Tropical Corn Hybrids in a No-tillage System

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INTRODUCTION

Tropical corn *(Zea mays* (L.)] can provide a much-needed energy source (grain and silage) for dairy and livestock operations in Florida (Wright and Prichard, 1988; Wright and Chambliss, 1989). It is well suited because of its long growing seasonand tolerance to diseases (Teare et al., 1989) and insects, with the exception of the fall armyworm *[Spodoptea frugiperda* (J.E. Smith)] (Teare et al., 1990). Dry weather normally keeps yields around 60 to 80 bu/acre for spring-planted, non-irrigated temperate corn in the Coastal Plain of the Southern states and around 30 bu/acre for summer-planted corn (Teare and Wright, 199Oa). Low yields and low prices have dramatically reduced acreage of temperate corn in the southeast.

Farmer acreage of tropical corn increased from 5,000 acres in 1986 to almost 40,000 acres in 1989 in the southern U.S. because growers wanted a more consistent grain or silage crop that could be grown under natural rainfall conditions to increase profitability and cash flow and provide a rotation crop in lieu of summer legumes (soybean and peanut, Teare et al., 1989)to reduce nematode numbers that build up from the continuous cropping of summer legumes. Since tropical corn is grown after wheat harvest during the summer months when rainfall is most bountiful, it should perform more consistently in the southeast than temperate corn. Initially, there was only one commercially available tropical hybrid ('Pioneer X304C'), and that hybrid is known for its tolerance to insects and diseases and its difficulty in threshing. Tropical corn yields and quality from these summer plantings of Pioneer X-304C have been equal to or better than the state average for temperate corn planted at the normal time.

Fall armyworm infestations were heavy in 1989. Avoidance of pest injury by producing a crop at times when pest populations are in non-damaging stages or at low population levels is recognized as one of the more successful integrated pest management practices (Herzog and Funderburk, 1986). After our experiences in 1989 with fall armyworm damage on tropical corn, we felt we could recommend a planting date that would reduce fall armyworm damage on Pioneer X-304C in a wheat-tropical corn double-crop system by planting before 10 June in north Florida (Teare et al., 1990).

However, growers wanted improved hybrids that would produce higher grain yields with increased energy content of silage. The objective of this study was to provide further information on fall armyworm avoidance and grain yield results of tropical corn hybrids grown in a no-tillage system in relation to drought and insect stress.

MATERIALS AND METHODS

These studies were conducted on a Norfolk sandy loam (fine, loamy siliceous, thermic Typic Kandiudult) located on the North Florida Research and Education Center, Quincy, Florida. The soil has a compacted layer located 7 to 14 in. below the surface.

In 1989, the fall armyworm devastated late-planted tropical corn fields, but avoidance of the fall armyworm damage appeared to be correlated with planting before 10 June in north Florida. Thus planting dates were selected before and after 10 June to provide two levels of fall armyworm infestation. The only successful 1989 planting date study was a planting date x N rate study conducted on Pioneer X-304C with planting dates of 29 May, 15 June and 14 July. Planting date x N rate studies were continued with Pioneer X-304C in 1990 comparing the same five N rates of 0, 50, 100, 150 and 200 lb N/acre with three planting dates (8 June, 14 June and 12 July; the early 29 May planting in 1990 was delayed by rain to 8 June).

In 1989, a rainfed tropical corn hybrid study (normally planted on 10 June) was delayed by excess rainfall and late-planted on 29 June (Fig. 1), setting up the situation for heavy fall armyworm infestation. The tropical corn hybrid study in 1990 was grown under rainfed conditions (summer drought) and limited irrigated conditions (limited to applications at the early vegetative stage--Fig.l). The planting dates were 11 June and 3 July for both water regimes.

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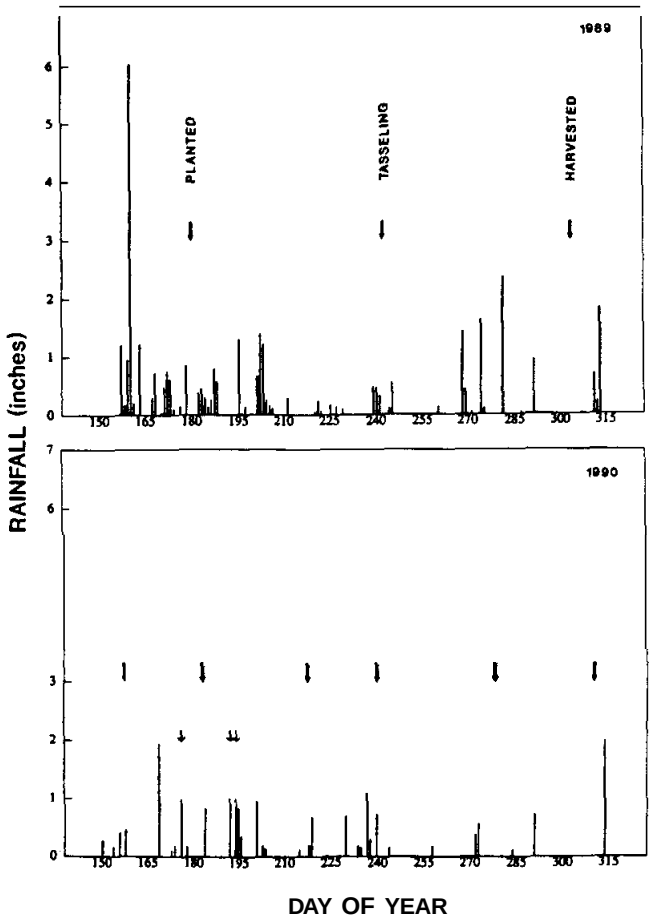

Fig. 1. Rainfall, planting date, 50% tasseling and harvest date during the 1989 and 1990 growing season. Three small arrows in 1990 indicate the limited irrigation. Days of year reported in days Julian.

The moderate energy input used in these experiments is the one described by Teare et al. (1989). A Brown Ro-Till™ planter was used to plant the tropical corn into standing wheat stubble at a plant population of 20,000 plants/acre. Twenty pounds N/acre was applied as starter fertilizer at planting and 100 lb N/acre when the corn was 12 in. tall. The experiments were not irrigated except as stated. Most of the tropical corn acreage planted in the southeast from 1988 to 1990 was based upon these recommendations.

The experiment was a randomized complete block design with four replications except for the 1990 irrigated and rainfed hybrid trial, which was a split plot with four replications. Interactions are illustrated according to Teare and Wright (1990b). The rows were 25 ft long with 30 in. between rows. Severe drought was experienced in 1990. Rainfall data, planting date, 50% tasseling and harvest date for 1989 and 1990 are shown for comparison in Fig. 1.

Fall armyworm adults were trapped in 1989, but the traps were located 200 to 800 yards from the tropical corn plots. This was considered too far from the experiment for realistic fall armyworm counts. Therefore, in 1990, larvae counts were made on ten tropical corn plants per replication for each of two hybrids and one open pollinated line of tropical corn.

RESULTS AND DISCUSSION

Environment and Phenology

In 1989, high rainfall (20 in. of rain fell from 21 May to 27 June 1989) delayed tropical corn planting from 10 June until after 27 June with severe fall armyworm injury and resulting yields of less than 40 bu/acre. Historically, the average tropical corn yield for Pioneer X-304C at this location has been 94 bu/acre when 120 lb N/acre has been applied. Tropical corn phenology for 1989 is shown in Fig. 1.

The year of 1990 was dry from early spring to late fall. The rainfall events and amounts resulting in severe drought are illustrated in Fig. 1. For this reason a limited irrigated companion study was included with the rainfed hybrid yield study. Irrigations are illustrated in Fig. 1 but were limited to applications at the early vegetative stage of tropical corn development. Tropical corn phenology is shown for 1990 in Fig. 1.

Planting Date

In 1989 and 1990, double-cropped Pioneer X-304C was studied at three planting dates and five nitrogen rates. Yield of no-till tropical corn in 1989 was highest from the May planting and decreased with each successive planting date (Table 1). Insect pressure from the fall armyworm also increased as planting dates were delayed (Fig. 2). The 1989 tropical corn yield data from the planting date by N rate study shows that the yields of Pioneer X-304C were 113 bu/acre on the 28 May planting date, 68 bu/acre on the 15 June planting date and 40 bu/acre on the 14 July planting date under rainfed conditions (Table 1). When the fall armyworm larvae counts (Fig. 2) are added to the previous information, it becomes evident that planting prior to 15 June results in greater yields and lower fall armyworm larvae counts than later planting dates. With the availability of 'Florida 303' wheat, which has the desirable traits of high yield, resistance to leaf rust and powdery mildew and early maturity (14 May, Teare et al., 1990), early tropical corn planting

Table 1. Planting date' and N rate influence on Pioneer X-304C yield, Quincy, Florlda, 1989 and 1990).

	Planting Date		
N Rate	28 May 1989	15 June 1989	14 July 1989
lb/acre	bu/acre		
0	71 a	39 a	41 a
50	96 b	69 b	44 a
100	113 c	68 b	40 a
150	112 c	81 b	42 a
200	115 c	72 b	43 a
Average	101	66	42
	8 June 1990	14 June 1990	12 July 1990
0	45 a	44 a	47 a
50	49 a	48 a	43 a
100	48 a	48 a	38 a
150	46.	53 a	43 a
200	51 a	45 a	47 a
Average	48	48	44

'All planted after florida 303 wheat was harvested in May.

dates will be practical. Common sense dictates that plantings of tropical corn should not occur after 1 June to avoid fall armyworms.

Nitrogen Rate

Higher rates of nitrogen in 1989 were most beneficial for early planting dates (Table 1). The trend was insignificant in 1990 because of the drought. In 1989, nitrogen rates that were sufficient for highest yields were 100 lb/acre for May planting, 50 lb/acre for June planting and 0 lb/acre for July planting.

Hybrid Yield Response

The yield expression of tropical corn hybrids studied in 1989 (severe fall armyworm damage) and 1990 (severe drought and fall armyworm damage) is shown in Table 2. Under severe fall armyworm stress (1989), the highest yield was that of Pioneer X-304C at 42 bu/acre, and other hybrid yields were as low as 7 bu/acre. The low yields of the rainfed hybrids in 1990 are a confounded expression of drought (Fig. 1) and fall armyworm damage (Fig. 2). Early-planted rainfed tropical corn yields in 1990 ranged from 18 to 44 bu/acre, and the late-planted rainfed tropical corn yields in 1990 ranged from 21 to 47 bu/acre. Pioneer X-304C yielded 21 and 40 bu/acre when planted early or late, respectively.

Limited early irrigation increased tropical corn yields of many of the new entries. Five early-planted hybrids yielded more than 100 bu/acre, and the range was 36 to 156 bu/acre under irrigation. The late-planted, irrigated tropical corn yields ranged from 18 bu to 140 bu/acre. Two of the hybrids ('Pioneer 3072' and 'Pioneer 3098') maintained high yields for both early and late plantings. Two other tropical corn hybrids also yielded 100 bu/acre. 'Sunbelt 1876' (a temperate corn) was grown for reference both years with consistently low yields at each planting date.

Since most of the useful data on tropical corn hybrid yield come from 1990, the data should be used cautiously because of the significant interaction of hybrid x water regime and hybrid x planting date.

Table 2. Tropical corn hybrid yields for 1989 (severe fall armyworm damage) and 1990 (fail armyworm damage and severe drought).

	29 May 1989	7 June 1990		3 July 1990	
Line	Rain-fed	Rain-fed	irri-gated	Rain-fed	Irri-gated
	bu/acre				
Flopup	30				
Pioneer XCJ 66	36				
Pioneer XCH 53	11				
Pioneer XCE72	12				
Pioneer 3212	16				
Pioneer X8965	12				
Pioneer 3226	20				
Pioneer 3238	7				
DeKalb B840	27				
DeKalb XL604	14				
DeKalb XL678C	14	21	75	34	84
Pioneer X-304X	42	21	73	40	73
Pioneer 6875	9	18	36	24	51
Cargill C343	26	32	85	36	79
Cargill C-381	18	26	77	36	a6
Pioneer 3230	16	24	52	33	49
Pioneer 3210	20	28	76	39	81
Pioneer 3072		38	122	41	140
Pioneer 3214		19	88	34	81
Pioneer 3098		31	130	37	107
Pioneer 3078		25	85	38	94
Sunbelt 1876 (Temperate)		15	25	20	33
Cargill C-333		39	156	35	74
Cargill C-501		27	54	21	101
Cargill C-611		34	102	42	83
Cargill T-327		23	103	25	55
Cargill T-321		44	78	36	52
Cargill T-320		31	92	32	66
Cargill C-805				37	32
Cargill C-701				47	91
Cargill C-803				42	105
Cargill C-955				38	18
Cargill C-606				48	80

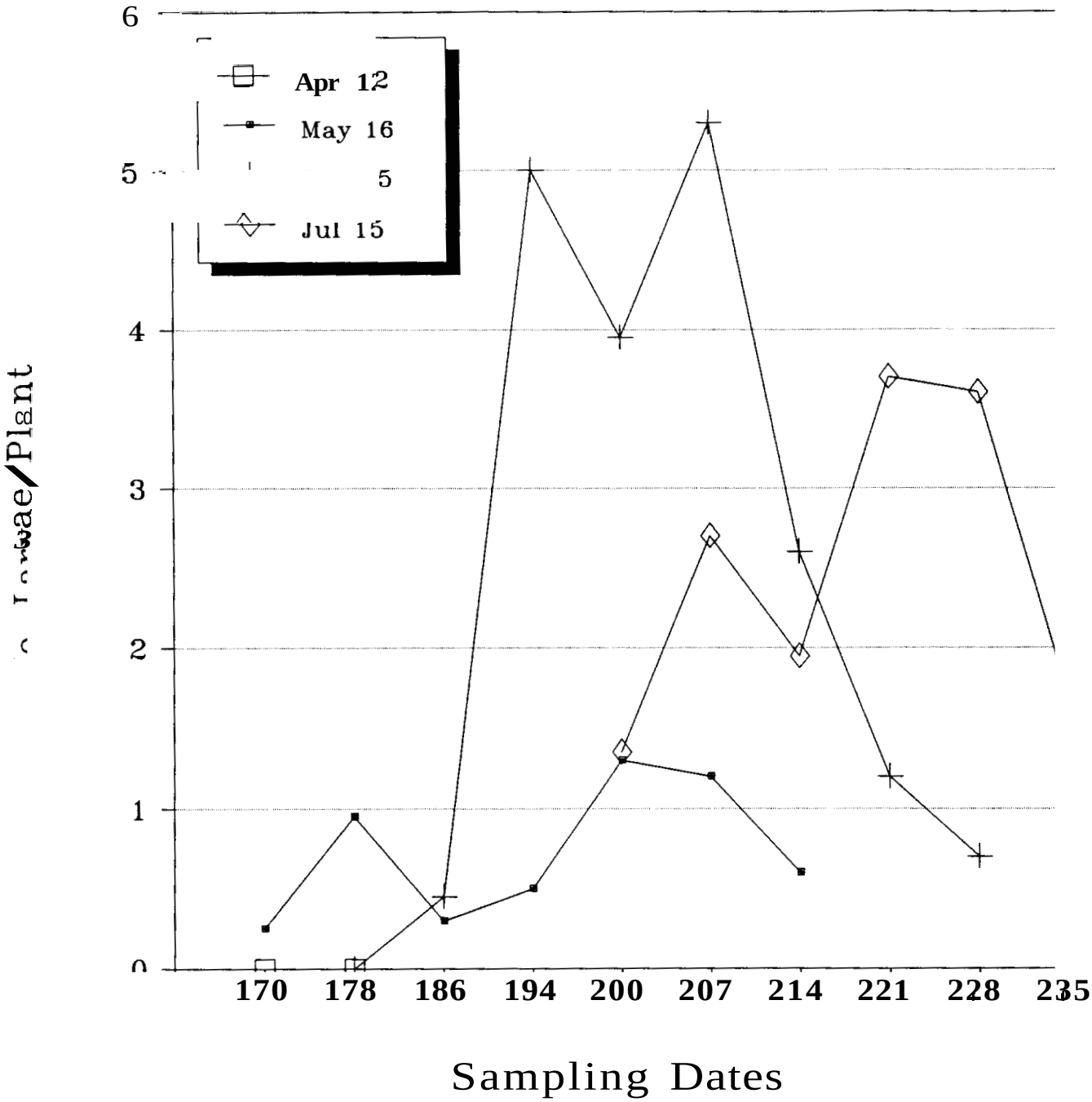

Fig. 2. Fall armyworm larvae counts in relation to days after planting for tropical corn planted on four planting dates (12 Apr, 16 May, 15 June and 15 July) In 1990.

Hybrid x Water Regime

A comparison of the interaction of corn hybrid yield in relation to water regime determines which hybrids did best under rainfed conditions and which did best under limited irrigation (positive changers) or remained the same (non-changers) (Fig. 3) for the two planting dates.

The asymptote (a line that is the limiting position that the tangent to a curve approaches) was used for isolating the positive changers and the non-changers from the median grouping. Seven hybrids were found with a wide range in yield in relation *to* water regime, and five hybrids were found with a narrow range in yield in relation *to* water regime in the early planting study.

In the late planting study, four wide-range hybrids in relation to water regime contained two of the same hybrids as in the early planting study (Pio-

neer 3072 and Pioneer 3098) and four of the same narrow-range hybrids in the late planting as in the early planting. *'Cargill* C-501', a narrow-range hybrid in the early planting, became a wide-range hybrid in the late planting, possibly indicating a favorable response of this hybrid to late planting.

Hybrid x Planting Date

The interaction of hybrid x planting date is illustrated in Fig. 4 for rainfed and irrigated conditions. Four positive changers ('DeKalb XL 678C', Pioneer X-304C, Pioneer 3214 and 'Pioneer 3078') having a wider range of yield than the others were noted in relation to planting date under rainfed conditions. The irrigated condition gave a wider range response. Three positive changers that did best when planted on 3 July were Cargill C-501, Pioneer 3072 and 'Pioneer 6875' with three negative changers that did best when planted on 7 June ('Cargill C-333', 'Cargill T-327' and 'Cargill T-320'). Three other negative changers that did well when planted on 7 June were 'Cafgill T-321', Pioneer 3098 and 'Cargill C-611'.

Fall Armyworm Preference

Fall armyworm seem to have definite preferences for certain tropical corn hybrids. In 1989, Pioneer X-304C showed that it was less susceptible to fall armyworm than other hybrids tested with resulting higher yields (Table 2). More evidence for fall armyworm preference is shown in Fig. 5 where Pioneer X-304C had significantly fewer fall armyworm than Flopup (a Florida open pollinated line) and Sunbelt 1876 (a temperate line) for all dates counted. In the 1990 limited irrigation hybrid tropical corn trials, fall armyworm definitely reduced yields of certain hybrids that have higher yield potentials in the absence of fall armyworm. Any hy-

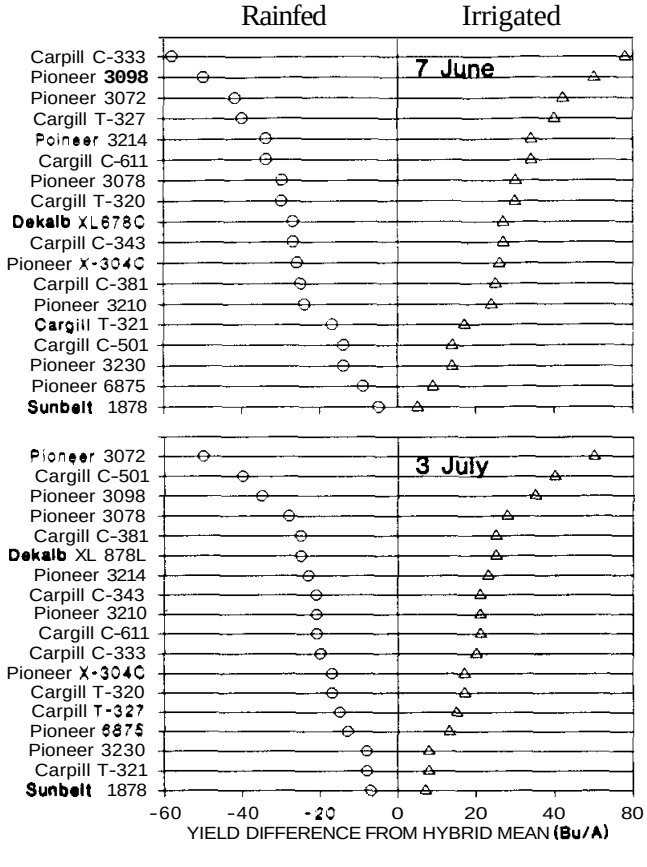

Fig. 3. Tropical corn hybrid yield interaction with water regime for early and late planting dates in 1990.

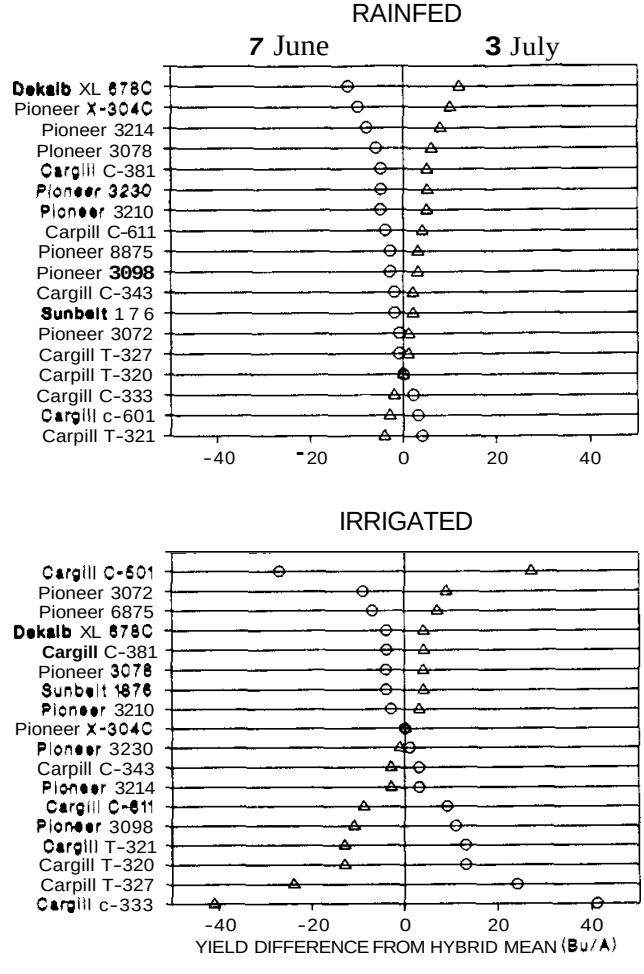

Fig. 4. Tropical corn hybrid yield interaction with planting date for rainfed and irrigated water regimes in 1990.

brid with a grain yield greater than 75 bu/acre was considered somewhat resistant to fall armyworm.

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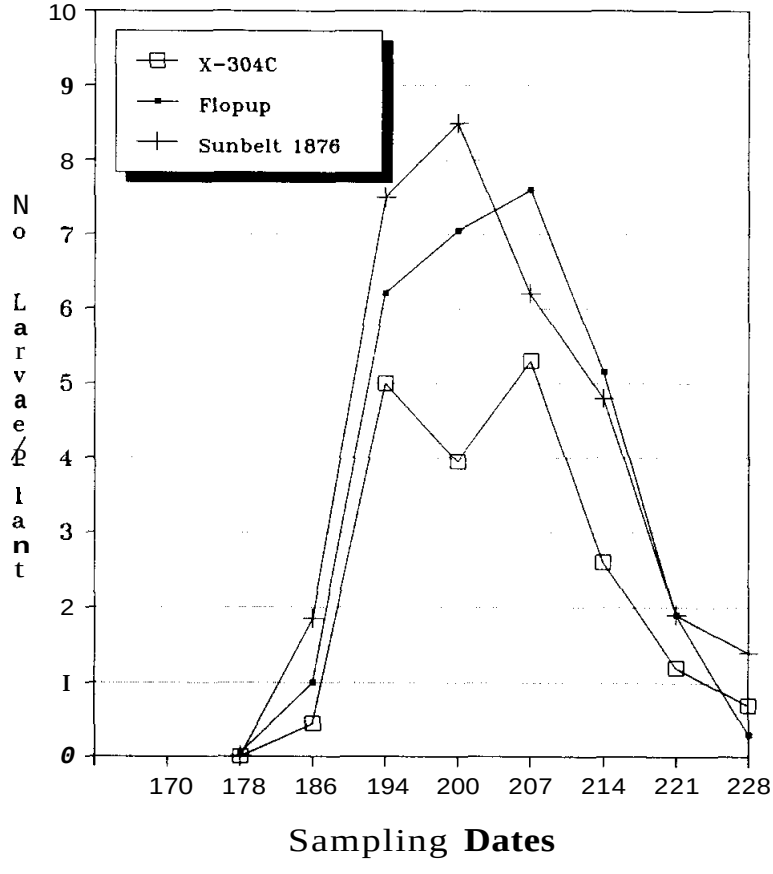

Fig. 5. Fall armyworm larvae counts In relation to two hybrids and one open pollinated lines of tropical corn In 1990 when planted on 15 June.