growers like in when planted late relative to other varieties)
  - Initial testing suggested disease was bacterial blight
- Alternaria is somewhat common on guar, but usually not at damaging levels, and not practical to treat

Guar--Profitability 'Keys'

- Production as a primary crop is better than as catch crop
- Wait to plant until soil moisture for germination/emergence is good

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Guar--Profitability 'Keys'

- Irrigation response: ~100-150 lbs./A per 1"
  - Caveat: 2001, Dawson Co.
  - Dryland corners, 1,100 lbs./A (a good year!)
  - Over-the-top sprinkler irrigation same as neighboring peanuts, 700 lbs./A (frequent spray irrigation) interfered with flowering, pollination, seed set, or all three
  - Consider sprinkler irrigation if needed to get crop up then convert to drag hoses on alternative furrows, preferably with furrow dikes, for irrigation.

Guar--Profitability 'Keys'

- Experienced harvesters with right headers and can increase harvestable yield considerably
  - Especially with air-reels, which I think are worth the added cost ($2-4/acre) with the custom harvester (Barrington Brothers, Oklahoma)
  - Since guar has a tendency for the pods to break off at harvest (break off, not split open), the air reel blows these shattered pods into the header

Air-Reel Headers

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Need for Harvest Aid Use in Guar

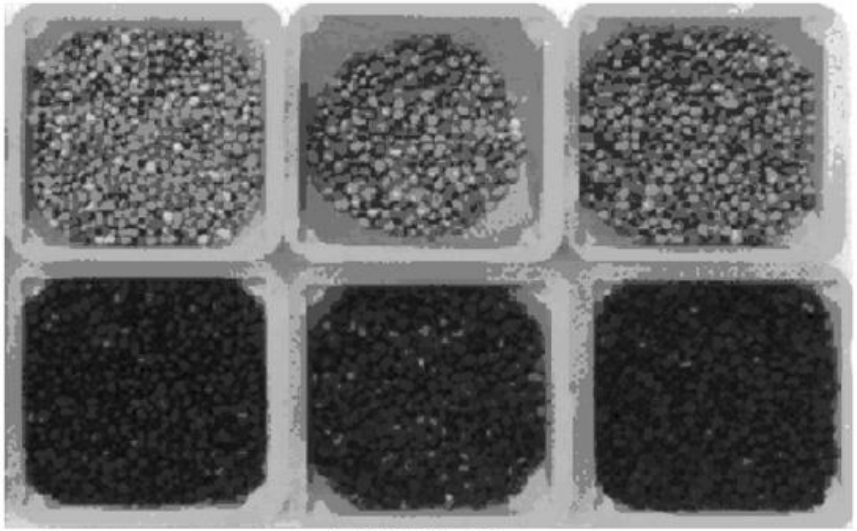
- If guar remains in the field a long time waiting for a killing frost, plant death, and subsequent dry-down, some seed may turn black, especially if wet conditions prevail and harvest is delayed.
  - This reduces grade and potentially reduces gum quality
- Use of a labeled harvest aid (desiccant, defoliant, herbicide) can allow earlier harvest and potentially higher quality guar gum product
  - Paraquat (Gramoxone)—labeled
  - Sodium chlorate—labeled
  - Glyphosate (Roundup, others)—we interpret the label for late-season weed control (not technically as a harvest aid)
  - Forthcoming Texas A&M AgriLife reports will note that Gramoxone & sodium chlorate are best.

Seed Quality

- Germination %? Maintain as high as you can get, but some guar may have germ of only ~67% after a couple of years
  - Long-term seed storage usually sees guar seed quality deteriorate to unacceptable levels after ~8 years
- Guar seed must be free of morningglory! Similar size & shape seed that can't be cleaned out

Seed Quality—Black Seed

- Texas Tech Univ. research on black seed, which is often assumed to be of inferior quality, and appears to be more common in the Rolling Plains than in the High Plains
- Germination is higher in black seed (degradation of seed coat, better water uptake), but endosperm content was not significantly different—gum ***content*** and ***quality*** not reported among different colored seeds.



Journal of Arid Environments 70 (2007) 29–38.

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Raw Guar Grading Standards

These are industry grades for U.S. grown guar off the farm (there is no Federal standard). Contract price is based on #1 Grade, and will specify discounts for lower grade. In many years all guar delivered to former WTG was #1.

GRADE	MOISTURE MAXIMUM (%)	MINIMUM TEST WEIGHT (Lbs./Bushel)
#1	13.5	60
#2	14.0	59
#3	14.5	58
#4	15.0	57
SAMPLE GRADE	above 15.1	below 56.9

Guar price may discount for black/dark seed above a certain % as dark seed may indicate possible lower gum quality. Dark seed often occurs due to greatly delayed harvest, rainy weather after maturity, or both. Guar Resources currently discounts only if black seed > 50% though it is certainly best to minimize it (black seed is a little more difficult to process).

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Guar--Mistakes

- Planting when soil moisture conditions are poor—poor stand establishment
- Guar is not for weedy ground—only three herbicides currently labeled
- Need to consider harvest method prior to planting—header type will affect flat vs. bedded planting; custom combine, $25/A
- Not using limited irrigation if it is available
- ATTITUDE!!!

What Growers Say Since 2001

- Use higher seeding rates, maybe 8 lbs./A even on dryland
- If irrigated, water up vs. planting into moisture (preferred?); watch for crust
- Reduced performance on ground which has undergone 'deep breaking' tillage (12-16")
- "I like the condition of my ground after guar"
- "My cotton looks better after guar"
- Roundup Ready "flex" cotton aids control of volunteer guar the next year (can be sprayed season long if needed)

What Growers Say Since 2001

- “Butch job” harvesting—avoid it
- Pay for experienced harvesters with right equipment
- How are you going to harvest?—ask at planting time
- “Got to get into the dirt” with your header to get all the yield
- Chemical termination or bean knifing?

Where Must Guar Yields Go? And What Type of Production?

- Guar at 50,000 acres in the U.S. vs. 250,000 acres or even 500,000 acres annually?
- Large guar gum users need major **consistent** supply to substantially commit to U.S. guar (quality considerations perhaps a different matter)
- 200 million pounds of guar gum use in North America? That's about 700,000 acres of production at 1,000 lbs./A.
- We can't reliably achieve this with only dryland—to make this potential viable and reliable, we have to:
  - increase yield per acre (breeding, GMO?, management)
  - produce some guar on irrigated land to minimize drought effects on supply

Future Seed Guar Seed Supplies

- Guar companies normally only supply seed to those who have signed production contracts
- Texas Foundation Seed Service, a unit of Texas A&M AgriLife Research, has some foundation 'Kinman'
  - Currently $4/lb. for high purity foundation seed (otherwise certified seed would be ~$2/lb.)
  - TFSS is increased small quantities of public varieties 'Lewis' and 'Santa Cruz' in 2013
  - http://tfss.tamu.edu (Dr. Richard Vierling)

Future Seed Guar Seed Supplies

- Status and availability of Plant Variety Protected (PVPA) varieties Matador and Monument released by Texas Tech Univ. is unknown (would require a Material Transfer Agreement, royalty payments from at seed purchase or from production)
- To inquire on their status, contact Texas Tech Univ. Dept. of Plant & Soil Sciences, 806-742-2838

Current USDA Funding on Guar

- Guar is generating interest at the federal level for research and extension funding, including the following:
  - Guar Planning Proposal (project outcome is a plan for a larger USDA proposal to link OK, TX, NM, AZ research into a coordinated four-year project to be re-submitted in 2019). $35,000
  - Guar-Wheat Rotations—project targets Northern Texas Rolling Plains and South Plains, 2017-2021; $499,000
  - Guar Breeding & Management in a Semi-Arid Region, ~$88,000
  - Guar is a component (about 10%) of a five-year AZ-NM bioenergy project focused mostly on guayule (native plant that produces a natural rubber), 2017-2022, ~$1.5 million (approximate guar portion).

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For Further Information

- http://lubbock.tamu.edu/othercrops/guar
- Your contractor