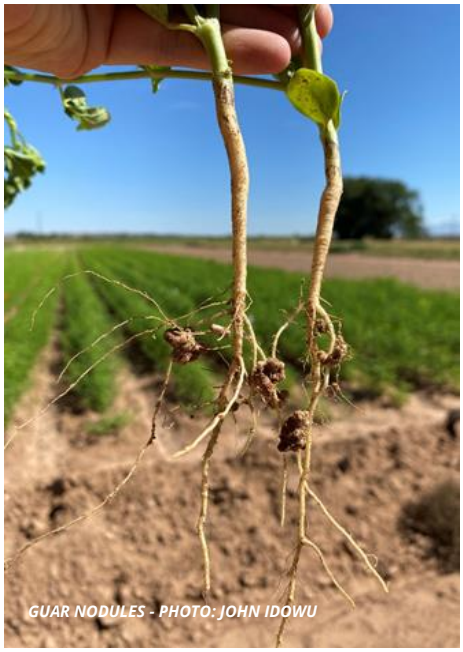
Guar Fertilization


GUAR NODULES - PHOTO: JOHN IDOWU

NITROGEN FIXATION

> A chemical process by which atmospheric nitrogen is transformed by microorganisms as part of the nitrogen cycle.

NITROGEN AND PHOSPHORUS FERTILIZATION TRIALS

> Guar (*Cyamopsis tetragonoloba*) is a legume that grows well in the arid and semiarid desert regions of New Mexico and Arizona. It is a low-input, drought-tolerant crop, thus a potential alternative crop in areas affected by changing water availability and climate change.

> As a legume, guar can fix nitrogen. Nitrogen is an essential nutrient for the growth of all plants and is the largest nutrient applied in agriculture. It improves the growth and yield of crops and is essential for cell elongation, photosynthesis, and seed formation.

MAKING NITROGEN IN PLANTS

> Nitrogen fixation in legumes is a process whereby a plant enters into a symbiotic association with a class of soil bacteria belonging to the *Rhizobium* species. The legume secretes special substances (flavonoids) through the roots into the soil which attracts the bacteria to attach to the cells of root hairs. Once the bacteria “infect” the root hairs, the plant cells respond by dividing and forming nodules where the bacteria are retained.

> Inside the nodules, the rhizobium bacteria convert the naturally occurring nitrogen found in the air and soil into nitrates, which is the form of nitrogen that plants can readily use. The nitrates are made available to the legume while the legume provides the bacteria in the nodules with carbohydrates necessary for their growth.

17 KEY ELEMENTS FOR PLANT GROWTH

• Carbon (C) • Hydrogen (H) •
• Oxygen (O) •
• Nitrogen (N) •
• Phosphorus (P) •
• Potassium (K) • Sulfur (S) •
• Calcium (Ca) •
• Magnesium (Mg) • Boron (B) •
• Chlorine (Cl) • Copper (Cu) •
• Iron (Fe) • Manganese (Mn) •
• Molybdenum (Mo) •
Nickel (Ni) • Zinc (Zn) •

NEW MEXICO FIELD TRIALS
PHOTO: KULBHUSHAN GROVER

PURPOSE OF THE SBAR FIELD TRIALS

> There are few reports in New Mexico and Arizona of guar forming nodules under field conditions. Without adequate nodulation, guar must acquire nitrogen from other sources. The absence of nodules has been attributed to high summer soil temperatures that may inhibit the nodulation process (Liu et al., 2011).

> Another key element for plant growth is phosphorus. Phosphorus is critical in legumes for root development, nodule formation, and nutrient uptake. Thus, it is important to learn whether guar may benefit from additional phosphorus applied to the soil at planting.

TRIAL METHODS

> To find out if guar yields are affected by the addition of nitrogen and phosphorus, we conducted field trials across four locations in New Mexico: Las Cruces, Los Lunas, Tucumcari, and Clovis, NM.

> We applied two rates of nitrogen and phosphorus to the soil before planting. The rates were 22 lb N/ac or 44 lb N/ac for nitrogen; and 22 lb P_2O_5/ac or 44 lb P_2O_5/ac for phosphorus. These rates were compared to a control plot with no additional nitrogen or phosphorus added.

> The experiments were conducted over two growing seasons, with growth and yields assessed at each location.

TRIAL RESULTS: WHAT WE LEARNED

> Three observations were made from the results of these trials:

1. The response to both nitrogen and phosphorus fertilizers varied among locations.
2. The response to fertilization varied each year.
3. The response to nitrogen and phosphorus application was generally small or not significant.

> This suggests that guar yields may vary with location and can be affected by the seasonal weather patterns.

> Added nitrogen and/or phosphorus may have little effect on overall yield.

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GUAR PLANT WITH PODS FORMING
PHOTO: JOHN IDOWU

TRIAL LOCATIONS

- Las Cruces, NM
- Los Lunas, NM
- Tucumcari, NM
- Clovis, NM

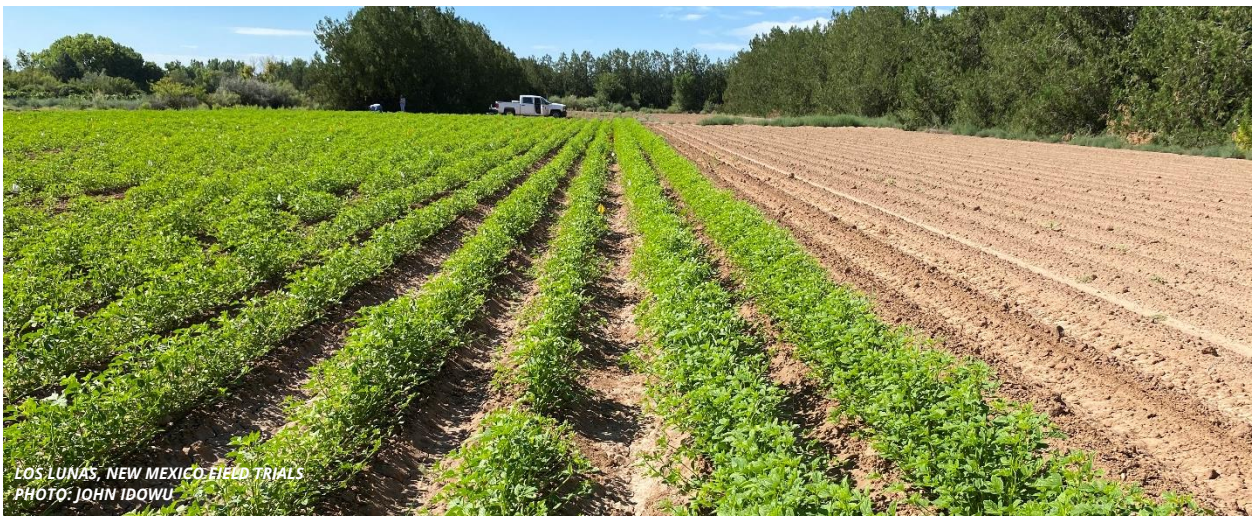
TRIAL DETAILS BY LOCATION

> In **Las Cruces** during the first year of the trial, guar bean yield was not affected by nitrogen but increased with phosphorus application compared to the control treatment that did not receive fertilizer. During the second year, guar yield was not affected by either nitrogen or phosphorus fertilizers compared to the control treatment. At Las Cruces, the highest bean yield the first trial was1165 lb/ac, while the highest yield during the second year was 867 lb/ac.

> Nitrogen and phosphorus fertilization did not affect the bean yields during both trial years in **Los Lunas**. The highest bean yield recorded for Los Lunas the first trial year was 685 lb/ac, and during the second year it was 2128 lb/ac. The very low guar yield during the first year was probably due to the early onset of colder temperatures during the guar reproductive phase.

> There were no significant effects of nitrogen and phosphorus fertilizer application during both trial years in **Tucumcari**. The highest bean yield in the first year was 951 lb/ac, while 1688 lb/ac bean yield was recorded in the second year.

> In the first trial year, nitrogen and phosphorus fertilizers did not affect guar bean yields in **Clovis**; however, during the second trial year guar responded to nitrogen with the best yield at the highest nitrogen rate, but again phosphorus did not affect bean yield. The highest yield recorded the first trial year was 1052 lb/ac, while 1336 lb/ac was recorded in the second year in this location.



LOS LUNAS, NEW MEXICO FIELD TRIALS
PHOTO: JOHN IDOWU

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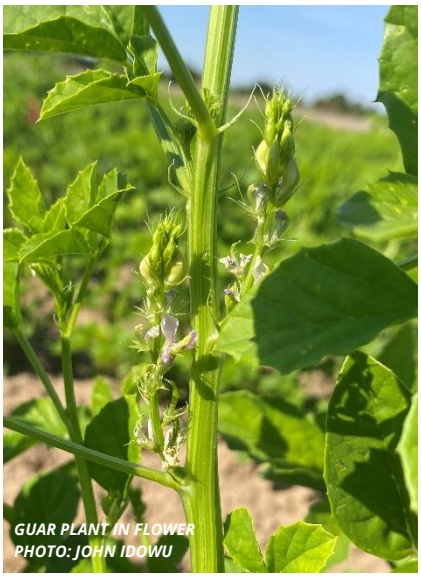

GUAR PLANT IN FLOWER
PHOTO: JOHN IDOWU

REFERENCES

> Liu, Y; Wu, L; Baddeley, J.A; Watson, C.A. **2011**. *Models of biological nitrogen fixation of legumes*. Sustainable Agriculture Volume 2, pp. 883-905.

LESSONS LEARNED

> From our trials, it appears that the yield of guar was not significantly affected by nitrogen and phosphorus fertilizers at most locations. The yield was improved in only one year in Las Cruces with the addition of phosphorus, while in Clovis the yield was improved one year by the addition of nitrogen.

> This trial suggests that guar would probably not need extra fertilizer inputs to grow well in New Mexico, but seasonal weather variation and different growing locations can affect yields.

> Another lesson learned is the need to plant as early as possible to avoid colder temperatures during the reproductive stage when the pods are actively forming.

> Although we have not seen a significant response to fertilization at most locations of our trials, it is still generally advisable for farmers to conduct a soil test before growing their crops, including guar. Soils vary across locations, and with soil testing, any nutrient deficiencies can be identified and promptly corrected.

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