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**NORTH CENTRAL CORN BREEDING
RESEARCH COMMITTEE
(NCR-167)**



1999 Meetings
February 8-9, 1999
Ames, Iowa

Report
of the

North Central Corn Breeding
Research Committee

NCR-167

Ames, Iowa
February 16-17, 1998

1998 Meetings
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Reported by
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Minutes of the
North Central Corn Breeding Research Committee
NCR-167

February 16-17, 1998
Holiday Inn Gateway Center
US 30 & Elwood Drive
Ames, Iowa 50014

Annual meeting of NCR-167 was held February 16 and 17, 1998 at the Holiday Inn Gateway Center, Ames, Iowa. Blaine Johnson, University of Nebraska, was originally scheduled to chair the 1998 NCR-167 meetings. Because Blaine Johnson had resigned from the University of Nebraska and accepted a position with a commercial firm outside the North Central Region, Kendall R. Lamkey, Research Geneticist, ARS/USDA at Ames, IA accepted the duties as chair for the 1998 NCR-167 meetings. He made the arrangements for the meeting place and planned and organized the program for the 1.5 day conference. The meetings were held jointly with NCR-25 with members of NCR-25 participating in the meetings. The meetings were organized into three, half-day sessions of voluntary papers: 1) February 16 – morning session included reports from NCR-167; 2) February 16 – afternoon session was a joint session with NCR-25 and included reports from members of NCR-25 concerned with diseases of corn; and 3) February 17 – morning session included reports on selection studies from members of NCR-167. The quality of the research reports was excellent for all sessions with well-prepared reports by each presenter. All sessions had excellent attendance. Abstracts of the reports for each of the three sessions are included herein.

Registered attendance for the 1.5 day meeting was 87. Attendees included representatives from NCR-167, NCR-25, graduate students, and individuals from the commercial research organizations. The broad list of topics attracted attendees from a broad array of individuals interested in corn improvement.

NCR-167 had a new administrative advisor for the 1998 meetings. Dr. Ronald P. Cantrell, Head, Department of Agronomy, Iowa State University, was appointed as our administrative advisor. Because of his past experience in corn improvement, we welcome his advise in the future direction of NCR-167. He addressed the group at the beginning of the meetings on February 16 and was in attendance throughout the meetings.

The principle goal of NCR-167 is the discussion of topics and issues related to the genetic improvement of germplasm, inbred lines, and hybrids for the North Central Region. The North Central Region includes the most important corn production area of the United States, which includes more than 85% of the area for grain production and more than 60% of the area for silage production. The area designated as the U.S. Corn Belt is included within the North Central Region, and much of the basic research needed to exploit the concept of hybrid corn and important germplasm sources that have contributed to increasing corn yields were developed within the North Central Region of the United States. The objectives of NCR-167 (and our previous designation, NCR-2) have been, and continue to be, to foster exchange of information and ideas for breeding, selection, and evaluation of germplasm among public and private corn breeders to ensure continued genetic improvement of materials made available to the growers of the North Central Region. The objectives of NCR-167 are attained by encouraging interactions among all researchers who have an interest in the theory and in the practice of corn improvement.

Kendall Lamkey called the meeting to order at 8:15 AM, February 16, 1998. After a welcome and some introductory remarks by Dr. Ronald P. Cantrell, NCR-167 Administrative Advisor, research reports were presented in the planned agenda developed by Kendall Lamkey. The meeting was organized into three, half-day sessions with 18 research reports presented.

Kendall Lamkey, ARS-USDA, was moderator for the February 16 morning session; Ward Strienstra, University of Minnesota, was moderator for the joint NCR-167 and NCR-25 session held in the afternoon, February 16; and Richard Pratt, Ohio State University, Wooster, was the moderator for the February 17 morning session. Meetings were adjourned at noon on February 17, 1998.

Abstracts of the research reports presented February 16 and 17 are included in the order in which the reports were presented.

GEM Grain Quality Traits and Analytical Techniques

S. Duvick and L.M. Pollak

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The Germplasm Enhancement of Maize Project (GEM) uses exotic germplasm in a breeding program to improve yield, pest resistance, and value-added traits of corn. One hundred 50% exotic breeding crosses were made with proprietary lines. CUBA164:S15, CUBA164, is the exotic, which is crossed to a stiff stock inbred form Cooperator number 15. One hundred and sixty 25% exotic breeding crosses were made with proprietary lines e.g. CUBA164:S1517, CUBA164 is the exotic line which was crossed to a stiff stock inbred by Cooperator number 15 then sent to Cooperator number 17 to be crossed to another stiff stock inbred. Over fifty proprietary breeding crosses are in development. In 1997, S2 top crosses were tested for yield in 21 experiments in 11 states, six were in the Midwest and five were in the Southeast. One Chilean line, an S2 line from a 50% exotic breeding cross yielded over 171 bu/acre over three locations. Additionally, 16 of 21 experiments conducted here in the Midwest; the S2 Topcrosses out-yielded the mean of the hybrid commercial checks. The range for yield was from 134% to 103% of the check mean. Grain Quality traits of interest include composition, protein quality, oil quality, and starch quality. Composition is the relative protein, oil, and starch of whole grain and the density value. The compositional values targeted for selecting germplasm for advancement are protein >16%, oil >7%, and starch >75%. Corn with elevated protein and energy contents is important for a complete animal feed ration. In the GEM materials, a public 50%, a private 25% and an S1 line had protein values over 16%; an S1 line from a 50% breeding cross and a 25% breeding cross had oil values of 7%; an S1 line had a starch value of 75% and there was a wide range in density from 1.21 to 1.37. The protein quality of corn is determined by its amino acid profile. The amino acids most important for feed are methionine, lysine and tryptophane. High performance liquid chromatography (HPLC) is used to separate and identify the amino acids. The oil quality of corn is determined by using Gas Chromatography (GC). The individual kernels are crushed and the oil extracted using hexane and the fatty acids in the oil are separated and identified with the GC. The five major fatty acid in corn oil are: C16:0 palmitic acid, C18:0 stearic acid, C18:1 oleic acid, C18:2 linoleic acid, C18:3 linolenic acid. The palmitic and stearic values added together are the total saturated fatty acids. Corn with high total saturated fatty acids is useful for developing a naturally hardened margarine product that would require less processing than normal corn oil. Corn oil with very low saturated fatty acid would be useful in developing polyunsaturated oil important for human and animal diets. Corn oil high in oleic acid has greater oxidative stability and resistance to rancidity. The targeted values for each fatty acid of interest are saturated >30% and <5%, oleic >80%. Compared to the normal corn values of 11-12% saturates, the GEM breeding crosses and lines were broader in range from 11-19% saturates. Normal corn has oleic acid values of 20-30% and the GEM breeding crosses and lines values ranged from 20-49%. The traits of interest in starch are amylose/amylopectin ratio, morphology, thermal and viscosity properties. The starch quality traits are measured with the Differential Scanning Calorimeter (DSC) and Rapid Visco Analysis (RVA) which measure the energy to thicken or gelatinize starch in water and the gelatinization properties. The targeted values include the onset temperature of gelatinization, <60°C, enthalpy of gelatinization, 2.5 cal/g or >4.0 cal/g, range in gelatinization, <5°C or >15°C, Peak height Index >1.2, enthalpy of retrogradation or recrystallization upon refrigeration, 1cal/g, and the percentage of retrogradation, <20% or >80%. These measures are designed to identify unique starches, which have numerous food, feed and industrial applications. The GEM materials as compared to normal corn had much broader starch thermal values. Normal corn thermal values are generally found as onset temperature of gelatinization, 64.7°C, enthalpy of gelatinization, 2.8 cal/g, range in gelatinization, 8.7°C, peak height index of 0.6, enthalpy of retrogradation, 1.2 cal/g, and the percentage of retrogradation, 58.7%. The Gem values ranged from 64.1 –70.3°C for onset of gelatinization, 2.5-3.5 cal/g for enthalpy of gelatinization, 4.7-10.7°C for range in gelatinization, 0.6 -1.4 for peak height index, 0.8-1.6 cal/g for enthalpy of retrogradation, and 51.6-69.1% for the percentage of retrogradation. GEM breeding crosses and lines have wide variation for all the traits measured. This is useful for selecting germplasm for advanced breeding and value-added trait development.

Transgenic Approaches to Improving the Value of Corn

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USDA-ARS and Iowa State University
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Corn has traditionally been marketed as a commodity crop, with little attention given to its end use. Because corn is used for many different products, a more efficient way to use corn is to develop varieties suited to particular end uses. This creates a value added market which necessitates complex grain handling processes and identity preservation systems. The added value of these specialty crops is driving the market in this direction in spite of these drawbacks. Transgenic crops have a tremendous potential to contribute to the specialty corn market. An example is our work to develop corn suited to swine nutrition. The limiting factor in corn used for swine feed is the amino acid balance. In order to improve the amino acid balance, we are developing transgenic corn plants expressing a protein called α -lactalbumin in the kernels. α -lactalbumin is a major protein from sow's milk and is ideally suited to the nutrition of young swine. Another example of transgenic specialty corn being developed is corn containing oral vaccines for livestock. Corn containing a vaccine against porcine transmissible gastroenteritis would be worth an added \$0.34 /Bu, and the demand for this corn would be about 50 million Bu/year. This high value, small market product is typical of transgenic specialty crops currently under development in industry and academia.

Nondestructive Amylose Determination in Corn by NITS

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Although breeders of specialty starch hybrids are interested in many starch properties, most of the effort continues in increasing starch-amylose levels. Applications of highamylose starches include candies, biodegradable polymers, barriers in fried food and nutraceuticals. Traditional laboratory techniques for determining starch-amylose levels are time consuming which greatly limits the amount of germplasm that can be screened in a breeding program. We are currently investigating the use of Near-infrared Transmittance Spectroscopy (NITS) as a rapid alternative that is also nondestructive. Previous studies with NITS have indicated a good predicative power; however, the calibration was made against amylose determined from corn flour (flour-amylose) rather than from isolated starch (starch-amylose). In this study we investigated NITS calibrations based only on starch-amylose using different sets of germplasm. When a group of experimental high-amylose inbreds and hybrids were used, a coefficient of correlation (r) was found to be $r = 0.90$ between actual starch-amylose values and NITS predicted values. The standard error of prediction (SEP) associated with the calibration was rather large (SEP = 4.97). Next, a different set of material comprised of 100 random S2 ears from a white synthetic population converted to the mutation amylose-extender (ae) was examined. In this set a coefficient of correlation of $r = 0.96$ was found with an improved SEP (SEP = 2.28). Results from these preliminary calibrations suggest that NITS could play a role in screening for high-amylose genotypes in a breeding program.

QTL and Candidates Genes for Resistance to First Generation European Corn Borer In Maize

A. J. Cardinal¹, W. D. Guthrie², J. Bing³, D. F. Austin¹, L. R. Veldboom¹, M. L. Senior², and M. Lee¹
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Our objectives were to locate and characterize genetic factors controlling resistance to first generation European corn borer (IECB) damage (*Ostrinia nubilalis*) and to compare the QTL detected in F2:3 and F6:8 generations. We crossed inbred lines Mo17 and H99 and developed F2:3 lines and F6:8 lines by continuous selfing the F2 population. Mo17 and H99 are highly susceptible and resistant, respectively, to leaf blade feeding by European corn borer. The F2:3 lines, two checks, Mo17, H99 and the F2 bulk were grown in single-row plots in a sets within replication design with 3 replications at the Agronomy Farm near Ames in 1989. The F6:8 lines, B73, Mo17 and H99 were grown in single-row plots in a 14 x 14 lattice with 2 replications at the Agronomy Farm in 1995. During the whorl stage of development, plots were infested with larvae dispensed in the whorl (300 larvae/plant). Leaf blade damage (LBD) was scored visually on a plot basis 2-3 weeks after infestation. The visual scale ranged from 1 to 9, with 1 representing the least amount of leaf feeding (Guthrie et al., 1960). A linkage map of 110 RFLP loci and one color (P1) locus was used in the QTL analysis of the F2:3 lines (Veldboom and Lee, 1996). The linkage map of the F6:8 lines was constructed with 100 RFLP loci, the P1 locus, and 42 SSR loci by Austin and Lee (1997). Eighty-eight loci are common to both maps. The QTL analysis was performed using composite interval mapping (CIM) following a multiple regression approach (Haley and Knott, 1992) with PLABQTL (Utz and Melchinger, 1996, Version 1.0).

The heritability was 76.6% in the F2:3 generation and was estimated as 90.7% in the F6:8 generation. Five QTL were detected in each generation. The QTL on chromosomes 4 and 7 were identified in both generations. Most of the phenotypic variation was explained by the QTL on chromosome 4 (Veldboom and Lee, 1993), corresponding to the region where *bx1*, *bx2*, *bx3*, *bx4*, and *bx5* genes have been mapped (Frey et al., 1997). H99 alleles in this region confer resistance. On chromosome 7, two adjacent QTL with opposite effects were detected in the F2:3 generation. Possibly H99 carries genetic factors for both resistance and susceptibility to IECB leaf damage in this region. One QTL was detected in this region in the F6:8 generation. Its position overlaps with the QTL detected in the F2:3 generation. The other QTL was not detected in the F6:8 generation possibly due to lack of more distal markers. However, the trend of the LOD score curves was consistent in both generations in this region. Other QTL were located on chromosomes 6 and 9 in the F2:3 generation and 1, 3 and 8 in the F6:8 generation. Fifty-seven to 70% of the genetic variation was associated with the QTL in the models.

Most of the phenotypic variation was accounted by the QTL detected on chromosome 4 in the vicinity of the *Bx* loci. Recently, *Bx1*, *Bx2*, *Bx3*, *Bx4*, and *Bx5* have been cloned and studied (Frey et al., 1997). Benzoxazinless 1 (*bx1*) recessive mutants do not produce cyclic hydroxamates. Benzoxazin2, 3, 4, and 5 (*Bx1*, *Bx2*, *Bx3*, *Bx4*, and *Bx5*) genes encode P450 dependent monooxygenases. These five genes map within 6 cM on chromosome 4. They are involved in the synthesis of DIBOA from indole-3-glycerol phosphate. DIBOA is a precursor of DIMBOA. DIMBOA has been found to confer resistance to IECB leaf damage (Klun et al., 1967). Are the *Bx* loci the QTL? Other QTL were detected indicating that other genetic factors different from the *Bx* loci also have an effect on resistance to IECB leaf damage. Are these duplicate factors? Other parts of the pathway? Other mechanisms? Genetics factors conferring resistance to IECB leaf damage can be found in susceptible and resistant parents. All QTL have additive gene action. This result is in agreement with previous studies where additive gene action was found to be more important than dominance (Scott et al., 1964; Scott and Dicke, 1965).

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Perspectives on the Genetics Underlying Flavone Synthesis and Corn Earworm Resistance

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Natural resistance to corn earworm (*Helicoverpa zea* Broddie) has been attributed to high concentrations of the C-glycosyl flavones maysin, apimaysin and methoxymaysin in young silk tissue. Flavone synthesis is one branch of a fairly well defined biochemical pathway. Genes encoding some of the structural enzymes and transcription factors involved in the pathway have been cloned, and there are numerous mutants and allelic variants in maize that are candidate genes associated with flavone synthesis. Flavone synthesis is monitored directly by quantifying the flavone compounds using reversed-phase high performance liquid chromatography (HPLC). Indirectly the agronomic effects of flavone synthesis are monitored through corn earworm larval bioassays

Previously, we have shown that the myb-like transcription factor P1 is required for flavone production and antibiosis (Byrne et al. 1996). In F₂ populations segregating for functional versus non-functional *pl* alleles, *pl* behaves as a major QTL showing additive gene action for maysin and dominant gene action for antibiosis. In addition to *pl*, *rem1*, a gene of unknown function located on the short arm of chromosome 9, enhances maysin concentrations when in the recessive state and in the presence of a functional *pl* allele (Byrne et al. 1996, 1997). *rem1* behaves as a QTL for maysin synthesis, but is not a QTL for antibiosis (Byrne et al. 1997, 1998).

We have examined two other aspects of flavone synthesis and antibiosis using F₂ mapping populations: 1. the synthesis of closely related compounds and, 2. the effect of a competing pathway. Maysin (3', 4'-dihydroxy) and apimaysin (4'-monohydroxy) differ by only one -OH group, but their synthesis appears to occur independently of one another (Lee et al. 1998). We have identified a QTL, *pr1*, which is important for apimaysin synthesis but does not affect maysin synthesis. The previously identified maysin QTL, *rem1*, behaved as a QTL for maysin in this population, but did not affect apimaysin synthesis. In this population *pr1* and *rem1* were involved in a significant interaction affecting total flavone levels, but the *pr1* x *rem1* interaction was not significant for maysin or apimaysin levels. The nature of this interaction appears to involve a ceiling affect governing the total level of flavones produced. In this population both *pr1* and *rem1* behaved as antibiosis QTLs, but the genotypes at *pr1* and *rem1* that resulted in the greatest reduction in larval weight were the genotypes that resulted in lower levels of apimaysin and maysin.

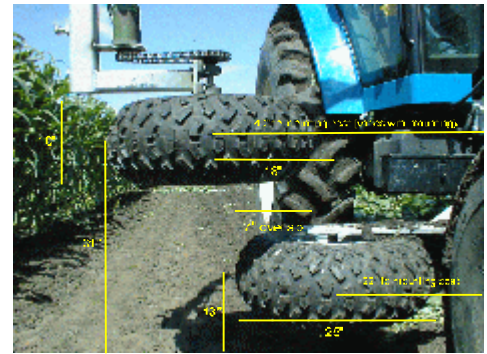
We used the *al* locus to examine whether a gene associated with a competing pathway behaves as a QTL for maysin synthesis. *al* encodes the first committed step in the 3-deoxyanthocyanin pathway. *al* behaves as a QTL for maysin synthesis, with the homozygous non-functional *al* genotype resulting in higher maysin levels. By blocking the competing 3-deoxyanthocyanin pathway using a non-functional *al* allele, more substrate is free to enter the C-glycosyl flavone pathway resulting in more maysin being synthesized. There was also a significant interaction between *al* and *pl* in this population, with *al*'s greatest affect occurring in those individuals that were homozygous for a functional *pl* allele. We are currently investigating the ramifications on antibiosis resulting from blocking a competing pathway.

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Measurement of Stalk Brittle Snapping: A tractor-mounted Device that Works!

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Stalk brittle snapping refers to stalk snapping at a node from 30 to 60 cm above the ground when high winds occur. Brittle snapping usually happens when plants are turgid and during a window of susceptibility two to three weeks long, just before flowering. Areas of particular vulnerability are Nebraska, eastern Kansas, and western Missouri, but it can occur anywhere with very strong winds and a susceptible genotype.

A tool or procedure to measure brittle snapping is needed. It should be rapid, repetitive, non-destructive, and low cost. Ideally, it should be able to characterize hybrids and also be used for selection in a nursery. We have looked at several options:

- Rind penetrometer used in the node.

- Stalk snapper using a torque wrench to measure breaking force.

- Stalk snapper using a Omnidata Polycorder® and load cell to measure breaking force.

- A board or steel rod pulled horizontally (with and without angling to the row) by a tractor driven down the rows.

- Harvest a 20 cm section of stalk from about 45 cm above the ground. Cut out a 5.1 cm section centered on the node and measure the density by water displacement looking for an association with brittle snapping.

- Measurement of stalk node density by using gamma-ray attenuation with a sealed gamma-ray source and detector mounted to a caliper that measured stalk diameter.

The middle four of these tools/procedures are destructive and none of the six consistently ranked the test hybrids. The concept for the present device arose from a demonstration by Dr. Gardner of manually causing brittle snapping. Kneeling/squatting down, she held the stalk with one hand ~12" above the ground and rapidly "struck" the stalk with her other hand held ~24" above the ground. The stalk either snapped, "squished" (broke, but did not snap), or did not snap. While this procedure worked, the physical cost was enormous and evaluation of large numbers of plots impossible.

We constructed a tractor-mounted device with ATV wheels/tires placed horizontally to bend the stalk as it passed between the offset wheels. The top wheel was powered by a finely-regulated hydraulic motor so as to match ground speed and the bottom wheel was an idler. In operation, the idler wheel was kept against the row of stalks by using a guide bar mounted on the front of the tractor.

Data were in agreement with Pioneer's brittle snapping ratings. A correlation of brittle snapping score (1=snaps, 9=does not snap) and brittle snapping percentage of $r = -0.86^*$ was obtained for combined data from three locations in 1997. Coefficients of variation of 22-26% were found across the three locations.

With a high-boy carrier, the device can be effectively used for election as well as characterization. For 1998, we would like to evaluate a broader spectrum of hybrids; and the hybrids used in 1997 should be evaluated over time (four-six day intervals) for three or so weeks before flowering to a week after flowering to determine the optimum window of vulnerability.

Inhibition of Aflatoxin Production in Mutants of Elite Corn Inbreds

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Resistance to aflatoxin production is a desired trait in those crops where aflatoxin has become a problem. In corn there have been several instances of germplasm being developed with resistance to fungal development on the grain, but there are no examples of elite genotypes with significant inhibition of aflatoxin production in spite of being infected by the fungus *Aspergillus flavus*. We found that hexane extracts of corn seed inhibit aflatoxin synthesis to a small degree with no apparent inhibition of growth of *A. flavus* when bioassayed *in vitro*. This may be due to some constitutive inhibitor in corn grain, and thereby a trait that can be enhanced in corn germplasm, possibly through mutagenesis. Bioassays of the *A. flavus* resistant corn germplasm developed in Georgia, Illinois, and Mississippi revealed that hexane extracts seed from these lines were no more inhibitory to aflatoxin synthesis than common inbred lines of corn.

A bioassay procedure was developed to select for mutants in mutagenized B73 and A632 that produce high levels of inhibitors of aflatoxin synthesis. The procedure involved adding hexane extracts to an agar medium that will allow for quantitative spectrofluorometric measurements of aflatoxin production after seeding the agar with *A. flavus*. More than 8000 M3 families from B73 and A632 were screened and four families from A632 and two families from B73 that had strong inhibition of aflatoxin synthesis. The elite mutagenized B73 and A632 germplasm used in this research was developed originally by Allen D. Wright when he was associated with the USDA-ARS at Iowa State University. The test is a destructive test and residual seed was used to increase the germplasm. Selfing through the M6 generation was needed to get materials with all progeny carrying high levels of inhibition of aflatoxin synthesis. In 1997, 20 M6 families of A632 and 40 families of B73 were selected for definitive field trials based on agronomic traits and the fact that each family had at least 70% seeds possessing high levels of inhibition of aflatoxin synthesis. Although extracts from the dry seeds may inhibit aflatoxin synthesis, the materials needed to be tested for inhibition of aflatoxin synthesis in the field. Open pollinated ears on the plants in the field were inoculated at the soft dough stage with *Aspergillus flavus* by injection with a syringe and a 14 gauge Hamilton No.5 point style needle directed through the developing kernels and along the cob. Inhibition of aflatoxin synthesis (concentrations at least one tenth the concentration in nonmutagenized B73 and A632) has been observed in aflatoxin assays of infected, but otherwise sound kernels.

Members of some mutant families were crossed with Mo17 and the hybrids were planted in a replicated field trial to assess some agronomic traits and yield in comparison with B73 x Mo17 and A632 x Mo17 with non-mutagenized parents. Tassel branch number, plant height, ear height, and grain yield did not differ significantly ($p = 0.05$) among the entries evaluated.

**INHERITANCE OF, MOLECULAR MARKERS ASSOCIATED WITH, AND
BREEDING FOR, RESISTANCE TO ASPERGILLUS EAR ROT AND
AFLATOXIN PRODUCTION IN CORN USING TEX6**

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Research at the University of Illinois is divided into four interrelated components including: 1) identifying sources of resistance; 2) determining the inheritance of resistance; 3) molecular marker mapping of genes for resistance; and 4) crossing resistance into B73 and/or Mo17 related inbreds.

Identification of Resistance. We have screened more than 1,200 corn inbreds as F₁ crosses with susceptible inbreds Mo17 and/or B73 for resistance to *Aspergillus* ear rot and aflatoxin production (4). All screening has been done using artificial inoculation (2). We have identified 13 inbreds that are highly resistant in F₁ combinations and resistant as inbreds per se (3). Our best source of resistance is the inbred line Tex6 which was selfed from a white corn population (PI 401762) that had been grown in the southern U.S. This inbred also has been identified as resistant in studies by others and may have unique proteins that account for part of the disease resistance (6).

Inheritance of Resistance in Tex6. Inheritance of resistance in the inbred Tex6 has been studied in crosses with susceptible inbreds B73 and Mo17 following inoculation in the field (5). From 1994 to 1996 plant generations included were the susceptible parent (P₁), the resistant parent (P₂), F₁, F₂, F₃, BCP₁, BCP₁-selfed, and BCP₂. The BCP₂-selfed generation was added in 1995-1996 for the B73 X Tex6 cross. In general, F₁ means deviated from the mid-parent value for resistance to aflatoxin production in both crosses indicating dominance for resistance. Analysis of generation means indicate that additive gene action is of primary importance for resistance to aflatoxin production in both crosses. Broad sense heritabilities for aflatoxin resistance were 63% for Mo17 X Tex6 and 65% for B73 X Tex6. Our biggest problem has been the classification of a family as being resistant, due to a low toxin value, that is genetically susceptible in years that do not favor aflatoxin production. With these families, susceptibility (high toxin value) becomes apparent in years that favor aflatoxin production.

Mapping Genes for Resistance. Genotypic analysis of the Tex6 X Mo17 F₃ mapping population has been completed with approximately 90 RFLP and SSR markers. Because of the variability of phenotypic traits between years, a modified data set was created for aflatoxin. In an attempt to identify those families with consistently low levels of aflatoxin, concentrations were scaled relative to Mo17 then the highest of the two years was used in the analysis. Using this data set, a stepwise multiple regression model from SAS including three probes accounted for 27% of the variation for aflatoxin. Individual year multiple regression models include 7-9 markers explaining approximately 22% of the variation. Three chromosomal regions were found to be significantly associated with resistance in the multiple regression (1L, 2L, 4S). Analysis of 21 "resistant" families indicated that 15 of these families were either homozygous Tex6 or heterozygous at all three regions. Five were either homozygous Tex6 or heterozygous at two regions. Comparison of the Tex6 X Mo17 F₃ population with previous mapping populations (LB31 X B73, 75-R001 X B73) indicates that while there are common regions associated with aflatoxin resistance, there also are some regions unique to one inbred associated with resistance. For example, all three resistant parents confer resistance on 3L, 4S whereas only Tex6 confers resistance on 3S. We are in the process of mapping the B73 X Tex6 F₃ population and the B73 X Tex6 backcross to B73 self population. If regions associated with resistance in these populations are similar to the Mo17 X Tex6 F₃ population this will indicate that we have identified chromosomal regions associated with resistance that are not in either B73 or Mo17. Genes in these regions would be very valuable in most cornbelt germplasm.

Breeding for Disease Resistance. We've made progress in transferring resistance from the inbred LB31 (1) into B73 related inbreds while maintaining yield. We've also been able to backcross resistance from Tex6 into both B73 and Mo17 related inbreds. Our ultimate goal is to have B73 X Mo17 type hybrids with resistance in both parents. This should result in a hybrid that could be used in areas where aflatoxin is a problem in most years. Highly resistant hybrids may need to have genes pyramided from different sources of resistance.

Conclusions. High levels of resistance have been identified and can be transferred into usable germplasm. In most cases, it appears that resistance is under the control of several genes acting in an additive fashion; however, these genes confer resistance in F₁ hybrids. Marker assisted selection is not a reality at this time, however, it has provided valuable information on chromosomal regions associated with resistance from different sources that may have some different genes for resistance. Mapping populations are starting to provide information that would allow us to pyramid resistance genes from different resistant parents. Also, we will be able to recombine lines during backcrossing to produce backcross derived lines with all of the chromosomal regions associated with resistance. The B73 X Tex6 and Mo17 X Tex6 mapping populations should provide information about resistance genes not found in most cornbelt germplasm.

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Occurrence and management of toxigenic *Fusarium* species in corn

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Fusarium graminearum, *F. moniliforme*, *F. proliferatum*, and *F. subglutinans* are the most prevalent *Fusarium* species infecting corn throughout most of the world. Each of these species is capable of producing a unique combination of mycotoxins that are harmful to livestock and humans. These species overlap considerably in their geographical distribution, but different species predominate at different latitudes. In the northernmost corn-growing regions of Europe, *Fusarium sporotrichioides* and *F. poae* are predominant, with *F. culmorum* and *F. graminearum* also common. In the northern corn belt of the U.S., *F. graminearum* and *F. subglutinans* become predominant. In the mid-northern corn belt (Iowa), *F. subglutinans* is predominant, and further south, *F. moniliforme* is the most common species. In Iowa, Fusarium ear rot, caused by *F. subglutinans*, *F. moniliforme*, and *F. proliferatum*, occurs in 70-100% of corn fields at low severity each year. Gibberella ear rot, caused by *F. graminearum*, is less common (10-40% of fields) but more severe in a given field. Fumonisin B1 and deoxynivalenol are the most common mycotoxins in U.S. corn. In most years, concentrations of these toxins are at safe levels in over 97% of the corn fields in Iowa. As corn from the more highly contaminated fields is mixed into the grain stream, mycotoxins are diluted to safe levels. Only in epidemic years are livestock health problems widespread. Breeding for *Fusarium* resistance has been only partially successful because of the lack of major genes for resistance, inconsistent symptom development in breeding trials, the need for laboratory analyses to detect symptomless infection and mycotoxins, and the general low priority given to *Fusarium* resistance in relation to other agronomic traits. Biotechnology may provide solutions to *Fusarium* infection of corn. Currently, we can observe reductions in *Fusarium* infection up to 90% due to the effects of Bt transformation. Because *Fusarium* infection is related to insect damage, the protection from insects provided by certain Bt hybrids results in protection from *Fusarium* as well. Early indications are that these hybrids also experience less fumonisin contamination than non-Bt hybrids. In the future, it is likely that transgenic resistance to fungi will be incorporated into corn hybrids.

Phenotypic and Genotypic Variation among Isolates of *Cercospora* from Corn

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Gray leaf spot (GLS) is currently considered to be the most important foliar disease of corn in the United States. During the 1970's, GLS increased in incidence and severity in the eastern Appalachian region in conjunction with the increased adoption of conservation tillage practices to reduce soil erosion. The disease has since spread and increased in incidence and severity as reduced tillage practices became commonplace throughout the eastern and midwestern cornbelts. GLS can now be routinely found in most of the United States corn production areas, from eastern Colorado (under center pivot irrigation) to coastal regions of North Carolina and Virginia.

Variability in pathogenic aggressiveness, growth rate and colony morphology in culture, the presence and relative abundance of spermogonia, and size of spermatia has been reported among isolates *Cercospora zeae-maydis*. There is, however, no evidence of specificity or races of *C. zeae-maydis*. One recurring problem encountered in conducting GLS trials in North Carolina has been the variable results often obtained from different test locations in the western mountains of the state. In particular, we have noticed that certain hybrids appear to have resistance equal that of the most resistant commercial hybrid when tested at locations in the northern mountains, but are badly blighted when tested at locations further south. The objectives of our research were to determine the extent of any molecular genetic and phenotypic variation among Czm isolates these NC test locations and determine if the observed genotype X environment interaction in GLS ratings is due to differences in isolates at those locations.

A set of ten hybrids representing a range of GLS reactions in tests across North Carolina were evaluated in a field trial against six isolates of Czm obtained from the North Carolina test sites and elsewhere. The trial was conducted in the summers of 1996 and 1997 at the Central Crops Research Station on the upper coastal plain of North Carolina at Clayton. Genetic analysis of the internal transcribed spacer (ITS) regions of nuclear rDNA, and portions of mitochondrial rDNA (both large and small subunits) were also carried out on the six isolates of *Cercospora* used in the field study along with six other isolates from NC, MN, IL IA, and Kenya. To determine the relationship of Czm isolates with other *Cercospora* spp., rDNA analysis was also used conducted on other *Cercospora* spp. included *C. kikuchii*, *C. medicaginis*, *C. nicotianae*, *C. sojina*, *C. asparagi*, and *C. beticola*. RAPD-PCR analysis was also conducted on the six isolates used in the field study. These six isolates used in the field test were also analysed for their growth rate and ability to produce the phytoxin, cercosporin.

The six *Cercospora* isolates from varied greatly in their aggressiveness on the set of ten hybrids. There was also a significant hybrid X isolate interaction observed in the trial, although the magnitude of the interaction was small in relation to the main effects of isolates and hybrids. The hybrid X isolate interaction often mirrored the type of genotype X environment interactions seen in NC GLS trials.

Molecular analysis via rDNA RFLPs and RAPDs resulted in isolates of Czm being placed into three distinct groups. Isolates from Laurel Springs NC were especially distinct genetically, behaving as a separate species. These isolates were slower growing, less aggressive, and produced less cercosporin than isolates in the other genetic groups. These preliminary findings suggest that what is currently known as *Cercospora zeae-maydis* may actually be a "species complex" composed of at least three genetically distinct groups

Recent Developments in Corn Pathology with Special Emphasis on Gray Leaf Spot

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In February -early March 1997 I traveled to the Republic of South Africa (RSA) and Zimbabwe to see first hand the gray leaf spot epidemic in Southern Africa. The trip was arranged by Dr. J. Ward of CEDARA, Pietermaritzburg, RSA and supported in part by a number of maize seed companies, the Cereal Grains Institute of RSA, and other farmer and agricultural organizations in both nations. During this visit I was called upon present a number seminars and talks at University of Natal, research institutes, grower meetings and seed corn companies. I was afforded the opportunity to visit with pathologists, breeders, agronomists, and farmers to see first hand the magnitude of the problem and the disease reaction of numerous lines of germplasm at commercial seed companies, universities and CYMMIT in Zimbabwe.

Gray leaf spot, first detected in South Africa in 1988 has since been detected in 1996 in Zimbabwe, Cameroon, Uganda, Zambia, Zaire, Kenya, Mozambique, Swaziland, Malawi, and Tanzania. It is likely that it will spread over much the southern two thirds of Africa. Losses in RSA reach 60 to 80% on maize fields not protected with fungicide applications. Resistant germplasm is available and will likely be incorporated in both yellow and white hybrids over the next several years, but progress is likely to be slow. A feature article in *Plant Disease* is soon to be published that will document the rise of and geographical expansion of gray leaf spot.

In addition to gray leaf spot several other maize diseases were noted, namely maize streak virus (destructive gemini virus), Kabatiella eyespot, common and southern rust, Northern and Southern leaf blight, head smut, and a disease new to me, *Phaeosphaeria* leaf spot or white leaf spot. This disease is caused by the fungal pathogen, *Phaeosphaeria maydis*. It was quite common in many farm fields, even those that had been sprayed one or more times for gray leaf spot control. It has been recently reported as occurring in maize nurseries in South Florida.

In Virginia work continues on the evaluation of resistance in elite hybrids under heavy naturally occurring disease pressure. In the 1997 growing season 49 hybrids and a known high yielding, susceptible check hybrid were evaluated for disease reaction (1-5 Disease Index), lodging, and grain yield at two locations. Although the months of July and August were extremely dry and gray leaf spot pressure was reduced over previous years at both locations differences among hybrids for disease resistance were easily distinguished and grain yields ranged from 92 to 154 bu/A under naturally occurring gray leaf spot pressure. Results are reported in *Biological and Cultural Control Tests for Control of Plant Diseases*, Volume 13, 1998.

Twenty-seven different elite hybrids and 29 inbreds from the Independent Professional Seedsmen Association were evaluated for their disease reaction at the University's Whitethorne-Kentland Farm in Montgomery County. These evaluations are part of a long term project to improve gray leaf spot resistance in hybrids produced and sold by the smaller and family owned and operated seed companies.

Twenty hybrids were evaluated for their disease reaction as part of the NCR-25 Gray Leaf Spot Monitoring Project to detect the possibility of races or biotypes of the pathogen, *Cercospora zae-maydis* across the Corn Belt and the Eastern United States.

Cooperative projects were begun with two seed corn companies to identify, map, and develop genetic markers for resistance QTLs (genes) in the gray leaf spot disease nursery. Individual plants from three F2 populations and their inbreds were rated for disease reaction over

weeks, selfed, and seed harvested for F3 population evaluations in 1998. The source of resistance is distinctly different from the Va14 source identified, mapped, and molecular markers used by Maroof, Stromberg and ICI Garst to develop resistant hybrid combinations (Theor. Appl. Genet. 93:539-546).

An evaluation of the efficacy of foliarly applied fungicides to control gray leaf spot and improved grain yields on the susceptible Pioneer Brand 3394 was conducted. Applications of candidate fungicides were made on 25 Jul when the hybrid was at 5% silking and significant blighting was confined to leaves below the ear leaf, but lesions were present on the ear leaf. The fungicides tested were Tilt 3.6E 1.8 oz ai/A, Folicur 3.6F 1.8 oz ai/A and 2.7 oz ai/A (one and two applications), and Quadris 2.08SC 1.6, 2.4, and 3.2 oz ai/A (one and two applications). All fungicides and rates gave significant increases in yield and decreases in disease severity over the non-treated control. The non-treated control became severely blighted by the end of August and produced only 106.9 bu/A, while a single application of Tilt 3.6E kept blighting from the two upper leaves until the 1st of September and produced a yield of 148.9 bu/A. The Folicur 3.6F treatment somewhat less effective and produced grain yields ranging from 122.5 to 147.8 bu/A depending on rate and number of applications. The Quadris 2.03SC applications regardless of rate or number of applications gave the best disease control (blighting and lesions were not detected above the ear leaf) and highest yields (146.9 to 167.4 bu/A). The results are reported in Fungicide and Nematicide Tests, Volume 53, 1998.

A new project was initiated with G.H. Lacy to characterize the DNA similarities among *Cercospora zea-maydis* (Czm) isolates from within a field, region, the United States and from around the world. In addition we are evaluating the phylogenetic relationships (association) within the genus *Cercospora* and that of (Czm) and other cercospora-like genera. To date a number of isolates have been collected from field samples, the ATCC, and from colleagues in Africa. We have obtained permits from USDA, APHIS, PPQ for additional isolates or diseased leaves from other areas of the U.S. and the world. We are looking for individuals to provide us with isolates for or study.

**Uniformity of Reaction of Corn Hybrids to Local Populations of *Cercospora zea-maydis* Across the U.S.:
Report of the NCR-25 Gray Leaf Spot Monitoring Project.**

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The NCR-25 gray leaf spot monitoring project was initiated to examine the variability in reaction among hybrids due to differences in location of disease screening nurseries. Changes in hybrid reaction across locations may indicate variability in local pathogen populations or major influences of the environment. A set of ten hybrids representing diverse genotypes with relative maturities of 95-110 days (northern nursery) and 110-117 days (southern nursery) were planted at up to 11 locations across the U. S. from Virginia to Nebraska in 1996 and 1997. Standard disease assessment protocols were followed at each location. The percentage ear leaf area affected was assessed on assessment of ten plants per hybrid at least three times during the growing season and the lesion type (necrotic flecks, restricted chlorotic lesions, large chlorotic lesions, or necrotic lesions) (Freppon et al, 1994) was recorded at mid-epidemic at each location. Percentage ear leaf area affected was used to calculate area under the disease progress curve (AUDPC) for each hybrid at each location. Hybrids were ranked according to final percentage ear leaf area affected and AUDPC at each location and rank means were calculated across locations.

Rankings of hybrids were similar at the different locations in both years based on final percentage ear leaf area affected and AUDPC. Friedman's test (Gibbons, 1976) indicated a highly significant ($P < 0.01$) difference among genotype ranks, as expected because hybrid reactions ranged from susceptible to moderately resistant. Kendall coefficient of concordance (W) (Gibbons, 1976) was calculated to determine the degree of agreement in genotype ranks among locations separately for the northern and southern nurseries. The range in W for northern and southern nurseries for final disease severity and AUDPC was 0.52-0.74 and 0.60-0.84, respectively. All W values were significantly greater than 0 ($P < 0.01$) and there was a high agreement among locations for genotype ranks. Genotype stability analysis of ranks, using Piepho's method (Piepho, 1997), indicated no genotype by environment (location) interactions in either the northern or southern nurseries over both years ($P < 0.01$). Differences in lesion types were reported for most hybrids across locations, but low disease intensity and variability in disease severity when lesion types were assessed at some locations limited conclusions based on lesion-types. Results based on final disease severity and AUDPC data indicated that hybrids responded similarly across environments and there was no evidence for differences in ability of local populations of *C. zea-maydis* to cause differential reactions on the hybrids tested.

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Origin and Importance of Richey Lancaster

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Lancaster Sure Crop was a flint-dent mixture that had repeated dent-variety crosses followed by selection for smoother, longer, more flinty ears. Uniformity was lacking for the first 50 years because of varietal crossing until 1910. Inbred line C103 was developed by Dr. Jones at Connecticut from Lancaster Sure Crop variety. Ears were collected at the Noah Hershey farm near Parkesburg in Chester County, Pennsylvania in 1938. Jones did 10 generations of individual plant and progeny selection. It was released in 1949. Inbred line C103 was a parent of DEKALB 805 the first (1957) popular, widely grown, single cross hybrid. A very important second-cycle Lancaster Sure Crop inbred line was Mol7 (C 103 x C1187-2 from Krug Reid). It was developed by Drs. Grogan and Zuber at Missouri; it was released in 1964.

Christian Hershey emigrated from Schangnau, Switzerland to Friedelsheim, Germany to Lancaster, Pennsylvania arriving in 1717. He bought 500 acres two miles west of Lancaster (part of which is now President Buchanan's home 'Wheatland'). Christian was a bishop in the Mennonite Church. Christian's great-great grandson, Jacob, came to depend on an early, slender, smooth, usually single-eared corn obtained originally in 1860 from the U.S. Patent Office by Henry High in nearby Byerston. The common corn grown locally was a large, late corn with medium to rough dent. Jacob mixed seed from two or three selected ears of this common corn with his pile of shelled seed corn. This was repeated a number of times and later Jacob's son John and John's son Jacob repeated the process six or eight more times with various dent varieties.

Richard Crabb in *The Hybrid Corn-makers* states that David Richey had grown Lancaster Sure Crop near LaSalle, Illinois many years before 1902 and that his son, Frank, was still growing it there in 1922. So, Lancaster Sure Crop had natural and human selection in northern Illinois certainly more than 20 years, perhaps decades more, by the Richey family. It was probably brought to Illinois by migration of Mennonites from Pennsylvania. One of the earliest groups (six families of 45 people) came to northern Illinois (Sterling) in 1867. More came later. They would certainly have brought seed for crops.

Richey Lancaster is the parent variety of inbred lines 6-5, C14-8, L3, L9, L289, L304A, L317, LDG, and Oh4OB. Inbred lines 6-5, C14-8 and L9 were developed by Dr. Frederick D. Richey (F.D.) at Arlington Farm, Virginia where the Pentagon now stands. Inbred line L9 was a parent of Hoosier Hybrid. Iowa inbred lines L289, L304A, and L3 17 were developed by Dr. Jenkins at Iowa. Inbred lines L289 and L317 were one of the parents of hybrids IA939 and U.S.13 respectively. All of these inbred lines trace back to Richey Lancaster variety collected from the Frank Richey farm by F.D. He selfed it himself at Arlington Farm, Virginia and also gave 50 ears to Dr. Jenkins at Iowa State College. F.D. later encouraged M. Glenn H. Stringfield to make a synthetic of Richey Lancaster inbred lines from which inbred line Oh4OB was selected at Ohio. Stringfield then developed inbred line Oh43 from hybrid Oh4OB x W8 (1/2Richey Lancaster, 1/4 Minnesota 13, 1/4 Northwestern Dent); it was released in 1949.

Nathaniel Richey, the ninth of 14 children, was born in western country, Pennsylvania in 1795. He was a War of 1812 veteran stationed near Lake Erie where and when Lt. O. Hazard Perry defeated the British fleet. He came to LaSalle County, Illinois from Zanesville, Ohio in 1830. They abandoned their cabin during the Black Hawk War (1832) in which three LaSalle County families perished. Nathaniel became Justice of the Peace and his home was an underground railroad station to free slaves.

Nathaniel's son David was the third of 11 children. Reared on a farm on the frontier, he attended school less than a year. David purchased 164 acres just south of his father's farm in 1850; he was a member (democrat) of the 31st Illinois Legislature. David's son Frank became an attorney and practiced in St. Louis where F.D. was born and raised. Frank later returned to the home farm after his father's death. F.D. spent his summers on Grandfather David's farm. In the fall of 1903, F.D. helped his ill grandfather by selecting the longer, heavier, smoother ears for 50 bushels of Richey Lancaster seed corn. At his own initiative, F.D. ran germination tests in cigar boxes and found their more-flinty seed corn germinated better than softer, rougher-eared, more-dented, competitive varieties. His grandfather died December 31, 1903; F.D. stayed over through planting. He sold the seed corn for \$3.50/bu when commodity corn price was \$0.36/bu.

F.D. Richey enrolled in general agriculture at the University of Missouri and graduated in 1909 with the intent of farming his father's farm. Instead, he took a job with Mr. C.P. Hartley at the United States Department of Agriculture (USDA) Bureau of Plant Industry in 1911. In 1916, he began inbreeding corn to develop inbred lines. In 1920 he gave Bloody Butcher inbred material to H. A. Wallace, who selfed it again and used it as the male of

Copper Cross hybrid seed corn sold in Iowa in 1924. In 1922, F.D. became principal agronomist in charge of USDA corn improvement (Richey, 1922).

F.D. became Chief of the Bureau of Plant Industry in USDA in 1934. In 1937 he was president of the American Society of Agronomy. In 1938, F. D. started a foundation seed business. He received the Distinguished Service Award for outstanding service in organizing and leading the cooperative corn-breeding program which gave hybrid corn to American agriculture. He received an honorary Doctor of Science degree from the University of Missouri in 1949. He was the author of numerous publications on corn growing, corn breeding, and statistical methods including a paper on cumulative selection that accurately predicted future corn breeding methodology (Richey, 1945, 1950). Dr. Richey retired after 37 years of USDA service and seven years of private or state service. His greatest achievement was to position the state-federal cooperative corn breeding effort that made hybrid corn happen sooner on a larger scale. He died in 1955 at 71 years of age; his ashes were scattered in a Piketon, Ohio cornfield where he formerly had foundation seed fields.

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Effect of One- and Two-Eared Selection on Stalk Strength and Other Characters in Maize

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Searching for ways to improve maize yield is always in the mind of maize breeders. Prolificacy is one of the most attractive traits for yield improvement. Prolificacy associated with higher grain yield has been mentioned by several researchers (Lonnquist, 1967; Russell, 1984; Subandi, 1990; Maita and Coors, 1996). Some researchers suggested that prolific maize gave more stable yields for a series of environments (Collins et al., 1965; Motto and Moll, 1983) while others reported that prolificacy was advantageous only at low plant densities or in favorable environments (Prior and Russell, 1975; Mareck and Gardner, 1979). One serious drawback often discussed is that prolificacy appears to be closely related to poor stalk quality and plant standability (Lonnquist, 1967; Motto and Moll, 1983).

One approach to study the effects of prolificacy is to compare prolific vs. nonprolific genotypes. To avoid genetic background differences, three populations were developed by crossing between one-eared and multiple-eared populations. After random mating, selection for one- and two-eared types was done. The objective of this research was to compare stalk strength and other agronomic characteristics of one- and two-eared selections in three maize populations evaluated at different nitrogen levels and plant densities.

The six entries included three one- and two-eared populations. The populations are:

[MoSQA(S7-H)C8 × Georgia Cow Corn](H-1Ear)C8
[MoSQA(S7-H)C8 × Georgia Cow Corn](H-2Ear)C8
[MoSQB(S8-H)C8 × Georgia Cow Corn](H-1Ear)C8
[MoSQB(S8-H)C8 × Georgia Cow Corn](H-2Ear)C8
SI171(H-1Ear)C8
SI171(H-2Ear)C8

The six entries were grown in nine combinations of three levels of nitrogen application (90, 180 and 270 kg N/ha) and three levels of plant density (35,900; 47,800; and 59,700 plants/ha). A randomized complete block design with treatments in a split-split-plot arrangement with three replications was used with nitrogen levels assigned to the main plots, plant densities to the sub-plots, and entries to the sub-sub-plots. The experiment was conducted in 1995 and 1996 at a total of five environments in Missouri. Each split-split-plot consisted of three rows 6.8 m long and spaced 0.9 m apart.

Selection of one- and two-eared sub-populations resulted in yield superiority of two-eared sub-populations compared to one-eared sub-populations at all combinations of different nitrogen levels and plant densities. However, root and stalk lodging were significantly higher in two-eared selections than one-eared selections, except for the SI171 population for root lodging. Two-eared selection also resulted in higher ear height than one-eared selections. In general, two-eared selections resulted in poorer root and stalk strength.

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Genetic Drift and Inbreeding in the BS13(S)C0 Maize Population
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Selection programs have been an invaluable source of quantitative genetic information. However, in agricultural species, selection programs have generally not been replicated, nor have control populations been used. Therefore, little information is available on how genetic drift affects selection response patterns. The objective of our research was to study the consequences of pure genetic drift in the absence of selection. We evaluated 200 lines developed by single-seed descent, without selection, from the BS13(S)C0 population in five generations of inbreeding ($F=0$ to $F=0.9375$) at five environments. Rates of inbreeding depression and the variance among lines were computed for grain yield and grain moisture. We estimated the total range of 95% of possible replicate populations derived without selection from BS13(S)C0 with the same population size as the BS13 S_2 progeny recurrent selection program. The initial population mean grain yield in this study was 5.1 Mg Ha^{-1} . In the BS13 selection program, 10 lines were recombined in the first two cycles, and 20 lines in later cycles. Assuming effective population size of $2N$, the following ranges were obtained (Mg Ha^{-1} grain yield): Cycle 1 - 4.7 to 5.4, Cycle 2 - 4.5 to 5.5, and Cycle 5 - 4.3 to 5.5. Assuming effective size of N , the ranges were: Cycle 1 - 4.5 to 5.5, Cycle 2 - 4.2 to 5.5, Cycle 5 - 3.8 to 5.5. Based on historical records of selection differentials and environmental variances and our genetic variance component estimates, predicted gains were computed. The predicted population means after selection were (in Mg Ha^{-1} grain yield): Cycle 1 - 5.4, Cycle 2, 5.6, and Cycle 5 - 6.1. Two points are illustrated here: 1) Pure genetic drift can result in changes in population means of nearly the same magnitude expected from selection, and 2) relatively large changes due to drift can occur very early in the inbreeding process. These results should be interpreted with some caution, as little information is available on how genetic drift and selection interact. Presumably, the application of selection pressure will reduce drift variance, but to what degree is unknown when directional dominance is important.

The following estimates of genetic variance-covariance components for inbred relatives were obtained for grain yield (measured in Mg Ha^{-1} , see Cockerham, 1983, for theory): $\sigma^2_A=0.30\pm 0.05$, $\sigma^2_D=0.22\pm 0.09$, $D_1=-0.18\pm 0.06$, $D_2=0.88\pm 0.20$, and $H=0.63\pm 0.51$. Consistent with previous observations in stiff stalk populations, additive and dominance variances were of similar magnitudes for grain yield. Estimates of D_1 and D_2 suggested that breeding value is negatively correlated with inbreeding depression (D_1) and that inbreeding depression rates are highly variable. For grain moisture (measured in g kg^{-1}), the estimates were: $\sigma^2_A=5.79\pm 0.67$, $\sigma^2_D=0.24\pm 0.74$, $D_1=-0.44\pm 0.52$, $D_2=3.06\pm 1.35$, and $H=-7.44\pm 5.24$. Grain moisture seemed primarily under additive gene action, with little inbreeding depression (-0.011 g kg^{-1} per 1% increase in inbreeding) and no appreciable dominance variance. However, D_2 , the variance of inbreeding depression effects was still quite important.

We conclude that random drift is a powerful force, capable of causing large changes in population means in the absence of selection, even with population sizes used in typical recurrent selection programs. The genetic models revealed that inbreeding depression rates are highly variable, and that for grain yield they are negatively correlated with breeding values.

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Response to Selection in Two Reciprocal Recurrent Selection
Methods in BS21 and BS22 Maize Populations

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ABSTRACT

Reciprocal recurrent selection (RRS) was proposed by Comstock et al. (1949) and has proven to be a successful method for improving the performance of a cross population and to increase the heterosis between populations. RRS, however, has not been widely adopted by the commercial breeders because RRS is not as efficient for recovery of inbred lines as other methods of inbred development (Russell and Eberhart, 1975). To overcome this limitation, Russell and Eberhart (1975) introduced a modification in the RRS procedure. They suggested the use of two inbred lines as testers instead of the opposite population as reciprocal testers in an RRS scheme. Line 1 is the tester for population A and line 2 is the tester for population B. The lines must be unrelated to the population that is under selection, but they may be related to the opposite population (line 1 unrelated to A but related to B and reverse for line 2).

RRS has proven to be a successful method for improving the performance of a cross population and to increase the heterosis between populations. However, RRS has not been widely adopted by the commercial breeders because RRS is not as efficient to recover inbred lines as other methods of inbred development. Use of two inbred lines as testers instead of the opposite population as reciprocal tester in a modified RRS (MRRS) scheme could reduce this limitation.

A selection program was initiated in 1974 at Iowa State University to evaluate the modified RRS procedure and RRS in BS21 and BS22 maize populations. The modification used inbred line A632 as tester for BS21 and inbred H99 as tester for BS22. After six cycles of selection were completed in BS21 and BS22 using MRRS and RRS, an experiment was conducted to evaluate the response to selection. The populations per se, testcrosses to inbred testers, and crosses between cycle populations of RRS and MRRS were evaluated in replicated yield trials.

There were significant increases in grain yield in all six populations as a consequence of selection. The rate of direct response was greater for the RRS procedure than for the MRRS [4.4, 1.6, and 2.8% cycle⁻¹ for BS21(R) x BS22(R), H99 x BS22(HI), and A632 x BS21(HI), respectively]. RRS was as effective as MRRS for improving the grain yield of the populations in crosses with the inbred lines, but MRRS was not as effective as RRS in the improvement of the cross population BS21 x BS22, with a significantly lower rate of increase in yield of 1.6% cycle⁻¹. Realized heritability and response to selection for yield were 25 to 50% of their predicted values.

There was no evidence that the genetic variance among testcrosses for yield was greater when using inbred lines as testers than when using populations as testers. The traditional RRS procedure was more effective than MRRS in improving grain yield in the cross population BS21 x BS22.

Selection Response with Marker-Based Assortative Mating

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Assortative mating can increase additive variance (V_A) and, consequently, selection response. Marker-based assortative mating (MAM)—the mating of individuals that have similar marker genotypes—has not been studied. My objectives in this simulation study were to (i) compare the selection response associated with MAM, phenotypic assortative mating (PAM), and random mating (RM) selected individuals and (ii) determine when MAM will be most useful in breeding programs. I simulated 25 generations of selection among 200 individuals, followed by MAM, PAM, or PAM, in a cross between two inbreds. A total of 100 codominant marker loci and 100 quantitative trait loci (QTL) were randomly distributed across 10 chromosomes, each 100 centiMorgans long. The effects of QTL were additive and followed an exponential distribution. Cumulative selection response was determined for different initial levels of heritability ($h^2 = 0.20, 0.50, \text{ and } 0.80$) and different numbers of individuals selected ($m = 4, 8, 16, \text{ and } 32$) in each generation. Compared with RM, MAM resulted in slight increases of 3-8% in selection response during the first several generations, particularly when $h^2 = 0.20$ and $m = 32$. The PAM procedure led to slight increases of 2-4% when $h^2 = 0.80$ and $m = 32$. Any advantage of assortative mating over RM dissipated by Generation 8 for MAM and Generation 15 for PAM. The loss of QTL heterozygosity was much greater with MAM than with PAM or RM. With nontruncation selection for a single trait—which occurs when improvement is sought for multiple traits—the advantage of MAM over RM was as high as 12% during the first several generations. For long-term improvement, selected individuals should be intermated by RM. The MAM procedure will be most useful for short-term improvement in a biparental cross, particularly when h^2 and selection pressure are low.

Reciprocal Recurrent Selection Using Different Types of Base Populations

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Reciprocal recurrent selection (RRS) was initiated using two strains, GG(A) and GG(B), randomly chosen from the same initial seed lot of the Golden Glow maize population. The protocol has changed somewhat over cycles, but the current system involves developing S_1 families by selfing plants within each strain and then crossing these S_1 families for yield trial evaluations. There has been no intentional per se selection among or within S_1 families. The GG(A) \times GG(B) crosses were evaluated in grain yield trials, and the best crosses were selected based on a performance index using grain yield and grain moisture. Corresponding S_1 families were then recombined to begin the next cycle. While the number of crosses evaluated in yield trials varied from cycle to cycle, the number of S_1 families recombined was always greater than 20 in order to maintain genetic variation and minimize genetic drift. The selection intensity has averaged 22% for the five cycles that have been completed.

Agronomic evaluations of response to RRS in Golden Glow were conducted in five environments with three replications environment⁻¹ during 1995 and 1996. Selection response for grain yield of the cross between strains GG(A) and GG(B) was 340 kg ha⁻¹ cycle⁻¹ (6.8% cycle⁻¹). Responses of strains GG(A) and GG(B) also increased appreciably, 210 kg ha⁻¹ cycle⁻¹ (4.3% cycle⁻¹) and 269 kg ha⁻¹ cycle⁻¹ (5.4% cycle⁻¹), respectively, but the responses were significantly less than for the population cross. The gene frequencies in the initial strains should have been equal, and dominance interactions would not contribute appreciably to selection response. In other words, the program would be equivalent to an FS intrapopulation improvement program. Once gene frequencies in the GG(A) and GG(B) began to diverge (either through drift or unintentional selection within the A and B strains), then additional response was possible through utilization of dominance. This effect occurred fairly quickly because the population cross significantly exceeded the mean of the A and B substrains from the second cycle on.

We have also completed five cycles of “double-cross improvement” using RRS with different two double-crosses, W577 and W03545. Each program used as parental populations the F_2 generation of one of the two parental single crosses for each double-cross hybrid (W577A = F_2 of W64A \times A295, W577B = F_2 of OH43 \times W374R, W03545A = F_2 of W64A \times B46, and W03545B = F_2 of OH43 \times A635). The selection protocol was essentially the same as for the GG RRS program. Selection intensities were 20% for W577 and 17% for W03545. After five cycles, the direct response from RRS (A \times B crosses) using W577 and W03545 were 389 kg ha⁻¹ cycle⁻¹ (4.7% cycle⁻¹) and 475 kg ha⁻¹ cycle⁻¹ (6.1% cycle⁻¹), respectively. By the fourth cycle, the population crosses significantly outyielded the original double-cross hybrids for either program. By the fifth cycle, the A \times B population crosses significantly outyielded all four possible nonparental single crosses involved in either W577 or W03545. In contrast to the RRS program for Golden Glow, there was no significant per se response for the A and B populations involved in either W577 or W03545.

Based on these studies, both additive and dominant gene action can contribute to response from RRS as originally predicted. The relatively large relative gains of the A and B populations per se compared to the A \times B population cross for Golden Glow program suggest that additive gene action may be quite important if the two source populations are closely related. The lack of population per se gain in the W577 and W03545 programs suggests that dominance interactions due to the initial divergence of the base populations were the primary means of improvement. Furthermore, there was no evidence that the narrow germplasm base of the A and B populations of W577 and W03545 significantly reduced selection response. Selection using such narrow-based germplasm can still be quite effective.

RANDOM MATING--AN AID TO UNDERSTANDING QTL

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This paper reports results from the study of the F_2 (Syn0) and Syn 4 (produced by four generations of random-mating, beginning with the Syn0) generations from the cross between generations 70 of Illinois High Protein and Illinois Low Protein. Random-mating was done using bulk pollinations of approximately 200 ears each generation. From the Syn0 and from the Syn4 200 random S_1 families were produced. These families were evaluated as lines, per se, and in testcrosses to FR616 and FR1064. For each environment, the lines or testcrosses were arranged in a generalized lattice [α (0,1)] design with 2 replications of 20 blocks of 10 families. Lines per se were evaluated in 1994 and 1995 at two locations each year. The testcrosses were evaluated at two locations in 1996 and 1997. However, testcross data are reported for only 1996.

RFLP marker data were obtained for 74 probes covering the genome for each S_1 line. These probes were chosen for having shown previous significant associations with starch in a cross of generations 76 of IHP X ILP and to provide coverage of the entire genome. Probes showing significant associations with starch in the Syn0, were used to genotype the S_1 families from the Syn4. This was done because it seemed unlikely that probes not detecting significant associations in the Syn0 would show significant associations in the Syn4 and to reduce the cost of probing.

No significant differences between Syn0 and Syn4 per se or testcross means were observed for starch, protein, oil, grain yield, or grain moisture. Significant differences in allele frequencies between generations were observed for only 4 of the 44 probes used in both generations. Thus random-mating had a minimal effect on the population. In agreement with previous work (Dudley, 1994), genetic variances in the Syn4 were significantly less than in the Syn0 for starch and protein as would be expected based on a predominance of additive genetic variance and the presence of coupling phase linkages.

Results from estimation of marker-*qtl* associations from the Syn0 and Syn4 will be compared and their interpretation discussed. Results from application of a formula for estimation of recombination using Syn0 and Syn4 data will be presented. Where marker associated effects were significant at the 0.01 level in the Syn0, estimates of linkage between the per se data and the data from the two testers were consistent.

Reference

Dudley, J.W. 1994. Linkage disequilibrium in crosses between Illinois maize strains divergently selected for protein percentage.

Business Meeting
NCR-167

February 16, 1998
Ames, Iowa

The annual NCR-167 business meeting was called to order by Kendall Lamkey at 5:20 PM, February 16, immediately after the joint afternoon session of research reports. The annual business meeting includes representatives from each state in the North Central Region, ARS/USDA, and other interested stations in the public sector. The business meeting includes reports by the chairs of each subcommittee for planning the 1999 annual meeting and for coordinating the 1998 and 1999 regional maturity group trials. Subcommittee reports were presented in the order of the subcommittee listings on page 70 of the minutes of the 1997 NCR-167 annual meeting.

Meeting Place Subcommittee:

R. J. Lambert and K. R. Lamkey led the discussion of possible meeting dates and places for 1999. There was general consensus that the location and facilities for the 1998 meetings were satisfactory, and that generally favored holding the 1999 meetings at the same location; i.e., Ames, IA. Possible dates were discussed relative to other meetings. There was also some discussion about holding NCR-167 meetings in conjunction with some other meeting, such as Maize Genetics meetings or Illinois Corn Breeding School. No definite decisions made how satisfactory this may be. No decisions were made to hold NCR-167 meeting with some other meeting related to corn.

Some possible dates were discussed. After some discussion, it was proposed that the 1999 NCR-167 meetings be held at Ames, IA on February 8-9, 1999. K. R. Lamkey checked with the Holiday Inn Gateway Center and verified that facilities would be available February 8-

9, 1999. R. J. Lambert moved, Zeno Wicks seconded that 1999 NCR-167 meetings be held February 8-9, 1999 at the Holiday Inn Gateway Center, Ames, IA. Motion passed unanimously.

Nominating Subcommittee:

L. L. Darrah presented the report. A review of the Executive Committee and Subcommittee rosters (p. 70, 1997 Annual Report) indicated that several vacancies had occurred because of retirements and change of positions. B. E. Johnson (University of Nebraska) had left the region, and H. Z. Cross (North Dakota State University), Dale Harpstead (Michigan State University, being represented by Keith Dysinger), and Bob Hamilton (Plant Research Center, Ottawa) have retired since the 1997 annual meeting. The Nominating Subcommittee submitted the following nominees:

Elizabeth Lee (Guelph) for the 1998-2001 term on the Executive Committee;

Bill Tracy (Univ. of Wisconsin) to replace H. Z. Cross on the Germplasm Release Subcommittee;

E. Lee to replace H. Z. Cross on the Uniform Tests for 100-300 Maturity Group Subcommittee;

Add E. Lee and A. R. Hallauer to the Uniform Tests for the 400-600 Maturity Group Subcommittee with J. G. Coors to become chair of the subcommittee; and

B. E. Johnson is not available to chair the 700-800 Maturity Group Subcommittee. Hence, R. Pratt was designated to chair the 700-800 Maturity Group subcommittee.

There were no other nominations from the floor. R. J. Lambert moved, J. G. Coors seconded motion to accept the report. Motion passed unanimously.

Germplasm Release Subcommittee:

J. G. Coors prepared and submitted a report from information he had received prior to the meetings. There were no further additions to the report and a report is included in the minutes.

Uniform Tests of 100-300 Maturity Group Subcommittee:

The report was prepared and submitted in absentia by Harold Cross. Data were collected at six locations in 1997. Seed for 1998 testing was produced in North Dakota for 27 inbred lines crossed to two related-line testers. The future of the 100-300 Maturity Group test is becoming more limited with retirements at North Dakota, Michigan, Ottawa, and a vacancy at Minnesota. Summaries of data collected in 1997 and of seed available for testing in 1998 were made available to interested participants.

Uniform Tests for 400-600 Maturity Group Subcommittee:

Zeno Wicks presented the report for data collected at six locations in 1997. Keith Dysinger produced seed in Michigan for 28 testcrosses for test in 1998. Lists were circulated for those who plan to test in 1998 and those who wish to submit lines to produce testcross seed in 1998 for test in 1999. Testcross seed for the 400-600 Maturity Group has been produced by Keith Dysinger for several years, but no further corn breeding research is anticipated at Michigan with the retirement of Dale Harpstead. J. G. Coors will produce the testcross seed in Wisconsin in 1998 for test in 1999.

Uniform Tests for 700-800 Maturity Group Subcommittee:

Arnel Hallauer, substituting for Blaine Johnson, presented the report. Trials were conducted at six locations in 1998, and data for each location and combined across locations for grain yield and grain moisture are included. Root pulling resistance data were collected at Columbia, MO. Testcross seed was produced at Ames in 1997 for 21 lines for test in 1998. Lists were circulated for those who plan to conduct trials in 1998 and those who plan to submit

lines to produce testcross seed in 1998 for test in 1999. Testcross seed in 1998 will be produced at Ames, IA.

Genetic Vulnerability Subcommittee:

Linda Pollak submitted the report for the 1997 trials. The trial for 1997 included only five populations tested at two locations. Because of the limited interest currently expressed for the evaluation of germplasm, Linda Pollak moved that the Genetic Vulnerability Subcommittee be disbanded; Z. Wicks seconded the motion. After brief discussion, motion passed unanimously to disband the subcommittee.

Other Business:

R. Pratt announced that he had assembled and distributed copies of the mini-symposium held at the 1997 NCR-167 meetings. The report also was included in the minutes of the NCR-167 1997 Annual Report (p. 21-34).

The possibilities of electronic registration for the 1999 NCR-167 meetings were discussed, and considered feasible. R. Pratt also stated he saw the web page for NCR-167 and a good idea.

Mike Lee suggested that NCR-167 should align itself with either the Maize Genetics meetings or Plant Genome. He suggested that NCR-167 meet on Thursday, the day before the Maize Genetics meeting. This was a possibility, but if Maize Genetics meeting held outside North Central Region this could cause some complications; e.g., if meetings are in, say California. Also suggested before or after Illinois Corn Breeding School, but J. Dudley and R. Lambert indicated this would require prior approval from the steering committee of the Illinois Corn Breeding School. It may not be feasible because of the different groups involved with the two meetings. No action was taken.

J. Coors indicated the GEM project needs a venue to put out information. GEM project is maturing and perhaps a half-day session of NCR-167 meetings could be scheduled to present progress reports of GEM project. No action taken, but idea seemed good and general agreement that plans could be made to include reports on the GEM project. Also suggested that posters could be presented within the facilities used for the meetings.

K. Lamkey presented a brief report on the financial status of NCR-167. With assistance from Dr. Ron Cantrell, it seemed the \$40 registration fee for faculty and \$20 registration fee for graduate students were adequate to cover costs.

R. Pratt conveyed to K. Lamkey the members' expression of thanks for the planning and organization of the 1998 NCR-167 meetings. Everyone agreed that we had a successful meeting.

Meeting adjourned at 6:10 PM.

Report of the Subcommittee for Germplasm Releases

The following germplasms were released since the 1997 report:

<u>Release</u>	<u>Source</u>	<u>Comments</u>
Inbreds:		
B110	BS13(S)C5-12-12	Developed by single-seed descent from Iowa Stiff Stalk Synthetic population, BS13. Yellow, dent line with good plant health and combining ability. Maturity is AES 700-800.
B111	BSSS(R)C9-106	Developed by single-seed descent from Iowa Stiff Stalk Synthetic after 9 cycles of reciprocal recurrent selection with Iowa Corn Borer Synthetic No. 1 as tester. Yellow, dent line with above average root and stalks in crosses and good combining ability. Maturity is AES 700-800.
B112	BSCB1(R)C11-9081-1	Developed by pedigree selection from Iowa Corn Borer Synthetic No. 1 after 11 cycles of reciprocal recurrent selection with Iowa Stiff Stalk Synthetic as tester. Yellow, dent line with good vigor and combining ability. Maturity is AES 700-800.
B113	BS11(FR)C9-3237-12-2	Developed by pedigree selection after 9 cycles of reciprocal full-sib selection with BS10. Yellow, semi-dent line good root and stalk strength, plant health, and combining ability. Maturity is AES 800.
B114	CIMMYT(NT)Pool 41	Developed by pedigree selection from CIMMYT(NT)Pool 41-C15-19-2. Yellow, flint line with good vigor and combining ability. Maturity is AES 500-600.
PA791	(PA91 x A667)PA91	Yellow dent selected from a cross to A667 with one backcross to PA91. Combines well with IA stiff stalk lines. Late AES 700 maturity.
PA812	(PA91 x A667)PA91 _{BC2}	Yellow dent selected from a cross to A667 with two backcrosses to PA91. Combines well with IA stiff stalk lines. Early AES 800 maturity.
PA763	(PA762 x H101)PA762	Yellow dent selected from a cross to H101 with one backcross to PA762. Combines well with both IA stiff stalk and C103 related lines. Mid AES 700 maturity.
PA764	(PA762 x H101)PA762 _{BC2}	Yellow dent selected from a cross to H101 with two backcrosses to PA762. Combines well with IA stiff stalk lines. Mid AES 700 maturity.

PA757	(PA887P x A669)PA887 _{BC2}	Yellow dent selected from a cross to A669 with two backcrosses to PA887P. Combines well with IA stiff stalk lines. Mid AES 700 maturity.
PA 787	(PA887p x H55)PA887 _{BC2}	Yellow dent selected from a cross to H55 with two backcross to PA887P. Combines well with IA stiff stalk lines. Late AES 700 maturity.
PA 858	PA Comp. III (GLS) LDHSC1	Yellow dent selected from half sib cycle 1 of OH43/40B related population developed for GLS resistance. Combines well with both stiff stalk and MO17 related lines. AES 800 maturity that has shown good resistance to NLS and GLS.
PA895	PA SAAM Syn RRSC ₉	Yellow dent selected from RRS C ₉ of SAAM Syn. Combines well with IA stiff stalk lines. Late AES 800 maturity. Its has shown good NLS resistance per se and in crosses.

Populations:

BS21(R)C6	BS21 developed from the cross of (BS5 x BS20). BS5 was formed from 23 lines that were 36% Minnesota 13, 24% Reid Yellow Dent, 26% European Flint, and 15% others. BS20 was formed by intermating 12 lines sthat had 85% Reid Yellow Dent germplasm.	BS21(R)C6 is a yellow, dent cultivar developed by 6 cycles of reciprocal half-sib recurrent selection with BS22(R)Cn as the tester.
BS22(R)C6	BS22 developed by intermating 16 inbred lines that were 45% Reid Yellow Dent, 13% Lancaster Sure Crop, 9% Minnesota 13, and 34% unknown origin.	BS22(R)C6 is a yellow, dent cultivar developed by 6 cycles of reciprocal half-sib recurrent selection with BS21(R)Cn as the tester.

H.Z. Cross
L.L. Darrah
A.R. Hallauer
J.G. Coors, Chair

REPORT OF THE SUB-COMMITTEE ON UNIFORM TESTS IN THE 100-300 MATURITY SERIES

Seed for 1998 testing was produced in North Dakota for 27 inbreds topcrossed onto two related-line testers (A665 x CM105) and (ND245 x ND252). Except for a few crosses with low quantities (Table 1), seed quantities should be adequate for a 54-entry test in 1998. Data for the 1997 tests (Table 3) were obtained from two North Dakota locations (Fargo, and Casselton), Michigan, Guelph, Pennsylvania, and Wisconsin.

Zeno Wicks, III
H.Z. Cross, Chairman

Table 1. Inbreds used for producing seed, pedigrees, and seed quantities of three-way hybrids for the 1998 regional tests.

Inbred	Source	Approximate seed supply	
		Tester 1 (A665xCM105)	Tester 2 (ND245xND252)
		-----No. of kernels-----	
CG88	CG Lancaster(RRS)C3	192	584
CG91	CG HOPE1A(S2)C1*Pioneer3921	2232	1352
CG93	S5 from Pion. 3969*Pion.3929	2916	1940
CG95	France-Canada Shuttle*Pio.3929	3932	3768
CG96	CG HOPE Elite A (RRS)C3*Pion.3921	1188	1028
CG100	Stalk Quality 1*Pion. 3921	2904	6928
CG102	CG Stiff Stalk (Comb)C2	1720	4872
CG103	CG Lancaster(RRS)C3	5832	3748
CG97	CG Wigor(S2)C2*Pion. 3921	1616	5452
CO407	CO266xKW6114//CO266	3432	2176
CO411	Pioneer 3995	1464	4544
CO417	CB3xCM383	2148	4172
CO419	Lethbridge 24-44-1	752	300
CO421	Dea (Pion. Europ. Hybrid)	1892	4716
ND94-22	NDSM	3100	2632
ND95-1W	NDSF(FS)C5	3448	5088
ND95-7W	NDSF(FS)C5	2496	2072
ND95-14	NDSM(MS)C1	5428	5780
ND95-21	NDSF(FS)C5	4244	3752
ND95-23	NDSKxNDSL	4024	5348
ND95-25	NDSB(FS)C5	200	580
ND95-29	NDSAB(MER)C6	3780	1264
ND95-30	NDSAB(MS)C10	660	1216
ND95-33	NDSB(FS)C5	2452	4284
ND95-36	NDSAB(MER)C6	3868	3892
ND95-37	NDSKxNDSL	1568	1340
ND95-38	NDSAB(MS)C2	3348	5100

Table 2. Inbreds and pedigrees of lines tested in the 1997 regional 100-300 maturity topcross tests.

Inbred	Source	Inbred	Source
CG76	PION 3859	ND93-20	NDSF X NDSB
CG77	PION 3950	ND93-21	NDSB X NDSF
CG78	PION 3925	ND93-29	NDSF X NDSB
CG79	PION 3803	ND93-32	NDSB
CG80	PION 3737	ND93-40	NDSAB
CG82	PION 3902	ND94-15	NDSA
CG84	PION 3929	ND94-20	NDSCD
CG85	PION 3790	ND94-29	NDSG
CG87	EMS TRTD A632	ND94-33	((ND245XND252)XB73)XND247
CO386	Mo17 X MAG	ND94-37	(ND245XND252)XNDSL
CO387	CO272 X CO266	ND94-41	((ND245XND252)XB52)XND301
CO393	Mo17 X CO266//CO266	ND94-7	NDSL
CO394	Mo17 X CO266//CO266	PA92-30	PA326 X PA361
CO395	Mo17 X CO266//CO266	PA92-55	(PA373 X A556) X PA373 BC4
ND93-11	NDSCD	PA92-57	(PA373 X A556) X PA373 BC3

Table 3. Summary of data from the 100-300 topcrosses, 1997.

Pedigree	Entry	Yield							Prfor. index+
		NDF	NDC	CG	PA	WI	MI	Aver	
		-----Mg ha-1-----							
(A665xCM105)xCO393	12	6.78	8.13	5.05	6.70	7.46	6.67	6.80	127.1
(A665xCM105)xCO386	10	7.32	7.64	6.24	8.58	8.47	6.28	7.42	125.8
(A665xCM105)xCG76	1	7.21	7.04	5.37	6.76	8.90	6.21	6.92	124.7
(A665xCM105)xND94-37	26	7.63	6.64	5.85	6.89	9.19	7.18	7.23	122.4
(A665xCM105)xCO395	14	6.03	6.86	4.44	8.32	7.30	6.10	6.51	121.2
(A665xCM105)xCG77	2	5.58	4.84	6.44	8.66	9.75	6.81	7.01	121.1
(A665xCM105)xCO394	13	6.02	6.95	5.06	6.07	8.18	5.99	6.38	119.9
(A665xCM105)xCG80	5	7.40	6.84	4.67	7.24	10.86	8.45	7.58	115.9
(A665xCM105)xND93-29W	18	5.65	6.09	3.61	7.87	8.38	5.97	6.26	115.1
(A665xCM105)xCG78	3	5.59	6.65	5.32	9.24	9.78	6.79	7.23	115.1
(A665xCM105)xND93-20	16	6.54	7.19	4.01	8.42	7.70	6.13	6.66	108.9
(ND245xND252)xCG82	36	5.95	6.75	5.29	4.62	5.60	6.21	5.74	106.0
(A665xCM105)xCG85	8	6.46	7.82	4.03	7.26	6.75	6.71	6.50	104.9
(A665xCM105)xCG79	4	4.95	4.95	5.72	8.60	9.66	6.94	6.80	104.6
(A665xCM105)xND94-7	21	4.93	6.91	3.79	5.41	7.59	6.53	5.86	103.1
(ND245xND252)xCO387	41	6.00	5.76	5.08	3.34	4.26	6.10	5.09	103.0
(ND245xND252)xCG77	32	6.38	5.91	4.28	4.81	7.03	6.06	5.74	102.7
(ND245xND252)xND94-41	57	5.71	6.68	5.82	6.09	6.92	6.55	6.30	102.2
(A665xCM105)xND93-11	15	5.53	5.83	3.81	6.62	8.03	5.55	5.89	101.5
(ND245xND252)xCG76	31	5.30	5.74	5.37	4.47	7.08	6.45	5.73	101.1
(ND245xND252)xCG84	37	5.29	5.28	4.42	4.08	5.77	6.04	5.15	100.2
(ND245xND252)xCG85	38	6.00	7.20	4.99	4.51	5.76	6.25	5.78	99.5
(ND245xND252)xND94-15	52	4.96	5.42	4.76	5.07	5.08	6.54	5.30	98.6
(ND245xND252)xCO395	44	4.89	6.27	4.37	3.95	4.84	5.42	4.96	98.6
(ND245xND252)xCG87	39	6.02	5.94	6.38	6.52	4.04	6.62	5.92	98.3
(ND245xND252)xCO393	42	5.23	5.40	5.07	4.56	4.46	6.01	5.12	98.3
(ND245xND252)xND93-11	45	5.97	5.69	3.93	3.04	6.06	6.62	5.22	96.8
(A665xCM105)xND93-32	19	5.42	5.87	3.63	5.07	7.30	5.63	5.49	96.3
(ND245xND252)xCG78	33	5.76	6.11	4.69	4.52	5.65	6.12	5.47	96.0
(ND245xND252)xCO386	40	5.02	5.64	5.91	5.61	5.00	5.97	5.52	95.0
(A665xCM105)xND94-33	25	6.29	6.41	3.68	7.80	8.45	5.39	6.34	93.4
(A665xCM105)xND93-40	20	5.50	5.80	4.49	6.68	8.89	6.21	6.26	93.4
(ND245xND252)xCG79	34	5.62	6.22	6.25	5.65	4.82	6.94	5.92	92.6
(ND245xND252)xND93-29W	48	4.54	4.49	4.43	3.66	5.26	6.07	4.74	92.5
(A665xCM105)xPA92-57	30	6.38	6.26	3.38	7.64	7.35	5.63	6.11	91.6
(A665xCM105)xND94-20	23	6.11	5.40	1.97	6.59	8.16	5.00	5.54	91.6
(ND245xND252)xPA92-55	59	5.51	6.37	4.62	3.85	1.53	6.34	4.70	89.8
(ND245xND252)xND93-32	49	5.53	5.83	3.56	3.96	4.18	7.04	5.02	89.1
(ND245xND252)xND94-29	54	5.85	4.99	5.02	4.03	4.79	6.69	5.23	89.0
(ND245xND252)xCO394	43	3.92	5.45	4.37	3.65	3.94	5.86	4.53	87.8
(A665xCM105)xCG87	9	4.79	4.90	4.36	5.26	9.53	3.75	5.43	85.1
(ND245xND252)xND94-20	53	5.46	5.61	4.44	4.55	6.59	4.76	5.24	85.0
(ND245xND252)xND93-20	46	6.02	6.05	5.00	4.97	4.10	5.28	5.24	84.4
(ND245xND252)xND94-7	51	4.40	5.27	5.21	3.55	3.57	6.43	4.74	83.6
(ND245xND252)xND93-21	47	3.86	4.13	3.13	4.26	4.72	5.50	4.27	81.1
(ND245xND252)xND93-40	50	4.78	4.90	5.91	3.32	4.88	5.34	4.86	80.4
(ND245xND252)xND94-33	55	5.12	4.54	4.05	3.53	5.92	4.31	4.58	75.3

Table 3. (Continued)

Pedigree	Entry	Yield							Prfor. index+
		NDF	NDC	CG	PA	WI	MI	Aver	
		-----Mg ha-1-----							
(A665xCM105)xCG82	6	5.67	7.79	4.92	8.83	9.59		7.36	
(A665xCM105)xND94-15	22	7.34	5.93			8.18		7.15	
(A665xCM105)xND94-29	24	5.75	6.02	5.50	5.03	11.99		6.86	
(ND245xND252)xCG80	35	6.53	6.23	6.48	5.30	7.43		6.39	
(A665xCM105)xPA92-30	28	5.57	6.64	5.39	7.99	5.88		6.29	
(A665xCM105)xND94-41	27	7.03	8.13	4.67		5.12		6.24	
(A665xCM105)xCG84	7	6.38	5.16	3.97	6.60	8.58		6.14	
(A665xCM105)xND93-21	17	4.84	5.23	4.33	6.95	8.85		6.04	
(A665xCM105)xCO387	11	4.64	4.70	5.11	7.09	7.76		5.86	
(A665xCM105)xPA92-55	29	6.01	4.97	3.89	7.42	6.25		5.71	
(ND245xND252)xPA92-30	58	6.31	6.68	6.23	7.77	0.86		5.57	
(ND245xND252)xPA92-57	60	6.43	4.25	4.88	4.43		6.09	5.22	
(ND245xND252)xND94-37	56	5.35	4.78	3.87	4.01		6.48	4.90	

+Performance index = ((yield/aver.yield)/(moist./aver.moist.))*100.

Table 3. Continued

Pedigree	Entry	Moisture						MI	Aver.
		NDF	NDC	CG	PA	WI			
		-----%-----							
(ND245xND252)xCO387	41	10.2	6.8	23.3	18.6	16.3	26.2	16.9	
(ND245xND252)xCO395	44	10.2	8.2	24.4	18.9	15.4	26.0	17.2	
(ND245xND252)xND93-29W	48	10.8	10.7	23.6	19.6	15.3	25.2	17.5	
(ND245xND252)xCG84	37	11.1	8.7	24.2	19.4	15.2	26.8	17.6	
(ND245xND252)xCO394	43	10.2	7.9	25.9	18.6	16.0	27.2	17.6	
(ND245xND252)xCO393	42	10.3	8.2	25.9	18.6	16.1	27.8	17.8	
(ND245xND252)xPA92-55	59	15.4	11.5	27.9	19.7	1.0	31.9	17.9	
(ND245xND252)xND93-21	47	10.7	8.5	24.9	19.2	16.8	27.8	18.0	
(A665xCM105)xCO394	13	11.9	10.3	25.5	18.4	15.1	27.9	18.2	
(A665xCM105)xCO393	12	11.9	9.2	26.9	18.9	15.1	27.7	18.3	
(A665xCM105)xCO395	14	11.5	9.5	27.1	19.0	15.9	27.1	18.4	
(ND245xND252)xND94-15	52	12.2	9.6	24.8	19.4	15.2	29.0	18.4	
(ND245xND252)xND93-11	45	12.5	7.3	27.2	18.5	16.0	29.0	18.4	
(ND245xND252)xCG82	36	14.1	9.4	25.1	18.9	15.7	27.8	18.5	
(A665xCM105)xND93-29W	18	12.1	10.4	27.9	18.9	15.6	26.7	18.6	
(A665xCM105)xCG76	1	13.8	9.5	26.4	19.0	15.8	29.3	19.0	
(ND245xND252)xCG77	32	16.3	9.9	25.9	18.6	14.9	29.1	19.1	
(ND245xND252)xND93-32	49	14.5	10.5	27.9	18.5	15.8	28.2	19.2	
(ND245xND252)xND94-7	51	15.0	11.6	25.9	19.0	15.8	29.0	19.4	
(ND245xND252)xCG76	31	14.6	9.6	26.5	19.5	15.5	30.7	19.4	
(A665xCM105)xND94-7	21	11.1	10.5	29.1	19.5	15.3	31.1	19.4	
(A665xCM105)xND93-32	19	12.1	9.5	29.0	20.3	16.0	29.9	19.5	
(ND245xND252)xCG78	33	15.4	11.7	26.7	19.1	15.5	28.5	19.5	
(A665xCM105)xCG77	2	16.5	12.6	25.3	19.0	16.0	29.4	19.8	
(A665xCM105)xND93-11	15	12.7	9.8	28.6	19.4	17.3	31.4	19.9	
(ND245xND252)xCO386	40	15.6	10.3	26.9	19.1	16.2	31.2	19.9	
(ND245xND252)xCG85	38	18.4	11.6	26.6	18.6	15.7	28.4	19.9	
(ND245xND252)xND94-29	54	15.3	10.0	26.5	19.6	16.5	32.6	20.1	
(A665xCM105)xCO386	10	14.8	10.4	29.4	20.6	15.6	30.2	20.2	
(A665xCM105)xND94-37	26	15.4	12.2	29.2	18.4	17.5	28.4	20.2	
(ND245xND252)xCG87	39	17.3	11.4	27.3	19.0	15.5	33.0	20.6	
(ND245xND252)xND93-40	50	14.5	13.1	28.8	18.3	16.5	32.6	20.6	
(A665xCM105)xND94-20	23	15.3	11.5	30.1	18.7	15.7	32.7	20.7	
(ND245xND252)xND94-33	55	14.8	11.0	29.7	18.8	16.2	34.2	20.8	
(A665xCM105)xND93-20	16	14.9	10.4	29.1	19.7	15.6	35.8	20.9	
(ND245xND252)xND94-20	53	19.3	12.8	27.2	18.9	16.3	31.7	21.0	
(ND245xND252)xND94-41	57	16.3	10.3	29.9	19.4	16.0	34.4	21.1	
(A665xCM105)xCG85	8	19.0	14.0	29.0	19.0	16.3	29.9	21.2	
(ND245xND252)xND93-20	46	15.1	12.9	29.7	19.4	16.4	33.8	21.2	
(A665xCM105)xCG78	3	16.6	14.7	29.8	21.1	16.7	29.9	21.5	
(A665xCM105)xCG87	9	18.7	11.7	30.3	18.7	16.1	35.5	21.8	
(ND245xND252)xCG79	34	18.4	12.4	29.5	19.4	16.2	35.2	21.8	
(A665xCM105)xCG79	4	17.1	14.5	31.0	19.7	16.9	34.1	22.2	
(A665xCM105)xCG80	5	17.3	14.9	30.9	19.6	15.6	35.8	22.3	
(A665xCM105)xPA92-57	30	17.1	13.2	33.9	19.0	16.2	37.2	22.8	
(A665xCM105)xND93-40	20	19.4	15.5	34.1	19.0	16.4	33.0	22.9	
(A665xCM105)xND94-33	25	18.5	14.6	32.1	19.8	16.8	37.2	23.2	

Table 3. Continued

Pedigree	Entry	Moisture					MI	Aver.
		NDF	NDC	CG	PA	WI		
		-----%-----						
(A665xCM105)xND94-15	22	13.5	10.5			16.2		13.4
(A665xCM105)xCO387	11	10.6	8.9	24.8	18.5	15.1		15.6
(A665xCM105)xND93-21	17	12.3	9.0	26.9	18.7	15.7		16.5
(A665xCM105)xCG84	7	13.1	9.4	28.3	20.0	16.6		17.5
(A665xCM105)xCG82	6	14.0	10.0	28.8	19.6	15.6		17.6
(A665xCM105)xND94-41	27	14.8	10.3	30.7		15.1		17.7
(ND245xND252)xCG80	35	15.9	9.8	28.0	19.5	15.6		17.7
(ND245xND252)xPA92-30	58	20.4	13.5	32.2	19.3	3.8		17.8
(ND245xND252)xND94-37	56	12.1	9.1	24.9	19.2		29.5	19.0
(A665xCM105)xND94-29	24	17.5	13.0	29.7	20.2	18.1		19.7
(A665xCM105)xPA92-55	29	17.7	14.8	31.0	19.1	16.2		19.8
(ND245xND252)xPA92-57	60	17.1	12.2	26.5	20.3		34.0	22.0
(A665xCM105)xPA92-30	28	24.8	20.4	33.2	22.4	15.6		23.3

Table 3. Continued

Pedigree	Entry	Stalk lodging						Root lodging		
		NDF	NDC	CG	PA	MI	Aver.	NDC	NDF	Aver.
		-----%-----								
(ND245xND252)xCG85	38	0.0	10.0	-1.5	0.6	0.6	1.9	18.49	0.02	9.3
(ND245xND252)xCG78	33	6.5	0.0	5.2	1.3	0.0	2.6	92.04	-0.02	46.0
(ND245xND252)xCG76	31	1.7	1.7	8.0	3.2	0.6	3.0	25.83	0.00	12.9
(ND245xND252)xCO393	42	3.2	8.2	5.2	2.1	1.6	4.1	43.3	10.00	21.7
(A665xCM105)xCG78	3	3.3	1.9	14.4	1.9	1.6	4.6	76.0	80.00	38.0
(ND245xND252)xCO394	43	3.5	3.9	11.7	1.9	2.2	4.7	26.59	1.85	14.2
(ND245xND252)xCO395	44	2.9	4.3	15.4	1.3	0.5	4.9	29.06	-0.03	14.5
(ND245xND252)xCG82	36	5.2	9.2	8.6	1.9	2.4	5.5	35.19	0.01	17.6
(ND245xND252)xCO386	40	1.8	10.3	15.6	0.0	0.6	5.6	41.5	10.00	20.8
(ND245xND252)xCG79	34	7.0	4.8	10.0	6.4	1.1	5.9	67.29	-0.02	33.6
(ND245xND252)xND93-21	47	8.3	9.5	11.4	1.3	2.1	6.55	6.58	0.00	28.3
(ND245xND252)xND94-33	55	7.4	0.0	21.9	2.7	1.2	6.69	5.92	0.02	48.0
(A665xCM105)xCG85	8	8.6	10.3	13.0	1.3	1.1	6.9	18.58	-0.01	9.3
(ND245xND252)xND94-7	51	4.2	2.1	24.4	2.5	2.4	7.1	64.49	0.02	32.3
(ND245xND252)xND94-20	53	2.9	3.8	22.6	6.4	0.6	7.21	4.10	0.01	7.1
(ND245xND252)xND93-20	46	4.3	0.0	27.5	3.2	1.6	7.37	5.40	0.01	37.7
(ND245xND252)xCG77	32	6.3	7.5	23.0	1.9	0.0	7.7	45.08	-0.02	22.5
(ND245xND252)xCG87	39	8.3	6.7	17.3	3.2	4.0	7.9	65.82	-0.01	32.9
(A665xCM105)xCO394	13	4.6	8.6	17.4	5.1	4.4	8.0	52.9	10.01	26.5
(ND245xND252)xCG84	37	13.3	8.3	16.7	1.9	1.7	8.4	55.0	10.00	27.5
(ND245xND252)xND94-29	54	4.6	20.3	10.2	3.8	3.6	8.54	2.73	0.00	21.4
(ND245xND252)xND93-11	45	6.5	6.3	22.6	5.1	2.3	8.54	7.88	0.03	24.0
(ND245xND252)xCO387	41	6.1	9.5	24.2	6.4	0.5	9.3	32.14	0.00	16.1
(A665xCM105)xCG76	1	9.5	8.7	16.8	9.6	2.2	9.4	46.63	-0.02	23.3
(ND245xND252)xND94-15	52	4.5	1.9	33.7	3.2	4.2	9.5	90.52	0.00	45.3
(A665xCM105)xCO393	12	8.0	17.8	19.2	1.3	2.2	9.7	8.39	-0.01	4.2
(A665xCM105)xCO386	10	3.2	17.5	21.5	6.4	0.5	9.8	19.82	0.00	9.9
(ND245xND252)xND94-41	57	6.6	15.8	23.4	3.2	0.6	9.9	40.04	0.00	20.0
(ND245xND252)xPA92-57	60	10.9	6.1	29.8	1.3	1.7	10.0	80.66	-0.01	40.3
(A665xCM105)xCG80	5	10.0	7.7	25.8	6.4	0.5	10.1	84.29	0.01	42.1
(A665xCM105)xCO395	14	12.0	26.3	4.9	3.2	4.2	10.1	29.61	0.00	14.8
(A665xCM105)xCG77	2	9.0	0.0	33.8	7.1	1.7	10.3	90.12	2.94	46.5
(ND245xND252)xPA92-55	59	16.9	8.7	18.6	3.2	4.5	10.4	57.01	0.00	28.5
(A665xCM105)xND94-33	25	7.9	12.4	27.8	4.5	0.0	10.5	61.47	0.00	30.7
(A665xCM105)xCG79	4	20.1	2.0	25.5	5.8	0.6	10.8	88.09	-0.01	44.0
(A665xCM105)xND93-11	15	8.9	10.5	31.5	0.6	3.1	10.9	76.52	-0.02	38.2
(ND245xND252)xND93-40	50	3.7	6.0	39.6	4.5	3.4	11.4	85.90	-0.01	42.9
(A665xCM105)xND93-20	16	11.8	3.3	37.8	3.8	1.1	11.6	16.67	0.00	8.3
(ND245xND252)xND94-37	56	6.9	8.5	40.7	2.8	1.2	12.0	62.99	0.00	31.5
(A665xCM105)xND94-7	21	11.1	12.9	35.1	3.8	1.6	12.9	16.08	-0.01	8.0
(A665xCM105)xCG87	9	12.3	11.6	19.5	21.8	1.1	13.3	32.35	0.01	16.2
(A665xCM105)xND94-37	26	9.6	3.8	46.2	3.2	7.5	14.1	87.00	0.01	43.5
(A665xCM105)xND94-20	23	10.1	12.2	29.9	21.2	3.0	15.3	30.66	0.00	15.3
(ND245xND252)xND93-29W	48	12.1	0.0	57.0	6.4	1.6	15.4	84.10	0.01	42.1
(A665xCM105)xPA92-57	30	11.5	10.0	50.5	3.8	2.9	15.7	50.13	1.61	25.9
(A665xCM105)xND93-40	20	12.9	8.5	41.3	18.6	8.3	17.9	78.62	-0.01	39.3
(A665xCM105)xND93-29W	18	13.9	8.3	51.0	13.5	6.7	18.7	69.77	0.02	34.9
(A665xCM105)xND93-32	19	22.7	19.8	52.5	15.8	4.1	23.0	39.29	0.00	19.6
(ND245xND252)xND93-32	49	21.9	25.1	52.5	19.2	5.6	24.9	46.02	0.00	23.0

Table 3. Continued

Pedigree	Entry	Stalk lodging					Root lodging			
		NDF	NDC	CG	PA	MI	Aver.	NDC	NDF	Aver.
		-----%-----								
(ND245xND252)xCG80	35	10.7	7.1	5.6	1.3		6.2	70.98	0.00	35.5
(A665xCM105)xND94-15	22	7.9	4.8				6.3	84.61	-0.01	42.3
(A665xCM105)xCG84	7	5.1	1.9	15.0	8.3		7.6	61.40	-0.01	30.7
(A665xCM105)xND94-29	24	6.9	7.7	12.3	4.5		7.9	85.22	0.01	42.6
(A665xCM105)xCO387	11	6.8	7.8	14.1	3.2		8.0	56.68	0.00	28.3
(A665xCM105)xPA92-30	28	4.3	2.4	29.3	0.0		9.0	18.11	0.00	9.1
(ND245xND252)xPA92-30	58	5.9	17.4	19.2	1.3		10.9	46.00	0.02	23.0
(A665xCM105)xCG82	6	10.5	20.0	13.3	11.5		13.8	30.21	0.00	15.1
(A665xCM105)xPA92-55	29	16.3	4.8	43.3	3.8		17.0	83.69	-0.01	41.8
(A665xCM105)xND93-21	17	23.3	19.2	25.7	7.7		19.0	35.46	0.00	17.7
(A665xCM105)xND94-41	27	7.3	33.6	39.6			26.8	21.37	0.02	10.7

Table 3. Continued

		Test weight				Aver.	Days	Plant	Ear	Stand
		NDF	MI	CG	PA		to silk PA	ht. PA	ht. PA	
		-----lb/bu-----					-----cm-----			%
(ND245xND252)xND93-11	45	62.5	54.9	46.9	54.8	75.0	137.2	61.0	89.3	
(ND245xND252)xC395	44	62.4	55.2	45.3	54.3	75.0	152.4	71.1	91.3	
(ND245xND252)xCG77	32	62.2	53.7	46.9	54.3	75.0	149.9	73.7	95.7	
(ND245xND252)xC393	42	62.8	52.9	46.9	54.2	75.0	154.9	71.1	93.0	
(ND245xND252)xC387	41	60.4	53.8	48.0	54.1	75.0	149.9	63.5	94.3	
(ND245xND252)xC394	43	63.1	53.3	45.6	54.0	76.0	147.3	71.1	94.3	
(ND245xND252)xND93-29W	48	62.2	55.3	44.4	54.0	75.0	149.9	71.1	92.7	
(ND245xND252)xND94-7	51	62.1	52.0	46.2	53.4	74.0	137.2	66.0	90.7	
(ND245xND252)xND93-21	47	61.2	53.7	45.2	53.4	75.0	144.8	61.0	95.0	
(ND245xND252)xC386	40	62.1	52.3	45.7	53.4	75.0	162.6	68.6	94.7	
(ND245xND252)xND94-15	52	61.8	53.0	45.3	53.4	76.0	147.3	73.7	88.0	
(ND245xND252)xCG84	37	62.5	51.9	45.4	53.2	74.0	154.9	76.2	91.3	
(ND245xND252)xND94-37	56	61.0	53.1	45.1	53.1	75.0	137.2	61.0	90.7	
(ND245xND252)xND93-32	49	62.9	51.6	43.9	52.8	75.0	162.6	83.8	92.3	
(ND245xND252)xND94-41	57	61.6	50.5	45.7	52.6	75.0	157.5	81.3	89.0	
(ND245xND252)xND94-33	55	61.8	50.2	45.2	52.4	78.0	157.5	71.1	85.0	
(ND245xND252)xND94-29	54	61.2	50.7	45.2	52.4	74.0	114.3	61.0	86.7	
(ND245xND252)xND93-20	46	61.2	49.8	45.8	52.3	77.0	167.6	76.2	95.3	
(A665xCM105)xND93-29W	18	60.8	52.8	42.9	52.2	77.0	182.9	86.4	94.3	
(ND245xND252)xND93-40	50	62.0	50.6	43.9	52.2	75.0	137.2	55.9	94.3	
(ND245xND252)xCG76	31	60.3	50.7	45.0	52.0	75.0	149.9	66.0	90.7	
(ND245xND252)xCG85	38	59.4	49.3	46.4	51.7	75.0	154.9	73.7	92.0	
(A665xCM105)xND93-11	15	60.9	49.3	44.4	51.5	78.0	167.6	63.5	98.3	
(ND245xND252)xPA92-57	60	59.1	50.2	45.2	51.5	75.0	152.4	68.6	92.0	
(ND245xND252)xPA92-55	59	59.5	50.9	43.9	51.4	77.0	142.2	73.7	93.7	
(A665xCM105)xCO393	12	59.5	51.4	43.4	51.4	76.0	182.9	71.1	97.3	
(ND245xND252)xND94-20	53	59.8	49.8	44.4	51.3	75.0	165.1	83.8	93.0	
(A665xCM105)xND94-37	26	59.3	51.6	43.1	51.3	78.0	170.2	73.7	90.3	
(A665xCM105)xND93-20	16	59.7	50.2	43.3	51.0	77.0	190.5	76.2	98.3	
(A665xCM105)xCO394	13	60.4	50.1	42.5	51.0	75.0	162.6	66.0	93.7	
(ND245xND252)xCG82	36	58.5	51.2	43.2	51.0	76.0	152.4	76.2	87.0	
(A665xCM105)xCO395	14	58.4	51.1	43.4	50.9	77.0	188.0	81.3	88.7	
(A665xCM105)xND94-7	21	60.1	49.9	42.6	50.9	77.0	147.3	66.0	98.0	
(ND245xND252)xCG79	34	58.8	49.5	44.1	50.8	75.0	147.3	63.5	91.7	
(ND245xND252)xCG78	33	59.6	48.4	44.2	50.7	76.0	149.9	68.6	96.3	
(A665xCM105)xCG77	2	57.3	50.8	42.9	50.3	78.0	185.4	78.7	92.3	
(A665xCM105)xND94-33	25	59.6	49.1	42.1	50.3	81.0	172.7	76.2	86.0	
(ND245xND252)xCG87	39	58.5	49.1	42.0	49.8	75.0	165.1	76.2	93.7	
(A665xCM105)xND93-32	19	61.1	48.2	39.9	49.7	79.0	167.6	68.6	87.3	
(A665xCM105)xCO386	10	58.8	49.3	40.4	49.5	76.0	177.8	73.7	91.0	
(A665xCM105)xCG76	1	57.8	48.4	42.1	49.4	76.0	185.4	76.2	94.3	
(A665xCM105)xCG79	4	57.6	48.5	42.1	49.4	78.0	162.6	78.7	93.3	
(A665xCM105)xND93-40	20	58.8	48.1	41.0	49.3	77.0	167.6	68.6	94.3	
(A665xCM105)xND92-57	30	57.7	47.9	42.0	49.2	76.0	170.2	71.1	91.3	
(A665xCM105)xCG80	5	57.9	47.1	40.4	48.4	80.0	180.3	73.7	94.3	
(A665xCM105)xND94-20	23	57.7	46.6	40.5	48.3	80.0	185.4	76.2	87.0	
(A665xCM105)xCG85	8	55.9	46.5	40.0	47.5	79.0	172.7	78.7	89.7	

Table 3. Continued

		Test weight			Aver.	Days	Plant	Ear	Stand
		NDF	MI	CG		to silk PA	ht. PA	ht. PA	
		-----lb/bu-----				-----cm-----			%
(A665xCM105)xCG78	3	55.2	47.6	39.4	47.4	78.0	172.7	71.1	98.3
(A665xCM105)xCG87	9	56.6	43.3	40.9	46.9	81.0	175.3	68.6	93.7
(A665xCM105)xND94-15	22	58.3			58.3				
(A665xCM105)xCO387	11	59.8		44.5	52.2	77.0	162.6	63.5	
(A665xCM105)xND93-21	17	59.5		43.7	51.6	76.0	154.9	76.2	
(A665xCM105)xND94-41	27	59.0		42.8	50.9				
(A665xCM105)xPA92-55	29	58.0		43.7	50.8	76.0	157.5	78.7	
(A665xCM105)xND94-29	24	57.5		44.0	50.8	77.0	134.6	63.5	
(ND245xND252)xCG80	35	59.5		41.5	50.5	78.0	157.5	68.6	
(A665xCM105)xCG84	7	58.1		42.7	50.4	79.0	180.3	83.8	
(ND245xND252)xPA92-30	58	57.1		43.4	50.2	77.0	170.2	78.7	
(A665xCM105)xCG82	6	56.5		41.6	49.0	78.0	167.6	71.1	
(A665xCM105)xPA92-30	28	55.4		42.3	48.8	80.0	182.9	73.7	

NCR-167 UNIFORM 400-600 MATURITY TRIALS - 1997

Inbred lines x 2 testers (A632Ht and LH82) and hybrid checks were tested in 6 environments in 1997 (Michigan, Wisconsin, Pennsylvania, and 3 locations in Iowa). Table 1 contains summary data for grain yield and grain moisture content at harvest for all locations. Tables 2 through 8 contain data for individual locations.

ENTRY #	INBRED LINE		TESTER
1	Ontario	CO396	A632HT
2	Ontario	CO397	A632HT
3	Ontario	CO398	A632HT
4	Ontario	CO399	A632HT
5	Ontario	CO400	A632HT
6	Ontario	CO410	A632HT
7	Iowa	IA95:24	A632HT
8	Iowa	IA95:27	A632HT
9	Iowa	IA95:1232	A632HT
10	Iowa	IA95:1233	A632HT
11	Iowa	IA95:1285	A632HT
12	Pennsylvania	PA92-38	A632HT
13	Pennsylvania	PA92-41	A632HT
14	Pennsylvania	PA92-42	A632HT
15	Ontario	CO396	LH82
16	Ontario	CO397	LH82
17	Ontario	CO398	LH82
18	Ontario	CO399	LH82
19	Ontario	CO400	LH82
20	Ontario	CO410	LH82
21	Iowa	IA95:24	LH82
22	Iowa	IA95:27	LH82
23	Iowa	IA95:1232	LH82
24	Iowa	IA95:1233	LH82
25	Iowa	IA95:1285	LH82
26	Pennsylvania	PA92-38	LH82
27	Pennsylvania	PA92-41	LH82
28	Pennsylvania	PA92-42	LH82
29	Pioneer 3573 (Yellow check)		J. G. Coors K. Dysinger
30	Pioneer 3752 (Yellow check)		Z. W. Wicks, III, Chair

Table 1. Grain yield (Q/Ha) and grain moisture (%) data for testcrosses and checks in the 400-600 maturity group tested in six locations (Michigan, Wisconsin, Pennsylvania, and 2 locations in Iowa).

Entry	Line	Calumet, Iowa		Kanawha, Iowa		Nashua, Iowa		Pennsylvania	
		Yield q/ha	H ₂ O %	Yield q/ha	H ₂ O %	Yield q/ha	H ₂ O %	Yield q/ha	H ₂ O %
1	A632Ht x CO396	36.7	17.5	57.6	14.5	58.7	16.3	86.2	20.6
2	A632Ht x CO397	44.9	18.9	72.1	12.7	50.2	17.2	79.2	21.9
3	A632Ht x CO398	45.0	17.5	59.7	14.8	40.0	16.1	88.4	20.9
4	A632Ht x CO399	32.8	17.2	56.8	12.5	47.7	17.1	89.5	23.9
5	A632Ht x CO400	44.8	19.5	75.4	12.6	64.9	15.8	87.9	22.2
6	A632Ht x CO410	32.7	18.3	65.4	13.7	54.4	17.6	87.1	22.3
7	A632Ht x IA95:24	41.9	20.8	66.1	17.0	48.9	19.7	115.2	25.6
8	A632Ht x IA95:27	43.4	19.4	70.3	15.5	57.6	19.0	104.6	23.8
9	A632Ht x IA95:1232	38.6	19.5	60.9	14.7	59.3	19.0	102.3	27.0
10	A632Ht x IA95:1233	45.1	20.5	66.7	16.1	56.6	20.2	115.8	26.2
11	A632Ht x IA95:1285	53.2	51.0	72.1	17.1	49.6	20.4	112.8	26.2
12	A632Ht x PA92-38	52.1	19.3	76.3	15.8	59.4	19.5	107.9	25.8
13	A632Ht x PA92-41	39.7	19.4	70.0	15.0	50.8	18.2	94.0	26.4
14	A632Ht x PA92-42	42.0	20.2	73.3	14.7	63.6	19.6	110.5	27.1
15	LH82 x CO396	46.3	18.6	73.3	14.5	51.1	17.0	99.6	25.0
16	LH82 x CO397	45.4	19.4	72.1	16.0	51.4	18.1	91.9	23.0
17	LH82 x CO398	52.1	18.3	80.6	13.9	54.2	18.1	113.8	22.9
18	LH82 x CO399	39.9	19.9	70.2	15.1	55.1	19.5	85.7	23.2
19	LH82 x CO400	41.8	19.2	68.0	15.3	50.4	18.5	89.1	24.2
20	LH82 x CO410	49.2	19.6	77.8	14.4	62.4	18.9	92.9	22.0
21	LH82 x IA95:24	53.1	21.8	82.5	19.4	55.5	20.6	122.9	26.7
22	LH82 x IA95:27	48.4	20.8	61.4	18.8	55.6	20.9	113.1	25.8
23	LH82 x IA95:1232	43.5	21.3	62.8	14.3	48.9	19.5	105.7	25.9
24	LH82 x IA95:1233	50.5	20.1	80.9	18.0	68.1	21.4	126.4	27.3
25	LH82 x IA95:1285	43.8	20.8	80.1	17.5	52.5	20.2	105.4	26.8
26	LH82 x PA92-38	51.6	20.1	75.1	17.2	54.3	20.9	98.2	30.4
27	LH82 x PA92-41	41.2	19.6	71.2	15.5	55.4	19.7	104.1	27.5
28	LH82 x PA92-42	50.9	20.3	66.6	14.9	50.2	20.0	90.6	27.0
29	Pioneer 3573	60.1	20.3	90.7	15.9	70.7	19.2	134.9	26.7
30	Pioneer 3752	58.7	18.9	86.2	15.6	60.5	19.2	108.8	27.1
	Exp. Minimum	32.7	17.2	56.8	12.5	40.0	15.8	79.2	20.6
	Exp. Maximum	60.1	21.8	90.7	19.4	70.7	21.4	134.9	30.4
	Exp. Mean	45.6	19.6	71.4	15.4	55.3	18.9	102.2	25.1
	LSD (.05)	13.4	1.5	12.8	2.3	13.4	0.7	16.9	2.8

Table 1. (Continued)

Entry	Line	Wisconsin		Michigan		Averages	
		Yield q/ha	H ₂ O %	Yield q/ha	H ₂ O %	Yield q/ha	H ₂ O %
1	A632Ht x CO396	102.7	16.6	79.6	25.7	70.3	18.5
2	A632Ht x CO397	121.6	17.3	79.6	24.7	74.6	18.8
3	A632Ht x CO398	108.4	16.7	84.6	23.1	71.0	18.2
4	A632Ht x CO399	105.4	18.2	81.8	23.2	69.0	18.7
5	A632Ht x CO400	110.9	17.2	92.2	23.8	79.3	18.5
6	A632Ht x CO410	107.4	19.5	96.4	27.8	73.9	19.9
7	A632Ht x IA95:24	111.1	23.4	97.1	29.2	80.1	22.6
8	A632Ht x IA95:27	107.4	20.2	89.2	27.5	78.7	20.9
9	A632Ht x IA95:1232	94.7	21.5	79.9	27.5	72.6	21.5
10	A632Ht x IA95:1233	112.2	24.8	79.9	31.6	79.4	23.2
11	A632Ht x IA95:1285	116.2	25.4	88.8	30.3	82.1	28.4
12	A632Ht x PA92-38	109.7	20.7	97.1	28.9	83.8	21.7
13	A632Ht x PA92-41	99.2	19.3	83.2	28.9	72.8	21.2
14	A632Ht x PA92-42	123.9	23.0	102.1	29.5	85.9	22.4
15	LH82 x CO396	105.2	16.8	90.5	25.4	77.7	19.6
16	LH82 x CO397	107.0	17.4	89.1	24.4	76.2	19.7
17	LH82 x CO398	119.6	16.8	95.1	24.8	85.9	19.1
18	LH82 x CO399	98.4	20.6	92.7	27.4	73.7	21.0
19	LH82 x CO400	99.6	20.0	86.1	27.3	72.5	20.8
20	LH82 x CO410	106.2	20.3	93.0	27.2	80.2	20.4
21	LH82 x IA95:24	107.1	24.7	108.5	30.1	88.3	23.9
22	LH82 x IA95:27	115.6	22.9	93.4	27.7	81.3	22.8
23	LH82 x IA95:1232	85.6	21.5	79.7	27.6	71.0	21.7
24	LH82 x IA95:1233	130.7	22.4	103.5	31.1	93.4	23.4
25	LH82 x IA95:1285	114.1	23.0	97.5	29.5	82.2	23.0
26	LH82 x PA92-38	106.8	24.0	96.8	29.5	80.5	23.7
27	LH82 x PA92-41	98.9	21.4	94.7	29.0	77.6	22.1
28	LH82 x PA92-42	99.1	21.0	101.7	29.2	76.5	22.1
29	Pioneer 3573	137.7	23.8	133.4	28.8	104.6	22.5
30	Pioneer 3752	125.2	20.8	122.2	26.3	93.6	21.3
	Exp. Minimum	85.6	16.6	79.6	23.1		
	Exp. Maximum	137.7	25.4	133.4	31.6		
	Exp. Mean	109.6	20.7	93.7	27.6		
	LSD (.05)	15.6	1.6	11.2	1.3		

Table 2. Summary data of the NCR-167 400-600 uniform maturity trials from Calumet, Iowa.

Entry	Line	Yield bu/ac	Yield q/ha	Stand M/ha	H ₂ O	Lodging		Dropped ears
						Root	Stalk	
						-----%		
1	A632Ht x CO396	54.7	36.7	43.8	17.5	0.0	8.8	5.6
2	A632Ht x CO397	66.9	44.9	49.0	18.9	2.4	10.9	2.5
3	A632Ht x CO398	67.1	45.0	57.7	17.5	0.0	12.4	2.1
4	A632Ht x CO399	48.9	32.8	64.1	17.2	0.0	5.6	1.8
5	A632Ht x CO400	66.8	44.8	51.1	19.5	0.0	2.5	2.5
6	A632Ht x CO410	48.7	32.7	55.4	18.3	0.0	7.2	3.7
7	A632Ht x IA95:24	62.4	41.9	58.5	20.8	0.0	14.4	2.1
8	A632Ht x IA95:27	64.7	43.4	54.2	19.4	4.6	6.2	1.6
9	A632Ht x IA95:1232	57.5	38.6	58.5	19.5	0.7	2.0	1.3
10	A632Ht x IA95:1233	67.2	45.1	58.9	20.5	0.0	7.5	2.1
11	A632Ht x IA95:1285	79.3	53.2	56.2	51.0	0.0	8.6	2.1
12	A632Ht x PA92-38	77.6	52.1	59.7	19.3	0.0	4.0	1.4
13	A632Ht x PA92-41	59.2	39.7	56.9	19.4	2.6	3.6	1.9
14	A632Ht x PA92-42	62.6	42.0	49.0	20.2	0.8	9.2	1.7
15	LH82 x CO396	69.0	46.3	56.2	18.6	0.7	11.9	1.4
16	LH82 x CO397	67.6	45.4	55.4	19.4	0.0	16.3	3.4
17	LH82 x CO398	77.6	52.1	60.9	18.3	0.0	9.3	0.6
18	LH82 x CO399	59.5	39.9	46.6	19.9	0.0	8.1	0.9
19	LH82 x CO400	62.3	41.8	50.2	19.2	0.0	5.7	1.7
20	LH82 x CO410	73.3	49.2	53.8	19.6	0.0	7.3	0.0
21	LH82 x IA95:24	79.1	53.1	58.5	21.8	0.0	23.0	0.0
22	LH82 x IA95:27	72.1	48.4	54.2	20.8	0.7	2.9	3.7
23	LH82 x IA95:1232	64.8	43.5	57.7	21.3	0.0	4.1	0.0
24	LH82 x IA95:1233	75.2	50.5	59.7	20.1	0.0	7.0	0.5
25	LH82 x IA95:1285	65.3	43.8	59.7	20.8	1.4	2.6	0.0
26	LH82 x PA92-38	76.9	51.6	51.8	20.1	0.0	5.4	0.0
27	LH82 x PA92-41	61.4	41.2	56.2	19.6	1.5	0.0	1.4
28	LH82 x PA92-42	75.8	50.9	64.5	20.3	3.7	1.8	0.6
29	Pioneer 3573	89.5	60.1	59.7	20.3	0.0	7.8	0.7
30	Pioneer 3752	87.5	58.7	62.5	18.9	0.0	3.8	1.9
	Exp. Minimum	48.7	32.7	43.8	17.2	0.0	0.0	0.0
	Exp. Maximum	89.5	60.1	64.5	21.8	4.6	23.0	5.6
	Exp. Mean	67.9	45.6	56.0	19.6	0.6	7.3	1.6
	LSD (.05)	20.0	13.4	6.2	1.5	3.0	8.7	3.6

Table 3. Summary data of the NCR-167 400-600 uniform maturity trials from Kanawha, Iowa.

Entry	Line	Yield bu/ac	Yield q/ha	Stand M/ha	H ₂ O	Lodging		Dropped ears
						Root	Stalk	
						-----%		
1	A632Ht x CO396	85.8	57.6	52.6	14.5	2.3	6.3	9.7
2	A632Ht x CO397	107.4	72.1	59.7	12.7	0.0	14.6	0.7
3	A632Ht x CO398	89.0	59.7	59.3	14.8	0.0	10.0	2.6
4	A632Ht x CO399	84.6	56.8	57.3	12.5	0.0	8.5	2.1
5	A632Ht x CO400	112.3	75.4	61.7	12.6	0.6	1.9	1.3
6	A632Ht x CO410	97.4	65.4	59.3	13.7	0.0	2.6	0.6
7	A632Ht x IA95:24	98.5	66.1	62.5	17.0	0.0	20.4	3.8
8	A632Ht x IA95:27	104.7	70.3	59.3	15.5	0.0	10.8	2.6
9	A632Ht x IA95:1232	90.7	60.9	57.3	14.7	0.7	6.4	0.0
10	A632Ht x IA95:1233	99.4	66.7	64.1	16.1	0.0	5.7	3.1
11	A632Ht x IA95:1285	107.4	72.1	59.7	17.1	0.0	6.6	2.1
12	A632Ht x PA92-38	113.7	76.3	58.9	15.8	0.0	4.1	0.0
13	A632Ht x PA92-41	104.3	70.0	60.1	15.0	0.0	3.3	6.0
14	A632Ht x PA92-42	109.2	73.3	63.7	14.7	0.0	13.8	5.7
15	LH82 x CO396	109.2	73.3	58.9	14.5	0.0	18.4	1.4
16	LH82 x CO397	107.4	72.1	63.7	16.0	0.0	25.6	0.6
17	LH82 x CO398	120.1	80.6	62.9	13.9	0.0	11.6	2.0
18	LH82 x CO399	104.6	70.2	61.7	15.1	0.0	4.6	1.3
19	LH82 x CO400	101.3	68.0	62.5	15.3	0.0	1.2	0.6
20	LH82 x CO410	115.9	77.8	62.1	14.4	0.0	3.3	1.3
21	LH82 x IA95:24	122.9	82.5	61.3	19.4	0.0	18.8	2.0
22	LH82 x IA95:27	91.5	61.4	62.9	18.8	0.0	22.3	2.4
23	LH82 x IA95:1232	93.6	62.8	61.3	14.3	0.0	0.0	0.7
24	LH82 x IA95:1233	120.5	80.9	64.5	18.0	0.0	10.6	0.6
25	LH82 x IA95:1285	119.3	80.1	63.7	17.5	0.6	2.5	1.3
26	LH82 x PA92-38	111.9	75.1	62.9	17.2	0.0	1.9	0.0
27	LH82 x PA92-41	106.1	71.2	62.9	15.5	0.0	1.9	0.0
28	LH82 x PA92-42	99.2	66.6	62.1	14.9	0.0	3.1	2.5
29	Pioneer 3573	135.1	90.7	63.3	15.9	0.0	4.3	1.9
30	Pioneer 3752	128.4	86.2	63.3	15.6	0.0	2.5	0.6
	Exp. Minimum	84.6	56.8	52.6	12.5	0.0	0.0	0.0
	Exp. Maximum	135.1	90.7	64.5	19.4	2.3	25.6	9.7
	Exp. Mean	106.4	71.4	61.2	15.4	0.1	8.2	2.0
	LSD (.05)	19.1	12.8	5.9	2.3	0.9	8.6	3.6

Table 4. Summary data of the NCR-167 400-600 uniform maturity trials from Nashua, Iowa.

Entry	Line	Yield bu/ac	Yield q/ha	Stand M/ha	H ₂ O	Lodging		Dropped ears
						Root	Stalk	
						-----%-----		
1	A632Ht x CO396	87.5	58.7	53.4	16.3	0.0	39.9	8.7
2	A632Ht x CO397	74.8	50.2	61.3	17.2	0.0	62.9	1.8
3	A632Ht x CO398	59.6	40.0	65.7	16.1	2.4	41.9	0.6
4	A632Ht x CO399	71.1	47.7	63.3	17.1	0.0	8.0	1.8
5	A632Ht x CO400	96.7	64.9	60.9	15.8	1.2	6.6	0.0
6	A632Ht x CO410	81.1	54.4	61.7	17.6	0.6	24.0	1.3
7	A632Ht x IA95:24	72.9	48.9	62.1	19.7	0.6	36.0	4.6
8	A632Ht x IA95:27	85.8	57.6	60.9	19.0	0.0	18.1	1.2
9	A632Ht x IA95:1232	88.4	59.3	55.8	19.0	0.0	11.1	1.5
10	A632Ht x IA95:1233	84.3	56.6	64.1	20.2	0.0	20.9	1.9
11	A632Ht x IA95:1285	73.9	49.6	65.7	20.4	6.1	27.2	0.0
12	A632Ht x PA92-38	88.5	59.4	62.5	19.5	10.0	4.4	2.1
13	A632Ht x PA92-41	75.7	50.8	63.7	18.2	1.9	6.9	1.9
14	A632Ht x PA92-42	94.8	63.6	58.1	19.6	16.6	9.5	0.7
15	LH82 x CO396	76.1	51.1	59.7	17.0	0.0	44.2	1.2
16	LH82 x CO397	76.6	51.4	63.3	18.1	0.0	38.1	0.0
17	LH82 x CO398	80.8	54.2	63.3	18.1	0.0	29.6	1.3
18	LH82 x CO399	82.1	55.1	56.5	19.5	1.4	2.1	0.7
19	LH82 x CO400	75.1	50.4	63.7	18.5	1.2	1.9	0.0
20	LH82 x CO410	93.0	62.4	54.2	18.9	0.0	7.2	1.6
21	LH82 x IA95:24	82.7	55.5	61.7	20.6	6.6	33.5	0.0
22	LH82 x IA95:27	82.8	55.6	55.8	20.9	10.9	12.2	1.4
23	LH82 x IA95:1232	72.9	48.9	63.3	19.5	1.3	7.0	0.6
24	LH82 x IA95:1233	101.5	68.1	60.1	21.4	3.9	16.5	2.7
25	LH82 x IA95:1285	78.2	52.5	62.1	20.2	0.6	12.1	0.0
26	LH82 x PA92-38	80.9	54.3	63.3	20.9	12.5	5.7	0.6
27	LH82 x PA92-41	82.5	55.4	58.1	19.7	4.7	12.4	0.0
28	LH82 x PA92-42	74.8	50.2	64.5	20.0	6.2	12.3	0.0
29	Pioneer 3573	105.3	70.7	66.1	19.2	4.3	10.2	1.2
30	Pioneer 3752	90.1	60.5	66.9	19.2	0.6	10.1	4.8
	Exp. Minimum	59.6	40.0	53.4	15.8	0.0	1.9	0.0
	Exp. Maximum	105.3	70.7	66.9	21.4	16.6	62.9	8.7
	Exp. Mean	82.4	55.3	61.4	18.9	3.1	19.1	1.5
	LSD (.05)	20.0	13.4	6.2	0.7	6.3	13.0	3.3

Table 5. Combined summary data of the NCR-400-600 uniform maturity trials from all Iowa sites.

Entry	Line	Yield bu/ac	Yield q/ha	Stand M/ha	H ₂ O	Lodging		Dropped ears
						Root	Stalk	
						-----%-----		
1	A632Ht x CO396	70.2	47.1	49.9	16.1	0.8	18.3	8.0
2	A632Ht x CO397	82.7	55.5	56.7	16.3	0.8	29.5	1.7
3	A632Ht x CO398	74.5	50.0	60.9	16.1	0.8	21.4	1.8
4	A632Ht x CO399	69.7	46.8	61.6	15.6	0.0	7.4	1.9
5	A632Ht x CO400	91.3	61.3	58.0	15.7	0.6	3.7	1.3
6	A632Ht x CO410	75.8	50.9	58.8	16.5	0.2	11.3	1.9
7	A632Ht x IA95:24	78.5	52.7	61.1	19.2	0.2	23.6	3.5
8	A632Ht x IA95:27	84.6	56.8	58.1	17.9	1.5	11.7	1.8
9	A632Ht x IA95:1232	75.4	50.6	57.2	17.7	0.5	6.5	0.9
10	A632Ht x IA95:1233	85.5	57.4	62.4	18.9	0.0	11.3	2.4
11	A632Ht x IA95:1285	89.5	60.1	60.5	19.5	2.0	14.1	1.4
12	A632Ht x PA92-38	94.0	63.1	60.4	18.2	3.3	4.2	1.2
13	A632Ht x PA92-41	81.2	54.5	60.3	17.5	1.5	4.6	3.3
14	A632Ht x PA92-42	86.6	58.1	56.9	18.2	5.8	10.8	2.7
15	LH82 x CO396	83.7	56.2	58.3	16.7	0.2	24.8	1.3
16	LH82 x CO397	85.1	57.1	60.8	17.8	0.0	26.7	1.3
17	LH82 x CO398	94.3	63.3	62.4	16.8	0.0	16.9	1.3
18	LH82 x CO399	78.5	52.7	55.0	18.2	0.5	4.9	0.9
19	LH82 x CO400	80.8	54.2	58.8	17.7	0.4	2.9	0.8
20	LH82 x CO410	89.5	60.1	56.7	17.6	0.0	5.9	0.9
21	LH82 x IA95:24	95.2	63.9	60.5	20.6	2.2	25.1	0.7
22	LH82 x IA95:27	78.7	52.8	57.6	20.2	3.9	12.5	2.5
23	LH82 x IA95:1232	78.4	52.6	60.8	18.4	0.4	3.7	0.4
24	LH82 x IA95:1233	98.5	66.1	61.5	20.1	1.3	11.5	1.3
25	LH82 x IA95:1285	88.4	59.3	61.9	19.5	0.9	5.7	0.4
26	LH82 x PA92-38	90.9	61.0	59.3	19.4	4.2	4.3	0.2
27	LH82 x PA92-41	81.4	54.6	59.1	18.3	2.1	4.8	0.5
28	LH82 x PA92-42	85.7	57.5	63.7	18.4	3.3	5.8	1.0
29	Pioneer 3573	113.1	75.9	63.1	18.5	1.4	7.4	1.3
30	Pioneer 3752	105.8	71.0	64.2	17.9	0.2	5.4	2.4
	Exp. Minimum	69.7	46.8	49.9	15.6	0.0	2.9	0.2
	Exp. Maximum	113.1	75.9	64.2	20.6	5.8	29.5	8.0
	Exp. Mean	85.5	57.4	59.5	18.0	1.3	11.6	1.7
	LSD (.05)	11.3	7.6	3.5	1.0	2.3	6.0	2.0

Table 6. Summary data of the NCR-167 400-600 uniform maturity trials from one Pennsylvania site.

Entry	Line	Yield bu/ac	Yield q/ha	Stand -----%-----	H ₂ O	Height		Days to silk
						Plant -----cm-----	Ear	
1	A632Ht x CO396	128.4	86.2	84.5	20.6	210.8	104.1	84
2	A632Ht x CO397	118.0	79.2	87.2	21.9	203.2	111.8	80
3	A632Ht x CO398	131.7	88.4	90.4	20.9	213.4	101.6	79
4	A632Ht x CO399	133.4	89.5	96.8	23.9	188.0	91.4	81
5	A632Ht x CO400	131.0	87.9	98.1	22.2	200.7	94.0	82
6	A632Ht x CO410	129.8	87.1	97.5	22.3	203.2	96.5	82
7	A632Ht x IA95:24	171.6	115.2	94.2	25.6	203.2	101.6	83
8	A632Ht x IA95:27	155.9	104.6	95.9	23.8	215.9	104.1	82
9	A632Ht x IA95:1232	152.4	102.3	99.4	27.0	198.1	96.5	83
10	A632Ht x IA95:1233	172.5	115.8	98.1	26.2	208.3	96.5	84
11	A632Ht x IA95:1285	168.1	112.8	91.7	26.2	213.4	101.6	84
12	A632Ht x PA92-38	160.8	107.9	99.4	25.8	198.1	94.0	82
13	A632Ht x PA92-41	140.1	94.0	96.8	26.4	205.7	88.9	81
14	A632Ht x PA92-42	164.6	110.5	92.3	27.1	203.2	104.1	83
15	LH82 x CO396	148.4	99.6	94.9	25.0	195.6	91.4	81
16	LH82 x CO397	136.9	91.9	94.2	23.0	190.5	88.9	79
17	LH82 x CO398	169.6	113.8	94.9	22.9	185.4	91.4	78
18	LH82 x CO399	127.7	85.7	94.9	23.2	182.9	83.8	81
19	LH82 x CO400	132.8	89.1	100.0	24.2	180.3	86.4	82
20	LH82 x CO410	138.4	92.9	95.5	22.0	203.2	94.0	80
21	LH82 x IA95:24	183.1	122.9	97.5	26.7	200.7	88.9	84
22	LH82 x IA95:27	168.5	113.1	95.5	25.8	180.3	76.2	80
23	LH82 x IA95:1232	157.5	105.7	98.7	25.9	165.1	73.7	82
24	LH82 x IA95:1233	188.3	126.4	95.5	27.3	198.1	86.4	81
25	LH82 x IA95:1285	157.0	105.4	98.1	26.8	180.3	86.4	83
26	LH82 x PA92-38	146.3	98.2	96.1	30.4	175.3	78.7	81
27	LH82 x PA92-41	155.1	104.1	98.7	27.5	172.7	76.2	81
28	LH82 x PA92-42	135.0	90.6	97.5	27.0	165.1	73.7	80
29	Pioneer 3573	201.0	134.9	95.5	26.7	205.7	106.7	82
30	Pioneer 3752	162.1	108.8	98.7	27.1	193.0	86.4	78
	Exp. Minimum	118.0	79.2	84.5	20.6	165.1	73.7	78.0
	Exp. Maximum	201.0	134.9	100.0	30.4	215.9	111.8	84.0
	Exp. Mean	152.3	102.2	95.6	25.1	195.6	91.4	81
	LSD (.05)	25.2	16.9	6.8	2.8	15.2	20.3	1

Table 7. Summary data of the NCR-167 400-600 uniform maturity trials from one Wisconsin site.

Entry	Line	Yield	Yield	H ₂ O
		bu/ac	q/ha	%
1	A632Ht x CO396	152.9	102.7	16.6
2	A632Ht x CO397	181	121.6	17.3
3	A632Ht x CO398	161.4	108.4	16.7
4	A632Ht x CO399	156.9	105.4	18.2
5	A632Ht x CO400	165	110.9	17.2
6	A632Ht x CO410	159.9	107.4	19.5
7	A632Ht x IA95:24	165.4	111.1	23.4
8	A632Ht x IA95:27	159.8	107.4	20.2
9	A632Ht x IA95:1232	141	94.7	21.5
10	A632Ht x IA95:1233	167	112.2	24.8
11	A632Ht x IA95:1285	173	116.2	25.4
12	A632Ht x PA92-38	163.3	109.7	20.7
13	A632Ht x PA92-41	147.7	99.2	19.3
14	A632Ht x PA92-42	184.4	123.9	23
15	LH82 x CO396	156.6	105.2	16.8
16	LH82 x CO397	159.3	107.0	17.4
17	LH82 x CO398	178	119.6	16.8
18	LH82 x CO399	146.5	98.4	20.6
19	LH82 x CO400	148.3	99.6	20
20	LH82 x CO410	158	106.2	20.3
21	LH82 x IA95:24	159.4	107.1	24.7
22	LH82 x IA95:27	172.1	115.6	22.9
23	LH82 x IA95:1232	127.4	85.6	21.5
24	LH82 x IA95:1233	194.5	130.7	22.4
25	LH82 x IA95:1285	169.8	114.1	23
26	LH82 x PA92-38	158.9	106.8	24
27	LH82 x PA92-41	147.2	98.9	21.4
28	LH82 x PA92-42	147.5	99.1	21
29	Pioneer 3573	204.9	137.7	23.8
30	Pioneer 3752	186.4	125.2	20.8
	Exp. Minimum	127.4	85.6	16.6
	Exp. Maximum	204.9	137.7	25.4
	Exp. Mean	163.1	109.6	20.7
	LSD (.05)	23.2	15.6	1.6

Table 8. Summary data of the NCR-167 400-600 uniform maturity trials from one Michigan site.

Entry	Line	Yield bu/ac	Yield q/ha	H ₂ O %	Test	Stand	Lodging
					weight	-----%	-----
1	A632Ht x CO396	118.5	79.6	25.7	51.7	81.1	5.4
2	A632Ht x CO397	118.4	79.6	24.7	52.5	84.4	5.6
3	A632Ht x CO398	125.9	84.6	23.1	52.7	83.0	7.4
4	A632Ht x CO399	121.7	81.8	23.2	53.8	89.0	3.6
5	A632Ht x CO400	137.2	92.2	23.8	51.5	83.6	3.0
6	A632Ht x CO410	143.5	96.4	27.8	52.2	80.5	3.6
7	A632Ht x IA95:24	144.5	97.1	29.2	51.5	82.2	8.0
8	A632Ht x IA95:27	132.7	89.2	27.5	50.2	82.2	4.8
9	A632Ht x IA95:1232	118.9	79.9	27.5	49.3	75.3	2.9
10	A632Ht x IA95:1233	118.9	79.9	31.6	50.6	84.2	5.6
11	A632Ht x IA95:1285	132.2	88.8	30.3	51.4	85.0	4.3
12	A632Ht x PA92-38	144.5	97.1	28.9	52.3	85.1	3.0
13	A632Ht x PA92-41	123.8	83.2	28.9	51.1	81.7	1.7
14	A632Ht x PA92-42	152.0	102.1	29.5	50.8	85.8	4.9
15	LH82 x CO396	134.7	90.5	25.4	53.5	85.0	10.3
16	LH82 x CO397	132.6	89.1	24.4	53.2	92.8	9.5
17	LH82 x CO398	141.6	95.1	24.8	52.4	81.4	6.7
18	LH82 x CO399	138.0	92.7	27.4	52.1	86.0	3.6
19	LH82 x CO400	128.2	86.1	27.3	51.4	82.4	2.1
20	LH82 x CO410	138.4	93.0	27.2	51.6	84.2	2.1
21	LH82 x IA95:24	161.5	108.5	30.1	55.7	92.6	4.7
22	LH82 x IA95:27	139.0	93.4	27.7	49.6	84.7	3.4
23	LH82 x IA95:1232	118.6	79.7	27.6	51.4	81.4	4.0
24	LH82 x IA95:1233	154.1	103.5	31.1	51.6	90.2	5.3
25	LH82 x IA95:1285	145.1	97.5	29.5	51.7	94.2	2.7
26	LH82 x PA92-38	144.0	96.8	29.5	51.0	86.4	1.2
27	LH82 x PA92-41	140.9	94.7	29.0	50.7	82.2	3.9
28	LH82 x PA92-42	151.4	101.7	29.2	50.7	93.9	2.7
29	Pioneer 3573	198.6	133.4	28.8	50.4	80.5	0.9
30	Pioneer 3752	181.8	122.2	26.3	52.2	92.7	2.0
	Exp. Minimum	118.4	79.6	23.1	49.3	75.3	0.9
	Exp. Maximum	198.6	133.4	31.6	55.7	94.2	10.3
	Exp. Mean	139.4	93.7	27.6	51.7	85.1	4.3
	LSD (.05)	16.7	11.1	1.3	2.5	8.7	4.5

NCR-167 UNIFORM 400-600 MATURITY HYBRIDS – 1998

Seed produced in 1997 by Michigan State for 1998 regional trials 14 inbreds x 2 testers (A632 Ht) and (LH82) = 28 entries + 2 check hybrids = 30 entries.

Entry no.	Pedigree	Inbred
1	(A632Ht) x PA 93-52	PENN PA 93-52
2	" x PA 93-53	PENN PA 93-53
3	" x IA 95:21	IOWA IA 95:21
4	" x IA 96:1	IOWA IA 96:1
5	" x IA 96:1166	IOWA IA 96:1166
6	" x IA 96:1167	IOWA IA 96:1167
7	" x CO 413	ONT CO 413
8	" x CO 414	ONT CO 414
9	" x CO 415	ONT CO 415
10	" x CO 416	ONT CO 416
11	" x CO 418	ONT CO 418
12	" x CG Stiff Stalk (5)	Guelph CG Stiff Stalk (5)
13	" x CG Stiff Stalk (RRS)	Guelph CG Stiff Stalk (RRS)
14	" x CG Stiff Stalk (comb)	Guelph CG Stiff Stalk (comb)
15	(LH82) x PA 93-52	
16	" x PA 93-53	
17	" x IA 95:21	
18	" x IA 96:1	
19	" x IA 96:1166	
20	" x IA 96:1167	
21	" x CO 413	
22	" x CO 414	
23	" x CO 415	
24	" x CO 416	
25	" x CO 418	
26	" x CG Stiff Stalk (5)	
27	" x CG Stiff Stalk (RRS)	
28	" x CG Stiff Stalk (comb)	
29	PIONEER 3573	
30	PIONEER 3752	

NCR-167
700-800 Maturity Group Test
1998

Trials were conducted at six locations in 1997 from single-cross seed produced in 1996. Trials were conducted at: five locations (two locations in Iowa and one location in Illinois, Ohio, and Pennsylvania) to collect data for grain yield, grain moisture, and other agronomic traits, and rind data were collected at Missouri for penetrometer resistance and for vertical root pulling resistance. Average yield across locations was 8.12 t ha⁻¹ (129.9 bu acre⁻¹) with an average grain moisture of 20.8% at harvest. Average yield of individual hybrids ranged from 6.13 to 9.86 t ha⁻¹. Percentage of root lodging was not as great as expected because B97 and B84 have weak roots. Average rind penetrometer resistance was 3.76 with individual hybrids ranging from 3.10 to 4.43 load-kg plant⁻¹. Vertical root pulling resistance ranged from 197.5 to 289.6 load-kg plant⁻¹ with an average across hybrids of 252.2

Testcross seed was produced at Ames in 1997 for 21 lines. Depending on needs for 1998, it seems adequate quantities of seed will be available for 19 crosses for test in 1998. Seed for 1999 trials will be produced in 1998 at Ames.

700-800 Maturity Group Subcommittee:

R. Bernardo

M. W. Johnson

R. J. Lambert

R. C. Pratt

Report assembled by A. R. Hallauer

EXPERIMENT 14 MEANS
ACROSS 5 ENVIRONMENTS

GRAIN YIELD

Entry	Line	Ames	Ankeny	Illinois	Ohio	Penn	Average
		-----Mg/ha-----					
1	ILL.95:6426-1 x B97	8.39	7.15	8.95	9.79	10.16	8.89
2	ILL.95:6431-1 x B97	8.83	6.72	9.65	10.42	10.06	9.14
3	IA.95:43 x 97	5.75	7.94	9.14	6.69	9.79	7.86
4	IA.95:44 x B97	7.25	7.67	9.77	9.4	10.51	8.92
5	IA.95:1366 x B97	8.09	8.84	10.21	10.99	11.17	9.86
6	IA.95:1343 x B97	8.88	6.73	9.52	9.36	9.03	8.70
7	MO.SCSSS(H26)COS6-62-1 x B97	7.39	6.5	8.24	9.1	8.58	7.96
8	MO.SCSSS(R19)C1S7-11 x B97	7.89	7.45	5.38	9.26	9.38	7.87
9	PA91-4 x B97	6.85	6.27	6.4	9.42	10.62	7.91
10	PA91-10 x B97	4.82	6	5.94	8.36	9.47	6.92
11	CO368 x B97	6.52	6.91	9.75	10.29	8.88	8.47
12	CO388 x B97	7.26	7.09	9.52	11.32	8.51	8.74
13	CO391 x B97	8.98	7.7	8.03	11.42	8.99	9.02
14	MO17Syn(H14C2S7-20) x B84	6.3	6.79	6.8	10.42	9.79	8.02
15	BJSC11022-2-1-1 x B84	8.09	7	8.06	9.46	8.45	8.21
16	95 NEX 204 x B84	7.68	6.48	10.31	9.75	9.48	8.74
17	95 NEX 214 x B84	8.91	8.55	6.84	9.86	9.27	8.69
18	93 NEX 318 x B84	6.22	5.24	6.36	8.75	8.83	7.08
19	93 NEX 321 x B84	5.1	5.51	4.39	7.74	7.91	6.13
20	93 NEX 505 x B84	7.86	7.65	10.04	10.71	10.21	9.29
21	PA91-10 x B84	7.22	5.07	7.01	8.83	8.30	7.29
22	CO363 x B84	6.77	7.68	4.08	8.14	6.82	6.70
23	CO388 x B84	5.2	5.28	9.81	9.78	8.43	7.70
24	CO391 x B84	5.36	6.18	7.24	7.98	7.32	6.82

EXPERIMENT 14 MEANS
ACROSS 5 ENVIRONMENTS

GRAIN MOISTURE

Entry	Line	Ames	Ankeny	Illinois	Ohio	Penn	Average
-----%-----							
1	ILL.95:6426-1 x B97	20.6	14.8	13.9	26.1	22.9	19.66
2	ILL.95:6431-1 x B97	19.9	14.4	13.7	26.1	21.9	19.20
3	IA.95:43 x 97	17.3	15.3	16.5	27.6	23.9	20.12
4	IA.95:44 x B97	22.1	15.3	16.6	28.6	24.8	21.48
5	IA.95:1366 x B97	21.2	18	19.8	27.4	24.6	22.20
6	IA.95:1343 x B97	18.4	14.4	13.8	26.6	23.4	19.32
7	MO.SCSSS(H26)COS6-62-1 x B97	18.1	14.6	12.4	26	22.4	18.70
8	MO.SCSSS(R19)C1S7-11 x B97	18.9	13.5	11.9	26.6	20.9	18.36
9	PA91-4 x B97	22.5	17.4	19.3	28.4	23.8	22.28
10	PA91-10 x B97	18.9	14.4	14.2	26.6	22.9	19.40
11	CO368 x B97	19.4	13.4	12.3	22	19.0	17.22
12	CO388 x B97	20	15.4	13.9	25.4	21.2	19.18
13	CO391 x B97	19.3	14	12.7	22.9	20.8	17.94
14	MO17Syn(H14C2S7-20) x B84	21.3	19.2	20.6	27.2	25.4	22.74
15	BJSC11022-2-1-1 x B84	22.1	15.1	13.3	26.7	24.2	20.28
16	95 NEX 204 x B84	21.5	15.6	16.2	24.4	24.6	20.46
17	95 NEX 214 x B84	20.4	16.5	16.4	26.6	24.4	20.86
18	93 NEX 318 x B84	20.2	15.4	19.9	27.4	24.7	21.52
19	93 NEX 321 x B84	24.8	18.4	22.6	30.9	26.1	24.56
20	93 NEX 505 x B84	22.6	16.2	18.5	27.4	24.9	21.92
21	PA91-10 x B84	17.4	15.4	15.2	27.6	24.1	19.94
22	CO363 x B84	19.3	14.5	9.9	21.3	18.3	16.66
23	CO388 x B84	20.1	13	13.4	23.8	22.2	18.50
24	CO391 x B84	20.2	15.4	14.6	25.4	21.8	19.48

1997 NCR-167 700-800 MATURITY TEST AMES, IOWA

Entry	Line	Yield Mg/ha	Stand P/h	Moist -----%	Lodging		Dropped ears	Ear height (1-5)
					Root	Stalk		
1	ILL.95:6426-1 x B97	8.39	61700	20.6	0	10.7	0	4.3
2	ILL.95:6431-1 x B97	8.83	66500	19.9	0	10.8	0	4.3
3	IA.95:43 x 97	5.75	64500	17.3	0	11.7	0.7	5
4	IA.95:44 x B97	7.25	66900	22.1	0	22	0	5
5	IA.95:1366 x B97	8.09	66900	21.2	0	8.3	0	5
6	IA.95:1343 x B97	8.88	64100	18.4	0	14.2	0	4.3
7	MO.SCSSS(H26)COS6-62-1 x B97	7.39	66900	18.1	0	3.6	0	4.3
8	MO.SCSSS(R19)C1S7-11 x B97	7.89	65300	18.9	0	10.5	0	4.7
9	PA91-4 x B97	6.85	64100	22.5	0	25.7	0.6	5
10	PA91-10 x B97	4.82	65700	18.9	0.6	13.9	0	5
11	CO368 x B97	6.52	63700	19.4	0.7	12.8	0	4.7
12	CO388 x B97	7.26	66100	20	1.8	6	1.2	4.3
13	CO391 x B97	8.98	62900	19.3	0.7	14.6	0	4.7
14	MO17Syn(H14C2S7-20) x B84	6.3	63700	21.3	0	10.7	0	5
15	BJSC11022-2-1-1 x B84	8.09	61300	22.1	0.8	17	0	5
16	95 NEX 204 x B84	7.68	66900	21.5	0	11.3	0	5
17	95 NEX 214 x B84	8.91	66100	20.4	1.2	6.7	0	4.7
18	93 NEX 318 x B84	6.22	62500	20.2	0	14.3	0	4.3
19	93 NEX 321 x B84	5.1	66100	24.8	0	24.8	0	4.3
20	93 NEX 505 x B84	7.86	66000	22.6	0	10	0	5
21	PA91-10 x B84	7.22	65700	17.4	0	15.2	0	5
22	CO363 x B84	6.77	65700	19.3	0	12	0	4.7
23	CO388 x B84	5.2	66900	20.1	0.6	11.9	0	5
24	CO391 x B84	5.36	65700	20.2	0	18.7	0	4.7
25	LH227 x LH176	8.4	66000	19.2	0	2.7	0	3
26	LH228 x LH172	8.4	64500	15.7	0	2.5	0	3
27	LH198 x LH172	9.62	66500	16.4	1.8	7.2	0	3
28	LH227 x LH185	8.19	66100	17.8	0	8.4	0	3.3
29	LH233 x LH172	7.75	64900	18.9	0	9.2	0	3
30	LH198 x LH185	8.02	66900	18.5	0.6	7.1	0	3.7
	Experiment Minimum	4.82	61300	15.7	0	2.5	0	3
	Experiment Maximum	9.62	66900	24.8	1.8	25.7	1.2	5
	Experiment Mean	7.4	65200	19.8	0.3	11.8	0.1	4.4

1997 NCR-167 700-800 MATURITY TEST ANKENY, IOWA

Entry	Line	Yield Mg/ha	Stand P/h	Moist -----%	Lodging		Dropped ears	Ear height (1-5)
					Root	Stalk		
1	ILL.95:6426-1 x B97	7.15	66100	14.8	6.2	2.4	0.6	4.3
2	ILL.95:6431-1 x B97	6.72	65300	14.4	0.6	0.6	2.4	4.7
3	IA.95:43 x 97	7.94	65300	15.3	3	1.9	1.3	5
4	IA.95:44 x B97	7.67	66900	15.3	13.7	7.1	0.6	4.7
5	IA.95:1366 x B97	8.84	65300	18	2.4	4.3	0	5
6	IA.95:1343 x B97	6.73	61700	14.4	4.9	2.6	3.5	4
7	MO.SCSSS(H26)COS6-62-1 x B97	6.5	64500	14.6	1.2	1.2	0.6	4
8	MO.SCSSS(R19)C1S7-11 x B97	7.45	64100	13.5	0.6	1.9	0	4
9	PA91-4 x B97	6.27	61700	17.4	9	2.6	0	5
10	PA91-10 x B97	6	65700	14.4	14.7	6.8	1.8	4.7
11	CO368 x B97	6.91	65300	13.4	11.6	4.9	0	4
12	CO388 x B97	7.09	66100	15.4	2.4	2.4	0	4
13	CO391 x B97	7.7	66900	14	6.5	3.6	1.2	4.7
14	MO17Syn(H14C2S7-20) x B84	6.79	64900	19.2	9.1	0.6	5	5
15	BJSC11022-2-1-1 x B84	7	64500	15.1	2.5	6.7	0	5
16	95 NEX 204 x B84	6.48	62900	15.6	6.3	1.3	2	5
17	95 NEX 214 x B84	8.55	66100	16.5	1.8	3.6	1.8	4.3
18	93 NEX 318 x B84	5.24	64900	15.4	0	3.2	7.1	4
19	93 NEX 321 x B84	5.51	64500	18.4	50.1	7.4	0.6	5
20	93 NEX 505 x B84	7.65	66100	16.2	17.9	5.5	0	5
21	PA91-10 x B84	5.07	66900	15.4	14.9	10.7	4.8	5
22	CO363 x B84	7.68	62900	14.5	1.2	6.5	0	4.3
23	CO388 x B84	5.28	64100	13	1.9	2.6	1.4	4
24	CO391 x B84	6.18	60500	15.4	22.5	6.5	0	4.3
25	LH227 x LH176	6.52	66100	12.7	0.6	1.2	0.6	3
26	LH228 x LH172	7.16	66500	13.1	0	1.2	0	3
27	LH198 x LH172	6.42	65700	13.4	0	0.6	0.6	3
28	LH227 x LH185	6.61	65300	12.9	2.4	3.1	0	3.3
29	LH233 x LH172	5.35	66500	13.4	0	0	0	3
30	LH198 x LH185	8.03	66500	13.3	3	0	0	3.7
	Experiment Minimum	5.07	60500	12.7	0	0	0	3
	Experiment Maximum	8.84	66900	19.2	50.1	10.7	7.1	5
	Experiment Mean	6.82	65000	14.9	7	3.4	1.2	4.3

1997 NCR-167 700-800 MATURITY TEST ILLINOIS

Entry	Line	Yield Mg/ha	Stand	Stand	Moisture -----%-----	Stalk lodging
1	ILL.95:6426-1 x B97	8.95	55	99	13.9	29.57
2	ILL.95:6431-1 x B97	9.65	56	100	13.7	29.17
3	IA.95:43 x 97	9.14	55	98	16.5	15.21
4	IA.95:44 x B97	9.77	54	97	16.6	58.45
5	IA.95:1366 x B97	10.21	55	99	19.8	23.48
6	IA.95:1343 x B97	9.52	55	99	13.8	54.61
7	MO.SCSSS(H26)COS6-62-1 x B97	8.24	56	100	12.4	19.64
8	MO.SCSSS(R19)C1S7-11 x B97	5.38	55	99	11.9	81.3
9	PA91-4 x B97	6.4	55	97	19.3	32.22
10	PA91-10 x B97	5.94	56	100	14.2	51.19
11	CO368 x B97	9.75	56	99	12.3	42.94
12	CO388 x B97	9.52	56	99	13.9	27.58
13	CO391 x B97	8.03	56	100	12.7	49.41
14	MO17Syn(H14C2S7-20) x B84	6.8	56	100	20.6	58.33
15	BJSC11022-2-1-1 x B84	8.06	55	98	13.3	48.39
16	95 NEX 204 x B84	10.31	56	99	16.2	50.92
17	95 NEX 214 x B84	6.84	55	99	16.4	60.91
18	93 NEX 318 x B84	6.36	55	98	19.9	56.38
19	93 NEX 321 x B84	4.39	55	99	22.6	86.09
20	93 NEX 505 x B84	10.04	55	98	18.5	53.34
21	PA91-10 x B84	7.01	56	100	15.2	54.17
22	CO363 x B84	4.08	56	99	9.9	63.6
23	CO388 x B84	9.81	56	100	13.4	38.09
24	CO391 x B84	7.24	56	100	14.6	69.64
25	P32K61	12.93	55	98	18.8	12.11
26	P33A14Bt	9.65	56	100	12.7	30.96
27	P3335	12.34	56	100	12.9	20.83
28	P3489	10.59	55	99	12.4	18.19
29	B84(633)BC2S4 x LH185	8.06	56	100	13.3	31.55
30	MO17(339)BC1S6 x FR1064	10.29	55	99	14.7	13.85
	Mean	8.51	55.47	99.07	15.21	42.74

1997 NCR-167 700-800 MATURITY TEST OHIO

Entry	Line	Yield Mg/ha	Final Stand Plants/ha	H2O -----%-----	Lodging
1	ILL.95:6426-1 x B97	9.79	66443	26.1	6
2	ILL.95:6431-1 x B97	10.42	66443	26.1	3
3	IA.95:43 x 97	6.69	55812	27.6	2.1
4	IA.95:44 x B97	9.4	59799	28.6	2.2
5	IA.95:1366 x B97	10.99	65114	27.4	5.2
6	IA.95:1343 x B97	9.36	64450	26.6	7.4
7	MO.SCSSS(H26)COS6-62-1 x B97	9.1	61792	26	3.3
8	MO.SCSSS(R19)C1S7-11 x B97	9.26	57141	26.6	4.7
9	PA91-4 x B97	9.42	62456	28.4	11.7
10	PA91-10 x B97	8.36	54483	26.6	8.6
11	CO368 x B97	10.29	67772	22	5.9
12	CO388 x B97	11.32	66443	25.4	2
13	CO391 x B97	11.42	63785	22.9	4.2
14	MO17Syn(H14C2S7-20) x B84	10.42	59799	27.2	3.3
15	BJSC11022-2-1-1 x B84	9.46	59799	26.7	5.5
16	95 NEX 204 x B84	9.75	62456	24.4	12.8
17	95 NEX 214 x B84	9.86	65779	26.6	2
18	93 NEX 318 x B84	8.75	62456	27.4	12.8
19	93 NEX 321 x B84	7.74	53819	30.9	2.5
20	93 NEX 505 x B84	10.71	65779	27.4	6.1
21	PA91-10 x B84	8.83	66443	27.6	38
22	CO363 x B84	8.14	63785	21.3	4.2
23	CO388 x B84	9.78	63785	23.8	5.2
24	CO391 x B84	7.98	49168	25.4	9.4
	B73 x Mo17	10.57	63785	26.4	3.1
	Pioneer 3394	9.84	51826	25.6	2.6
	DeKalb 604	11.07	59799	27	2.2
	Mean	9.54	61497	26.4	5.9
	LSD .05	2.06		1.9	8

1997 NCR-167 700-800 MATURITY TEST PENNSYLVANIA

Entry	Line	Yield Mg/ha	H2O -----%-----	Erect	Days to silk	Height	
						Plant	Ear
						-----cm-----	
1	ILL.95:6426-1 x B97	10.16	22.9	95.8	92	198.1	86.4
2	ILL.95:6431-1 x B97	10.06	21.9	95.2	93	190.5	94.0
3	IA.95:43 x 97	9.79	23.9	91.7	98	210.8	106.7
4	IA.95:44 x B97	10.51	24.8	94.9	99	203.2	88.9
5	IA.95:1366 x B97	11.17	24.6	95.8	96	215.9	101.6
6	IA.95:1343 x B97	9.03	23.4	95.8	95	195.6	78.7
7	MO.SCSSS(H26)COS6-62-1 x B97	8.58	22.4	94.5	94	185.4	86.4
8	MO.SCSSS(R19)C1S7-11 x B97	9.38	20.9	93.1	93	172.7	99.1
9	PA91-4 x B97	10.62	23.8	93.7	97	203.2	94.0
10	PA91-10 x B97	9.47	22.9	79.4	95	205.7	99.1
11	CO368 x B97	8.88	19.0	91.0	91	188.0	94.0
12	CO388 x B97	8.51	21.2	92.4	90	167.6	88.9
13	CO391 x B97	8.99	20.8	93.7	96	198.1	86.4
14	MO17Syn(H14C2S7-20) x B84	9.79	25.4	87.2	95	205.7	106.7
15	BJSC11022-2-1-1 x B84	8.45	24.2	82.0	95	198.1	91.4
16	95 NEX 204 x B84	9.48	24.6	79.2	94	221.0	129.5
17	95 NEX 214 x B84	9.27	24.4	95.2	96	175.3	86.4
18	93 NEX 318 x B84	8.83	24.7	96.7	95	180.3	83.8
19	93 NEX 321 x B84	7.91	26.1	78.3	96	185.4	99.1
20	93 NEX 505 x B84	10.21	24.9	84.1	98	198.1	104.1
21	PA91-10 x B84	8.30	24.1	82.0	96	210.8	106.7
22	CO363 x B84	6.82	18.3	86.9	93	167.6	83.8
23	CO388 x B84	8.43	22.2	92.4	95	175.3	83.8
24	CO391 x B84	7.32	21.8	80.5	95	193.0	96.5
25	PIONEER 3223 (Check)	10.00	23.4	81.2	95	200.7	101.6
	Grand Mean	9.20	23.1	89.2	95	193.0	94.0
	LSD (.05)	1.82	1.2	12.2	3	15.2	25.4

Results from the 1997 NCR-167 700-800 Regional Test at Columbia, MO.

Entry/pedigree	Entry no.	Rind penetrometer resistance (load-kg/plant)	Vertical root pulling resistance (load-kg/plant)
Ill.95:6426-1 x B97	1	4.37	268.8
Ill.95:6431-1 x B97	2	4.10	273.2
Ia.95:43 x B97	3	3.93	264.0
Ia95:44 x B97	4	3.97	285.7
Ia95:1366 x B97	5	3.87	289.6
Ia95:1343 x B97	6	4.27	288.3
Mo.SCSSS(H26)C0S6-62-1 x B97	7	4.13	255.7
Mo.SCSSS(R19)C1S7-11 x B97	8	4.00	229.6
Pa91-4 x B97	9	4.07	294.0
Pa91-10 x B97	10	4.07	236.8
C0368 x B97	11	4.23	211.5
C0388 x B97	12	4.43	282.7
C0389 x B97	13	3.87	248.0
Mo17 Syn(H14C2 S7-20) x B84	14	3.57	251.0
91BJSC11022-2-1-1 x B84	15	3.67	233.5
95 Nex 204 x B84	16	3.13	255.1
95 Nex 214 x B84	17	3.30	242.2
93 Nex 318 x B84	18	3.10	270.1
93 Nex 321 x B84	19	3.17	234.9
93 Nex 505 x B84	20	3.23	248.1
Pa91-10 x B84	21	3.20	243.3
C0363 x B84	22	3.30	197.5
C0388 x B84	23	3.60	245.7
C0391 x B84	24	3.43	211.4
B73 x Mo17	25	3.53	225.5
Pioneer Brand 3394 (Check)	26	4.37	271.5
Mean		3.76	252.2
Minimum		3.10	197.5
Maximum		4.43	294.0
LSD (0.05)		0.65	41.1
CV (%)		10.6	10.0

NCR-167 700-800 Maturity Group
Seed Produced in 1997

<u>Expt. No.</u>	<u>Pedigree</u>	<u>Source</u>	<u>Seed Supply</u>
1	B97 x BS13(S)C6-7601	97:3725-26	4.0
2	B97 x BS13(S)C6-7712	3727-28	4.5
3	B97 x BSSS(R)C10-7042	3729-30	3.0
4	B97 x Mo96:2199-2202	3731-32	5.0
5	B97 x IL RSC C7-929058	3733-34	2.0
6	B97 x IL RSC C7-919030	3735-36	2.5
7	B97 x IL RSC C7-929085	3737-38	3.5
8	B97 x BSKRL1(HI)C0-7400	3739-40	4.0
9	B97 x BSKRL1(HI)C0-7746	3741-42	4.5
10	B97 x PA94-27	3743-44	2.5
11	B97 x PA94-59	3745-46	3.0
12	B97 x C0310	3751-52	1850 k
13	B97 x C0336	3753-54	2.0
14	B97 x 93NEX 318	3755-56	3.0
15	B104 x Mo96:2203-2206	3757-58	5.0
16	B104 x RBS10C7-929164	3759-60	5.5
17	B104 x PA94-2	3761-62	4.0
18	B104 x 95NEX214	3771-72	2.5
19	B104 x 95NEX201	3773-74	3.5
		Marginal Seed Supply	
	B104 x PRC97A	97:3763-64	613 k
	B104 x PRC97B	3765-66	865 k

Sub-Committee on Genetic Vulnerability Evaluation
of Populations Containing Non-Corn Belt Germplasm

1997 NCR-167 Genetic Vulnerability Trials

	<u>Early Populations</u>	<u>Participants</u>	<u>Source</u>
1.	ALQUAT COMPTON SIB	Pollak	Iowa
2.	ALQUAT SYN2 SIB	Cross	North Dakota
3.	CG LANCASTER [RRS]C4	Hamilton	Ottawa
4.	CG LANCASTER [S2]C2	Kannenberg	Guelph
5.	CG LANCASTER [COMBINED]C4	Dysinger	Michigan
6.	A619 x A632		
7.	P3394		
8.	CARGILL BT HYBRID		

L. W. Kannenberg
A. R. Hallauer
L. M. Pollak, Chair

Table 1. Summary of the data collected for five early populations and the check hybrid, A619 x A632, at two locations in 1997. Also check hybrids P3394 and CARGILL BT HYBRID, only at the Iowa location.

	1 ^{*a}	1	1	1	2	1	2	2	1	2	2	3	3
Pedigree	FLOWER	H.U.	PH	EH	Pop. PLT/A	% Stand	% SL	% RL	% DE	Yield bu/acre	MOIST	Test wt LB/BU	Pi ^b
Alaquat Compton Sib	70	1165.25	196	96	17156	81.25	29.16	11.22	2.83	44.96	22.73	57.87	64.68
Alaquat Syn2 Sib	73.5	1259.5	209.5	93	20148.5	75.78	10.97	14.82	3.10	38.68	19.00	62.09	69.48
CG Lancaster [RRS]C4	73	1247.75	212.5	107.5	20927	73.44	11.49	15.98	0.98	98.51	16.28	61.25	183.67
CG Lancaster [S2]C4	72.5	1234.75	201.5	89.5	22757	85.16	5.78	8.32	8.29	53.55	14.39	59.56	113.61
CG Lancaster [Combined]C4	71.5	1206	184.5	81	20755.5	80.47	3.38	10.70	3.06	68.42	14.55	57.02	120.41
A619 x A632	70	1165.25	195	99.5	21078.5	74.22	7.87	4.55	8.30	95.89	20.98	55.26	95.74
Averages	71.8	1213.1	199.8	94.4	20470.4	78.4	11.4	10.9	4.4	66.7	18.0	58.8	107.9
	1 ^{*a}	1	1	1	1	1	1	1	1	1	1		
P3394	74.5	1287.25	235.5	104	26620	85.94	12.48	0.00	2.76	137.79	18.35		
CARGILL BT HYBRID	72	1220.5	203	97.5	26862	86.72	6.27	0.00	5.15	126.92	23.75		
Check averages	73.3	1253.9	219.3	100.8	26741	86.3	9.4	0.0	4.0	132.4	21.1		

^{*a} Data was collected at the following locations:

- 1) Iowa
- 2) Iowa and North Dakota
- 3) North Dakota

^b Pi = Performance Index = [(Yield/test mean)/(moist./test mean)] x 100

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 Ronald P. Cantrell
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- Executive Committee -

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K. R. Lamkey, Past Chair	1998
R. Bernardo	1997-2000
E. Lee	1998-2001
B. Briggs, Industry Representative	1997-2000
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2. Nominating:
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3. Germplasm Releases:
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4. Uniform Tests for 100-300 Maturity Group:
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5. Uniform Tests for 400-600 Maturity Group:
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6. Uniform Tests for 700-800 Maturity Group:
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