No-Till Research with Tropical Corn in a Doublecrop System

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Introduction

Mother Nature is a no-till farmer never leaving the earth bare of vegetation. No-till farming is not new, but an old approach adapted to modern machinery and farming. Excessive tillage and poor tillage practices are the primary causes of soil erosion from farmland. Eliminate tillage operations and you also save time and money. Every trip across a field with a tillage tool represents an investment in time and dollars. A need also exists for alternative crops to soybean for use in no-till wheat *[Triticum aestivum* (L.)]doublecropping in the southern USA. While soybean *[Glycine max* (L.) Merr.] predominates, other crops such as grain sorghum *[Sorghum bicolor* (L.) Moench.], sunflower *[Helianthus annuus* (L.)], and temperate corn *(Zea mays* (L.)] have shown varying potentials in doublecropping (Sanford et al.. I986).

Winter wheat is normally harvested between 1 and 15 June in the S.E. USA. Doublecropped soybean is usually planted about 12 June for optimum yields. Temperate corn following winter wheat is not a suitable double-crop in the S.E. Coastal plain because of the occurrence of damaging insects and disease (Sanford et al., 1988). specifically fall armyworm *(Spodoptera frugiperda* (J.E. Smith)] and southern corn rust *[Puccinia polysora* (Undrew)].

Tropical corn hybrids with satisfactory grain yields at moderate fertility (120 lb N/A) have become available (Taylor and Bailey, 1979). Yet. tropical corn hybrids generally yield less grain than temperate adapted hybrids (Muleba, etal.. 1983) under spring climate (March15 to Aug 26). high fertility, irrigation and low insect and disease intensities. but they may be useful as a nonirrigated late summer crop (June to October) in the S.E. United States.

The study was conducted to 1. determine yield potential of no-till tropical corn with moderate energy input doublecropped after no-till wheat, 2. compare the economics of moderate energy input summer no-till tropical corn with no-till soybean and temperate corn. 3. document the rainfall and air temperature patterns of the June to October growing seasons of moderate energy input tropical hybrids over years.

Materials and Methods

Following the harvest of Florida 302 wheat, tropical corn was planted no-till into winter wheat stubble with a Brown-Hardin Ro-ti1 planter[2] in 30-inch rows at a population density of 18,000 plants/A.

Tropical corn was grown in a moderate energy input system of 120 lb N/A and no irrigation (dryland). Tropical corn (Pioneer X-304C) planting dates were 13 June 1985, 16 June 1986.24 June 1987 , and 8 June 1988. In 1987, Asgrow 5509, a temperate hybrid, was no-till planted as a singlecrop on 26 March in a high energy input system of high fertility (250 lb N/A). irrigation, and population density of 30,000 plants/A. In 1988, Asgrow 5509 was no-till planted at a population density of 18,000 plants/A on 15 June in a moderate energy input system.

The research was conducted at the North Florida Research and Education Center at Quincy, FL on a Norfolk sandy loam soil (fine-loamy, siliceous, thermic. Typic Paleudult) under natural rainfall conditions, for late summer tropical corn, and irrigation, for high energy input spring temperate corn. Herbicides used in the experimental plots were a pre-emerge tank mix of Aatrex (2-chloro -4-ethylamino-6-isopropylamino-s-tri-azine) @1 1/2 qt/A, Lasso (2-Chloro-2'-6'-diethyl-N-(methoxymethyl)-acetanilide] @ 2 qt/A, Paraquat (I, 1'-Dimethyl-4,4-bipyridinium ion as dimethyl sulfate salt) @ 1 pt/A, and a non-ionic surfactant (X-77) at I pt/l00 gal for weed control [primarily morning glory (Ipomoea spp.)]. Each year, ammonium polyphosphate (10-34-0) was banded (@ 20 lb N/A as a starter fertilizer on one side of the row, and Furadan [2-(methoxy carbarnolamino)-benzimidazole] was banded @ 8 lbA behind the planter wheel for lesser cornstalk borer *[Elasmopalpus lignosellus* (Zeller)] control.

In 1985, fall armyworm were sprayed with Lannate **[S-**Methyl-N-((methylcarbamoy1)oxy)-thioacetimidate] July and 16 July @ I 1/2 pt/A. In 1986, Lorsban 4E [O,O-Diethyl 0-(3,5,6-trichloro-2-pyridinyl)-phosphorothioate] @ 3 pt/A was applied for fall armyworm control on I July. Nitrogen was sidedressed at 100 lb NIA on I July 1985 (when tropical corn was 24 to 30 inches high), 100 lb N/A on 8 July 1986(12 inches high) 1,05 lb N/A on 22 July 1987 (12 inches high), and 100 lb N/A on 12 July 1988 (12 inches high). A post-directed spray of 2.4-D (2,4-Dichlorophenoxyacetic acid) @ 1/2 pt/A + Paraquat @ 1 pt/A with a surfactant (X-77) was applied near mid-July of each of the four years for weed control. The temperate hybrid had the same rate of 100 lb N/A sidedressed on 20 April, and 2,4-D + Paraquat as a directed spray 1 week later.

Tropical corn was harvested on 3 October 1985, 2I October 1986, 27 October 1987, and 24 October 1988. The temperate, high-fertility, irrigated, spring-planted plots (Asgrow 5509) were harvested on 27 August in 1987 and the moderate-fertility, no irrigation, spring-planted plots were harvested 24 August 1987; while the summer planted, moderate-fertility, no irrigation plots (Asgrow 5509) were harvested 24 October 1987 from 2 rows, 20 feet long. Grain moisture was determined with an electronic meter and grain yields were corrected to 15.5% moisture.

The temperate, high energy input corn (Asgrow 5509) was grown in adjacent plots at Quincy in the State Performance Trials. The hybrid was planted in a conventional seedbed

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with a Brown-Hardin Ro-til planter on 26 March 1987 after a preplant incorporation of Sutan (S-Ethyl diisobuty-Ithiocarbomate) @ 4.75 pt/A and Aatrex @ 2 qt/A. The corn was fertilized with 250-1O0-200) lb N-P-KIA and irrigated with I inch of water eight times during the growing season.

Experimental design was a randomized complete block each year. There were 3 replications in 1985. 4 replications in 1986, 6 replications in 1987, and 5 replications in 1988. The Stare Yield Performance Trial was also a randomized complete block with 4 replications, and its inclusion was for the purpose of economic analysis of an intensive management system compared to a dryland single- and doublecrop system.

Results and Discussion

Comparisons of grain yields of Pioneer X-304C for all four years are shown in Table 1 and days of planting. tasseling and harvest can be related to air temperature and rainfall data in Figures I. Note that the rainfall period correlates with planting and tasseling followed by a dry period at harvest. Rainfall during the summer growing season (planting date to harvest date) of 1985, 1986. 1987, and 1988 years was 16 inches durinp I 13days, 25 inches during I27 days, I5 inches during 125 days, and 23 inches during 159 days, respectively. The warm temperatures of June and July caused the tropical corn to grow much faster than expected so that the sidedress application of 100 lb N/A at 24-30 inches high in I985 (as recommended with spring-grown temperate corn) was late, reducing the yield, and hence the change in N sidedress signal to 12 inch high tropical corn for 1986, 1987. and 1988. The 1985 tropical corn yields were further reduced by the lodging problem caused by two hurricanes. In 1985. ninety-five percent of the corn lodged 20 to 30^o from the vertical but did not fall down. The leaning caused the roots to be exposed during the grain fill period and presumably resulted in less water and nutrient uptake during ear fill. The reduced yield (88 bu/A) of Pioneer X-340C in 1988 (Table I) is probably related to the dry period around tasseling (Fig. I).

The grain yields of Pioneer X-34OC grown in the summer under moderate energy inputs were compared with temperate corn (Asgrow 5509). Moderate fertility and a dry period during April and May of 1987 with no irrigation reduced temperate corn yields from 174 bu/A to 46 bu/A. The summer-grown 1988 temperate corn resulted in 29 bu/A grain yield that had a high incidence of corn earworm [Heliothis *zea (Boddie)]* and rice weevil *[Sitophilus oryzae* (Linnaeus)]I damage. The summer-grown, moderate energy input tropical corn averaged 87 bu/A over the four years and had very little corn earworm or rice weevil damage.

Yield, cost, price and net return for no-till winter wheat, doublecropped soybean, singlecropped and doublecropped dryland tropical corn, and singlecropped temperate corn

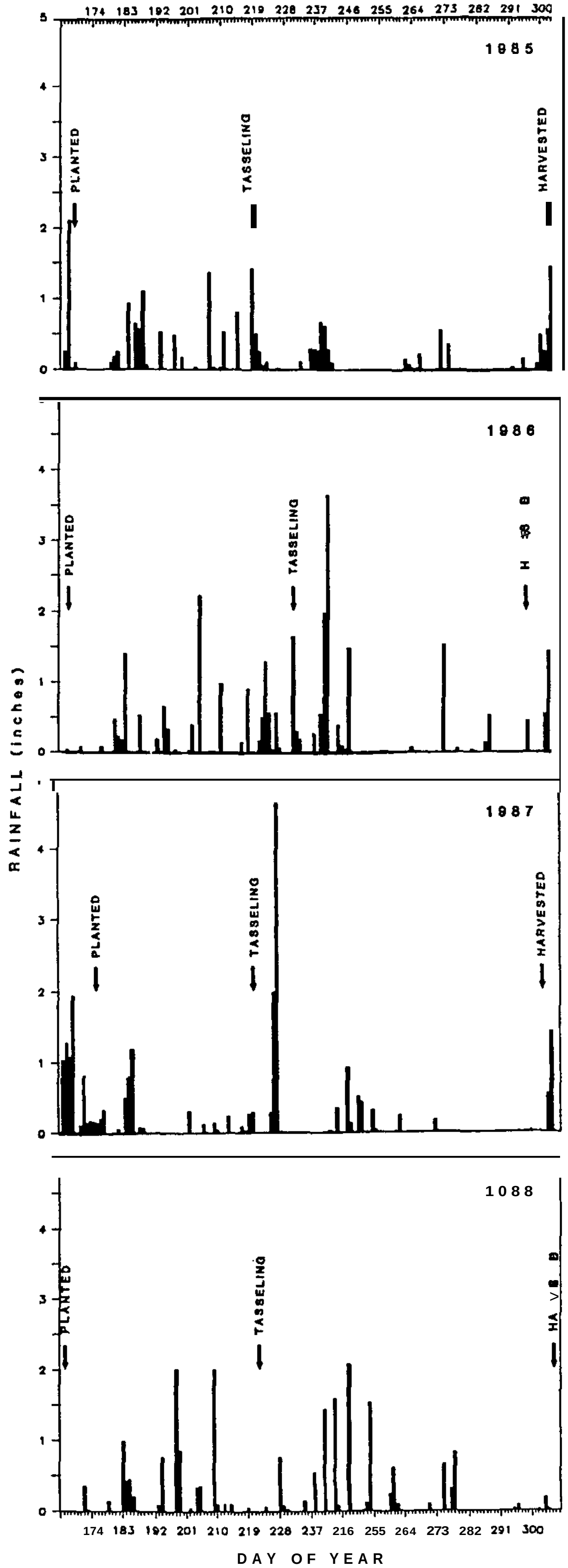

Figure Legends

Figure 1. Rainfall during tropical corn growing seasons of 1985, 1986, 1987, and 1988. Arrows indicate planting, tasseling and harvest date. Days of year are reported in days Julian.

Table 1. No-till tropical corn yields with moderate energy inputs at Quincy, FL for Pioneer X-304C in 1985, 1986, 1987, and 1988.

Year	Yield (bu/A)	t test**	CV
1985	64	c	8.7
1986	98	a	10.3
1987	95	ab	11.5
1988	88	b	10.6

*Columns with the same letter are not significantly different at the 1% level of probility using the Waller-Duncan K ratio t test.

Table 2. Yields, costs/A, costs/bu, projected 1989 prices, and net returns for no-till crops at Quincy, FL.

	No-Till Crop					
	Wheat	Soybean	Tropical Corn		Temperate Corn +/	
		Double	Double	Single-	Irrig.	Dryland
Variable cost/acre	82	90	120	140	240	I25
Fixed cost/acre	30	30	30	40	110	30
Total cost/acre	112	120	150	180	350	155
Yield (bu/acre)	47	25	87	87	174	49
Total cost/bu	2.38	4.80	1.72	2.07	2.01	3.16
Price ($/bu)	4.10	7.40	2.60	2.60	2.60	2.60
Net return/bu	1.82	2.60	0.88	0.53	0.59	-0.56
Net return/acre	X0.84	65.00	76.56	46.11	102.66	-27.44

+/Temperate corn singlecropped only

(irrigated and dryland) are displayed in Table 2. Yields are from the experiments, cost estimates are based upon the cultural practices used in the experiments and prices are projections of 1989 market prices. Dryland temperate corn is the only singlecrop with a projected negative net return. All other crops have a projected positive net return. The anticipated net return from an acre of high energy input (irrigated) temperate corn (spring planted) are about $35 greater than that of an acre of singlecropped, moderate energy input tropical corn (summer planted).

No-till doublecropping reduces production costs of both soybean and tropical corn. The cost savings in tropical corn is $0.35/bu or about $30/A. Doublecropped tropical corn returns almost $18/A more than double-cropped soybean.

The advantage of no-till tropical corn grown during the summer lies in the fact that good yields can be obtained with moderate economic inputs by taking advantage of the summer rains that are fairly dependable for much of the S.E. Coastal Plain during the period from late June through early September, which corresponds to the period of highest tropical corn need, and a predictable early fall drought for maturity and harvest. The dry fall permits few weeds to germinate and grow as they do when temperate hybrids mature in late July and early August. Early in the growing season, IPM practices must be adhered to for control of lesser cornstalk borer and fall armyworm, but we have observed that tropical corn husks are tighter than temperate hybrids making it less susceptible to corn earworm (aparticularly bad fall pest), immune to corn smut *[Ustilago maydis* (CD) Cda.), and with little incidence of aflotoxin *(Aspergillus* spp.). The exterior of the kernel is so hard the rice weevils find it difficult to enter the kernel and therefore damage to tropical corn was less than temperate corn when allowed to stand in the field after maturity. Fertility inputs for corn production are also lower in a doublecropping program because the tropical corn can utilize residual fertility from the previous crop. In general, no-tillage farming practices have proven successful for growing tropical corn in north Florida

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References

Muleba, N., T.G. Hart and G.M. Paulsen. 1983. Physiological factors affecting maize *(Zea mays* L.) yields under tropical and temperate conditions. Trop Agric. (Trinidad) 60 (1):3-l0.

Sanford, J.O.. B.R. Eddleman, S.R. Spurlock, and J.E. Hairston. 1986. Evaluating ten cropping alternatives for the Midsouth. Agron. J. 78:375-880.

Sanford, J.O., W.P. Williams, J.E. Hairston. and L.L. Reinschmiedt. 1988. Doublecropping insect and disease resistant corn with wheat. J. Prod.Agric. 1(1):60-63.

Taylor, B.R., and T.B. Bailey. 1979. Response of maize varieties to environment in West Africa. Trop. Agric. 56(2):89-97.