# THE ROLE OF CORN VARIETY AND POPULATION IN MEETING TARGET YIELD LEVEL FOR PHASE III BOND RELEASE[1]

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Abstract. -- Two experiments were conducted in western Kentucky to evaluate the effects of varietal selection, plant population, and soil ripping on productivity of corn (*Zea mays* L.) growing on recently-reconstructed prime farmland. In Experiment 1, 3 corn hybrids with known maturities (full-season--125 days, mid-season--120 days, early-season--115 days) were planted at populations of 14,900; 19,000; 20,600; and 24,200 kernels per acre to form a 3 by 3 factorial treatment set. All treatment combinations were further split into ripped and nonripped variables. Four replications were used, and the experiment was conducted 3 consecutive years. The full-season hybrid was more productive than the mid-season hybrid, which was more productive than the early-season hybrid. The effect of population was somewhat variable, depending upon available soil moisture and/or precipitation. The highest overall average corn yield was attained at the highest population (24,200 kernels per acre). Soil ripping increased corn yield for each hybrid x population treatment each year. In a separate experiment, the productivity of 42 commercial corn hybrids available in western Kentucky was evaluated. This experiment indicated that yield of corn will vary considerably depending upon the hybrid used. Yields ranged from 104.3 to 64.4 bu/a, with 14 of the 42 hybrids exceeding the yield needed for Phase III bond release. There was a relationship between maturity date and yield in that early-season varieties generally produced higher yields than later-maturing varieties.

## INTRODUCTION

Prime farmland (PFL) that is disturbed by coal mining operations must be restored to productivity levels that equal premining levels. Current regulations in Kentucky require that the productivity levels of PFL be achieved 3 consecutive years before release of (Phase III) reclamation bonds. For at least 1 of the 3 years, corn (*Zea mays* L.) must be planted. Success in producing corn yields on reconstructed PFL equal to or above that required for Phase III bond release has not been easily achieved, but has been realized with the use of proper soil reconstruction techniques (Barnhisel and Powell, 1985). Further improvement of corn yields on reconstructed PFL has resulted from proper fertilization, weed control, tillage, and

[1] Paper presented at the 1988 Mine Drainage and Surface Mine Reclamation Conference sponsored by the American Society for Surface Mining and Reclamation and the U.S. Department of the Interior (Bureau of Mines and Office of Surface Mining Reclamation and Enforcement), April 17-22, 1988, Pittsburgh, PA. Published with the approval of the Director of Ky. Agr. Exp. Stn., as Journal Article No. (88-3-32).

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Proceedings America Society of Mining and Reclamation, 1988 pp 257-265
DOI: 10.21000/JASMR88020257

organic amendments (Powell et al., 1986). In the above studies, the same corn hybrid was used.

In addition to selecting the best tillage and fertilization practices, corn yields are affected by choice of hybrid, planting strategy, and pest control measures for site-specific conditions (Larson and Hanway, 1977). Preliminary data for soybeans (Glycine max (L.) Merr.) and grain sorghum (Sorghum bicolor (L.) Moench.) indicate large differences in yield among varieties of these species on restored PFL (Barnhisel et al., 1986). For example, yields from Group III soybeans were very poor as compared to Group V, although soybean cultivars from Group III are recommended varieties for non-mined PFL in this region of Kentucky. For reconstructed PFL, little if any information is available concerning either corn variety selection or planting population.

Compared to other crops, corn may have a more demanding water requirement (Barnhisel, 1983), but it is difficult to evaluate water requirements due to the differences among crop species for growing habits. Some crops such as corn and grain sorghum, C4 species, are approximately two times more efficient than alfalfa, a C3 plant (Gardner et al., 1985); however, the growing period for alfalfa is approximately 60 days longer than for corn, which affects how the efficiency rating is computed. Ground cover also affects these calculations. For example, alfalfa has a high percent ground cover throughout the growing season, whereas the percent ground cover for corn increases from 0 to 100% between planting and a week or two prior to silking. Both the planting date and choice of hybrid maturity are management inputs which can affect ground cover, water requirements, and grain yield of corn (Hanway and Russell, 1969).

Corn growing on reconstructed PFL will more likely be subjected to moisture stress than corn on natural soils. In general, low moisture availability will delay or reduce plant vigor. Three periods within the life cycle of corn are critical with respect to the final grain yield. During the first or vegetative growth stage, moisture stress may reduce development rates of leaves and ear primordia that would ultimately affect yield potential. If the stress occurs within 2 weeks of, anthesis (pollination) the second stage, serious yield reductions are also possible (Shaw, 1977). During this stage of growth, ovules and pollen mature, fertilization occurs, and maximum kernel number is determined. Water stress early in this growth period can delay ovule and/or pollen maturation which could cause reduced seed set (Schoper et al., 1986). Water stress later on in this period could cause premature kernel abortion or reduced growth rate of the kernel, which could reduce the size and/or number of mature kernels (Schoper et al., 1986; Quattar et al., 1987). The corn plant's development is timed so as to minimize this stress, since the root system develops to its maximum size during the tassel to pollination phase of growth (Mengel and Barber, 1974). In Kentucky, corn will enter into this growth stage approximately 70 to 90 days after planting. The last period is mid- to late-grain filling period, where moisture stress will reduce the size (weight) of individual kernels. If at any one of these periods moisture is limited for a few days, yields may be significantly reduced.

Management strategies should be based upon the best available information, since corn yields can be seriously reduced by minor variations of micro-climate when grown on reconstructed soils. These soils will, at least initially, possess unfavorable physical properties such as soil compaction and poor structure. The greatest consequence of excessive compaction is reduced infiltration and/or hydraulic conductivity and the subsequent reduced water holding capacity. Newly-reconstructed PFL will rarely have a soil structure that is sufficiently porous to allow plant roots to fully exploit an equivalent soil mass of a nonmined soil. Coincidental with the 70 to 90 days after planting, at a time when rainfall deficits are most likely to occur, corn in Kentucky will exhibit its highest water demand. At this time, average water demand for corn will be approximately 0.13 in./day, and on hot and windy days the water demand can exceed 0.25 in./day (Donway, 1971). This would be equal to one single corn plant utilizing 1/2 gal. of water/day.

Corn varieties normally available for general use in the humid regions of the U.S. are usually not specifically selected for drought resistance, although it is likely that some differences may exist. For example, it has been shown that corn hybrids containing male sterile cytoplasm can withstand water stress better than hybrids with normal cytoplasm (Vincent and Woolley, 1972). Drought resistance exhibited by a specific hybrid can also be confounded by other factors such as population, row width, and soil fertility (Larson and Hanway, 1977).

The plant density recommended for optimum corn yield tends to vary for areas within the Corn Belt as well as hybrid genotype. Many factors, including climatic variables and soil types, and there are used to match predicted growing conditions with the available hybrids. Experiments have been performed (on natural soils) in which corn yields were related to plant populations, but data for reclaimed PFL are not available. Plant populations may be varied by changing the number of kernels within the row or changing the row width. In general, yield will increase as row width is decreased from a range of 60 to 40 inches to 40 to 20 inches (Stickler, 1964). The higher yield of narrow-row corn is attributed to more efficient utilization of available soil water and greater solar radiation interception (Andrew and Peek, 1971; Demead et al., 1962).

From the above information, it seems reasonable to assume that any combination of treatments which would aid in maximizing the total rooting volume of reconstructed PFL would result in greater yield. Productivity might be further enhanced if more were known about optimum populations and hybrid selections for PFL. In addition, it is also possible that these factors may significantly interact. Lorens et al., (1987) found that the relative degree of drought resistance expressed by a specific corn hybrid was related to its ability to grow deeper root systems. With the above factors in mind, two experiments were designed with the following objectives:

1 Determine if hybrid selection for drought-prone, reconstructed PFL will favor hybrids of earlier of late maturity.
2 Determine if the optimum corn seeding rate for reconstructed PFL is different from that currently recommended for corn production on non-mined agricultural soils.
3 Evaluate whether subsoiling (ripping) reconstructed PFL results in different outcomes for objectives 1 and 2.
4 Evaluate whether reconstructed PFL alters the relative performance of 42 corn hybrids from that observed on non-mined agricultural soils.

## METHODS AND MATERIALS

The experiments were conducted on two separate sites within 3/4 of a mile from each other on similarly reconstructed soils. The corn population-maturity date experiment was conducted on a block of PFL reconstructed in 1981, whereas the PFL for the corn variety experiment was reconstructed in 1983. Both experiments were located at Peabody Coal Company's River Queen Mine, Muhlenberg County, KY.

### Experiment 1. Corn Population-Maturity Date

Reconstructed PFL for this experiment consisted of 10 inches of Ap horizon (topsoil) placed over 30 inches of a mixture of B and C horizon subsoil. The majority of the original soil was Waverly silt loam (coarse-silty, mixed, acid, thermic Typic Fluvaquent). Topsoil and subsoil had been stockpiled for a period of 14 months, and the soil was reconstructed using scraper pans. Following reconstruction, a good vegetative cover of tall fescue (*Festuca arundinacea* Schreb.), alfalfa (*Medicago sativa* L.), and red clover (*Trifolium pratense* L.) was established. This vegetation had been maintained on the site for two years prior to the establishment of the population-maturity date experiment in 1985.

A split plot experimental design with 4 replications was used. The area for each replication was 180 x 150 feet and was subdivided into 2 equal parts of 90 x 150 feet each. One split of each replication was ripped. Sufficient space was available within each split for three corn cultivars at four populations. Each treatment was 4 rows wide, with 8 border rows on all sides.

The ripping treatment was established in March of 1985. Ripping was performed on each appropriate area using a parabolic ripper operated at a depth of 20 inches with 30-inch spacing. The ripping treatment was repeated in the spring of 1987 on the same areas ripped in 1985. Duplicate, two-inch diameter core samples (6 inches in length) were collected from each treatment to a depth of 40 inches for bulk density determination.

The area was fertilized with P and K according to recommendations from soil tests, and ammonium nitrate was applied at 136 lb/a of N. Fertilizer incorporation and final seedbed preparation were accomplished by disking. A side dressing of ammonium nitrate was also applied in early June at 50 lbs/a of N.

The three hybrids used were: FR27 x PA91 (125-day maturity), FR27 x MO17 (120-day maturity), and FR27 x LH38 (115-day maturity), henceforth referred to as full-, mid-, and early-season, respectively. The planting populations were 14,900; 19,000; 20,600; and 24,200 kernels per acre. Planting was accomplished with a four-row, plateless, conservation planter with a 30-inch row spacing. Appropriate herbicides and insecticides were applied at planting using recommended rates.

Experiment 1 was conducted for three years. Each year the location of each corn hybrid-population treatment was randomly assigned. Planting dates were April 18, April 18, and April 10 for 1985, 1986, and 1987, respectively. Corn yields were determined by harvesting the two middle rows of each four-row plot with a small two-row, self-propelled combine. Grain weight and moisture content for each treatment were determined in the field. Yields are reported at the standard 15.5% moisture content.

### Experiment 2. Corn Variety

The soil for this experiment consisted of 8 inches of Ap horizon replaced over 32 inches of a mixture of B and C horizon materials. The soil was reconstructed from separate topsoil and subsoil stockpiles which originated from Belknap (Coarse-silty, mixed, acid, mesic, Aeric Fluvaquent) and Sadler (Fine-silty, mixed, mesic, Glossic Fragiudalf) silt loam soils. The ratio of the reconstructed PFL soil was approximately 25% Belknap and 75% Sadler. These soil materials were replaced with scraper pans.

Permanent vegetation had not been established on this area, as was done in the case of the other experiment; however, the area had been used as a location for a soybean (Glycine max L. Merr.) variety trial the previous two years. The entire area had been ripped each year, as described for the population-maturity date experiment.

A lattice experimental design with four replications was used to evaluate 42 corn hybrids, identified later in table 4. The corn variety test was planted April 29, 1987. A two-row plot planter with a 36-inch row spacing was used to plant at a population of approximately 24,000 kernels per acre.

Lime had been applied at a rate of 1.5 t/a in 1984. Each year this area has received both P and K fertilizers according to recommendations from soil tests. In 1987, the N fertilizer, and weed and insect control treatments were identical to those used for the population-maturity date experiment. Yields were determined in a similar manner as in Experiment 1.

## RESULTS AND DISCUSSION

### Experiment 1. Corn Population-Maturity Date

Specific bulk density values are not reported were for the population-maturity date experimental site, even though soil ripping was one of the treatment variables. In general, soil ripping reduced bulk density by approximately 0.2 $g/cm^3$ to a depth of 18 inches as compared to the nonripped treatments. Although bulk density measurements were not made for these soils prior to mining, even the ripped treatment had a bulk density slightly greater than that reported for the natural Waverly soil series.

Corn yields as affected by maturity date, population, and soil ripping are shown in table 1. Considering the current Kentucky PFL regulations, composition of the original soil series, and allowable climatic adjustments, the target level yield for corn on this site is 81 bu/a. For the duration of the experiment, the target yield was exceeded only one time in three years when in 1985 the yield for the ripped treatment was planted to the full-season hybrid at 19,000 kernels per acre.

Although two of the standard corn hybrids used in this experiment i.e., FR27 X PA91 and FR27 X LH38, generally produce lower yields than most commercially-available hybrids, they serve as a basis to compare the effects of plant population and maturity. In 1985, there was a trend for the full-season hybrid to out-yield the other two hybrids, especially for the ripped treatment. In both 1986 and 1987, the maturity date of the hybrid did not consistently affect yield. In 1985, there was also a trend for the lowest corn population to produce less yield than the other three populations, but it rarely resulted in a significantly lower yield.

Ripping had the most consistent effect on corn yield. In both 1985 and 1987, ripping significantly increased yield for 11 of the 12 maturity-population treatments. This treatment resulted in an average increase in yield of 20 bu/a in 1985 and 25 bu/a in 1987. There were no significant interactions between ripping and either maturity or population. In 1986, the ripping treatment done in 1985 did not change corn yields, hence the plots were ripped again in 1987. This ripping treatment appears to have allowed for better exploitation of stored soil water by the corn roots.

The fact that corn yields were lower than the target yield each year, especially in 1986 and 1987, may be the result of below rainfall levels at this site. Table 2 shows rainfall data measured at a meteorological station approximately 1 mi. from the study site.

It is obvious that there were moisture deficiencies each month of each year, except June of 1986, which had a small excess (0.14 in.). Although 1986 was the best year with respect to precipitation received during the growing season (only a 1.75-in. deficit), the overall yields given in table 1 were lower than for the other two years. Since much of the rain that was received in June and July occurred as intense rain storms (unpublished data), it is likely that 1/2 of it was lost by runoff.

Peters and Bartelli (1958) reported that corn must make use of water stored in the top and subsoil because rainfall received during a season will rarely be adequate to produce average yields. Corn will withdraw water from a depth of about 30 inches in natural PFL. Elkins et al., (1961) reported that the average amount of stored soil water needed for acceptable corn production should be between 7 and 10 inches above that usually received as rainfall during the growing season. Soil moisture was not measured at this site; however at another experiment within 1/2 mi. there was less soil moisture available at the beginning of the 1986 growing season than for either of the other two years (unpublished data). This was due to lower than normal winter (1985-86) and spring (1986) precipitation. Therefore, the 1986 yields given in table 1 may actually represent performance under the "worst case" condition. Since soil moistures in 1985 and 1987 were near field capacity below a depth of 6 inches when the corn was planted (based on unpublished data from the adjacent site).

This experiment illustrates that even if when corn is grown under some moisture deficit, ripping will likely increase yield, as was observed between the ripped and nonripped treatments in 1985 and 1987.

Table 1.--Corn yield for years, 1985, 1986, and 1987 as a function of the maturity date, plant population, and ripping.

| Maturity Date | Seeded Population | 1985 R* | | | 1985 NR* | | | 1986 R | | | 1986 NR | | | 1987 R | | | 1987 NR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | bu/a | | | | | | | | | | | | | | | | | |
| Full-season | 14,900 | 71 | BCD | a** | 53 | BCDE | b | 39 | E | a | 42 | BCD | a | 67 | A | a | 39 | AB | b |
| Full-season | 19,000 | 88 | A | a | 64 | A | b | 46 | CDE | a | 42 | BCD | a | 64 | A | a | 42 | AB | b |
| Full-season | 20,600 | 78 | ABC | a | 55 | BC | b | 42 | DE | a | 36 | D | a | 66 | A | a | 38 | AB | b |
| Full-season | 24,200 | 80 | AB | a | 59 | AB | b | 45 | CDE | a | 40 | CD | a | 59 | ABC | a | 40 | AB | b |
| Mid-season | 14,900 | 67 | CD | a | 56 | BC | b | 45 | CDE | a | 45 | ABC | a | 64 | A | a | 41 | AB | b |
| Mid-season | 19,000 | 67 | CD | a | 47 | DEF | b | 48 | BCD | a | 44 | BCD | a | 51 | C | a | 40 | AB | a |
| Mid-season | 20,600 | 76 | ABC | a | 47 | DEF | a | 50 | BC | a | 50 | AB | a | 66 | A | a | 40 | AB | b |
| Mid-season | 24,200 | 72 | BCD | a | 45 | EF | b | 60 | A | a | 52 | A | a | 62 | ABC | a | 34 | AB | b |
| Early-season | 14,900 | 67 | CD | a | 45 | F | b | 43 | CDE | a | 40 | CD | a | 63 | AB | a | 37 | AB | b |
| Early-season | 19,000 | 69 | BCD | a | 50 | CDEF | b | 44 | CDE | a | 42 | BCD | a | 68 | A | a | 36 | AB | b |
| Early-season | 20,600 | 65 | D | a | 57 | AB | a | 44 | CDE | a | 41 | CD | a | 59 | ABC | a | 32 | B | b |
| Early-season | 24,200 | 70 | BCD | a | 54 | BCD | b | 54 | AB | a | 44 | BCD | a | 63 | ABC | a | 44 | A | b |

* R denotes ripped treatment. NR denotes Nonripped treatment.

** Numbers followed by same letter are not significantly different at the 90 % confidence level. Uppercase letters are for comparison within a respective column, whereas lowercase letters are for comparison between ripped vs. nonripped for a given year and treatment.

Table 2. Monthly precipitation and deviation from average for the growing season of each year.

| Month | Avg.* | 1985 (actual) | 1985 (+/-) | 1986 (actual) | 1986 (+/-) | 1987 (actual) | 1987 (+/-) |
|---|---|---|---|---|---|---|---|
| May | 4.63 | 2.86 | -1.76 | 4.57 | -0.05 | 3.35 | -1.27 |
| June | 3.60 | 3.31 | -0.29 | 3.74 | +0.14 | 3.16 | -0.44 |
| July | 3.43 | 1.17 | -2.26 | 3.14 | -0.29 | 2.39 | -1.04 |
| August | 3.05 | 2.14 | -0.91 | 2.39 | -0.66 | 1.00 | -2.05 |
| Total | 14.71 | 9.48 | -5.22 | 10.26 | -1.75 | 8.03 | -4.59 |

* Average monthly precipitation for Muhlenberg County. Data taken from the McLean-Muhlenberg County Soil Survey, USDA-SCS. p. 84.

Table 3. Average yield of corn over three years as a function of maturity date, population, and soil ripping.

| Maturity | 14,900 R* | 14,900 NR* | 19,000 R | 19,000 NR | 20,600 R | 20,600 NR | 24,200 R | 24,200 NR | Ave. R | Ave. NR |
|---|---|---|---|---|---|---|---|---|---|---|
| | bu/a | | | | | | | | | |
| Full | 59 | 47 | 66 | 49 | 62 | 43 | 61 | 47 | 62 | 47 |
| Mid | 59 | 48 | 55 | 43 | 64 | 46 | 65 | 44 | 61 | 45 |
| Early | 58 | 41 | 60 | 43 | 56 | 43 | 62 | 47 | 59 | 44 |
| Ave. | 59 | 45 | 60 | 45 | 61 | 44 | 63 | 46 | 53 | 45 |

* R denotes ripped, NR denotes nonripped.

The absence of a yield advantage for ripping in 1986 could have been caused by the absence of this tillage treatment in 1986, as plots in 1986 were planted in the same areas as in 1985, or by the poor rainfall distribution.

Table 3 summarizes the effects of corn maturity, population, and ripping on corn yield averaged over all three years. In addition the advantage for ripped over nonripped, the yield rank from high to low was associated with maturity date since yield tended to decrease from full- to mid- to early-season hybrids. Such ranking, with an even greater advantage for full-season hybrids, would normally be expected for non-disturbed soils and normal growing seasons. In the 1987 Hybrid Corn Performance Test (Evans et al., 1987) at 7 locations, FR27 X PA91 yielded 3.4% more than FR27 X MO17 and 2.4% more than FR27 X LH38. Since the advantage of the full- over the early-season hybrid in this study was only 6%, it is likely that the full-season hybrid encountered more stress than the early-season hybrid in there reclaimed soils and suggests that proper selection of hybrid maturity and planting date could maximize yield production, particularly if one could predict the time of the drought stress. In western Kentucky, drought stress is more likely in late July and August; hence an early maturing hybrid may be able to avoid the moisture stress by producing more of its grain dry matter before the onset of drought. The planting dates for this experiment were relatively early (April 18, April 18, and April 10 for 1985, 1986, and 1987, respectively) and most likely did provide an advantage for the early hybrid. Since FR27 X LH38 was not developed for this southern production area and may not be adopted to the disease and insect problems oat this latitude, it is possible that other early-season hybrids may provide an even greater yield advantage.

For the ripped treatments, yield tended to decrease as population decreased. For the nonripped treatments, a similar order was observed. This ranking is similar to what one would expect from commercial hybrids, as most of them have been selected under high population densities. As with the plant maturity variable, it is likely that drought stress may have limited full expression of yield advantages for higher plant densities. Given the conditions expected to occur for reconstructed PFL, 20,000 kernels per acre may give maximum yields most years. If early hybrids are grown, a higher plant density than 24,000 may be needed to achieve complete ground cover.

Experiment 2. Corn Variety Experiment

Relative performance of 42 selected hybrids is reported in table 4. This data is only for 1987, since problems occurred in 1985 and 1986 that reduced our confidence in data for those years. The problems included low soil fertility, areas of high bulk density within replications, vandalism, and drought. Except for drought, most of the negative effects were eliminated or significantly reduced for 1987.

Also reported in table 4 are average performances of these varieties for 5 other Kentucky locations Evans, et al., (1987). The hybrids planted at the reclaimed PFL site are a subset of the 132 hybrids evaluated in the Prog. Rep. 308. When one considers the serious rainfall deficit of 1987 at the River Queen PFL site, the overall yields from this test were good. Based upon current regulations, the soil series that were a part of the reconstructed soil, and allowable climatic adjustments, the target level yield for phase III bond release is 81 bushels per acre. Fourteen of the 42 hybrids exceeded target level yield.

One must assume that part of the yield differences between the hybrids are due to drought tolerance. From Experiment 1, we concluded that at least part of the yield advantage for drought tolerant corn is that early maturing hybrids avoiding the of "normally occurring" drought in western Kentucky. Thus, in addition to the actual test results for yield, hybrid maturity may provide a second useful evaluation for hybrids to be used on reclaimed PFL sites. One can estimate, from seed moisture content at the time of harvest, the relative harvest maturity dates of the hybrids. We have included, for comparison purposes, in this River Queen variety test, three inbred lines of known maturity date. These same entries were also included in the University hybrid performance test.

The three hybrids in the University test had average harvest grain moisture contents of 15.8, 14.4, and 13.9 percent for full-, mid-, and early-season hybrids, respectively. Moisture contents of these hybrids in the River Queen test were 18.2, 15.4, and 11.9 percent, respectively. For each data set, i.e., River Queen and University Performance Tests, the mid-point between the moisture of each check hybrid was used to establish ranges in moisture content by which the known hybrids were grouped into three categories of "wet", "medium" or "dry" relative moisture at the time of harvest. For example, any hybrid with a moisture greater than 15.2 was placed into the "wet" group for the University data set. The average yield of each group was determined and these data are given in table 5.

There is a reversal between these two data sets. For reclaimed PFL, the early-season hybrids had higher yields than the later maturing hybrids; the opposite was true for the hybrids grown on natural soils. For droughty reclaimed PFL, earlier hybrids yielded more than later hybrids. For the University test group, where moisture conditions were much better, the rank was reversed. There was a major inconsistency for yields of the "standard" hybrids for the two experiments. The yield for the mid-season hybrid (FR27 X MO17) in Experiment 2 yielded significantly more than either the full- or early-season hybrids. Since this result was inconsistent with Experiment 1 results and the maturity groupings shown in table 5, it is possible that the high yield of FR27 X MO17 was an experimental error attributed to an anomalous genotype by environment interaction. Although the trends noted from Experiment 2 generally

Table 4. Yield and comparison of relative rank of hybrids tested at the River Queen site with results of the five western Kentucky sites of the University of Kentucky's statewide test[3] 1987.

| PFL Rank | Corn Hybrid | -- River Queen -- Yield | Moisture | five - W. KY Sites Yield | Rank |
|---|---|---|---|---|---|
| | | bu/a | % | bu/a | |
| 1. | McCurdy 7676 | 104.3 | 13.5 | 175.2 | 3 |
| 2. | Dennis DS642 | 97.8 | 13.8 | 168.7 | 6 |
| 3. | Coker 8696 | 95.0 | 17.6 | * | * |
| 4. | Asgrow/O's Gold 2570 | 93.7 | 13.4 | 164.1 | 13 |
| 5. | Colbert 345 | 92.4 | 17.9 | 168.5 | 7 |
| 6. | Zimmerman Z28 | 90.8 | 14.6 | 163.2 | 14 |
| 7. | Southern Cross 511 | 90.7 | 16.4 | 138.8 | 39 |
| 8. | FR27 X MO17 | 89.7 | 15.4 | 159.6 | 20 |
| 9. | Super Crost 5460 | 89.4 | 15.0 | 154.8 | 30 |
| 10. | Garst Seed 8344 | 88.3 | 14.9 | 150.3 | 34 |
| 11. | Princeton SX 860 | 88.3 | 15.4 | 136.5 | 41 |
| 12. | DeKalb-Pfizer DK 689 | 87.6 | 15.5 | 174.7 | 4 |
| 13. | Northrup-King PX 9581 | 86.9 | 20.3 | 156.5 | 26 |
| 14. | Prairie Stream SX 702 | 86.9 | 11.8 | 169.9 | 5 |
| 15. | Southern States SS 811 | 85.9 | 15.2 | 156.8 | 25 |
| 16. | Pioneer Brand 3320 | 85.8 | 13.6 | 165.3 | 11 |
| 17. | Select Seed 9131 | 85.3 | 15.1 | 165.3 | 11 |
| 18. | Agri-Pro HP 555 | 84.7 | 13.6 | 167.2 | 8 |
| 19. | Jacques 8700 | 84.1 | 19.1 | 162.9 | 15 |
| 20. | Crow's 688 | 83.5 | 14.4 | 149.1 | 37 |
| 21. | Agrigold A-6615 | 83.4 | 14.6 | 148.9 | 38 |
| 22. | Jacobi 8801 | 83.2 | 15.1 | 150.6 | 33 |
| 23. | Lynks LX 4533 | 82.9 | 14.9 | 152.8 | 32 |
| 24. | Stauffer S 7759 | 82.4 | 14.6 | 161.6 | 17 |
| 25. | Leader SX 717 | 82.3 | 14.7 | 149.9 | 36 |
| 26. | P.A.G. SX351 | 82.1 | 14.1 | 155.9 | 27 |
| 27. | Pioneer Brand 3165 | 81.7 | 14.8 | 182.8 | 1 |
| 28. | Becks 89X | 79.8 | 13.7 | 155.1 | 29 |
| 29. | Golden Acres T-E 6998 | 79.7 | 19.0 | 177.0 | 2 |
| 30. | Funk's R.A. 1502 | 79.3 | 15.6 | 161.7 | 16 |
| 31. | Funk's G-4635 | 79.3 | 14.6 | 158.7 | 22 |
| 32. | Adlers 88X | 79.1 | 18.9 | 166.5 | 10 |
| 33. | Southern States SX 728 | 78.8 | 13.5 | 152.9 | 31 |
| 34. | Bo-Jac 674 | 76.6 | 17.2 | 158.5 | 24 |
| 35. | Paymaster 8990 | 75.6 | 19.1 | 161.1 | 18 |
| 36. | Cargill 967 | 73.4 | 14.3 | 160.7 | 19 |
| 37. | Cargill 980 | 72.5 | 18.3 | 150.0 | 35 |
| 38. | Seedtec H-2675 | 72.2 | 15.2 | 158.6 | 23 |
| 39. | Agratech GK900 | 70.7 | 14.2 | 155.6 | 28 |
| 40. | FR27 X PA91 | 66.5 | 18.2 | 165.0 | 12 |
| 41. | D & H Seeds DH 9113 | 65.8 | 16.5 | 159.1 | 21 |
| 42. | FR27 X LH38 | 64.4 | 11.9 | 138.0 | 40 |
| | $\bar{X}$ = | 82.9 | 15.5 | 159.3 | |
| | $LSD_{0.10}$ = | 18.1 | 2.7 | N.D. | |

* 'Coker 8696' was a hybrid tested at the River Queen site but was not included in the University of Kentucky statewide test. (See Evans et. al., 1987).

support the conclusions based on data from Experiment 1, an additional two years of data should be obtained before these trends can be considered reliable indications of hybrid maturity responses on reclaimed PFL.

Table 5. Average 1987 yield of hybrids as "grouped" by maturity date estimated from grain moisture percentage at harvest.

| Relative Moisture | River Queen | University |
|---|---|---|
| | --- bu/a | --- |
| Wet (Full-season)* | 77.8 | 161.7 |
| Medium (Mid-season) | 85.0 | 158.4 |
| Dry (Early-season) | 86.9 | 157.4 |

* Maturity date estimated by grouping similar moisture content to moisture content of hybrids of known maturity date.

## CONCLUSIONS

There is danger in making conclusions with one or even three year's data; however, to the best of our knowledge, this study provides the only data available for assistance in making corn production management decisions on reclaimed PFL soils. Our discussions of maturity date influences on PFL corn yield should be considered tentative, but promising, and should stimulate further research related to these types of management inputs. There are many studies that need to be done. For example, early-maturing varieties at the River Queen site produced high yields, but the planted population was held constant at 24,000. It is not known how the planting date will affect yields on reclaimed PFL. How should corn planted on PFL be adjusted to match the predicted drought period so as to increase chances of success for specific maturing hybrids? Would specific hybrids selected for drought tolerance be more suitable for corn production on PFL in Kentucky? Are the specific corn diseases or insects more influential on reclaimed PFL sites than on nonmined sites?.

Perhaps we have raised more questions than we have answered; however, from these experiments the following conclusions have been drawn:

1 High populations (approximately 24,000 kernels per acre) are better than low populations (approximately 14,000).
2 Soil ripping will increase corn yields on PFL regardless of hybrid used, maturity date, and population.
3 Commercially-available hybrids exceeded target level yield for corn even during an extremely stressful year.
4 Relative yield ranking of corn hybrids evaluated on natural soils may not be accurate predictors of hybrid performance on reclaimed PFL soils.

The last conclusion may be the most important from a practical point of view of mine land reclamation. Prior research has shown that relative yield ratings for varieties of wheat (*Triticum aestivum* L.) were similar when grown on either reconstructed or natural soils (Powell et al., 1987). The same relationship appears to be true for grain sorghum and soybeans (Barnhisel et al., 1986).

Corn hybrids in our test did not follow this pattern. Further testing of corn varieties should be done to determine if our 1-year hybrid yield evaluation was adequate to evaluate PFL yield performance or to identify specific hybrids with a high degree of drought tolerance. Corn hybrids with this characteristic would increase the chance of success during the interim between soil reconstruction and the time it takes for the subsoil to develop desirable soil structure characteristics.

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