TEXAS

Fertilization for Cotton-Sorghum Rotations vs. Continuous Cotton

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Sorghum is the main rotation crop in the 3 million acre cotton growing region of the Southern High Plains of Texas. However, fertilizer requirements for the cotton-sorghum rotation are not well documented. We observed no rotation effect on the yield of cotton. Nitrogen (N) and phosphorus (P) fertilizer response was affected by rotation during the 4 years of this study.

Crop rotation has been long recognized as a benefit to soil and crops from the standpoint of pest, diseases, and soil fertility. The main rotation crop in cotton cropping in the Southern High Plains is sorghum. Surprisingly, yield data on the cotton-sorghum rotation compared to continuous cotton for this region is sparse. In other regions, rotating sorghum with cotton has reportably helped control nematodes in cotton. Although much soil fertility information has been generated in the last 40 years on mono-cropped sorghum and cotton, very little study has been done on the fertilizer needs of the cotton-sorghum rotation.

In the 2000 cropping season, we established a limited irrigation study evaluating rotation sequences of cotton-sorghum, sorghum-cotton, and continuous cotton. Fertilizer treatments included three rates of N, two rates of P, and two rates of zinc (Zn). The main objective of this study was to document N, P, and Zn fertilizer response for the cotton-sorghum and cotton-cotton rotations. We also tested the hypothesis of yield gains by rotating versus mono-cropping. We compared soil organic matter build-up by rotating with sorghum compared to continuous cotton.

This field research study, located at the Texas A&M University Lubbock Research & Extension Center, was in a split-plot design with three replicates. Main plots (eight 40-in. rows wide, by 200 ft. long) were crop rotation: continuous cotton, cotton-sorghum, and sorghum-cotton. Subplots (eight 40-in. rows wide, by 50 ft. long) were factorial combinations of three rates of N, two rates of P, and two rates of Zn fertilizer. Crops were planted in early May on 40-in. wide ridges that were re-listed every spring following fall disc plowing. Soil samples were taken every spring from the 0 to 6, 6 to 12, 12 to 24, and 24 to 36 in. soil layers for extractable soil nitrate (NO_3^-). The 0 to 6 in. depth was analyzed for other nutrients such as P, potassium (K), Zn, and iron (Fe). Additionally, we analyzed the top two layers for soil organic matter by "loss on ignition" and for total soil carbon (C) and N by dry combustion.

Table 1 describes the soil test results and the rates of fertilizer applied. Phosphorus (0-18-0 as H_3PO_4 in 2000 and in 2001, 10-34-0 in 2002 and 2003), and Zn (10% EDTA-Zn) were applied pre-plant by knifing-in liquid fertilizers 3 in. deep

Cotton and sorghum plots in Texas study.

Table 1. Soil test results (fertilized plots after 2000) and N, P, and Zn fertilizer rates applied to cotton following cotton, cotton following sorghum, and sorghum following cotton.

Crop	Previous crop	Soil NO_3-N	1st N rate	2nd (2x) N rate	Soil P ppm	P rate lb P_2O_5/A	Soil Zn, ppm	Zn rate lb Zn/A
		------------ lb/A ------------						
		Spring 2000						
Cotton	N/A	39	51	102	20	45	0.25	2
Sorghum	N/A	39	31	62	20	40	0.25	4
		Spring 2001						
Cotton	Cotton	99	0	0	35	0	0.33	2
Cotton	Sorghum	22	68	136	27	30	0.36	0
Sorghum	Cotton	75	0	0	28	20	0.45	0
		Spring 2002						
Cotton	Cotton	52	38	76	39	0	0.32	0
Cotton	Sorghum	20	70	140	29	30	1.4	0
Sorghum	Cotton	54	16	32	30	20	0.41	2
		Spring 2003						
Cotton	Cotton	23	67	135	46	0	0.38	0
Cotton	Sorghum	14	76	153	39	0	0.71	0
Sorghum	Cotton	24	46	93	35	0	0.53	2

below the rows. The first rate of N fertilizer (soil-test and yield goal based) and half of second rate (based on two times the first rate) was knifed-in pre-plant (32-0-0, urea ammonium nitrate) at 3 in. depth, 3 in. off the row. The second half of the higher N rate was applied in the same manner at first square in cotton and at the 12 in. height of sorghum. The grain yield goal for sorghum was 4,000 lb/A and the N fertilizer to be added was 70 lb N minus 0 to 24 in. soil NO_3-N, according to regional recommendations. The lint yield goal for cotton was 750 lb/A and the N fertilizer to be added was 90 lb N minus 0 to 24 in. soil NO_3-N, also following regional recommendations. At the start of the study, the soil tested 39 lb NO_3-N/A (0 to 24 in.), 20 parts per million (ppm) Mehlich 3-extractable P (0 to 6 in.), and 0.25 ppm DTPA-extractable Zn (0 to 6 in.) See **Table 1**.

Soil test P in the zero P control plots tended to increase to about 30 ppm for reasons not clear to us. Soil test Zn in the zero Zn control plots remained between 0.25 and 0.30 ppm. Soil test P and Zn in fertilizer addition plots increased in all cases (**Table 1**). Spring extractable NO_3-N in 0 to 24 in. soil depth was on average 39 lb N/A less in plots following sorghum compared to continuous cotton plots.

In the establishment year of the study (2000), sorghum grain yields and cotton lint yields averaged 5,500 and 740 lb/A, respectively (data not shown). Nitrogen, P, or Zn fertilizer responses were not observed. Discussion from this point on will focus on the three seasons of data where rotation data applies, from 2001-2003.

Cotton lint yields were similar following sorghum compared to cotton following cotton for all 3 years (**Table 2**). On average, 39 lb more fertilizer-N/A was applied to the 1X N rate for cotton following sorghum compared to continuous cotton (**Table 1**). In 2001, sorghum grain yields were only about half of the expected level. In 2002 and 2003, sorghum yields were greater and similar to the 4,000 lb/A yield goal. Continuous cotton lint yields equaled the expected goal of 750 lb/A in 2001 and 2003 and cotton in both rotations exceeded the yield goal in 2002. The summer of 2001 was hotter and drier than average and both crops suffered from water stress.

Nitrogen response was observed in all 3 years in cotton following sorghum, but was absent in the cotton-cotton rotation

Table 2. Yields of cotton and sorghum as affected by previous crop and N, P, or Zn fertilizer.

2001 Crop	2000 Crop	2001 Yields	Standard deviation	N response	P response	Zn response
		------- lb/A -------				
Cotton	Cotton	765	79	No	Yes	No
Cotton	Sorghum	630	79	Yes	No	No
Sorghum	Cotton	2,356	410	No	No	No
2002 Crop	2001 Crop	2002 Yields				
Cotton	Cotton	1,086	42	No	No	No
Cotton	Sorghum	1,096	42	Yes	No	No
Sorghum	Cotton	5,096	487	Yes	No	No
2003 Crop	2002 Crop	2003 Yields				
Cotton	Cotton	763	166	No	Yes	No
Cotton	Sorghum	654	201	Yes	No	No
Sorghum	Cotton	4,095	880	No	No	No

(**Table 2**). Grain sorghum responded to N fertility in 2002 only. Phosphorus response was observed in continuous cotton only, and only in 2001 and 2003. No Zn fertility responses were observed in any rotation or in any year.

Important in understanding N fertilizer response on the Acuff sandy clay loam soil is that about 50 lb N/A is available from mineralization of soil organic matter and from previous cotton crop leaf litter. Sorghum residue, on the other hand, may be biologically "tieing-up" or immobilizing N. This may contribute to the more consistent N fertilizer responses in cotton following sorghum compared to cotton after cotton. As N fertilizer recommendations for these cropping systems are refined, N credits may be needed for cotton leaf-fall and N debits for sorghum residue. Lack of P response in most rotations is probably because soil test P was near the regional recommended critical level of 33 ppm (**Table 1**). Soil Zn was likewise near the critical levels of 0.29 ppm for cotton and sorghum (**Table 1**).

The lack of a positive cotton lint yield response following sorghum compared to mono-cropped cotton was unexpected. In the stormy spring of 2003, the ground cover of about 30% of sorghum residue protected cotton seedlings from wind and blowing sand damage suffered in the continuous cotton. Nevertheless, no positive rotation effect in yield was observed.

Conservation compliance and protection of cotton seedlings is considered another benefit of rotating sorghum with cotton. Soil organic N and C (average of 0.06 and 0.55 %, respectively) analyzed from spring 2002 soil samples did not yet show rotation effects after 3 years and one or two sorghum crops. Soil organic matter buildup, therefore, probably requires several years of cotton-sorghum cropping. BC

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Nutrient Management of Soybeans with the Potential for Asian Rust Infection

Asian soybean rust has been identified in the U.S., and there are many questions about how it will affect production. The focus has been on fungicides and genetic development. For an article and related information about how plant nutrition might be a factor, check the PPI/PPIC website at: >**www.ppi-ppic.org**<.