ESTIMATION OF GENERAL AND SPECIFIC COMBINING ABILITIES OF SOME MAIZE INBRED LINES *(Zea mays L.)*

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For my family, wife and beloved daughter, Isra with love.

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ABSTRACT

The study was carred out during two years (2002-2003), and each of two years seasons (Summer and Winter), at the Faculty of agriculture and natural resources demonstration farm of the University of Kassala, New halfa town, Sudan, with a view to get informations about heterosis and combining ability in 13 inbred lines of maize (*Zea mays L.*).

In a line X tester fashion, nine lines were crossed to four testers. All the 36 F_1, hybrids and their 13 parents were sown in lattice square design with three replications. Observations were recorded on, days to 50% tasselling, days to maturity, plant height, number of nodes per plant, stem diameter, plant height to first cob, number of ear per plant, number of total leaves carried on the stem, leaf area, percentage of cob barness, cob length, cob diameter, number of kernel rows per cob, cob weight, shelling percentage, 100-seed weight , yield per plant and yield ton per hectare.

The analysis of variance mean squares dipicted significant ($P \geq 0.05$) differences among the tested entries, for most of the studied traits in both years and both season. The study revealed the existence of phenotpic variability. The across seasons analysis, showed significant ($P \geq 0.05$) differences among the evaluated accessions for most of the traits, at years, seasons and the interactions of years with seasons, years with genotypes, seasons with genotypes, years with seasons with genotypes emphasizing that, evaluation over more seasons and years is important.

Marked positive heterosis were showed by several crosses for most of the characters examined and more pronounced effects were found for grain yield ton per hectare. Over all study of hybrid vigour, revealed that, about 8 crosses possessed maximum desirable characters and potentials for commercial hybrid production.

The combining ability mean squares due to parents, parents versus crosses, crosses and lines X testers were significant ($P \geq 0.05$) for most of the characters. The percent contribution of lines, testers, and lines x testers to total variation among crosses, indicated that, days to 50% tasselling, plant height to first cob, number of kernel rows per cob, percent cob barness, shelling percentage, yield per plant and yield ton per hectare, were largely influenced by non-additive gene effects. While, stem diameter, number of total leaves per plant, leaf area, cob length, cob diameter, cob weight and 100-seed weight, were largely governed by additive ones.

Inbred lines 75, 111, 176 and 177 were the best general combiners for number of leaves carried on the stem, cob length, cob diameter, cob weight, yield per plant and yield ton per hectare. The analysis of specific combining ability effects, showed that, hybrids 8x160, 8x176, 8x177, 45x65, 45x160, 45x176, 45x177 and 66x65 gave higher SCA effects for nine traits, including cob length, cob diameter, number of kernel rows per cob and yield ton per hectare.

بسم الله الرحمن الرحيم

الـخلاصــــــــــــــــة

أجريت هذه الدراسة با زرعة الإيضاحية بكلية الزراعة وا وارد الطبيعية، جامعة كسلا، حلفا ا ديدة، السودان، خلال الأعوام 2002 – 2003 من خلال مو ي الصيف و الشتاء للحصول على معلومات عن قوة ا ج والقدرة العامة وا اصة على ا لط 13 سلالة نقية من الذرة الشامية.

أجرى التليقح القمي (سلالة×كشاف) حيث هجنت 9سلالات مع أربعة كشاف . ت زراعة يع ا جن الفردية النا ة (36) من التلقيح القمي بالإضافة لإبائهم (13) بتصميم شبكي متزن بعدد 3 مكرارات. أخذت القياسات لصفات، عدد ألأيام لأزهار 50% من النورات ا ذكرة، عدد الأيام للنضج، طول النبات، عدد العقد للنبات، قطر الساق، طول النبات لأول كوز، عدد الكيزان للنبات، عدد الأوراق للنبات، ا ساحة الورقية، النسبة ا ئوية للمساحة الفارغة من ا بوب بالكوز، طول الكوز، عرض الكوز، عدد الصفوف بالكوز، وزن الكوز، نسبة التفريض، وزن ا ئة بذرة، الإنتاجية للنبات با رام والإنتاج بالطن للهيكتار.

أظهر ليل التباين الفردي وجود أختلافات معنوية ب الطرز الوراثية عظم الصفات ال درست ا يش إ وجود تباينات مظهرية ب هذه الطرز.

أوضح ليل التباين ا شترك وجود اختلافات معنوية للأعوام، للمواسم والتداخلات ب الأعوام × ا واسم، الأعوام × الطرز، الأعوام × السن × الطرز، ا يؤكد أ ية إجراء مثل هذه الدراسات عدد من ا واسم لعدد من الأعوام.

عدد كب من ا جن أظهر قوة هج موجبة لعدد كب من الصفات ال درست. برهنت صفة الإنتاجية الطن للهيكتار أعلى قوة هج موجبة.

ليل التباين للقدرة العامة وا اصة على ا لط ، وجد أن متوسط مربع الإ رافات الراجع للأباء، الأباء × ا جن، ا جن × السلالات × الكشاف بينهما فروق معنوية. أشارت نسبة ا سا ات لكل من السلالات، الكشاف والسلالات × الكشاف بالنسبة للاختلافات الكلية ب ا جن، أن الصفات، عدد الأيام لإزهار 50% من النورات ا ذكرة، طول النبات لأول كوز، النسبة الفارغة من ا بوب الكوز، نسبة التفريط، الإنتاجية

للنبات والإنتاجية بالطن للهكتار تتحكم فيها الأفعال غ الإضافية للجينات، بينما الصفات، قطر الساق، عدد الأوراق ا محمولة على الساق، ا مساحة الورقية، طول الكوز، عرض الكوز، وزن الكوز ووزن ا ئة بذرة تتحكم فيها الأفعال الإضافية.

السلالات النقية 57، 111، 176 و 177 هي الأفضل القدرة العامة على ا لمط لصفات، العدد الكلي للأوراق ا محمولة على ساق النبات، طول الكوز، عرض الكوز، وزن الكوز، الإنتاجية للنبات والإنتاجية للطن للهكتار.

أوضح لميل القدرة ا اصة على ا لمط أن ا جن، 8×160، 8×176، 8×177، 45×65، 45×160، 45×176، 45×177 و66×65 أعطت أعلى تأث للقدرة ا اصة على ا لمط تسعة من الصفات من بينها طول الكوز، عرض الكوز، عدد الصفوف للكوز والإنتاجية بالطن للهكتار.

CHAPTER ONE

INTODUCTION

Maize (*Zea mays L.*). belongs to the tribe maydeae, tripsaceae, and distinguished from the related tribes by the separation of male and female flowers in the same plant.Agriculturally the crop form the backbone of the new world and it ranks equally with wheat, rice, and sorghum as staff of life in the world as a whole. These four grain crops in one form or another provide basic nourishment for world people, three of these four grain crops are native to the old world, wheat in near east, rice in Asia and sorghum in Africa, maize however is a native to the new world. Cultivated area of maize now covers more than 137 million hectares of moist fertile land in the temperate, subtropical and tropical upland regions of the world. The world production of maize is more than 604 million metric tons per year, and more than half of this amount is produced in the U.S.A.The grain yield per unit area of maize ranks first, exceeding that of wheat and rice (F.A.O, 2003).

The use of maize in the advanced countries differs from that in the devoloping countries. As, standard of living increases, maize tends to be used more for livestock feed and is replaced with wheat, rice and other starch sources in the human diet. Maize probably yields more industrial products than any other grain crop, the stalk, leaves, silk, cob and grain all have some commercial value, although that of the kernels is by far is the greatest.

In Sudan, maize has been known and grown for a long time, in small scale areas at different loactions under rain, flood and irrigation conditions. The total cultivated area was estimated as 169 thousand hectares, while production and yield were estimated as 56 thousand metric tons and 0.3 t/ha, (Aquino *et al.*2000).The crop is less popular as food, hence it received little attention as a potential food crop in the Sudan. Most of the improved varieties grown in the Sudan are open pollinated as variety 113, composite Geza 2, Mujtamaa 45, Hudeiba 1 and2.

From the seventeen century onwards, maize has been rapidly acquiring a more cosmopolitan status. This is partly due to an increase in the area under cultivation, and to improved crop yields.Amongst the most significant efforts which helped to make recent yield increase, if possible is by breeding activities and spreading of hybrid varieties.

One technique used extensively in maize breeding programmes has been to classify parental lines in terms of their ability to combine in hybrid combinations. With this method the resulting total genetic variation is partitioned into the effects of general and specific combining ability.

Among a variety of testing proceedures employed in particular by maize breeders, top crossing has been used extensively to evaluate inbred lines in hybrid combinations. Allard (1960) defined top cross as test crosses of selections, lines or clones with a common pollen parent which may be a line, single cross or variety.Hallauer and Miranda (1981) mentioned that the use of top cross in maize breeding has one of the following objectives:

1) Evaluation of combining ability of inbred lines in a hybrid breeding programme.
2) Evaluation of breeding values of genotypes (plants) for population improvement.

Accordingly, in the present investigation line x tester analysis has been carried out in an attempt to:

1- Evaluate 36 single cross hybrids of maize and their 13 parents, for grain yield and other agronomic characters.

2- Estimate the magnitude of heterosis for grain yield and other agronomic characters.
3- Estimate general and specific combining ability of the parental inbred lines which will provide a guide for early assessment of relative breeding potential of these parental materials.

CHAPTER TWO

LITERATURE REVIEW

2.1 Phenotypic variability:

Phenotypic variability in a population is of great importance for any successful breeding programme. This is because selection of the desirable genotypes for certain trait will not be effective unless considerable amount of variation is existing in the genotypes under study. Halluer and Miranda (1981) stated that information about the total phenotypic variation that is conditioned by joint action of genetic and environmental forces, is very important for the breeder in making decisions for allocation of resources and expected response to selection.

Studies on the phenotypic variability for yield and other quantitative traits in maize *(zea mays l.)* had been reported by many maize breeders (Eberheart and Russel 1966, Darrah *et al.*1978, Smith 1984) Abel and Pollak (1991) , reported significant variations among accessions of maize for grain yield, days to tasselling and plant height. Abu deif (2003) indicated significant difference among genotypes for ear height, 100-kernel weight, grain yield per plant, number of rows per ear and ear diameter. Badda (1995) reported significant differences among genotypes in number of leaves per plant, days to 50% tasselling, cob length, number of rows per cob, grain yield per plant, plant height, stem girth, and grain yield per hectare at both locations. On the other hand non-significant differences were observed in cobs per plant, cob weight and 100-grain weight at one of the two locations. In addition, the combined analysis of variances showed significant differences among genotypes in number of leaves per plant, cob length and grain yield kg/ha. Choukan (1999), in an investigation of 18 crosses of maize under normal and high plant densities, showed that there were significant differences for grain yield and row number per ear between crosses. However, Galeev *et al.* (1987) found no-significant variation in leaf number and plant height while low to moderate variation was observed in ear height.

Jha *et al.* (2002), using 30 crosses of maize and their 12 parental genotypes, reported significant variation among the parents and hybrids for plant height, basal stem girth and number of leaves per plant. Kara (2001), reported the existence of significant variation among F_1 and parents of maize genotypes for grain yield, ear diameter and ear height. Khalafalla and Abdalla (1997a), evaluated 45 maize genotypes at two sites, indicated significant differences among the evaluated genotypes for plant height, grain yield per plant, leaf area index, stem girth, height to first cob, days to 50% tasselling, 100-seed weight, cob length, cob weight, number of rows per cob and grain yield per hectare. On the other hand, he reported, non-significant differences in number of leaves per stem and number of cobs per plant at one of the two sites used.

The magnitude of the variation in a character is influenced by the environment. Has *et al.* (1999), in study of sweet corn, showed that genotype x year interaction was significanct for most of the traits, emphasizing their evaluation in different years. Kumar *et al.*(1999) conducted study to understand the influence of season on growth and yield of different cultivars of maize, pooled analysis of four years data indicate, a significant influence of genotypes, seasons and their interaction on plant height number and area of leaves.

Kumar and Satyanarayana (2001), in study of variation, heritability, genetic advance and correlation of yield and yield component in maize inbred lines, reported that the phenotypic variation was high for plant height, ear height, low phenotypic variation was recorded for grain yield per plot, number of seed rows per ear and ear girth. Matho and Ganguly (2001), in study including ten white seeded inbred lines of maize reported, significant difference in grain yield, days to maturity, 100-grain weight and shelling percentage. Meseka *et al.* (2003), in study of six land races of maize and their 15 F_1 hybrids for two years, reported highly significant differences for days to 50% tasselling, plant height, ear height, ear length and grain yield at two years, but no-significant differences were shown in number of ear per plant at the two years. Nevado and Crossa (1990), reported the existence of significant variations among crosses of maize for grain yield, ear per plant, number of leaves, leaf length and leaf width.

Parasad and Singh (1989), attributed the percentage of contribution of each character to the divergence between the genotypes and it was high for days to tasselling. Pandey and Gritton (1974) reported that, the environmental factors had an influence on plant height and ear length. Ron and Ordous (1987) reported that, there were significant differences among maize genotypes in plant height and number of leaves. From study of heterosis and combining ability study of tropical yellow endosperm maize populations, San-vicente *et al.* (2001) reported significant differences among parents and crosses for grain yield and plant height. Sindagi *et al.* (1970), in study of two intervarietal of maize, reported large genotypic variation in plant height,flowering date, number of leaves, 100-seed weight and grain yield per plant. Also Vacaro *et al.* (2002), in evaluation of 12 maize populations and their crosses indicated the existence of genetic divergence for plant height, point of insertion of the first ear, number of ears per plant and grain yield. Vasal *et al.* (1992), in a study to determine heterosis and combining ability in maize germplasm, indicated significant differences in grain yield.

Venkatesh *et al.* (2002), in the evaluation of 21 single cross hybrids of maize during rainy and winter seasons, showed that, number of days to 50% tasselling and ear length significantly varied with the growing season. Yousif *et al.* (2003) reported, significant differences for grain yield, plant and ear height, and total leaf area. Zelleke (2000) reported that, cross x year interaction was highly significant for plant height and days to maturity.

2.2 Heterosis studies:

The information about the extent of heterosis is an important aspect to be assessed in a breeding programme for hybrid development, degrees of heterosis with respect to grain and other characters in maize have been reported by a number of workers. Altinbas (1995), in study of heterosis and combining ability in a half diallel set of crosses involving 6 inbred lines, showed that most of the variation among genotypes for grain yield and plant height was accounted for by heterosis. High parent heterosis ranged from 72-140.7% for grain yield. However, Castro *et al.* (1964) using crosses of 5 open pollinated maize varieties, revealed that only minor portion of variation in days to flowering and plant height can be attributed to heterosis.

Debnath (1987) reported significant and positive heterosis over mid and better parental values, with the highest value been observed for ear length and 1000-grain weight. Dehghanpour *et al.* (1996), in study of white maize crosses, indicated that, mid-parent heterosis was 152% for grain yield. Dickert and Tracey (2002), in study of heterosis and combining ability in sweet corn cultivars, showed that, no hybrid was earlier than the earliest parent and average mid-parent heterosis was –0.8%. In contrast mid-parent heterosis was high for ear length 12.9%, ear height 8.6% and plant height 9.0%. Johanson (1973), reported that leaf area index was inherited in highly heterotic manner. Khalafalla and Abdalla (1997b) in evaluation of 45 maize genotypes at two sites, showed that, the highest magnitude of heterosis was expressed by grain yield (65.79% and 23.6%) in the first and second site, respectively. Most of the hybrids at each site expressed positive heterosis over the mid-parental values for all characters, indicating the great potential of some evaluated genotypes for hybrid production. Kara (2001) following line x tester approach in crosses of maize, showed that average heterosis was positive, except for days to tasselling. With the average hybrid grain yield being 79.89% that of the parents.

Larish and Brewbaker (1999) reported, from diallel analysis of temperate and tropical pop corns, that grain yield averaged 55% mid-parent heterosis for variety crosses and 105% for inbred crosses, heterosis for kernel weight was 81% for the variety diallel. Mahmoud *et al.* (1990), from study of heterosis and combining ability in 6 inbred lines of maize together with their crosses, revealed that yield per plant had the highest level of heterosis. Mickelson *et al.* (2001), in study of nine cultivars together with their diallel crosses of maize, reported low to moderate heterosis for grain yield. Mukherjee *et al.* (1971) in a 9X9 diallel mating system, reported that, 96.6% of the crosses exceeded the mid-parent and 75% of them exceeded the high parent in grain yield. Nigussie and Zelleke (2001), in study of heterosis and combining ability in 8 elite maize genotypes, reported variation in mid-parent heterosis for the different characters. It was in the range of – 11.6 to 21.9 for grain yield.

Ogunbodede *et al.* (2000), in the evaluation of 15 hybrids and their 6 parents for heterosis and combining ability, showed that 6 out of 15 F_1 hybrids had positive high parent heterosis for grain yield and three other crosses showed positive heterosis in number of rows per cob. Robinson and Cockerham (1961), reported that, heterosis measured from the mid-parent was manifested in the genotype crosses. Silva *et al.* (2003) showed that, total mid-parent heterosis effects ranged from – 4.3 to 17.3%, with an average heterosis of 3.37% for ear yield. Yurankova and Tsitok (1989), indicated, that considerable instability was noticed with respect to heterosis for ear width and ear length, while heterosis was slight or abscent for number of rows per ear.

2.3 Combining ability:

Sprague and Tatum (1942), defined general combining ability as the average performance of an inbred line in hybrid combinations, and as such, general combining ability is recognized as a primarily measure of additive gene action. Specific combining ability describes those instances in which certain hybrid combinations do relatively better or worse than would be expected on the basis of the average performance of the lines envolved, and is regarded as an estimate of the effects of non-additive gene action. They also reported that general combining ability (GCA)was more relatively important than specific combining ability (SCA) for unselected inbred lines, where as specific combining ability was more important for previously selected lines.

Abu deif (2003), in study of inbred lines of maize and their 6 F_1 crosses, showed that non-additive genetic variances play a major role in all studied traits except 100-seed weight Alamnie *et al.* (2003) reported, in study of the combining ability and heterosis, a wide range of diversity among parent, males, females and parent versus hybrids for plant height, ear height and grain yield. Similar results were also obtained for the interaction of line x tester for plant height and grain yield on the other hand, the variances due to line x tester was not significant for ear height. A high magnitude of specific combining ability (SCA), than general combining ability (GCA), for all the studied characters indicated the predominance of non-additive gene action. The variance of GCA and SCA were significant indicating the role of both additive gene actions in the inheritance of the characteristics.

Dehghanpour *et al.* (1996), in evaluation of inbred lines and their 28 F_1 progenies, revealed that mean squares for GCA and SCA were significant for plant height, ear height, kernel rows, kernel weight, indicating that both additive and non-additive gene actions were involved in the genetic variability of the characters examined. However, non-additive (dominance) effects appeared to be more important in the expression of these traits. Desai and Singh (2001), reported significant differences in general combining ability (GCA) and specific combining ability (SCA) for days to 50% tasselling, plant height, ear height, number of leaves per plant and grain yield per plot. Dodiya and Joshi (2002), in a line x tester experiment involving 20 lines and 3 testers of maize, showed that, mean squares due to line, tester and line x tester were significant for grain yield, plant height, ear size and 100-grain weight. The variance of SCA was higher than that of the GCA indicating the importance of non-additive gene action in the control of the characters. Dubey *et al.* (2001), in a study of 45 hybrids of maize resulted form 15x3 line by tester, showed that, both general and specific combining ability variances were important for grain yield.

Dhillon *et al.* (1978), in the evaluation of all possible crosses among 20 populations of maize at two plant densities, reported significant differences due to GCA and SCA for grain yield, plant height, ear length and kernel rows at both densities. However, SCA for grain at high density experiment was non-significant. El-hosary *et al.* (1997), from combining ability study in diallel crosses of maize, reported significant GCA and SCA for plant height, ear diameter, number of rows per ear, ear weight per plant and grain yield per plant. El- rouby *et al.* (1973), reported that the additive genetic variance was the major portion of the total genetic variance for all characters, with the exception of ear height where the estimates of dominance were significant.

Form study of general and specific combining abilities of 10 inbred lines of maize Choukan (1999), mentioned that, both additive and non-additive gene effects were important in genetical control of grain yield, plant height, number of kernel rows per cob, and additive gene effect was only important in controlling days to flowering, ear height and 1000-kernel weight. Geetha (2001) in study of crosses among 10 maize genotypes, indicated that additive gene action for plant height, number of grain rows per cob, cob weight and 1000-grain weight.

He *et al.* (2003) in an investigation of combining ability and hereditary parameters of main quantitative characters of 10 maize inbred lines, reported that, the variance of GCA was significant for growth period, plant height at heading, cob position, cob length, rows per cob, cob diameter, seed setting rate, kernel weight percentage and kernel yield. The variance for SCA was significant for growth period, plant height at heading, cob position, cob length, rows per cob, cob diameter and seed setting rate. The variances of GCA for these seven later traits were significantly higher than the variance of SCA, indicating that most of the quantitative characters measured were largely controlled by additive gene effect. Hede *et al.* (1999), in line x tester analysis at 6 environments, reported significant GCA effects for line, tester and line x tester for grain yield over all environments. Kalla *et al.* (2001), indicated, that both additive and non-additive gene actions were significant for kernel rows per ear, ear girth and ear length. The non-additive gene action was predominant for ear length and grain yield. Kara (2001) in an evaluation of 3 males and 6 females together with their 18 F_1 hybrids, showed that, SCA effects were significant for ear diameter, ear height and grain yield per unit area. With respect to ear height and grain yield per unit area, SCA effects were, more pronounce when compared to GCA effects indicating the predominance of non-additive gene action in the inheritence of these traits. Khalafalla and Abdalla (1997b), indicated that,the contribution of GCA and SCA among the hybrids for each of the traits, number of cobs per plant, number of rows per cob, cob weight and yield per plant were of equal magnitude. This reflects the importance of both additive and non-additive gene actions in determining these traits. However, for 100-grain weight and grain yield per hectare GCA was more important than SCA, indicating that additive gene actions were more important than non-additive ones for the expression of these traits. Konack *et al.* (1999), using data from crosses of 4 testers and 6 lines, reported higher specific combining ability for grain yield, thousand kernel weight, number of nodes, first ear height, ear length, and earliness. However, higher general combining ability values were noted for plant height and number of rows per ear. On the other hand, Konack *et al.* (2001) reported, non-additive gene effects for ear length and number of rows on ear and additive gene effect for yield, thousand kernel weight plant height and ear height. Martins and Miranda (1997) evaluaed 120 single crosses of maize for ear weight, plant and ear height, ear and cob diameter and days to tasselling.The result indicated that, general combining ability was more important than specific combining ability as a source of variation. Mathur *et al.* (1998), in evaluation of 98 single cross maize hybrids in non-stress and stress environment, indicated significant GCA for ear length, ear girth, number of rows per ear, shelling percentage and grain yield per plant in both environments. SCA variance was significant for ear length and shelling percentage under normal environment and for grain yield per plant in stress environment.

Mahmoud *et al.* (1990), from data on 8 yield components in 6 inbred lines and their F1, reported that genetic variance for ear length was mainly additive while for plant height and grain yield were non-additive.
Meseka et al. (2003) found that, mean square due to GCA and SCA were significant for days to 50% tasselling, plant height, ear height, ear length and grain yield. The ratios of GCA : SCA for days to 50% tasselling, plant height, ear length and grain yield were almost one or more indicating that the inheritence of these characters was due to both GCA and SCA effects, however, the ratio of GCA: SCA for ear height was less than one suggesting that the inheritence of this character was mostly due

to SCA effects. Mostafa *et al*. (1996), showed, that both general and specific combining abilities were highly significant, the proportion of SCA variance was, however, greater than GCA variance. Nigussie and Zelleke (2001) reported that, mean squares due to genotype,and general combining ability were significant for days to tasselling, plant height and grain yield. The magnitude of GCA was higher than SCA in all the cases, indicating that additive gene action was more important than non-additive in the inheritence of these traits.

Nirla and Jha (2002), reported significant differences among female and male parents for general combining ability (GCA), for days to 50% flowering, days to maturity, plant height, leaves per plant, girth of basal stem internode and grain yield. Significant differences for specific combining ability (SCA) among crosses were found for all characters. The magnitude of components of GCA were more pronounced than SCA for days to 50% tasselling, days to maturity and plant height, while the reverse was true for the rest of the characters. Ogunbodede *et al.* (2000), reported high significant differences in plant height, cob length and number of rows per cob. The mean values due to general combining ability was about 40% higher than that due to specific combining ability. Paul and Debnath (1999), indicated that, both general (GCA) and specific (SCA) combining abilities were significant for days to pollen shedding, plant height and ear height, with the GCA being higher than SCA combining ability, indicating that additive gene action was more important than non-additive one. Rana and Vinod (2001), reported significant differences for general combining ability and specific combining ability for kernel rows per cob, plant height, cob length, cob circumferance, days to maturity and days to pollen shed. The additive gene effects were important for days to maturity and days to pollen shed. Revilla *et al.* (1999), detected significant GCA and SCA for pollen date, total leaf number and plant height. The magnitude of combining ability is affected by the environmental factors. Rojas and Sprague (1952), concluded that, for corn GCA was relatively more stable over environment than SCA, hence more than a single environment should be used in testing hybrid combinations. San-Vicente *et al*. (2001) evaluated 36 hybrids and their 9 parents at 5 locations. The combined analysis of variance detected highly significant differences among genotypes, parents and crosses for plant height and grain yield. Variation among crosses was mainly due to GCA for plant height, while for grain yield the non-additive effect (SCA) was more important. Sanghi (1983) concluded that, variance components due to GCA and SCA for grain yield, stem girth and days to tasselling were significant. Sedhom (1994), in an evaluation of top crosses of maize, indicated that, GCA was predominant for plant height, ear height, ear diameter and number of rows per ear while SCA was more important in controlling grain yield per plant and ear length. Singh *et al.* (1998) carried out combining ability studies for maturity and height traits, general and specific ability variances were highly significant for days to tasselling and husk browning, plant and ear height. Variance due to GCA was preponderant for all the attributes. In a 15x2 line x tester analysis of maize genotypes, Singh and Singh (1998), mentioned that, the variability among top crosses was mainly due to contribution of line x tester interaction except for ear length, plant height and ear weight, where it was mainly due to line. For ear length and number of kernel rows per ear, SCA was more important but GCA was important for other characters like grain yield per plot, ear diameter, 100-kernel weight, plant height and ear height. Soliman and Sadek (1999), showed significant differences for tester, line and line x tester interaction in grain yield. plant height and ear position.

In combining ability study for yield and related characters in single cross hybrids of tropical maize. Sujiprihati *et al.* (2002), reported the significant of GCA and SCA effects that reflected the importance of both additive and non-additive gene action for yield and related characters. The SCA variance for yield and related characters studied were much higher than their respective GCA variance. Terron *et al*. (1997) evaluated 60 line x tester combinations of maize at four locations. In combined analysis across locations the variance component for GCA and SCA were significant. Tosquy *et al.* (1998) conducted 3 experiments each of 13 lines x 1 tester to evaluate top crosses of maize inbred lines, it was found that the testers had significant effects on height of plant and grain yield (experiment 2), days to tassel (experiment 3), general combining ability (GCA) was significant for all characters except height of ear (experiment 1 and 3). Line x tester interaction had significant effect on grain yield (experiment 2 and 3). Tulu and Ramachandrappa (1998) evaluated 21 crosses and their 7 parents of maize results showed that, mean squares due to entries and general combining ability effects were highly significant for ear height, plant height, and grain yield.Specific combining ability effects were not significant for ear and plant height. General combining ability variance, indicating the importance of additive genes in controlling these traits. Venkatish and Sarama (1999) studied combining ability in a set of 10 diverse maize inbred lines.Observation were recorded for plant height, ear height, ear girth, number of kernels rows per ear, 100-kernel weight and grain yield per plot. Additive gene action was predominant for most of the yield components, while non-additive gene action was predominant for maturity trait. In study of 12 maize lines crossed in line x tester fashion, Venugopal *et al.* (2002), reveeled significant differences among lines, testers and line x tester for most of the studied traits, that suggesting, the hybrids which had been obtained were relatively divergent. The magnitude of specific combining ability variance was higher than that of general combining ability variance for all traits studied except for ear girth indicating the predominance of non-additive gene action govering the respective traits.

From study of 40 crosses and their parent Wu *et al*. (2003), reported that, kernel weight percentage, growth period, plant height, rows per cob, cob length and cob position were mainly controlled by additive gene action while , cob diameter and seed setting percentage were controlled by both additive and non-additive gene action. Yadav *et al*. (2003), conducted genetic analysis for yield and its components on maize, the variance due to dominance effect was significant for number of days to 50% tasselling, leaf area, plant height and cob width. In investigations of combining ability and hereditary parameters of major draught resistant in maize, Wu *et al*. (2003) showed that, cob length, weight per cob, rows per cob and grain yield per plant were mainly controlled by an additive gene effect. while, cob diameter and 100-grain weight were controlled by non-additive gene effect. Zhao *et al*. (2003), analysed and evaluated 36 hybrids for combining ability, the results showed significant differences in general combining ability for kernel yield, seed setting rate, cob length, kernel row per cob, cob diameter, plant height and cob position. Informations derived by Zelleke (2000), on combining ability from data on grain yield, plant height, ear length days to maturity and 1000-grain weight, indicated that, both general (GCA) and specific combining ability (SCA) were significant for all traits. Cross x year interaction was highly significant for plant height and days to maturity.

CHAPTER THREE

MATERIALS AND METHODS

This study was conducted during summer and winter seasons of the years 2002 and 2003, at faculty of agriculture and natural resources,University of Kassala at New Halfa (35^0: $36^/$ E. longitude, 15^0:$19^/$ N. latitude and 450 meters above the sea level).

3.1 Materials.

Forty nine genotypes of maize (*Zea mays l.*) including four testers, nine lines and their 36 single cross hybrids were used in the study (Table 1).

3.2 Methods:

Several maize (*Zea mays l.*), inbred lines have been devoloped at the Agronomy Department, Faculty of Agriculture,University of Khartoum by inbreeding and line selection for 6 cycles. The selected parental lines that used in this study were chosen primarily for their high yielding ability, beside that diversity in phenotype, abundunt pollen shedding and vigor. The inbreds 8, 45, 66, 75, 111, 157-1, 157-2, 186 and 203 were used as lines while 65, 160, 176 and 177 were used as testers in a line x tester mating system. A crossing block was established in november 2001 at the demonstration farm of the faculty of agriculture and natural resources, University of Kassala.Each female line was grown in 6-row plot with row length of ten meters and each tester was grown in 10-row plot with row length of 10 meters. Spacing was 80 cm between rows and 30 cm between hills. Pests (insects and weeds) were controlled according to standard recomendations. Because of a limited amount of seed obtained, the seed increase of some crosses was done again during August 2002. The parents were crossed and selfed according to the method described by singh (1987).

Mating was carried in such a way that each female parent line was used to be pollinated by four males (testers).

Table 1. The maize accessions used in the study

Genotype code	**Pedigree**	Type
	Inbred line	
1	8	Line
2	45	**Line**
3	66	Line
4	75	Line
5	111	Line
6	157-1	Line
7	157-2	Line
8	186	Line
9	203	Line
10	65	Tester
11	160	Tester
12	176	Tester
13	177	Tester
	Hybrid	
14	8X65	Cross
15	8X160	Cross
16	8X176	Cross
17	8X177	Cross
18	45X65	Cross
19	45X160	Cross
20	45X176	Cross
21	45X177	Cross
22	66X65	Cross
23	66X160	Cross
24	66X176	Cross
25	66X177	Cross
26	75X65	Cross
27	75X160	Cross
28	75X176	Cross
29	75X177	Cross
30	111X65	Cross
31	111X160	Cross
32	111X176	Cross
33	111X177	Cross
34	157-1X65	Cross
35	157-1X160	Cross
36	157-1X176	Cross
37	157-1X177	Cross
38	157-2X65	Cross
39	157-2X160	Cross
40	157-2X176	Cross

41	157-2X177	Cross
42	186X65	Cross
43	186X160	Cross
44	**186X176**	Cross
45	186X177	Cross

Table 1. Continued.

Genotype code	**Pedigree**	Type
46	***203X65***	Cross
47	203X160	Cross
48	203X176	Cross
49	203X177	Cross

About 20 ears were produced for each cross. The crosses have been referred to as 8x65, 203 x 177 etc. Evaluation was done under irrigation condition with normal cultivation practices through four environments, namely, two seasons and two years. The seasons being summer and winter while the years being 2002 and 2003. Each of the four evaluation experiment was grown in square lattice design with three replications. The plot size was four rows of 3.5 meters length and spacing of 70 cm between rows and 20 cm between hills. Planting was made at a rate of two seeds per hill, which was then thinned to one plant per hill two weeks after sowing. Sowing was on 17 July, for the summer sowing, and First of November, for the winter sowing. One row at each side of the plot was treated as boarder row to avoid the inter plot competition. Except for days to 50% tasselling, days to maturity and yield ton per hectare, ten randomely selected plants from the middle two rows of each plot were used to record the data. Data were recorded on the following parameters:

1- Day to 50% tasselling: period from sowing at which 50% of the plants in a plot started to shed pollen.
2- Plant height (cm): measured from the base of the plant to the base of the tassel.
3- Days to maturity: number of days from planting untill the leaves had turn yellow and 95% of the cobs in the plot were ripe.
4- Stem diameter (cm): measured on the stalk at the second internode above the ground level using vernia.
5- Number of nodes per plant.

6- Plant height to first cob (cm): measured as height between the base of a plant to the insertion of the top ear of the same plant.

7- Number of ears per plant: counted as number of ears with at least one fully developed grain from the randomely selected plants.

8- Number of leaves per plant.

9- Leaf area (cm^2): the maximum length and width of the leaf at the fourth internode were measured on each of ten randomely selected plants per plot, then the leaf area was calculated as follows: leaf area ($L.A.cm^2$) = length X width X 0.75.

10- Cob barness (%): The tip of the ear which did not bear seeds was measured and divided by the length of the ear as follows:

$$\text{Cob barness} = \frac{\text{Length of the tip of ear not bear seed (cm)} \times 100}{\text{Length of the ear (cm)}}$$

11- Number of kernel rows in the cob.

12- Cob length (cm).

13- Cob diameter (cm).

14- Cob weight (g): Estimated as the mean cob weight from the 10 randomely selected plants.

15- Shelling percentage: The 10 randomely selected cobs were air dried, weighted then shelled and the weight of kernels was recorded, Shelling percentage was estimated as follows:

$$\text{shelling \%} = \frac{\text{weight of kernels}}{\text{Weight of cobs}} \times 100$$

16- 100-seed weight (g): The weight of a random sample of 100 grains, obtained from the grain yield of each plot.

17- Grain yield per plant (g): The average weight of grains produced by the ten randomely selected plants.

18- Grain yield ton per hectare: Cobs from each of the two middle rows of a plot were air dried and threshed in bulk, weighted and grain yield was then calculated according to the following formula:

$$\text{Grain yield(t/h)} = \frac{\text{grain wt. (g) of two middle rows of a plot} \times 0.053}{\text{no. of plants within the two middle rows}}$$

3.2.2 Statislical analyses:

The collected data were subjected to standard proceedures of statistical analyses as follows:

3.2.2.1. Individual and combined analysis of variances:

The proceedure described by Gomez and Comez (1984) was used to estimate the individual and combined analysis of variance. Individual analysis of variances was carried out for each season separately; then combined analysis of variance was done. Table 2 and 3 show the form of individual and combined analysis of variance.

3.2.2.2 Mean Separation:

The proceedure of Duncans Multiple Range Test (DMRT) at 0.05 level of significance was performed, as described by Gomez and Gomez (1984), as follows:

Step one: all the treatment means were ranked in decreasing order.

Step two: the adequate standard error of the differences ($\bar{s}d$) was computed according to the following formula =

$$\bar{s}d = \sqrt{\frac{2 \text{ effective error ms}}{r}}$$

where:

r = number of replications.

Step three : value of the shortest significant range at 0.05 level were calculated as :

$$Rp = [(rp).(\bar{s}d)] / \sqrt{2} \quad \text{for } P = 2,3, \ldots, g.$$

Where:

Rp = The (g-1) value.

g = The total number of genotype means under comparison.

P = The distance in rank between the pairs of treatment means to be compared.

Table 2. The form of analysis of variance for triple lattice design applied in the study.

Source of variation	d.f		M	F
Replication (R)	r-1	= 2	M_1	-
Block (adj.)	**R (k-1)**	**= 18**	M_2	-
Genotypes			M_3	
Unadjust.	$K^2 - 1$	= 48	M_4	M_4/M_6
Adjust.	$K^2 - 1$	= 48	M_5	M_5/M_6
Error	(k –1) (rk-k-1)	= 78	M_6	
Total				

Where :

R = is the number of replications.

K = is the block size.

G = is the number of genotypes.

M1, …., M6 = mean squares for replications, Block (adj.), Genotypes unadjust., Genotypes adjust. and intrablock Error espectively.

Table 3. Outline of the combined analysis of variance over years, based on RCBD design

Source of variation	Degrees of freedom	Mean square	Computed F
Year	(y-1)	M_1	M_1/M_9
Season	(s –1)	M_2	M_2/M_9
Year x season	(y – 1) (s – 1)	M_3	M_3/M_9
R (s x y)	(r-1) (ys)	M_4	M_4/M_9
Genotype	(g –1)	M_5	M_5/M_9
Year x genotype	(y –1) (g-1)	M_6	M_6/M_9
Season x genotype	(s –1) (g –1)	M_7	M_7/M_9
Year x season x genotype	[(y-1) (s-1) (g-1)]	M_8	M_8/M_9
Error	[YS(r-1) (g-1)]	M_9	
Total	[(rxyxsxg)-1]		

Where:

y = number of years.

s = number of seasons.

g = number of genotypes.

r = number of replications.

rp = The tabular value of significant studentized ranges of 0.05 level.

Step four: all treatment means which did not differ significantly from each other were then identified and grouped together.

Step five: alphabet notations were then used to indicate the non-significant difference between any two treatment means.

3.2.2.3. Coefficient of variation (C.V.):

Coefficient of variation for each character, in each seasons and in combined analysis was determined using the following formula:

$$C.V.\% = (\sqrt{E} \times 100) / G$$

Where:

E = The mean square of error .

G = Overall mean of the character.

3.2.3. Heterosis.

Using means computed from the combined analysis, percentage heterosis based on mid-parental (MP) and better parent (BP) values were calculated according to the formula described by Davis (1978) as follows:

$$\text{Mid-parental heterosis (MP)} = \frac{\bar{F}_1 - (\bar{P}_1 + \bar{P}_2)/2}{(P_1 + P_2)/2} \times 100$$

$$\text{Better parent heterosis (BP)} = \frac{\bar{F}_1 - \overline{BP}}{\overline{BP}} \times 100$$

Where:

$\bar{F}_1$ = The mean of F_1 hybrid.

$\bar{P}_1$, $\bar{P}_2$ and $\overline{BP}$ = means of the first, the second and better parent, respectively.

3.2.4. Combining ability.

For estimation of combining ability, the pooled data of the four environments (four seasons) were analyzed for general combining ability

(GCA) and specific combining ability (SCA) effects as described by Singh and Chaudhary (1977).

Estimation of GCA effect:

a) Lines: GCA (line) = $g_i = \frac{x_{l..}}{tr} - \frac{x_{...}}{ltr}$

b) Tester: GCA (Tester) = $g_t = \frac{x_{.j.}}{lr} - \frac{x_{...}}{ltr}$

c) Estimation of SCA effects:

$$S_{ij} = \frac{x_{ij.}}{r} - \frac{x_{i..}}{tr} - \frac{x_{.j.}}{lr} + \frac{x_{...}}{ltr}$$

Where:

l = number of lines

t = number of testers

r = number of replications

d) Proporional contribution of lines, testers and their interaction line x tester to the total variance were calculated as follows:

The contribution due to lines = $\frac{\text{ss due to lines}}{\text{ss due to crosses}} \times 100$

The contribution due to testers = $\frac{\text{ss due to testers}}{\text{ss due to crosses}} \times 100$

The contribution due to line x testers =

$$\frac{\text{ss due to lines x testers interactions}}{\text{ss due to crosses}} \times 100$$

Table 4 shows the form of analysis of variance for line x tester analysis including parents for the pooled data of the four enviroments (four seasons).

Table 4: The form of analysis of variance for line x tester analysis for the pooled data over the four environments (Four seasons).

Source of variation	*Degress of Freedom*	MS
Genotypes	(g-1)	M_8
Parents	(p-1)	M_7
Parents vs. crosses	1	M_6
Crosses	(c-1)	M_5
Lines	(l-1)	M_4
Testers	(t-1)	M_3
Lines X testers	(l-1) (t-1)	M_2
Error	(r-1) (g-1)	M_1

Where:

g = number of genotypes.

p = number of parents.

c = number of crosses.

l = number of lines.

t = number of testers.

CHAPTER FOUR

RESULTS

4.1. Phenotypic Variability:

Individual analysis of variance (Table 5) revealed significant difference among the 13 genotypes and their 36 crosses over the four seasons, for most of the characters studied. These characters included, days to 50% tasselling, plant height, days to maturity, number of nodes per plant, stem diameter, plant height to first cob, number of leaves per plant, leaf area, percent cob barness, cob length, cob diameter and grain yield (t/h). On the other hand a non-significant difference was obtained for number of kernel rows per cob, cob weight, shelling percentage, grain yield per plant during summer 2002, number of ears per plant, shelling percentage, 100- seed weight, during winter 2002 and ear per plant during winter 2003.

Table 6 illustrates across seasons analysis of variance it was found that years effect was significant for all characters, except grain yield (t/h). Also, for most of the characters, the seasons effect and the interaction of years x seasons were significant except for cob length similarly, the interaction of years x seasons x genotypes was significant for most of the characters, except number of leaves per plant and leaf area.

A great amount of variability, as measured by the range of means and the coefficient of variation, was expressed by the different characters (Table 7 and 8). In the individual analysis, the coefficient of variation, varied from 3.0%, for days to 50% tasselling, to 39.9%, for grain yield (t/h). In the across seasons analysis of variance from, 3.8% for days to 50% tasselling, to 34.8%, for grain yield (t/h).

Table 5. Mean square from analysis of variance for the different characters in forty nine maize (*Zea mays L.*) genotypes evaluated during summer and winter seasons of 2002 and 2003 at New halfa using square lattice design.

Character	**Replication d.f = 2**	Genotype **d.f = 48**	**Block within rep. d.f = 18**	**Error d.f = 78**
	Summer			Winter
	2002	2003	2002	2003
Days to 50% tasselling	17.1 *	5.6 *	14.2 *	20. 5 *
Plant height (cm)	1211.8 *	799.0 *	1143.0 *	1393.4*
Days to maturity	37.6 *	31.1 *	43.8 *	33.6 *
No. of nodes per plant	1.8 *	1.8 *	2.8 *	3.4 *
Stem diameter (cm)	9.9 *	8.1 *	10.6 *	20.6 *
Plant height to first cob	433.0 *	284.7 *	468.9 *	531.6 *
Ear per plant	0.3 *	0.3 *	0.3 n.s	0.3 n.s
No. of leaves per plant	2.6 *	1.4 *	3.4 *	3.4 *
Leaf area (cm^2)	10657.8 *	17579.0 *	10210.1 *	16708.9*
Percent cob barness	0.7 *	0.7 *	0.7 *	1.7 *
Number of kernel rows	2.4 *	1.9 n.s	3.1 *	5.7 *
Cob length (cm)	14.1 *	13.2 *	10.1 *	10.7*
Cob diameter (cm)	0.2 *	0.2 *	0.2 *	0.3 *
Cob weight (gm)	2224.6 *	798.8 n.s	1991.2 *	3395.7
Shelling %	83.5 *	66.5 n.s	75.0 n.s	29.9 *
100 – seed weight (g)	25.8 *	27.5 *	22.6 n.s	26.8 *
Yield per plant (g)	1810.8 *	689.7 n.s	1642.9 n.s	2103.5 *
Yield (t/ha)	5.2 *	2.5 *	6.2 *	5.9 *

* level of significance at 5%.

n.s. = not significant.

Table 6. Mean square from the combined analysis of variance for the different character in 49 maize (*Zea mays L.*) genotypes evaluated during summer and winter seasons of 2002 and 2003 at New Halfa, based on randomized complete block design.

Character	Year (y) d.f = 1	Season (s) d.f = 1	y x s d.f = 1	R (sy) d.f = 8	Genotype (g) d.f = 48	Y x G d.f = 48	S x G d.f = 48	Yx Sx G d.f = 48	Error d.f = 384
Days to 50% tasselling	260.0 *	31782.9 *	290.1 *	16.4 *	26.9 *	13.5 *	10.2 *	10.7 *	5.8
Plant height (cm)	31045.5 *	5576.8	3747.6 *	3189.7 *	2543.4 *	591.4 *	1023.6 *	511.7 *	302.7
Days to maturity	3150.2 *	17447.6 *	903.8 *	30.1 n.s	117.6 *	9.2 n.s	10.9 n.s	10.s 8 n.s	18.1
Number of nodes per plant	140.7 *	16.9 *	147.4 *	6.9 *	3.7 *	2.9 *	1.7	1.5 *	1.0
Stem diameter (cm)	688.4 *	1294.4 *	6821.8 *	7.8 n.s	23.0 *	7.5 *	9.5 *	9.9 *	5.1
Plant height to first cob (cm)	3071.3 *	55.0 n.s	52.1 n.s	1481.0 *	599.2 *	492.1 *	478.4 *	256.4*	126.9
Ears per plant	11.7 *	0.2 n.s	8.1 *	-	0.2 n.s	0.3 *	0.2 n.s	0.2 *	0.146
Number of total leaves/plant	38.8 *	3.8 *	38.8 *	1.5 *	7.1 *	0.6 n.s	2.5 *	0.6 n.s	0.6
Leaf area (cm)	120913.2 *	30095.8 *	140966.5 *	28770.4 *	24574.4 *	10335.2 *	11755.0*	9225.5 *	7110.7
cob barness %	3.1 *	2.5 *	16.7 *	1.5 *	1.1 *	1.0 *	0.7 *	0.4 *	0.4
Number of kernel rows	10.6 *	10.6 *	0.040 n.s	-	4.1 *	3.2 *	2.9 *	2.3 *	1.6
Cob length (cm)	429.9 *	4.7 n.s	0.4 n.s	42.8 *	25.5 *	8.7 *	7.8 *	8.2 *	4.4
Cob diameter (cm)	1.2 *	1.6 *	3.0 *	0.5 *	0.3 *	0.2 *	0.2 *	0.2 *	0.1
Cob weight (g)	13581.0 *	29767.9 *	2145.1 *	-	4536.6 *	1645.8 *	1380.9 *	1637.6 *	557.0
Shelling %	1590.0 *	60.4 n.s	4540.2 *	-	70.6 n.s	63.1 n.s	47.2 n.s	66.8 n.s	12.3
100-seed weight (g)	100.1 *	2110.5 *	33.8 n.s	-	48.7 *	20.2 *	22.1 *	16.9 *	12.3
Yield per plant (g)	6667.5 *	21235.5 *	111487.8	-	3422.9 *	1077.2 *	721.3 *	1185.2 *	472.9
Yiled (t/h)	0.0 n.s	12.8 *	48.8*	6.0 *	11.4 *	4.2 *	2.1 *	2.7 *	1.2

* significance at 5%

n.s. = non- significant.

TabLe 7. Means of the different characters in 49 maize genotypes evaluated in the summer and winter seasons of 2002 and 2003, at New Halfa.

Genotype	Days to 50% tasselling				Plant height (cm)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	57.0 a,-,j	55.7 b,-,e	67.1 c,-,l	71.7 a,-,j	116.4 m,-,n	91.9 g	163.4 a,-,g	121.0 h,-,p
45	52.5 i,-,k	56.0 a,-,e	67.3 b,-,i	73.0 a,-,h	121.6 k,-,o	132.8 a,-,e	101,4 no	93.8 p
65	60.6 a,-,c	57.0 a,-,c	73.0 a	71.0 c,-,l	122.7 i,-,o	138.4 a,-,e	127.7 i,-,n	102.0 l,-,p
66	56.1 b,-,k	59.0 a	71.4 a,-,f	69.0 f,-,l	154.8 a,-,k	131,8 a,-,f	157.5 a,-,h	134.6 c,-,k
75	59.0 a,-,e	54.0 c,-,e	66.7 c,-,i	70.3 d,-,l	102.7 o	94.3 fg	107.9 m,-,o	102.6 l,-,p
111	51.7 k	54.0 c,-,e	66.8 e,-,i	68.3 h,-,l	121.2 k,-,o	105.4 e,-,g	108.7 m,-,0	132.3 d,-,l
157 –1	55.7 d,-,k	55.7 b,-,e	66.1 g,-,i	72.7 a,-,i	111.6 no	142.9 a,-,e	126.3 j,-,n	103.0 l,-,p
157 –2	53.2 g,-,k	57.7 ab	66.9 e,-,i	69.0 f,-,l	125.5 h,-,o	108.9 c,-,g	96,6 o	95.1 p
160	55.5 d,-,k	54.3 b,-,e	71.1 a,-,g	73.0 a,-,h	121.3 k,-,o	137.6 a,-,e	134.5 h,-,m	116.0 j,-,p
176	59.6 a,-,d	56.0 a,-,e	72.2 ab	74.7 a,-,e	120.2 l,-,o	152.8 a	166.3 a,-,f	180.0 a
177	61.2 a	56.0 a,-,e	72.1 a,-,c	70.7 c,-,l	141.8 c,-,n	162.9 a	152.4 b,-,j	122.4 g,-,p
186	60.9 ab	54.3 b,-,e	72.0 a,-,d	72.3 a,-,j	122.2 i,-,o	110.2 b,-,g	141.7 d,-,l	119.4 i,-,p
203	52.3 i,-,k	54.0 c,-,e	67.3 b,-,i	69.0 f,-,l	132.0 f,-,o	146.9 a,-,c	120,3 l,-,o	97.3 op
8 X 65	55.6 d,-,k	55.3 b,.,e	71.0 a,-,g	71.0 c,-,l	174.5 a,-,c	144.8 a,-,e	146.8 b,-,l	135.0 c,-,k
8 X 160	55.0 d,-,k	55.3 b,-,e	67.1 c,-,i	76.3 ab	159.3 a,-,h	152.6 a	161.9 a,-,h	99.9 n,-,p
8 X176	55.6 d,-,k	55.7 b,-,e	70.5 a,-,h	72.3 a,-,j	161.7 a,-,g	137.8 a,-,e	172.4 a,-,c	143.3 b,-,j
8 X 177	56.2 b,-,k	55.7 b,-,e	69.0 a,-,i	69.0 d,-,l	166.5 a,-,e	149.8 ab	181.7 a	168.9 ab
45 X 65	58.1 a,-,g	56.7 a,-,d	68.0 a,-,i	76.7 a	134.8 e,-,o	137.8 a,-,e	149.5 b,-,k	103.0 l,-,p
45 X 160	52.9 h,-,k	54.0 c,-,e	66.5 f,-,i	74.0 a,-,f	146.4 b,-,m	139.8 a,-,e	140.1 e,-,l	115.4 j,-,p
45 X 176	53.4 g,-,k	53.7 c,-,e	66.1 g,-,i	73.0 a,-,h	159.6 a,-,h	155.5 a	163.7 a,-,g	129.0 e,-,n
45 X 177	53.3 g,-,k	55.7 b,-,e	68.8 a,-,i	70.0 d,-,l	179.7 ab	144.8 a,-,e	153.8 a,-,j	133.6 d,-,k
66 X 65	55.5 d,-,k	55.0 b,-,e	70.6 a,-,h	73.0 a,-,h	147.7 b,-,m	160.5 a	127.0 i,-,n	134.0 c,-,k
66 X 160	54.2 e,.,k	53.0 e	67.8 b,-,i	67.3 j,-,l	168.2 a,-,e	155.4 a	138.4 f,-,l	104.6 k,-,p
66 X 176	55.4 d,-,k	54.3 b,-,e	71.9 a,-,d	71.7 a,-,j	128.2 g,-,o	144.3 a,-,e	169.1 a,-,d	152.2 a,-,g
66 X 177	56.4 a,-,k	56.3 a,-,e	71.7 a,-,e	70.3 d,-,l	173.2 a,-,c	106.6 d,-,g	150.3 b,-,k	122.2 g,-,p

Table 7. Continued

Genotype	Days to 50% tasselling				Plant height (cm)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75 X 65	56.2 b,-,k	56.7 a,-,d	68.8 a,-,i	75.7 a,-,c	144.4 c,-,n	134.1 a,-,e	139.5 e,-,l	120.1 h,-,p
75 X 160	53.8 f,-,k	55.3 b,-,e	68.8 a,-,i	70.7 c,-,l	164.4 a,-,f	140.1 a,-,e	142.5 d,-,l	129.7 k,-,p
75 X176	54.9 d,-,k	56.7 a,-,d	68.6 a,-,i	68.3 h,-,l	150.9 a,-,l	131.3 a,-,f	172.2 a,-,c	151.8 b,-,g
75 X 177	55.2 d,-,k	53.7 c,-,e	70.8 a,-,h	73.0 a,-,h	159.6 a,-,h	135.4 a,-,e	165.4 a,-,f	142.0 b,-,j
111 X 65	53.5 f,-,k	54.3 b,-,e	65.9 hi	66.3 kl	140.5 c,-,n	131.5 a,-,f	139.7 e,-,l	131.9 d,-,l
111X160	53.4 g,-,k	53.7 c,-,e	68.4 a,-,i	69.3 f,-,l	173.3 a,-,c	150.6 a	147.7 b,-,l	155.0 a,-,f
111 X 176	57.7 a,-,h	56.0 a,-,e	69.0 a,-,i	69.7 e,-,l	153.2 a,-,l	136.1 a,-,e	158.4 a,-,h	163.7 a,-,c
111 X 177	56.0 c,-,k	53.0 e	69.0 a,-,i	70.0 d,-,l	158,9 a,-,h	147.8 a,-,c	172.9 a,-,c	156.8 a,-,e
157-1X65	57.3 a,-,i	56.3 a,-,e	67.1 d,-,i	71.3 b,-,k	149.3 b,-,m	132.5 a,-,e	154.6 a,-,j	92.1 p
157-1X160	54.1 e,-,k	54.7 b,-,e	70.1 a,-,h	75.7 a,-.c	167.9 a,-,e	156.1 a	157.3 a,-,h	134.5 c,-,k
157-1X176	56.3 b,-,k	56.7 a,-,d	69.2 a,-,h	73.7 a,-,g	156.2 a,-,i	151.0 a	145.6 c,-,l	114.3 j,-,p
157-1X177	53.1 h,-,k	55.3 b,-,e	66.6 f,-,i	68.7 g,-,l	171.2 a,-,d	140.4 a,-,e	162.6 a,-,h	154.3.a,-,f
157-2X65	55.6 d,-,k	55.3 b,-,e	66.1 g,-,i	73.0 a,-,h	158.5 a,-,h	148.2 a,-,c	141.9 d,-,l	150.2 b,-,h
157-2X160	52.7 i,-,k	56.0 a,-,e	70.1 a,-,h	72.7 a,-,i	162.2 a,-,g	136.1 a,-,e	156.5 a,-,h	119.6 i,-,p
157-2X176	55.6 d,-,k	57.7 ab	67.5 b,-,i	75.0 a,-,d	121.7 j,-,o	139.2 a,-,e	167.3 a,-,e	142.2 b,-,j
157-2X177	53.0 h,-,k	55.0 b,-,e	70.7 a,-,h	69.7 e,-,l	165.5 a,-,f	145.7 a,-,d	143.3 d,-,l	131.1 d,-,m
186X65	58.5 a,-,f	57.7 ab	67.1 c,-,i	73.0 a,-,h	151.9 a,-,l	136.8 a,-,e	135.3 g,-,l	126.6 f,-,o
186X160	56.6 a,-,k	54.7 b,-,e	71.0 a,-,g	71.0 c,-,l	138.1 d,-,n	134.6 a,-,e	139.7 e,-,l	159.5 a,-,d
186X176	56.5 a,-,k	55.3 b,-,e	67.9 b,-,i	74.7 a,-,e	162.5 a,-,f	139.8 a,-,e	155.2 a,-,i	132.3 d,-,l
186X177	55.5 d,-,k	56.0 a,-,e	66.1 g,-,i	67.7 i,-,l	183.8 a	162.7 a	174.1 ab	147.0 b,-,i
203X65	52.6 i,-,k	53.7 c,-,e	70.1 a,-h	69.7 e,-,l	155.7 a,-,j	153.4 a	123.3 k,-,n	122.3 g,-,p
203X160	52.5 i,-,k	53.0 e	66.0 g,-,i	74.7 a,-,e	146.3 b,-,m	143.0 a,-,e	153.5 a,-,j	116.2 j,-,p
203X176	52.2 jk	53.3 de	64.0 i	69.3 f,-,l	155.2 a,-,k	134.9 a,-,e	149.1 b,-,k	126.4 f,-,o
203X177	53.1 g,-,k	54.3 b,-,e	66.3 g,-,i	66.0 l	172.6 a,-,c	162.6 a	164.5 a,-,f	101.0 m,-,p
Mean	55.4	55.3	68.7	71.4	148.5	139.0	147.4	127.8
Over all Mean	55.4		70.1		143.8		137.8	
C.V. %	4.4	3.0	3.6	3.6	11.4	14.2	9.6	11.8

For the same character, figure having the same letter are not significantly different at 5% level, according to DMRT.

Table 7. Continued

Genotype	Days to maturity				Number of nodes per plant			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	91.1 a,-,f	97.0 a,-,f	100.8 a,-,g	101.7 d	10.5 b,-,h	8.5 e	13.0 a,-,e	11.0 a,-,d
45	87.5 b,-,h	99.4 a,-,d	105.1 a,-,e	110.0 a,-,d	9.3 gh	11.1 a,-,d	9.6 n	10.7 a,-,d
65	94.8 ab	101.3 ab	106.6 a,-,c	106.0 a,-,i	10.6 a,-,h	12.1 ab	10.5 l,-,n	11.0 a,-,d
66	90.9 a,-,g	99.4 a,-,d	105.5 a,-,d	104.3 a,-,k	12.3 ab	11.1 a,-,d	13.3 a,-,d	11.6 ab
75	92.4 a,-,d	96.0 e,-,h	99.0 b,-,g	102.9 b,-,k	8.9 h	8.5 e	10.6 l,-,n	9.9 a,-,e
111	83.4 g,-,j	91.1 e,-,h	98.1 b,-,g	97.6 jk	9.5 e,-,h	10.2 b,-,e	10.7 k,-,n	9.7 a,-,e
157-1	88.2 a,-,h	93.3 b,-,h	98.0 b,-,g	105.3 a,-,j	10.0 d,-,h	11.0 a,-,d	11.4 f,-,m	10.0 a,-,e
157-2	79.8 ij	89.7 f,-,h	98.6 g	98.5 i,-,k	9.9 d,-,h	9.5 de	10.6 l,-,n	11.7 ab
160	90.5 a,-,h	99.7 a,-,d	106.9 ab	102.6 b,-,k	12.7 a	11.0 a,-,d	11.3 h,-,m	11.7 ab
176	95.3 a	102.1 a	107.7 ab	110.1 a,-,c	10.4 b,-,h	11.1 a,-,d	12.4 a,-,i	11.9 a
177	94.6 a,-,c	95.4 a,-,h	106.3 a,-,c	104.6 a,-,j	9.7 e,-,h	12.3 a	10.9 j,-,n	11.3 ab
186	92.7 a,-,d	98.7 a,-,e	104.2 a,-,f	104.8 a,-,j	11.2 a,-,g	10.1 b,-,e	12.9 a,-,f	10.7 a,-,d
203	79.6 j	88.7 h	95.0 fg	96.2 k	9.3 f,-,h	11.2 a,-,d	10.2 mn	8.3 ef
8X65	91.3 a,-,e	101.4 ab	110.4 a	111.6 a	11.5 a,-,e	10.0 c,-,e	12.7 a,-,h	7.3 f
8X160	85.8 d,-,j	91.3 e,-,h	97.1 c,-,g	106.1 a,-,i	12.0 a,-,d	11.6 a,-,c	12.9 a,-,g	10.7 a,-,d
8X176	87.3 b,-,h	94.9 a,-,h	101.4 a,-,g	104.3 a,-,k	11.0 a,-,h	10.2 b,-,e	13.4 a,-,c	10.3 a,-,e
8X177	89.7 a,-,h	97.9 a,-,e	105.5 a,-,d	105.4 a,-,j	10.5 b,-,h	10.9 a,-,d	13.0 a,-,e	8.7 d,-,f
45X65	90.0 a,-,h	95.0 a,-,h	99.5 b,-,g	107.1 a,-,g	10.1 b,-,h	10.5 a,-,d	11.3 g,-,m	9.7 a,-,e
45X160	87.3 b,-,h	93.3 c,-,h	99.7 b,-,g	106.3 a,-,i	10.3 b,-,h	10.6 a,-,d	11.8 c,-,l	9.7 a,-,e
45X176	92.4 a,-,d	99.0 a,-,e	104.3 a,-,f	108.3 a,-,f	10.9 a,-,h	10.8 a,-,d	11.9 c,-,l	11.0 a,-,d
45X177	91.0 a,-,g	98.0 a,-,e	105.4 a,-,d	104.0 a,-,k	11.0 a,-,h	10.7 a,-,d	11.4 f,-,m	9.1 c,-,f
66X65	91.2 a,-,f	100.4 a,-,d	106.6 a,-,c	110.6 ab	10.9 a,-,h	11.7 a,-,c	11.0 i,-,n	10.3 a,-,e
66X160	86,9 c,-,i	94.3 a,-,h	101.7 a,-,g	101.2 e,-,k	10.6 b,-,h	11.1 a,-,d	12.1 b,-,k	9.9 a,-,e
66X176	89.9 a,-,h	98.3 a,-,e	107.6 ab	105.5 a,-,j	10.2 b,-,h	10.2 b,-,e	12.8 a,-,h	9.6 b,-,e
66X177	91.4 a,-,e	98.3 a,-,e	104.0 a,-,f	103.4 a,-,k	11.3 a,-,g	10.4 a,-,d	12.8 a,-,h	9.3 c,-,f
75X65	90.2 a,-,h	96.0 a,-,h	100.8 a,-,g	104.0 a,-,k	10.8 a,-,h	10.7 a,-,d	11.8 d,-,l	9.7 a,-,e
75X160	88.6 a,-,h	97.4 a,-,f	104.5 a,-,f	105.5 a,-,j	11.1 a,-,h	10.9 a,-,d	12.5 a,-,h	11.0 a,-,c

75X176	89.5 a,-,h	97.0 a,-,f	104.1 a,-,f	103.4 a,-,k	11.0 a,-,h	10.9 a,-,d	12.9 a,-,e	8.3 ef

Table 7. Continued

Genotype	Days to maturity				Number of nodes per plant			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75X177	90.7 a,-,h	98.0 a,-,e	105.8 a,-,d	106.9 a,-,h	11.1 a,-,g	10.7 a,-,d	12.7 a,-,h	9.9 a,-,e
111X65	87.4 b,-,h	94.3 a,-,h	100.2 b,-,g	98.8 h,-,k	10.7 a,-,h	11.0 a,-,d	12.2 a,-,j	9.6 b,-,e
111X160	85.9 d,-,j	93.0 c,-,h	101.0 a,-,g	102.2 c,-,k	12.0 a,-,d	11.3 a,-,d	12.7 a,-,h	9.6 b,-,e
111X176	91.3 a,-,e	96.9 a,-,g	102. a,-,g	103.4 a,-,k	11.2 a,-,g	10.2 b,-,e	12.8 a,-,h	11.7 ab
111X177	90.1 a,-,h	96.7 a,-,h	102.6 a,-,g	103.9 a,-,k	11.5 a,-,e	11.1 a,-,d	13.0 a,-,e	9.7 a,-,e
157-1X65	91.3 a,-,e	96.3 a,-,h	101.2 a,-,g	105.4 a,-,j	10.8 a,-,h	10.9 a,-,d	13.0 a,-,e	9.3 c,-,f
157-1X160	88.4 a,-,h	96.7 a,-,h	104.4 a,-,f	109.1 a,-,e	11.4 a,-,g	10.8 a,-,d	12.3 a,-,j	9.6 b,-,e
157-1X176	90.8 a,-,g	97.3 a,-,f	104.0 a,-,f	108.0 a,-,f	11.0 a,-,h	11.8 a,-,c	12.6 a,-,h	11.7 ab
157-1X177	87.4 b,-,h	95.3 a,-,h	101.2 a,-,g	103.0 b,-,k	11.1 a,-,h	10.2 b,-,e	13.0 a,-,e	10.0 a,-,e
157-2X65	85.5 d,-,j	92.3 d,-,h	95.4 e,-,g	101.3 e,-,k	10.9 a,-,h	10.6 a,-,d	12.5 a,-,h	10.0 a,-,e
157-2X160	83.5 f,-,j	92.7 d,-,h	101.1 a,-,g	106.3 a,-,i	11.5 a,-,f	11.4 a,-,d	12.9 a,-,e	10.0 a,-,e
157-2X176	87.1 b,-,i	92.6 d,-,h	98.3 b,-,g	105.8 a,-,j	10.9 a,-,h	11.4 a,-,d	13.6 ab	11.7 ab
157-2X177	87.0 c,-,i	96.0 a,-,h	103.7 a,-,f	103.4 a,-,k	11.3 a,-,g	10.9 a,-,d	11.8 d,-,l	10.9 a,-,d
186X65	91.0 a,-,g	95.0 a,-,h	99.5 b,-,g	104.4 a,-,j	12.2 a,-,c	11.8 a,-,c	12.1 b,-,k	10.9 a,-,d
186X160	91.0 a,-,g	98.3 a,-,e	106.2 a,-,c	105.6 a,-,j	10.1 c,-,h	10.6 a,-,d	11.3 h,-,m	11.0 a,-,d
186X176	94.2 a,-,c	101.0 a,-,c	106.4 a,-,c	105.3 a,-,j	10.5 b,-,h	11.5 a,-,d	13.1 a,-,e	10.7 a,-,d
186X177	91.2 a,-,e	97.0 a,-,f	101.9 a,-,g	109.2 a,-,e	10.9 a,-,h	11.9 a,-,c	13.7 a	11.0 a,-,c
203X65	85.8 d,-,j	94.3 a,-,h	103.7 a,-,f	101.3 e,-,k	11.0 a,-,h	11.0 a,-,d	13.0 a,-,e	8.0 ef
203X160	83.7 e,-,j	93.4 b,-,h	96.1 d,-,g	104.4 a,-,k	10.1 d,-,h	11.9 a,-,c	11.6 e,-,m	9.9 a,-,e
203X76	83.0 h,-,j	89.0 gh	95.4 e,-,g	99.3 g,-,k	11.0 a,-,h	10.1 b,-,e	11.6 e,-,m	8.3 ef
203X177	98.0 a,-,h	96.0 a,-,h	103.1 a,-,g	100.8 f,-,k	11.4 a,-,g	11.0 a,-,d	12.2 a,-,j	9.9 a,-,e
Mean	88.9	96.1	102.3	104.5	10.8	10.8	12.2	10.2
Over all mean	92.5		103.4		10.8		11.2	
C.V. %	4.3	4.1	4.7	3.9	9.8	9.0	6.3	11.2

For the same character, figure having the same letter are not significantly different at 5% level, according to DMRT.

Table 7. continued.

Genotype	Stem diameter (mm)				Plant height to first Cob.			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	17.2 e,-,m	22.4 c,-,j	27.3 d,-,l	18.2 b,-,e	35.4 m	23.9 h	75.3 a,-,g	46.2 c,-,m
45	17.9 b,-,m	22.1 c,-,k	25.7 i,-,l	23.1 a,-,c	47.6 i,-,m	47.4 b,-,g	39.9 no	46.1 c,-,m
65	19.5 a,-,h	24.9 a,-,c	30.0 a,-,g	19.9 a,-,e	70.1 a,-,g	66.0 a,-,c	61.6 e,-,l	58.2 b,-,f
66	20.6 a,-,d	25.9 a	31.1 ab	18.5 b,-,e	73.2 a,-,f	47.9 b,-,g	82.6 a	67.6 a,-,d
75	16.0 j,-,n	20.8 h,-,k	25.0 l m	17.8 b,-,e	42.0 k,-,m	33.5 f,-,h	39.4 no	42.5 e,-,m
111	16.3 h,-,m	21.6 e,-,k	26.7 f,-,l	17.1 b,-,e	52.0 g,-,m	38.4 d,-,h	43.8 m,-,o	53.1 b,-,l
157-1	15.9 k,-,n	20.7 i,-,k	25.5 J,-,l	16.6 b,-,e	45.1 J,-,m	55.4 a,-,g	59.2 g,-,m	30.7 k,-,m
157-2	15.3 mn	18.0 l	22.3 m	19.6 a,-,e	55.4 e,-,l	31.4 gh	37.0 o	56.2 b,-,j
160	15.4 l,-,n	22.2 c,-,k	29.1 a,-,i	18.3 b,-,e	37.6 lm	50.7 a,-,g	44.7 k,-,o	60.5 b,-,f
176	19.7 a,-,g	22.5 c,-,j	27.6 c,-,l	25.9 a	47.9 h,-,m	58.8 a,-,d	78.7 a,-,f	89.9 a
177	16.5 g,-,m	22.3 c,-,k	28.0 b,-,l	19.0 a,-,e	55.1 f,-,l	63.6 a,-,c	60.4 f,-,m	69.3 a,-,d
186	16.7 f,-,m	22.3 c,-,k	28.0 b,-,l	18.9 a,-,e	57.2 d,-,l	45.8 b,-,h	68.8 a,-,i	59.3 b,-,f
203	13.2 n	19.5 j,-,l	24.7 lm	14.7 de	54.8 f,-,l	59.2 a,-,d	43.8 m,-,o	33.5 g,-,m
8X65	19.3 a,-,i	23.7 a,-,i	29.0 a,-,i	17.2 b,-,e	72.4 a,-,f	53.5 a,-,g	62.3 d,-,k	56.6 b,-,i
8X160	18.8 a,-,k	22.9 b,-,i	27.7 c,-,l	18.1 b,-,e	77.4 a,-,d	53.7 a,-,g	70.5 a,-,h	27.0 m
8X176	20.9 ab	24.7 a,-,d	28.7 a,-,j	16.1 c,-,e	64.7 a,-,j	34.0 e,-,h	81.2 a,-,c	50.8 b,-,m
8X177	16.6 g,-,m	22.3 c,-,k	27.2 e,-,l	12.9 e	63.9 a,-,j	59.0 a,-,d	80.0 a,-,e	69.6 a,-,d
45X65	18.6 a,-,l	23.3 a,-,i	29.8 a,-,h	19.4 a,-,e	58.1 c,-,k	54.0 a,-,g	66.8 a,-,j	29.7 lm
45X160	18.7 a,-,k	22.1 c,-,k	27.0 e,-,l	20.1 a,-,e	67.7 a,-,h	54.7 a,-,g	63.8 a,-,j	32.8 h,-,m
45X176	18.5 a,-,m	22.8 b,-,i	27.2 e,-,l	22.2 a,-,c	73.1 a,-,f	56.1 a,-,f	71.2 a,-,h	52.1 b,-,m
45X177	19.4 a,-,i	22.2 c,-,k	26.7 g,-,l	17.6 b,-,e	81.0 a	48.9 b,-,g	70.2 a,-,h	52.1 b,-,m
66X65	21.3 a	24.6 a,-,e	28.7 a,-,j	18.5 b,-,e	65.3 a,-,i	67.3 ab	51.6 i,-,o	49.6 b,-,m
66X160	21.4 a	25.0 a,-,c	28.4 a,-,k	17.4 b,-,e	71.6 a,-,g	58.1 a,-,e	54.9 h,-,n	36.1 f,-,m
66X176	19.9 a,-,f	25.0 a,-,c	31.3 ab	17.2 b,-,e	45.3 j,-,m	46.6 b,-,h	80.5 a,-,d	57.5 b,-,g
66X177	20.3 a,-,e	24.7 a,-,d	28.7 a,-,j	14.8 de	69.4 a,-,g	38.4 d,-,h	63.3 b,-,j	47.1 c,-,m
75X 65	19.5 a,-,h	23.8 a,-,i	27.7 c,-,l	20.0 a,-,e	63.9 a,-,j	54.5 a,-,g	62.4 c,-,k	45.7 d,-,m
75X160	17.9 b,-,m	23.0 a,-,i	27.1 e,-,l	20.0 a,-,e	78.5 a,-,c	54.5 a,-,g	66.6 a,-,j	41.7 e,-,m
75X176	20.9 a,-,c	24.1 a,-,g	24.4 a,-,k	13.4 e	67.9 a,-,g	46.7 b,-,h	81.1 a,-,d	62.0 b,-,e

Table 7. Continued.

Genotype	Stem diameter (mm)				Plant height to first Cob.			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75X177	17.3 e,-,m	22.7 b,-,i	28.6 a,-,j	21.8 a,-,d	78.1 a,-,c	49.8 b,-,g	75.6 a,-,g	47.2 c,-,m
111X 65	19.5 a,-,h	24.5 a,-,e	29.3 a,-,h	20.8 a,-,d	70.7 a,-,g	46.5 b,-,h	61.5 e,-,l	62,2 b ,-,e
111X160	17.7 c,-,m	22.4 c,-,j	26.9 f,-,l	16.9 b,-,e	80.7 a	52.8 a,-,g	66.1 a,-,j	70.4 a,-,c
111X176	18.0 b,-,m	24.3 a,-,g	30.1 a,-,f	20.9 a,-,d	62.7 a,-,j	42.3 c,-,h	69.6 a,-,i	72.2 ab
111X177	17.9 b,-,m	22.6 c,-,i	26.6 g,-,l	23.8 ab	69.3 a,-,g	47.1 b,-,h	72.4 a,-,h	57.9 b,-,g
157-1X65	17.4 d,-,m	22.9 a,-,i	28.1 b,-,l	21.0 a,-,d	75.6 a,-,e	52.9 a,-,g	76.5 a,-,g	32.6 im
157-1X160	18.0 b,-,m	23.8 a,-,h	29.6 a,-,h	19.1 a,-,e	77.3 a,-,d	55.1 a,-,g	72.5 a,-,h	56.9 b,-,i
157-1X176	17.3 e,-,m	23.1 a,-,i	28.6 a,-,j	23.1 a,-,c	68.4 a,-,g	51.4 a,-,g	65.4 a,-,j	40.1 e,-,m
157-1X177	17.9 b,-,m	22.5 c,-,i	27.2 e,-,l	20.1 a,-,e	68.7 a,-,g	46.8 b,-,h	76.1 a,-,g	57.1 b,-,h
157-2X65	18.8 a,-,k	22.9 a,-,i	27.3 d,-,l	17.5 b,-,e	78.3 a,-,c	59.4 a,-,d	69.8 a,-,i	51.1 b,-,m
157-2X160	16.2 i,-,m	21.3 f,-,k	25.7 i,-,l	19.0 a,-,e	77.6 a,-,d	55.5 a,-,g	74.1 a,-,g	38.6 e,-,m
157-2X176	16.8 f,-,m	21.4 f,-,k	26.5 h,-,l	20.2 a,-,e	59.8 b,-,k	54.6 a,-,g	78.6 a,-,f	41.4 e,-,m
157-2X177	16.3 h,-,m	20.9 h,-,k	25.2 k,-,m	19.9 a,-,e	74.1 a,-,f	57.1 a,-,f	66.1 a,-,j	39.7 e,-,m
186X65	21.0 ab	25.7 ab	29.7 a,-,h	19.3 a,-,e	70.6 a,-,g	45.6 b,-,h	66.1 a,-,j	58.9 b,-,f
186X 160	19.2 a,-,j	24.3 a,-,f	28.6 a,-,k	18.8 a,-,e	55.5 e,-,l	52.2 a,-,g	44.0 l,-,o	69.4 a,-,d
186X176	19.1 a,-,k	19.4 kl	30.7 a,-,D	19.1 a,-,e	75.1 a,-,f	63.7 a,-,c	68.7 a,-,i	54.9 b,-,k
186X177	20.9 ab	25.0 a,-,c	30.4 a,-,e	22.9 a,-,c	79.5 ab	60.9 a,-,d	81.7 ab	36.2 f,-,m
203X65	18.9 a,-,k	21.2 g,-,k	31.5 a	22.2 a,-,c	74.8 a,-,f	74.5 a	48.8 j,-,o	40.4 b,-,m
203X160	16.7 f,-,m	23.5 a,-,i	30.8 a,-,c	16.3 c,-,e	72.1 a,-,g	66.6 ab	70.0 a,-,i	30.3 e,-,m
203X176	16.0 j,-,n	23.3 a,-,i	27.4 d,-,l	15.8 c,-,e	71.0 a,-,g	42.2 c,-,h	63.4 b,-,j	47.6 c,-,m
203X177	18.1 b,-,m	21.8 d,-,k	27.1 e,-,l	19.1 a,-,e	76.6 a,-,d	51.7 a,-,g	80.1 a,-,e	32.0 j,-,m
Mean	18.2	22.8	28.0	19.0	65.5	51.6	65.5	50.5
Overall mean	20.5		23.5		58.6		58.0	
C.V.%	8.7	6.5	5.9	18.8	15.3	22.9	14.1	23.8

For the same character, figure having the same letter are not significantly different at 5% level, according to DMRT.

Table 7. continued.

Genotype	Ears per plant				Number of leaves per plant			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	1.7 ab	0.9 bc	-	-	11.0 l,-,n	11.0 b,-,i	14.0 a	14.0 a
45	1.9 a	0.9 bc	-	-	10.4 n	11.3 a,-,h	9.0 l	9.0 j
65	1.3 ab	1.0 bc	-	-	12.2 e,-,m	12.6 ab	11.4 d,-,j	11.3 d,-,h
66	1.7 ab	1.0 bc	-	-	13.8 a,-,e	12.3 a,-,d	13.7 ab	13.8 ab
75	1.3 ab	0.9 bc	-	-	10.5 mn	9.7 i	11.0 f,-,g	11.0 e,-,h
111	1.7 ab	0.9 bc	-	-	12.1 e,-,n	10.7 e,-,i	10.1 j,-,l	10.0 h,-,j
157-1	1.3 ab	0.8 c	-	-	12.0 f,-,n	12.0 a,-,f	11.0 f,-,j	11.0 e,-,h
157-2	1.0 b	1.3 a,-,c	-	-	12.4 d,-,l	10.4 f,-,i	10.3 i,-,k	10.3 g,-,i
160	1.3 ab	0.9 bc	-	-	11.8 i,-,n	12.0 a,-,f	10.7 g,-,j	10.7 f,-,h
176	1.7 ab	0.9 bc	-	-	12.9 a,-,k	12.3 a,-,d	12.6 b,-,e	12.7 b,-,d
177	1.3 ab	1.1 bc	-	-	11.5 j,-,n	11.7 a,-,h	11.0 f,-,j	11.0 e,-,h
186	1.2 ab	1.3 a,-,c	-	-	12.9 b,-,k	11.0 b,-,i	12.3 b,-,f	12.3 b,-,e
203	1.0 b	0.9 c	-	-	11.9 h,-,n	11.4 a,-,h	9.3 kl	9.3 ij
8X65	1.4 ab	1.7 ab	-	-	13.2 a,-,I	10.9 d,-,i	12,0 c,-,h	12.0 c,-,f
8X160	1.1 b	1.6 a,-,c	-	-	14.6 a	12.6 ab	12.1 c,-,g	12.0 c,-,f
8X176	1.6 ab	1.0 bc	-	-	11.9 h,-,n	11.0 b,-,i	13.0 a,-,c	13.0 a,-,c
8X177	1.1 b	2.0 a	-	-	12.8 b,-,k	12.7 a	12.7 b,-,e	12.7 b,-,d
45X65	1.1 b	1.4 a,-,c	-	-	11.3 k,-,n	11.0 b,-,i	11.0 f,-,j	11.0 e,-,h
45X160	1.0 b	0.9 bc	-	-	11.7 i,-,n	11.3 a,-,i	11.0 f-,j	11.0 e,-,h
45X176	1.0 b	1.1 bc	-	-	12.0 e,-,n	11.6 a,-,h	11.4 d,-,j	11.3 d,-,h
45X177	1.1 b	1.3 a,-,c	-	-	12.1 e,-,m	10.7 d,-,i	11.3 d,-,j	11.3 d,-,h
66X65	1.0 b	1.3 a,-,c	-	-	12.1 e,-,m	11.7 a,-,h	11.6 c,-,I	11.7 c,-,g
66X160	1.0 b	1.4 a,-,c	-	-	13.1 e,-,j	11.3 a,-,i	11.4 d,-,j	11.3 d,-,h
66X176	1.3 ab	1.4 a,-,c	-	-	11.5 j,-,n	10.7 d,-,i	12.4 b,-,f	12,3 b,-,e
66X177	1.4 ab	0.9 bc	-	-	12.0 e,-,n	10.6 e,-,i	11.7 c,-,i	11.7 c,-,g
75X65	1.3 ab	1.5 a,-,c	-	-	12.8 b,-,k	12.0 a,-,f	12.3 b,-,f	12,3 b,-,e
75X160	1.0 b	1.1 bc	-	-	12.8 b,-,k	12.0 a,-,f	12.4 b,-,f	12.3 b,-,e
75X176	1.7 ab	1.1 bc	-	-	12.9 b,-,k	12.0 a,-,f	12,8 a,-,d	12.7 b,-,d

Table 7. Continud

Genotype	Ears per plant				Number of leaves per plant			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75X177	1.0 b	1.1 bc	-	-	12.6 b,-,l	11.7 a,-,h	12.0 c,-,h	12.0 c,-,f
111X65	1.4 ab	0.9 bc	-	-	12.7 b,-,l	11.4 a,-,h	11.3 e,-,j	11.3 d,-,h
111X160	1.4 ab	0.9 bc	-	-	13.7 a,-,g	12.0 a,-,f	12.3 b,-,f	12.3 b,-,e
111X176	1.4 ab	1.7 ab	-	-	12.8 b,-,k	11.0 b,-,i	12.3 b,-,f	12.3 b,-,d
111X177	1.3 ab	1.3 a,-,c	-	-	13.6 a,-,h	11.4 a,-,h	12.7 b,-,e	12.7 b,-,d
157-1X65	1.0 b	1.0 bc	-	-	13.0 a,-,k	12.0 a,-,e	13.0 a,-,c	13.0 a,-,c
157-1X160	1.0 b	1.4 a,-,c	-	-	13.6 a,-,h	11.7 a,-,h	12.3 b,-,f	12.3 b,-,e
157-1X176	1.3 ab	1.3 a,-,c	-	-	13.1 a,-,j	12.0 a,-,e	12.6 b,-,e	12.8 b,-,d
157-1X177	1.0 b	0.9 bc	-	-	13.3 a,-,i	10.3 hi	11.9 c,-,h	12.0 c,-,f
157-2X65	1.0 b	1.3 a,-,c	-	-	14.0 a,-,d	12.0 a,-,e	12.6 b,-,e	12.8 b,-,d
157-2X166	1.1 b	1.3 a,-,c	-	-	13.2 a,-,j	11.6 a,-,h	12.3 b,-,f	12.3 b,-,e
157-2X176	1.6 ab	0.9 bc	-	-	12.8 b,-,k	12.0 a,-,e	13.0 a,-,c	13.0 a,-,c
157-2X177	1.0 b	1.3 a,-,c	-	-	12.5 c,-,l	11.3 a,-,h	12.6 b,-,e	12.7 b,-,d
186X65	1.7ab	2.0 a	-	-	14.2 ab	12.4 a,-,d	12.3 c,-,f	12.3 b,-,e
186X160	2.0 a	1.3 a,-,c	-	-	11.9 g,-,n	11.6 a,-,h	10.3 i,-,k	10.3 g,-,i
186X176	1.0 b	1.1 bc	-	-	13.7 a,-,f	12.6 a,-,c	13.0 a,-,c	13.0 a,-,c
186X177	1.0 b	1.1 bc	-	-	14.2 ab	11.9 a,-,g	14.1 a	14.0 a
203X65	1.4 ab	1.3 a,-,c	-	-	12.1 e,-,n	11.4 a,-,h	12.0 c,-,h	12.0 c,-,f
203X160	1.0 b	1.0 bc	-	-	11.7 i,-,n	11.9 a,-,g	11.7 c,-,h	11.7 c,-,g
203X176	1.0 b	1.4 a,-,c	-	-	11.7 i,-,n	10.4 g,-,i	10.7 h,-,j	10.7 c,-,f
203X177	1.0 b	1.6 a,-,c	-	-	12.4 d,-,l	11.7 a,-,h	12.0 c,-,h	12.0 c,-,f
Mean	1.3	1.2	-	-	12.6	11.5	11.9	11.9
Overall mean	1.3		-		12.1		11.9	
C.V.%	31.6	33.2	-	-	6.7	6.9	5.9	6.0

For the same character, figure having the same letter are not significantly different at 5% level according to DMRT.

Table 7. Continued.

Genotype	Leaf area (cm^2)				Cob barness (%)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	338.6 f,-,j	143.0 i	375.4 b,-,j	449.7 a,-,f	3.6 a,-,j	2.7 d,-,f	3.6 a,-,i	3.6 c,-,i
45	352.6 d,-,j	364.9 a,-,h	312.9 h,-,k	545.0 a	3.9 a,-,j	4.1 a,-,d	3.8 a,-,h	2.8 g,-,i
65	424.4 a,-,h	328.4 a,-,h	400.0 b,-,j	486.8 a,-,d	2.9 h,-,j	4.3 a,-,c	2.9 g,-,i	4.3 b,-,f
66	491.9 a,-,d	270.9 e,-,i	481.8 a,-,d	457.8 a,-,f	3.1 f,-,j	3.7 a,-,f	3.1 d,-,i	4.1 b,-,i
75	327.8 g,-,j	252.4 f,-,i	318.9 g,-,k	415.5 a,-,f	4.1 a,-,g	2.5 f	4.1 a,-,e	3.9 b,-,i
111	379.5 b,-,i	404.1 a,-,g	358.5 c,-,j	408.3 a,-,f	3.7 a,-,j	3.4 a,-,f	3.7 a,-,i	3.9 b,-,i
157-1	238.i j	249.2 g,-,i	279.2 jk	307.6 c,-,j	3.6 a,-,j	3.5 a,-,f	3.6 a,-,i	4.2 b,-,h
157-2	286.1 ij	177.9 hi	211.4 k	435.0 a,-,f	4.4 a	4.1 a,-,d	4.3 ab	4.0 b,-,i
160	342.3 e,-,j	307.1 c,-,i	347.1 e,-,j	397.6 a,-,f	4.4 a	4.7 a	4.4 a	3.9 b,-,i
176	372.8 c,-,i	296.0 c,-,i	346.6 e,-,j	517.3 ab	4.4 a	3.9 a,-,e	4.3 ab	3.0 f,-,i
177	418.2 a,-,i	276.2 d,-,i	406.1 b,-,i	438.6 a,-,f	4.4 a	3.2 b,-,f	4.4 a	4.2 b,-,h
186	360.6 d,-,j	265.5 e,-,i	378.6 b,-,j	351.3 a,-,g	3.9 a,-,i	3.7 a,-,f	3.9 a,-,g	3.6 c,-,i
203	317.5 h,-,j	330.1 a,-,h	294.4 i,-,k	344.8 a,-,g	4.1 a,-,g	3.8 a,-,f	4.1 a,-,e	4.3 b,-,f
8X65	517.2 ab	410.9 a,-,g	425.4 a,-,h	452.5 a,-,f	3.3 a,-,j	3.5 a,-,f	3.3 b,-,i	5.8 a
8X160	406.1 a,-,i	361.9 a,-,h	357.6 d,-,j	296.8 d,-,g	3.6 a,-,i	3.2 b,-,f	3.6 a,-,i	3.5 d,-,i
8X176	490.1 a,-,d	249.1 g,-,i	413.4 b,-,i	382.6 a,-,f	3.0 h,-,j	3.9 a,-,e	2.9 f,-,i	4.0 b,-,i
8X177	427.6 a,-,h	392.0 a,-,g	386.5 b,-,j	381.5 a,-,f	3.7 a,-,j	2.9 c,-,f	3.7 a,-,i	3.7 c,-,i
45X65	447.7 a,-,h	396.0 a,-,g	447.5 a,-,f	403.7 a,-,f	4.2 a,-,f	3.5 a,-,f	4.2 a,-,c	2.9 f-,i
45X160	432.7 a,-,h	338.3 a,-,h	381.6 b,-,j	373.6 a,-,f	3.7 a,-,j	3.4 a,-,f	3.7 a,-,i	3.5 d,-,i
45X176	465.4 a,-,g	437.5 a,-,g	440.7 a,-,g	418.3 a,-,f	4.2 a,-,e	3.6 a,-,f	4.2 a,-,c	2.7 i
45X177	472.9 a,-,f	360.0 a,-,h	377.6 b,-,j	429.7 a,-,f	4.3 a,-,d	3.2 b,-,f	4.3 a,-,b	2.7 i
66X65	464.7 a,-,g	515.6 a	423.9 a,-,h	370.5 a,-,f	3.9 a,-,j	3.0 b,-,f	3.8 a,-,i	3.9 b,-,i
66X160	526.3 a	501.5 ab	437.7 a,-,g	275.8 e,-,g	3.1 e,-,j	2.6 d,-,f	3.1 d,-,i	5.1 ab
66X176	399.6 a,-,i	475.1 a,-,c	537.2 a	381.4 a,-,f	2.8 ij	2.5 ef	2.8 h,-,i	3.4 e,-,i
66X177	510.4 a,-,c	352.1 a,-,h	382.0 b,-,j	302.8 d,-,g	3.3 b,-,j	3.8 e,-,f	3.3 b,-,i	3.8 b,-,i
75X65	417.8 a,-,i	415.6 a,-,g	411.8 b,-,j	338.1 b,-,g	3.7 a,-,j	3.7 a,-,f	3.7 a,-,i	3.5 d,-,i
75X160	464.1 a,-,g	363.6 a,-,h	391.4 b,-,j	405.6 a,-,f	3.5 a,-,j	2.8 c,-,f	3.5 a,-,i	4.0 b,-,i
75X176	458.0 a,-,g	281.2 d,-,i	470.7 a,-,e	172.2 g	3.2 d,-,j	3.5 a,-,f	3.2 c,-,i	1.0 j

Genotype	leaf area (cm^2)				Cob barness (%)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75X177	469.3 a,-,f	359.3 a,-,h	488.7 ab	546.7 a	4.0 a,-,h	3.5 a,-,f	4.0 a,-,f	3.4 d,-,i
111X65	482.1 a,-,d	404.8 a,-,g	448.7 a,-,f	420.1 a,-,f	3.2 d,-,j	3.4 a,-,f	3.2 c,-,i	3.1 f-,i
111X160	418.4 a,-,i	381.2 a,-,g	407.8 b,-,i	374.0 a,-,f	3.7 a,-,j	3.5 a,-,f	3.7 a,-,i	3.5 d,-,i
111X176	403.1 a,-,i	448.4 a,-,e	447.4 a,-,f	391.8 a,-,f	3.6 a,-,j	3.4 a,-,f	3.5 a,-,i	3.6 d,-,i
111X177	437.5 a,-,h	428.3 a,-,g	437.1 a,-,h	508.5 a,-,c	4.2 a,-,e	3.9 a,-,f	4.2 a,-,c	3.4 e,-,i
157-1X65	378.8 b,-,i	332.3 a,-,h	451.1 a,-,f	363.7 a,-,g	3.9 a,-,i	4.4 ab	3.9 a,-,h	3.7 c,-,i
157-1X160	402.8 a,-,i	376.0 a,-,g	427.3 a,-,h	296.7 d,-,g	3.3 c,-,j	3.3 b,-,f	3.3 b,-,i	3.9 b,-,i
157-1X176	381.3 b,-,i	356.0 a,-,h	396.1 b,-,j	417.1 a,-,f	4.1 a,-,g	3.5 a,-,f	4.1 a,-,e	3.2 f,-,i
157-1X177	374.2 c,-,i	294.1 c,-,i	381.6 b,-,j	399.3 d,-,g	4.1 a,-,g	3.7 a,-,f	4.1 a,-,e	3.5 d,-,i
157-2X65	406.5 a,-,i	440.3 a,-,f	400.2 b,-,j	463.6 a,-,e	4.1 a,-,g	3.1 b,-,f	4.1 a,-,e	4.0 b,-,i
157-2X160	380.1 b,-,i	322.7 b,-,i	353.9 e,-,j	438.9 a,-,f	3.5 a,-,j	3.9 a,-,f	3.5 a,-,i	3.0 f-,i
157-2X176	386.9 b,-,i	330.7 a,-,h	331.5 f,-,j	448.3 a,-,f	3.6 a,-,j	3.4 a,-,f	3.6 a,-,i	2.8 h,-,i
157-2X177	412.0 a,-,i	358.5 a,-,h	354.3 e,-,j	355.4 a,-,g	4.4 a	3.6 a,-,f	4.4 a	3.6 d,-,i
186X65	442.5 a,-,h	418.0 a,-,g	428.8 a,-,h	392.1 a,-,f	2.8 j	3.8 a,-,f	2.7 i	4.0 b,-,i
186X160	395.3 a,-,i	333.6 a,-,h	431.6 a,-,h	478.5 a,-,e	3.3 c,-,j	4.0 a,-,d	3.3 b,-,i	3.5 d,-,i
186X176	435.2 a,-,h	293.0 c,-,I	482.5 a,-,c	445.0 a,-,f	3.1 g,-,j	3.7 a,-,f	3.1 e,-,i	5.0 a,-,c
186X177	488.3 a,-,d	402.4 a,-,g	400.9 b,-,j	468.3 a,-,e	3.8 a,-,j	4.3 a,-,c	3.7 a,-,i	4.0 b,-,i
203X65	478.3 a,-,e	464.6 a,-,d	447.8 a,-,f	445.6 a,-,f	3.7 a,-,j	3.5 a,-,f	3.7 a,-,i	3.8 c,-,i
303X160	408.1 a,-,i	353.9 a,-,h	421.1 a,-,h	429.6 a,-,f	3.5 a,-,j	3.0 b,-,f	3.5 a,-,I	4.0 b,-,i
203X176	383.5 b,-,i	383.3 a,-,g	368.1 b,-,j	255.7 fg	4.3 ab	3.8 a,-,f	4.2 ab	4.9 a,-,d
203X177	410.4 a,-,i	405.1 a,-,g	406.6 b,-,I	368.2 a,-,g	3.9 a,-,j	3.9 a,-,f	3.9 a,-,h	4.7 a,-,e
Mean	414.8	355.2	398.1	398.9	3.7	3.5	3.3	3.7
Overall mean	385.0		398.5		3.6		3.5	
C.V. %	16.4	26.1	15.3	25.0	14.9	19.9	16.4	18.6

For the same character, figure having the same letter are not significantly different at 5% level, according to DMRT.

Table 7.continued.

Genotype	Number of kernel rows				Cob length (cm)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	12.3 c,-,f	-	14.0 a,-,f	13.3 a,-,c	11.7 k,-,o	7.1 l	13.2 e,-,k	12.8 b,-,g
45	14.7 a,-,c	-	13.0 b,-,f	14.3 ab	16.3 a,-,g	12.2 b,-,j	14.3 b,-,j	15.2 a,-,d
65	14.7 a,-,c	-	11.6 f	14.0 ab	17.6 a,-,c	11.0 e,-,k	16.2 a,-,t	12.5 b,-,g
66	13.7 a,-,d	-	12.4 c,-,f	14.3 ab	17.4 a,-,d	12.4 b,-,j	16.0 a,-,t	13.2 b,-,g
75	11.3 ef	-	14.3 a,-,e	14.0 ab	12.4 i,-,o	9.0 j,-,l	14.5 b,-,j	13.2 b,-,g
111	12.0 d,-,f	-	11.7 f	9.3 de	12.5 i,-,o	11.2 d,-,k	12.6 t,-,k	11.6 b,-,g
157-1	12.7 b,-,f	-	14.0 a,-,f	13.0 a,-,c	9.2 o	9.5 i,-,l	11.7 j,-,L	9.0 g
157-2	13.0 b,-,f	-	13.4 a,-,f	14.3 ab	10.2 no	8.0 kl	8.9 L	12.0 b,-,g
160	13.4 a,-,f	-	15.0 a,-,c	12.3 a,-,d	12.3 i,-,o	9.9 h,-,l	12.3 g,-,k	13.0 b,-,g
176	13.0 b,-,f	-	13.1 b,-,f	13.3 a,-,c	14.7 b,-,l	12.5 b,-,j	14.1 c,-,k	16.0 a,-,c
177	11.0 f	-	14.3 a,-,e	14.3 ab	11.1 l,-,o	10.7 f,-,l	13.1 e,-,k	12.9 b,-,g
186	12.0 d,-,f	-	11.7 ef	13.8 ab	12.3 I,-,o	11.4 c,-,k	17.0 a,-,d	11.6 b,-,g
203	12.6 b,-,f	-	13.4 b,-,f	12.3 a,-,d	14.4 b,-,m	12.1 b,-,j	10.7 kL	11.7 b,-,g
8X65	13.7 a,-,e	-	13.7 a,-,f	10.0 c,-,e	16.5 a,-,g	15.3 a,-,d	16.0 a,-,t	11.9 b,-,g
8X160	14.3 a,-,d	-	14.3 a,-,e	13.8 ab	12.4 I,-,o	12.6 b,-,j	14.1 c,-,k	12.1 b,-,g
8X176	14.0 a,-,d	-	14.7 a,-,c	14.3 ab	16.8 a,-,e	9.9 h,-,l	16.0 a,-,t	11.3 b,-,g
8X177	13.3 b,-,f	-	14.9 a,-,c	14.3 ab	14.8 b,-,l	14.0 a,-,h	15.1 b,-,j	15.6 a,-,d
45X65	13.3 b,-,f	-	14.3 a,-,e	13.7 ab	14.6 b,-,m	14.6 a,-,f	16.4 a,-,e	11.8 b,-,g
45X160	13.4 e,-,f	-	13.3 b,-,f	13.7 ab	13.6 d,-,n	14.7 a,-,f	15.5 b,-,h	13.0 b,-,g
45X176	13.7 a,-,e	-	14.7 a,-,c	14.0 ab	15.6 a,-,j	13.6 a,-,I	14.5 b,-,j	15.1 a,-,d
45X177	15.0 ab	-	13.7 a,-,f	14.7 ab	16.0 a,-,I	11.4 c,-,k	14.0 c,-,k	14.8 a,-,e
66X65	13.0 b,-,f	-	12.7 b,-,f	13.0 a,-,c	14.4 b,-,m	14.9 a,-,f	14.0 c,-,k	11.1 c,-,g
66X160	14.0 a,-,d	-	12.6 c,-,f	11.7 b,-,d	19.1 a	15.6 ab	15.1 b,-,j	10.9 d,-,g
66X176	13.3 b,-,f	-	14.0 a,-,f	13.3 a,-,c	16.8 a,-,e	17.5 a	17.8 ab	13.6 b,-,g
66X177	14.0 a,-,d	-	13.3 b,-,f	12.3 a,-,k	17.2 a,-,e	14.3 a,-,g	15.3 b,-,j	13.0 b,-,g
75X65	14.7 a,-,c	-	15.0 a,-,c	14.0 ab	14.0 c,-,m	13.7 a,-,I	14.4 b,-,j	13.2 b,-,g
75X160	14.0 a,-,d	-	15.0 a,-,c	15.7 a	16.3 a,-,h	15.5 a,-,c	16.1 a,-,f	13.8 b,-,g

Tavle 7. Continued.

Genotype	Number of kernel rows				Cob length (cm)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75X176	15.7 a	-	14.4 a,-,d	8.0 e	17.8 ab	13.1 b,-,j	15.7 a,-,h	14.7 a,-,e
75X177	14.0 a,-,d	-	14.0 a,-,f	14.7 ab	13.5 e,-,n	12.7 b,-,j	15.7 a,-,h	15.0 a,-,e
111X65	15.0 ab	-	13.7 a,-,f	15.0 ab	16.9 a,-,e	14.0 a,-,h	15.3 b,-,i	16.0 a,-,c
111X160	13.3 b,-,f	-	14.0 a,-,f	13.0 a,-,c	13.6 d,-,n	12.8 b,-,j	14.8 b,-,j	10.9 d,-,g
111X176	14.0 a,-,d	-	15.3 ab	12.7 a,-,c	15.2 b,-,k	14.9 a,-,f	16.7 a,-,e	13.9 a,-,f
111X177	13.0 b,-,f	-	13.3 b,-,f	14.0 ab	14.0 c,-,m	13.3 b,-,i	14.7 b,-,j	18.6 a
157-1X65	14.0 a,-,d	-	13.6 a,-,f	13.0 a,-,c	10.9 m,-,o	12.1 b,-,j	14.8 b,-,j	11.2 b,-,g
157-1X160	13.4 a,-,f	-	12.0 d,-,f	13.7 ab	13.9 c,-,n	14.3 a,-,g	14.3 b,-,j	11.1 c,-,g
157-1X176	12.7 b,-,f	-	13.0 b,-,f	13.0 a,-,c	12.9 f,-,n	12.8 b,-,j	13.4 d,-,kl	13.8 b,-,g
157-1X177	13.0 b,-,f	-	15.0 a,-,c	14.0 ab	12.6 h,-,o	10.2 g,-,l	14.2 b,-,k	14.5 a,-,e
157-2X65	14.3 a,-,d	-	15.0 a,-,c	12.7 a,-,c	11.9 j,-,o	12.2 b,-,j	13.2 e,-,k	10.8 d,-,g
157-2X160	13.3 b,-,f	-	13.0 b,-,f	15.0 ab	14.4 b,-,m	12.8 b,-,j	14.4 b,-,j	12.1 b,-,g
157-2X176	12.3 b,-,f	-	14.7 a,-,c	12.7 a,-,c	15.9 a,-,i	13.6 a,-,I	12.1 h,-,L	16.11 ab
157-2X177	13.3 b,-,f	-	14.0 a,-,f	14.0 ab	12.8 g,-,o	12.5 b,-,j	11.8 i,-,L	12.9 b,-,g
186X65	12.3 b,-,f	-	12.6 c,-,f	14.0 ab	16.0 a,-,I	16.0 ab	17.6 a,-,c	12.5 b,-,g
186X160	13.3 b,-,f	-	13.0 b,-,f	13.7 ab	16.6 a,-,f	13.0 b,-,j	15.0 b,-,j	13.7 b,-,g
186X176	14.0 a,-,d	-	16.0 a	13.0 a,-,c	16.6 a,-,f	11.3 c,-,k	19.0 a	11.9 b,-,g
186X177	14.7 a,-,c	-	14.4 a,-,d	14.3 ab	16.3 a,-,g	12.8 b,-,j	14.9 b,-,j	13.5 b,-,g
203X65	14.0 a,-,d	-	13.0 b,-,f	14.0 ab	14.4 b,-,m	15.1 a,-,e	15.7 a,-,h	15.0 a,-,e
203X160	13.0 b,-,f	-	13.1 b,-,f	13.7 ab	14.6 b,-,m	12.9 b,-,j	15.5 a,-,h	10.2 e,-,g
203X176	13.3 b,-,f	-	14.3 a,-,e	12.3 a,-,d	14.9 b,-,k	13.2 b,-,i	15.9 a,-,g	9.4 fg
203X177	13.7 a,-,e	-	15.3 ab	13.7 ab	15.5 a,-,k	14.8 a,-,f	14.4 b,-,j	12.9 b,-,g
Mean	13.5	-	13.8	13.4	14.5	12.8	14.6	13.0
Overall mean	-		13.6		13.7		13.8	
C.V.%	8.9	-	9.4	12.6	12.8	16.2	12.3	18.6

For the same character, figure having the same letter are not significantly different at 5% level,according to DMRT.

Table 7. continued.

Genotype	Cob diameter (cm)				Cob weight (g)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	3.6 a	-	3.8 a,-,e	4.0 a,-,e	62.0 e,-,l	58.4 bc	91.4 c,-,k	77.4 h,-,o
45	4.0 a	-	3.9 ef	4.5 a	56.8 g,-,l	65.1 bc	86.6 d,-,k	86.4 g-,m
65	4.2 a	-	3.5 c,-,f	3.8 a,-,f	64.2 e,-,l	79.0 bc	73.2 g,-,l	66.2 i,-,p
66	4.2 a	-	3.7 a,-,f	4.1 a,-,d	60.6 e,-,l	64.2 bc	67.8 h,-,l	79.6 h,-,n
75	3.7 a	-	3.6 b,-,f	4.1 a,-,d	45.2 h,-,l	64.7 bc	73.7 g,-,l	61.8 j,-,p
111	3.8 a	-	3.5 c,-,f	4.0 a,-,e	54.8 g,-,l	47.5 bc	75.5 t,-,l	74.9 h,-,p
157-1	3.5 a	-	3.7 a,-,f	3.6 b,-,f	32.4 l	50.7 bc	81.5 e,-,k	60.6 k,-,p
157-2	3.7 a	-	3.1 f	3.9 a,-,f	33.4 l	65.6 bc	30.4 l	32.6 p
160	3.7 a	-	3.8 a,-,e	3.7 a,-,f	59.5 f,-,l	53.7 bc	73.6 g,-,l	34.5 op
176	3.1 a	-	3.6 b,-,f	3.9 a,-,f	38.2 kl	68.2 bc	84.1 d,-,k	100.7 e,-,l
177	3.4 a	-	3.7 a,-,f	4.0 a,-,e	38.2 kl	49.2 bc	60.7 j,-,l	78.2 h,-,o
186	3.4 a	-	3.7 a,-,f	3.8 a,-,f	42.7 j,-l	71.4 bc	72.4 g,-,l	54.7 m,-,p
203	3.6 a	-	3.6 b,-,f	3.6 b,-,f	44.4 i,-,l	72.2 bc	57.7 kl	91.4 f,-,m
8X65	4.1 a	-	3.7 a,-,f	4.1 a,-,e	16.4 a,-,f	94.0 a,-,f	98.9 b,-,k	106.9 e,-,j
8X160	3.8 a	-	3.7 a,-,f	3.6 b,-,f	64.0 e,-,l	72.2 bc	108.7 a,-,k	69.1 h,-,p
8X176	4.4 a	-	4.1 a,-,c	3.8 a,-,f	121.9 a,-,d	40.6 c	121.9 a,-,g	60.2 k,-,p
8X177	4.1 a	-	4.0 a,-,c	4.1 a,-,d	91.2 b,-,k	77.8 a,-,c	107.9 a,-,k	75.1 h,-,p
45X65	3.9 a	-	4.3 ab	4.0 a,-,e	68.7 d,-,l	89.3 a,-,e	134.9 a,-,e	80.1 h,-,n
45X160	4.0 a	-	3.9 a,-,e	3.8 a,-,f	85.1 b,-,l	68.5 bc	109.5 a,-,k	100.5 e,-,l
45X176	4.1 a	-	3.9 a,-,e	4.2 a,-,c	87.6 b,-,k	81.4 a,-,c	99.0 b,-,k	128.6 c,-,g
45X177	3.9 a	-	3.9 a,-,e	4.1 a,-,d	91.4 b,-,k	92.7 a,-,c	92.6 c,-,k	141.0 b,-,e
66X65	4.1 a	-	3.8 a,-,e	3.4 c,-,f	89.3 b,-,k	76.0 a,-,c	90.8 c,-,k	53.1 m,-,e
66X160	4.2 a	-	3.7 a,-,f	3.1 f	152.7 a	93.8 a,-,c	98..7 c,-,k	53.1 m,-,e
66X176	3.7 a	-	4.1 a,-,c	4.0 a,-,e	100.9 b,-,g	127.7 a,-,c	137.2 a,-,d	81.2 h,-,n
66X177	4.4 a	-	3.9 a,-,e	4.0 a,-,e	136.9 ab	63.4 bc	82.1 e,-,k	134.3 c,-,f
75X65	4.0	-	4.1 a,-,c	4.0 a,-,e	90.9 b,-,k	75.6 a,-,c	123.1 a,-,g	84.2 g,-,n
75X160	4.0 a	-	3.9 a,-,e	3.7 a,-,f	106.1 a,-,g	90.5 a,-,c	107.4 a,-,k	103.9 e,-,k

Table 7. Continued.

Genotype	Cob diameter (cm)				Cob weight (g)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75X176	4.3 a	-	4.1 a,-,c	3.2 ef	114.2 a,-,e	81.7 a,-,c	128.5 a,-,f	111.7 d,-,h
75X177	4.0 a	-	4.1 a,-,c	4.6 a	83.0 c,-,l	84.4 a,-,c	122.2 a,-,g	176.9 ab
111X65	4.0 a	-	4.1 a,-,c	4.0 a,-,e	129.1 a,-,c	83.0 a,-,c	131.0 a,-,e	127.0 c,-,g
111X166	3.9 a	-	3.9 a,-,e	3.8 a,-,f	74.2 d,-,l	60.4 bc	105.0 bk	80.1 h,-,n
111X176	4.0 a	-	4.4 a	4.2 a,-,c	98.1 b,-,h	77.7 a,-,c	148.4 ab	107.3 e,-,I
111X177	3.8 a	-	3.9 a,-,e	4.4 ab	82.5 c,-,l	80.0 a,-,c	106.3 b,-,k	185.1 a
157-1X65	3.9 a	-	3.9 a,-,e	3.8 a,-,f	61.4 e,-,l	83.3 a,-,c	112.7 a,-,j	43.4 h,-,p
157-1X160	3.8 a	-	3.8 a,-,e	3.6 b,-,f	80.2 c,-,l	86.9 a,-,c	92.4 c,-,k	60.1 k,-,p
157-1X176	3.8 a	-	3.9 a,-,e	4.1 a,-,d	72.2 d,-,l	63.6 bc	94.3 c,-,k	96.6 f,-,m
157-1X177	3.8 a	-	4.1 a,-,c	4.4 ab	70.3 d,-,l	73.7 bc	118.3 a,-,h	154.0 a,-,c
157-2X65	4.0 a	-	4.1 a,-,c	4.0 a,-,e	66.9 e,-,l	93.3 a,-,c	109.4 a,-,k	72.0 h,-,p
157-2X160	3.5 a	-	3.8 a,-,e	3.7 a,-,f	70.6 d,-,l	86.6 a,-,c	89.5 c,-,k	91.9 f,-,m
157-2X176	3.6 a	-	4.0 a,-,c	4.1 a,-,e	91.8 b,-,j	53.9 bc	89.9 c,-,k	112.8 c,-,h
157-2X177	3.8 a	-	3.7 a,-,f	4.1 a,-,e	75.0 d,-,l	69.8 bc	64.0 i,-,l	93.3 f,-,m
186X65	4.0 a	-	3.3 d,-,f	4.1 a,-,e	96.4 b,-,i	73.5 bc	96.5 b,-,k	79.7 h,-,n
186X160	3.9 a	-	3.8 a,-,e	3.9 a,-,f	87.9 b,-,k	69.8 bc	91.7 c,-,k	90.5 f,-,m
186X176	4.1 a	-	4.2 ab	3.7 a,-,f	113.9 a,-,e	51.8 bc	159.0 a	58.2 l,-,p
186X177	4.2 a	-	3.8 a,-,e	4.0 a,-,e	107.7 a,-,g	97.0 ab	87.4 c,-,k	96.6 f,-,m
203X65	4.0 a	-	3.9 a,-,e	4.0 a,-,e	103.1 a,-,g	100.9 ab	70.0 g,-,l	84.5 g,-,n
203X160	4.0 a	-	4.0 a,-,c	3.6 b,-,f	83.2 c,-,l	77.1 a,-,c	122.9 a,-,g	52.6 m,-,p
203X176	4.0 a	-	4.0 a,-,c	3.2 d,-,f	73.5 d,-,l	95.1 ab	140.5 a,-,c	40.5 a,-,d
203X177	4.2 a	-	4.1 a,-,c	4.3 ab	98.9 b,-,g	70.2 bc	117.5 a,-,i	151.9 a,-,d
Mean	3.9	-	3.9	3.9	80.9	74.7	98.6	89.7
Overall mean	-		3.9		77.8		94.2	
C.V.%	8.5	-	8.8	11.4	32.4	34.8	26.6	24.9

For the same character, figure having the same letter are not significantly different at 5% level, according to DMRT.

Table 7. Continued.

Genotype	Shelling percentage				100-seed weight (g)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	76.7 a,-,d	-	-	80.4 b,-,e	20.9 d,-,i	13.5 n	-	17.8 b,-,g
45	79.9a,-,d	-	-	80.7 b,-,e	21.4 d,-,h	19.5 g,-,m	-	20.2 a,-,g
65	81.9 a,-,c	-	-	78.1 c,-,e	25.6 a,-,f	24.5 a,-,g	-	20.6 a,-,g
66	80.9 a,-,d	-	-	78.2 b,-,e	23.3 b,-,h	18.3 h,-,m	-	17.9 a,-,g
75	72.4 cd	-	-	78.7 b,-,e	22.3 b,-,h	22.0 c,-,k	-	14.3 fg
111	77.9 a,-,d	-	-	79.6 b,-,e	22.3 b,-,h	22.1 c,-,k	-	23.0 a,-,d
157-1	75.2 a,-,d	-	-	79.2 b,-,e	18.0 g,-,j	17.5 j,-,n	-	16.0 d,-,g
157-2	77.4 a,-,d	-	-	79.6 b,-,e	15.2 j	15.3 mn	-	17.2 c,-,g
160	71.6 cd	-	-	76.7 de	22.5 b,-,h	21.3 c,-,k	-	16.1 d,-,g
176	70.0 d	-	-	79.6 b,-,e	15.4 ij	19.9 g,-,m	-	15.6 e,-,g
177	51.7 e	-	-	82.5 a,-,e	24.3 b,-,f	20.9 e,-,l	-	17.5 b,-,g
186	70.0 d	-	-	81.0 b,-,e	22.0 c,-,h	16.0 l,-,n	-	15.5 e,-,g
203	74.8 b,-,d	-	-	87.2 a,-,c	21.0 d,-,i	22.4 c,-,k	-	17.7 b,-,g
8X65	81.9 a,-,c	-	-	82.0 a,-,e	24.1 b,-,f	23.8 a,-,g	-	24.9 a
8X160	81.4 a,-,c	-	-	81.4 a,-,e	20.0 f,-,j	17.6 i,-,n	-	13.6 g
8X176	81.6 a,-,c	-	-	80.4 b,-,e	23.0 b,-,h	18.3 h,-,m	-	15.0 fg
8X177	79.3 a,-,d	-	-	80.9 b,-,e	23.5 b,-,h	22.6 c,-,j	-	17.6 b,-,g
45X65	79.6 a,-,d	-	-	80.1 b,-,e	21.4 d,-,h	24.2 a,-,g	-	17.9 a,-,g
45X160	79.3 a,-,d	-	-	85.0a,-,e	22.8 b,-,h	20.6 e,-,l	-	15.4 e,-,g
45X176	79.8 a,-,d	-	-	80.9 b,-,e	25.3 a,-,f	20.4 f,-,l	-	17.9 a,-,g
45X177	78.2 a,-,d	-	-	75.3 e	24.0 b,-,g	19.4 g,-,m	-	17.6 b,-,g
66X65	79.6 a,-,d	-	-	81.7 a,-,e	23.9 b,-,g	25.1 a,-,f	-	13.6 g
66X160	81.9 a,-,c	-	-	88.1 ab	30.8 a	26.3 a,-,c	-	15.5 e,-,g
66X176	80.0 a,-,d	-	-	81.6 a,-,e	26.7 a,-,d	27.7 ab	-	17.2 c,-,g
66X177	78.4 a,-,d	-	-	85.8 a,-,d	28.2 ab	20.3 f,-,l	-	20.4 a,-,g
75X65	82.4 a,-,c	-	-	79.2 b,-,e	23.0 b,-,h	22.8 a,-,i	-	18.0 a,-,g
75X160	81.2 a,-,c	-	-	83.9 a,-,e	23.5 b,-,h	21.7 e,-,k	-	16.8 d,-,g

Table 7. Continued.

Genotype	Shelling percentage				100-seed weight (g)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75X176	77.6 a,-,d	-	-	85.6 a,-,d	23.0 b,-,h	19.7 g,-,m	-	19.8 a,-,g
75X177	78.1 a,-,d	-	-	78.5 b,-,e	22.9 b,-,h	20.7 e,-,l	-	24.6 ab
111X65	80.3 a,-,d	-	-	82.6 a,-,e	27.5 a,-,c	24.6 a,-,g	-	20.8 a,-,g
111X160	86.2 a	-	-	84.2 a,-,e	21.6 c,-,h	20.9 e,-,l	-	18.5 a,-,g
111X176	75.7 a,-,d	-	-	77.0 de	23.2 b,-,h	25.7 a,-,e	-	24.2 a,-,c
111X177	71.8 cd	-	-	79.5 b,-,e	24.1 b,-,f	26.2 a,-,d	-	21.3 a,-,f
157-1X65	75.3 a,-,d	-	-	78.9 b,-,e	21.1 d,-,h	20.5 f,-,l	-	18.7 a,-,g
157-1X160	81.5 a,-,c	-	-	80.6 b,-,e	26.5 a,-,e	21.1d,-,l	-	14.8 fg
157-1X176	80.6 a,-,d	-	-	75.9 de	20.7 d,-,j	20.6 e,-,l	-	17.2 c,-,g
157-1X177	81.7 a,-,c	-	-	77.6 c,-,e	20.9 d,-,i	20.8 e,-,l	-	22.5 a,-,e
157-2X65	81.9 a,-,c	-	-	80.4 b,-,e	20.6 e,-,j	22.7 c,-,i	-	16.8 d,-,g
157-2X160	78.8 a,-,d	-	-	80.3 b,-,e	17.7 h,-,j	17.3 k,-,n	-	20.5 a,-,g
157-2X176	76.4 a,-,d	-	-	83.2 a,-,e	21.2 d,-,h	21.1 d,-,l	-	20.5 a,-,g
157-2X177	80.3 a,-,d	-	-	77.3 c,-,e	20.7 d,-,j	20.5 f,-,l	-	19.4 a,-,g
186X65	79.1 a,-,d	-	-	79.2 b,-,e	25.7 a,-,f	27.8 a	-	20.0 a,-,g
186X160	75.9 a,-,d	-	-	79.6 b,-,e	26.5 a,-,e	24.3 a,-,g	-	20.4 a,-,g
186X176	78.8 a,-,d	-	-	78.6 b,-,e	25.9 a,-,f	22.8 b,-,i	-	14.6 fg
186X177	80.9 a,-,d	-	-	81.3 b,-,e	23.1 b,-,h	21.3 c,-,k	-	18.2 a,-,g
203X65	81.6 a,-,c	-	-	91.0 a	24.2 b,-,f	24.0 a,-,g	-	24.4 ab
203X160	82.4 a,-,c	-	-	81.0 b,-,e	22.7 b,-,h	21.2 c,-,l	-	13.6 g
203X176	83.7 ab	-	-	85.8 a,-,e	21.2 d,-,h	24.1 a,-,g	-	15.6 e,-,g
203X177	84.1 ab	-	-	81.4 a,-,e	24.7 b,-,f	23.3 a,-,h	-	21.0 a,-,f
Mean	78.3	-	-	81.0	22.9	21.5	-	18.0
Overall mean	-		-		22.2		-	
C.V. %	6.9	-	-	6.0	12.9	10.9	-	19.2

For the same character, figure having the same letter are not significantly different at 5% level, according to DMRT.

Table 7. Continued.

Genotype	Yield per plant (g)				Yield (t/h)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
8	27.8 k,-,o	-	78.9 c,-,l	41.2 OP	1.5 k,-,m	1.7 c,-,f	0.9l,-,n	2.2 mn
45	45.8 f,-,o	-	67.3 e,-,m	63.1 h,-,p	2.4 f,-,m	2.0 b,-,f	1.0 j,-,n	3.4 h,-,n
65	19.8 o	-	53.5 i,-,m	36.3 p	1.1 m	1.9 b,-,f	1.1 i,-,n	2.0 n
66	34.4 h,-,o	-	98.3 a,-,i	59.2 h,-,p	1.8 i,-,m	2.1 b,-,f	1.4 g,-,n	3.2 h,-,n
75	32.6 i,-,o	-	53.8 i,-,m	38.0 p	1.8 i,-,m	2.9 b,-,f	1.3 g,-,n	2.1 mn
111	38.9 g,-,o	-	64.9 f,-,m	51.2 j,-,p	2.0 h,-,m	1.7 c,-,f	0.7 mn	2.6 i,-,n
157-1	24.1 m,-,o	-	60.6 g,-,m	39.7 op	1.3 lm	1.4 ef	0.7 mn	2.0 mn
157-2	25.2 l,-,o	-	26.9 m	40.8 op	1.3 lm	1.8 b,-,f	1.2 h,-,m	2.1 mn
160	35.6 h,-,o	-	54.4 i,-,m	36.4 p	1.9 h,-,m	1.8 b,-,f	0.6 n	2.2 l,-,n
176	27.9 k,-,o	-	74.3 c,-,l	47.6 k,-,p	1.5 k,-,m	2.5 b,-,f	1.4 f,-,n	2.5 j,-,n
177	21.7 no	-	45.0 k,-,m	49,8 j,-,p	1.1 m	1.9 b,-,f	1.2 h,-,n	2.7 i,-,n
186	30.0 j,-,o	-	60.1 h,-,m	44.3 l,-,p	1.6 j,-,m	2.5 b,-,f	1.1 i,-,n	2.4 k,-,n
203	33.0 i,-,o	-	50.4 j,-,m	49.2 k,-,p	1.3 lm	0.9 f	0.8 k,-,n	2.5 j,-,n
8X65	89.9 a,-,e	-	82.8 c,-,l	84.6 d,-,h	4.8 a,-,e	4.1 ab	3.2 b,-,l	3.3 h,-,n
8X160	50.7 e,-,o	-	91.7 a ,-,k	57.7 h,-,p	2.7 e,-,m	3.0 b,-,f	3.0 b,-,m	3.0 h,-,n
8X176	99.5 a,-,d	-	106.8 a,-,h	51.5 j,-,p	5.3 a,-,d	1.8 b,-,f	5.2 a,-,c	2.8 i,-,n
8X177	51.6 e,-,o	-	85.0 b,-,l	94.2 c,-,g	2.8 e,-,m	3.8 a,-,d	3.7 b,-,g	3.9 f,-,k
45X65	54.1 e,-,o	-	119.6 a,-,c	62.0 h,-,p	2.3 g,-,m	4.0 ab	3.8 b,-,f	3.3 h ,-,h
45X160	66.7 b,-,m	-	92.1 a,-,j	83.0 e,-,i	3.6 b,-,l	2.6 b,-,f	3.5 b,-,i	4.3 e,-,i
45X176	69.5 b,-,k	-	89.3 a,-,k	113.1 b,-,d	3.7 b,-,k	3.0 b,-,f	3.7 b,-,g	6.0 b,-d
45X177	70.1 b,-,k	-	83.0 c,-,l	116.7 a,-,c	3.8 b,-,k	3.7 a,-,d	4.0 b,-,e	6.2 a,-,c
66X65	71.5 b,-,j	-	76.4 c,-,l	43.5 m,-,p	3.3 c,-,m	3.8 a,-,d	3.2 b,-,l	2.4 k,-,n
66X160	125.5 a	-	69.0 d,-,m	74.2 e,-,m	6.6 a	2.6 b,-,f	2.9 c,-,n	3.6 g,-,m
66X176	82.4 b,-,f	-	114.1 a,-,e	72.5 e,-,n	4.4 b,-,g	5.5 a	3.7 b,-,g	3.9 f,-,k
66X177	107.5 ab	-	69.2 d,-,m	82.2 e,-,i	5.6 ab	3.0 b,-,f	5.1 a,-,d	5.6 b,-,e
75X65	74.9 b,-,i	-	94.4 a,-,j	72.5 h,-,p	4.0 b,-,i	3.5 a,-,e	2.7 d,-,n	3.3 h,-,n
75X160	86.4 a,-,f	-	90.0 a,-,k	85.8 d,-,h	4.5 a,-,g	3.0 b,-,f	3.2 b,-,l	4.6 d,-,h
75X176	88.4 a,-,f	-	107.9 a,-,f	95.9 c,-,f	4.6 a,-,f	2.5 b,-,f	3.0 b,-,m	5.1 c,-,g

Table 7. Continued.

Genotype	Yield per plant (g)				Yield (t/h)			
	Summer 2002	Summer 2003	Winter 2002	Winter 2003	Summer 2002	Summer 2003	Winter 2002	Winter 2003
75X177	64.9 b,-,m	-	93.5 a,-,j	118.0 a,-,c	3.4 b,-,l	3.3 b,-,e	3.2 b,-,l	6.3 a,-,c
111X65	104.5 a,-,c	-	107.3 a,-,g	100.0 b,-,e	5.6 a,-,c	3.4 b,-,e	4.8 b,-,d	5.3 b,-,f
111X160	65.7 b,-,m	-	72.5 d,-,l	63.7 g,-,p	3.5 b,-,l	2.8 b,-,f	3.6 b,-,h	3.3 h,-,n
111X176	75.1 b,-,i	-	115.7 a,-,d	80.1 e,-,j	4.0 b,-,i	3.3 b,-,e	4.4 b,-,d	4.3 e,-,i
111X177	65.7 b,-,n	-	90.6 a,-,k	142.6 a	3.5 b,-,l	2.6 b,-,f	2.8 c,-,n	7.5 a
157-1X65	46.0 f,-,o	-	96.5 a,-,j	70.7 e,-,o	2.4 f,-,m	2.2 b,-,f	3.2 b,-,l	3.8 f,-,l
157-1X160	65.8 b,-,m	-	76.8 c,-,l	49.9 j,-,p	3.5 b,-,l	3.8 a,-,d	3.2 b,-,l	2.6 j,-,n
157-1X176	58.4 d,-,o	-	91.9 a,-,j	74.4 e,-,m	3.1 d,-,m	2.4 b,-,f	3.5 b,-,i	4.1 e,-,j
157-1X177	58.2 d,-,o	-	105.6 a,-,h	52.7 i,-,p	3.1 d,-,m	2.0 b,-,f	4.0 b,-,e	2.7 i,-,n
157-2X65	56.5 d,-,o	-	100.0 a,-,i	44.3 l,-,p	2.8 e,-,m	3.9 a,-,c	4.1 b,-,d	2.4 k,-,n
157-2X160	55.7 e,-,o	-	77.8 c,-,l	75.7 e,-,k	3.0 d,-,m	2.2 b,-,f	3.9 b,-,e	4.0 e,-,j
157-2X176	72.1 b,-,j	-	75.5 c,-,l	95.3 c,-,f	3.8 b,-,j	1.9 b,-,f	3.2 b,-,l	5.1 c,-,g
157-2X177	60.5 d,-,o	-	56.3 i,-,m	75.1 e,-,l	3.2 d,-,m	3.0 b,-,f	1.8 e,-,n	4.0 f,-,g
186X65	76.6 b,-,h	-	74.0 c,-,l	46.3 k,-,p	4.1 b,-,i	3.6 a,-,e	3.2 b,-,l	2.5 j,-,n
186X160	67.2 b,-,l	-	77.2 c,-,l	69.6 f,-,o	3.6 b,-,l	2.3 b,-,f	4.2 b,-,d	3.6 g,-,m
186X176	89.4 a,-,e	-	134.9 a	43.7 m,-,p	4.7 a,-,f	1.8 b,-,f	7.0 a	2.3 k,-,n
186X177	79.5 b,-,g	-	75.1 c,-,l	84.8 d,-,h	4.2 b,-,h	2.9 b,-,f	3.4 b,-,j	4.6 d,-,n
203X65	84.0 b,-,f	-	41.5 lm	41.9 n,-,p	4.5 a,-,g	1.3 ef	4.0 b,-,e	2.1 mn
203X160	68.0 b,-,l	-	111.0 a,-,f	41.3 o,-,p	3.6 b,-,k	1.6 d,-,f	5.4 ab	2.2 l,-,n
203X176	63.3 c,-,n	-	129.6 ab	32.6 p	3.3 c,-,m	2.9 b,-,f	2.7 b,-,k	1.8 n
203X177	83.3 b,-,f	-	104.7 a,-,h	125.0 ab	4.4 b,-,g	3.4 b,-,e	3.3 b,-,k	6.6 ab
Mean	62.2	-	83.0	67.4	3.3	2.7	3.0	3.6
Overall mean	-		75.2		3.0		3.3	
C.V.%	34.2	-	27.8	22.9	34.9	41.5	39.9	22.6

For the same character, figure having the same letter, are not significantly different at level, according to DMRT.

Table 8. Means of different characters in 49 maize genotypes evaluated during the summer and winter seasons of 2002 and 2003 at New Halfa.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Year			
Y_1	62.0	147.9	59.6	11.5	23.1	65.5
Y_2	63.3	133.4	100.3	10.5	20.9	51.0
			Season			
S_1	55.3	143.7	-	10.8	20.5	-
S_2	70.0	137.6	-	11.2	23.5	-
			Year X Season			
Y_1 X S_1	55.3	148.5	-	10.8	18.2	-
Y_1 X S_2	68.7	147.4	-	12.2	28.0	-
Y_2X S_1	55.3	139.0	-	10.8	22.9	-
Y_2X S_2	71.4	127.8	-	10.2	19.0	-
			Genotype			
8	63.1	121.2	97.9	10.7	21.4	43.5
45	62.4	112.8	100.8	10.3	22.3	45.9
65	65.6	122.6	102.4	11.1	23.6	63.0
66	64.1	140.7	100.5	12.1	24.1	65.7
75	62.9	102.4	97.4	9.6	20.1	39.9
111	60.3	116.7	92.9	10.0	20.5	46.5
157-1	62.4	122.7	96.1	10.6	19.7	48.3
157-2	61.7	104.2	90.4	10.3	18.6	44.6
160	63.8	125.0	100.1	11.6	21.2	48.2
176	65.8	151.8	104.1	11.5	24.0	68.3
177	65.2	144.1	100.3	11.0	21.5	61.9.
186	65.1	122.4	100.3	11.2	21.4	57.4
203	60.9	123.0	89.7	9.7	18.0	48.0
8X65	63.3	149.4	103.5	10.3	22.2	61.0

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Genotype			
8X160	63.3	143.7	94.8	11.7	21.8	57.3
8X176	63.9	152.3	96.8	11.3	22.6	57.8
8X177	62.5	165.7	99.4	10.7	20.0	67.6
45X65	65.0	132.2	97.8	10.4	22.9	52.6
45X160	62.0	136.4	96.4	10.6	22.0	53.8
45X176	61.6	151.8	100.8	11.0	22.7	61.5
45X177	62.2	153.1	99.3	10.5	21.4	63.2
66X65	63.6	140.4	102.2	11.0	23.2	58.1
66X160	60.3	143.0	96.3	11.1	23.1	56.1
66X176	63.0	148.8	100.3	10.7	23.2	57.5
66X177	63.6	138.0	99.2	10.9	22.2	53.8
75X65	64.3	134.3	98.1	10.8	22.8	55.7
75X160	62.1	137.2	99.3	11.3	22.1	58.9
75X176	61.8	151.7	98.7	10.7	21.6	64.5
75X177	62.8	151.5	100.2	11.1	22.7	63.5
111X65	60.1	137.7	95.2	11.0	23.6	61.5
111X160	60.8	160.4	95.1	11.4	21.0	68.5
111X176	62.9	154.6	98.4	11.4	23.3	61.7
111X177	62.1	157.7	98.3	11.3	22.8	60.6
157-1X65	63.0	134.1	98.4	11.0	22.4	61.1
157-1X160	63.6	152.1	99.9	11.0	22.7	64.5
157-1X176	63.8	142.5	99.9	11.8	23.0	56.9
157-1X177	60.7	158.4	96.8	11.2	21.9	62.2
157-2X65	62.6	150.1	93.3	11.1	21.6	64.8
157-2X160	62.7	143.5	95.9	11.5	20.5	61.5
157-2X176	63.8	145.2	95.7	11.9	21.1	60.3
157-2X177	62.2	143.7	97.8	11.2	20.6	58.9
186X65	63.8	139.4	97.4	11.8	24.1	62.6

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Genotype			
186X160	63.2	146.3	100.3	10.9	22.8	56.5
186X176	63.7	147.3	101.9	11.6	22.0	64.4
186X177	61.2	166.8	99.7	11.9	24.7	64.1
203X65	61.7	139.6	96.3	10.8	23.3	62.2
203X160	61.6	138.8	94.5	11.0	21.8	60.9
203X176	50.5	143.3	91.6	10.3	20.6	57.4
203X177	59.9	151.7	97.2	11.2	21.6	60.8
			Year X genotype			
Y_1X 8	62.5	134.8	-	11.7	22.5	52.6
Y_1X 45	60.3	110.1	-	9.7	22.1	44.3
Y_1X 65	67.2	122.8	-	10.5	24.8	63.6
Y_1X66	64.2	150.2	-	12.7	25.9	74.9
Y_1X75	63.7	105.6	-	9.8	20.8	41.5
Y_1X111	59.3	114.1	-	10.0	21.7	47.9
Y_1X157-1	60.7	122.6	-	10.7	20.7	54.0
Y_1X157-2	60.0	110.4	-	10.2	18.4	45.1
Y_1X160	63.8	125.0	-	12.0	22.2	39.6
Y_1X176	66.3	139.8	-	11.5	23.7	61.9
Y_1X177	67.0	146.1	-	10.2	22.3	55.7
Y_1X186	66.8	130.2	-	12.0	22.2	61.1
Y_1X203	60.3	125.8	-	9.7	18.8	49.4
Y_1X(8X65)	63.3	158.7	-	12.0	24.0	66.0
Y_1X(8X160)	60.8	162.1	-	12.3	23.1	74.4
Y_1X(8X176)	63.2	167.9	-	12.3	24.7	73.8
Y_1X(8X177)	62.7	175.3	-	11.7	22.3	72.0
Y_1X(45X65)	63.3	145.0	-	10.7	24.5	63.3
Y_1X(45X160)	60.0	145.4	-	11.0	22.9	64.5
Y_1X(45X176)	59.8	159.4	-	11.2	22.8	71.0

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Year X genotype			
Y_1X (45X177	61.5	167.4	-	11.2	22.9	76.3
Y_1X(66X65)	63.2	133.9	-	11.0	24.9	57.7
Y_1X(66X160)	60.3	155.5	-	11.5	25.0	65.1
Y_1X(66X176)	63.0	151.9	-	11.5	25.4	63.8
Y_1X(66X177)	63.8	161.6	-	11.8	24.6	64.8
Y_1X(75X65)	62.5	141.5	-	11.3	23.8	62.8
Y_1X(75X160)	61.2	150.4	-	11.7	22.3	70.1
Y_1X(75X176)	61.2	161.2	-	11.8	24.4	74.8
Y_1X(75X177)	62.3	163.9	-	11.8	23.2	78.2
Y_1X(111X65)	59.8	142.2	-	11.7	24.5	68.4
Y_1X(111X160)	60.2	164.0	-	12.3	22.4	74.2
Y_1X(111X176)	63.0	157.4	-	11.8	24.0	66.1
Y_1X(111X177)	62.7	164.0	-	12.2	22.4	68.8
Y_1X(157-1X65)	62.0	153.6	-	11.8	22.9	78.3
Y_1X(157-1X160)	62.0	160.3	-	11.8	23.8	73.7
Y_1X(157-1X176)	62.5	151.6	-	11.8	23.0	67.3
Y_1X(157-1X177)	59.3	169.1	-	12.2	22.5	74.6
Y_1X(152-2X65)	61.0	149.7	-	11.8	23.0	74.8
Y_1X(157-2X160)	61.0	158.4	-	12.2	20.3	75.8
Y_1X(157-2X176)	61.3	148.4	-	12.3	21.4	71.3
Y_1X(157-2X177)	62.0	150.1	-	11.5	20.9	69.5
Y_1X(186X65)	62.3	148.5	-	12.3	25.8	73.3
Y_1X(186X160)	63.5	142.8	-	10.8	24.1	52.0
Y_1X(186X176)	62.3	157.5	-	12.0	24.8	70.5
Y_1X(186X177)	60.5	177.5	-	12.3	25.4	79.2
Y_1X(203X65)	61.7	140.3	-	12.0	25.0	62.3
Y_1X(203X160)	59.3	148.5	-	11.0	23.6	69.9
Y_1X(203X176)	57.7	156.8	-	11.3	21.6	70.1

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Year X genotype			
Y_1X(203X177)	59.7	169.4	-	11.8	22.7	78.9
Y_2X8	63.7	107.7	-	9.8	20.3	34.4
Y_2X45	64.5	115.5	-	10.9	20.6	47.4
Y_2XX65	64.0	122.4	-	11.6	22.4	62.5
Y_2X66	64.0	131.2	-	11.4	22.2	56.5
Y_2X75	62.2	99.2	-	9.3	19.3	38.3
Y_2X111	61.2	119.4	-	10.0	19.3	45.1
Y_2X157-1	64.2	122.7	-	10.5	18.7	42.6
Y_2X157-2	63.3	98.0	-	10.5	18.8	44.1
Y_2X160	63.7	125.1	-	11.3	20.2	56.8
Y_2X176	65.3	163.7	-	11.5	24.2	74.7
Y_2X177	63.3	142.2	-	11.8	20.7	68.2
Y_2X186	63.3	114.6	-	10.3	20.6	53.8
Y_2X203	61.5	120.3	-	9.7	17.1	46.6
Y_2X(8X65)	63.2	140.2	-	8.7	20.4	56.1
Y_2X(8X160)	65.8	125.3	-	11.1	20.5	40.1
Y_2X(8X176)	64.0	136.8	-	10.2	20.4	41.8
Y_2X(8X177)	62.3	156.2	-	9.8	17.6	63.2
Y_2X(45X65)	66.7	119.4	-	10.0	21.3	41.4
Y_2X(45X160)	64.0	127.4	-	10.2	21.1	43.1
Y_2X(45X176)	63.3	144.2	-	10.9	22.5	51.9
Y_2X(45X177)	62.8	138.9	-	9.8	19.9	50.3
Y_2X(66X65)	64.0	147.0	-	11.0	21.6	58.4
Y_2X(66X160)	60.2	130.4	-	10.6	21.2	47.0
Y_2X(66X176)	63.0	145.7	-	9.8	21.1	51.1
Y_2X(66X177)	63.3	114.4	-	9.9	19.8	42.8

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Year X genotype			
Y_2X(75X65)	66.2	127.1	-	10.2	21.9	48.7
Y_2X(75X160)	63.0	124.0	-	10.9	22.0	47.7
Y_2X(75X176)	62.5	142.2	-	9.6	18.7	54.3
Y_2X(75X177)	63.3	139.1	-	10.3	22.3	48.8
Y_2X(111X65)	60.3	133.2	-	10.3	22.7	54.7
Y_2X(111X160)	61.5	156.7	-	10.5	19.6	62.7
Y_2X(111X176)	62.8	151.8	-	10.9	22.6	57.4
Y_2X(111X177)	61.5	151.4	-	10.3	23.2	52.4
Y_2X(157-1X65)	63.8	114.6	-	10.1	22.0	44.0
Y_2X(157-1X166)	65.2	143.9	-	10.3	21.5	55.3
Y_2X(157-1X176)	65.2	133.4	-	11.8	23.1	46.4
Y_2X(157-1X177)	62.0	147.6	-	10.1	21.3	49.7
Y_2X(157-2X65)	64.2	150.4	-	10.3	20.2	54.9
Y_2X(157-2X160)	64.3	128.5	-	10.7	20.2	47.3
Y_2X(157-2X176)	66.3	142.1	-	11.5	20.8	49.2
Y_2X(157-2X177)	62.3	137.3	-	11.0	20.4	48.3
Y_2X(186X65)	65.3	130.3	-	11.4	22.5	51.8
Y_2X(186X160)	62.8	149.9	-	10.9	21.6	60.9
Y_2X(186X176)	65.0	137.2	-	11.2	19.2	58.3
Y_2X(186X177)	61.8	156.1	-	11.5	23.9	49.0
Y_2X(203X65)	61.7	138.9	-	9.5	21.7	62.1
Y_2X(203X160)	63.8	129.1	-	11.1	19.9	52.0
Y_2X(203X176)	61.3	129.9	-	9.2	19.6	44.7
Y_2X(203X177)	60.2	134.1	-	10.5	20.5	42.6
			Season X genotype			
S_1X8	56.5	101.9	-	9.4	19.8	27.8

S_1X45	54.5	126.0	-	10.4	20.0	48.3

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Season X genotype			
S_1X65	59.0	129.0	-	11.4	22.2	65.8
S_1X66	57.8	141.5	-	11.6	23.2	59.0
S_1X75	57.3	96.8	-	8.8	18.4	36.7
S_1X111	53.2	110.6	-	9.8	18.9	44.9
S_1X157-1	55.8	127.1	-	10.5	18.3	51.3
S_1X157-2	55.3	114.7	-	9.5	16.7	43.4
S_1X160	55.0	126.8	-	11.8	18.8	42.9
S_1X176	37.7	135.1	-	10.7	21.1	52.9
S_1X177	58.7	148.8	-	10.8	19.4	56.5
S_1X186	57.8	113.7	-	10.5	19.5	49.8
S_1X203	53.0	137.0	-	10.1	16.4	56.5
S_1X(8X65)	55.3	159.3	-	10.7	21.5	63.2
S_1X(8X160)	55.2	156.6	-	11.8	20.8	66.7
S_1X(8X176)	55.8	150.7	-	10.7	22.8	50.8
S_1X(8X177)	56.0	156.4	-	10.6	19.5	59.8
S_1X(45X65)	57.5	136.3	-	10.2	21.0	56.0
S_1X(45X160)	53.8	143.0	-	10.5	20.4	59.3
S_1X(45X176)	53.7	158.2	-	10.7	20.6	64.5
S_1X(45X177)	54.8	162.8	-	10.8	20.8	65.8
S_1X(66X65)	55.2	154.4	-	11.4	23.0	67.2
S_1X(66X160)	53.3	162.0	-	11.1	23.2	66.4
S_1X(66X176)	54.5	136.6	-	10.2	22.5	47.2
S_1X(66X177)	56.2	138.9	-	10.8	22.5	52.7
S_1X(75X65)	56.3	141.4	-	10.9	21.7	60.2
S_1X(75X160)	54.3	150.8	-	10.9	20.5	66.1
S_1X(75X176)	55.3	142.9	-	11.0	22.5	58.7

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Season X genotype			
S_1X(75X177)	54.0	147.5	-	10.8	20.0	64.2
S_1X(111X65)	54.0	136.6	-	10.9	22.0	60.0
S_1X(111X160)	53.2	163.1	-	11.7	20.0	67.1
S_1X(111X176)	56.7	146.7	-	10.5	21.1	53.3
S_1X(111X177)	54.5	152.3	-	11.2	20.2	57.7
S_1X(157-1X65)	56.5	142.3	-	10.8	20.2	65.7
S_1X(157-1X160)	54.0	162.9	-	11.1	20.9	66.4
S_1X(157-1X176)	56.2	152.4	-	11.4	20.2	59.2
S_1X(157-1X177)	54.0	156.6	-	10.8	20.2	58.7
S_1X(157-2X65)	55.5	154.8	-	10.8	20.9	69.2
S_1X(157-2X160)	54.2	147.7	-	11.4	18.8	66.5
S_1X(157-2X176)	56.7	132.0	-	11.2	19.2	58.1
S_1X(157-2X177)	53.8	154.0	-	11.0	18.6	65.1
S_1X(186X65)	57.7	145.5	-	12.1	23.4	60.1
S_1X(186X160)	55.5	139.5	-	10.6	21.8	55.0
S_1X(186X176)	56.0	154.4	-	11.3	19.3	69.3
S_1X(186X177)	55.7	175.3	-	11.5	23.0	69.9
S_1X(203X65)	53.5	157.5	-	11.0	20.1	74.6
S_1X(203X160)	53.0	147.5	-	11.2	20.2	69.5
S_1X(203X176)	52.8	146.9	-	10.5	19.7	57.9
S_1X(203X177)	53.7	169.0	-	11.2	20.0	64.2
S_2X8	69.7	140.6	-	12.0	23.1	59.1
S_2X45	70.3	99.6	-	10.2	24.7	43.5
S_2X65	72.2	116.3	-	10.7	25.1	60.2
S_2X66	70.3	139.8	-	12.5	24.9	72.4
S_2X75	68.5	108.0	-	10.3	21.7	43.0

S_2X111	67.3	122.8	-	10.2	22.1	48.1
$S_2X157-1$	69.0	118.2	-	10.7	21.1	45.3

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Season X genotype			
S_2X157-2	68.0	93.7	-	11.2	20.6	45.8
S_2X160	72.5	123.2	-	11.5	23.6	53.5
S_2X176	74.0	168.5	-	12.3	26.8	83.7
S_2X177	71.7	139.5	-	11.2	23.6	67.3
S_2X186	72.3	131.1	-	11.8	23.3	65.0
S_2X203	68.8	109.1	-	9.3	19.6	39.5
S_2X(8X65)	71.2	139.5	-	10.0	22.9	58.9
S_2X(8X160)	71.5	130.8	-	11.7	22.8	48.8
S_2X(8X176)	71.3	153.9	-	11.8	22.3	64.8
S_2X(8X177)	69.0	175.1	-	10.8	20.5	75.4
S_2X(45X65)	72.5	128.2	-	10.5	24.9	49.2
S_2X(45X160)	70.2	129.9	-	10.7	23.6	48.3
S_2X(45X176)	69.5	145.4	-	11.3	24.7	58.5
S_2X(45X177)	69.5	143.5	-	10.2	22.0	60.8
S_2X(66X65)	72.0	126.5	-	10.7	23.4	48.9
S_2X(66X160)	67.2	124.0	-	11.0	23.0	45.8
S_2X(66X176)	71.5	160.9	-	11.2	24.0	67.8
S_2X(66X177)	71.0	137.0	-	11.0	21.8	54.9
S_2X(75X65)	72.3	127.2	-	10.7	23.9	51.3
S_2X(75X160)	69.8	123.5	-	11.7	23.8	51.8
S_2X(75X166)	68.3	160.4	-	10.5	20.6	70.4
S_2X(75X177)	71.7	155.5	-	11.3	25.5	62.8
S_2X(111X65)	66.2	138.8	-	11.0	25.2	63.0
S_2X(111X160)	68.5	157.7	-	11.2	22.0	69.8
S_2X(111X176)	69.2	162.5	-	12.2	25.4	70.2
S_2X(111X177)	69.7	163.0	-	11.3	25.3	64.2
S_2X(157-1X65)	69.3	125.9	-	11.2	24.7	56.5

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Season X genotype			
S_2X(157-1X160)	73.2	141.3	-	11.0	24.0	62.6
S_2X(157-1X176)	71.5	132.6	-	12.2	25.8	54.6
S_2X(157-1X177)	67.3	160.1	-	11.5	23.6	65.6
S_2X(157-1X65)	69.7	145.4	-	11.3	22.3	60.4
S_2X(157-2X160)	71.2	139.2	-	11.5	22.2	56.5
S_2X(157-2X176)	71.0	158.5	-	12.7	23.1	62.5
S_2X(157-2X177)	70.5	133.5	-	11.5	22.7	52.7
S_2X(186X65)	70.0	133.4	-	11.7	24.8	65.0
S_2X(186X160)	70.8	153.2	-	11.2	23.8	58.0
S_2X(186X176)	71.3	140.3	-	11.8	24.7	59.5
S_2X(186X177)	66.7	158.3	-	12.3	26.3	58.3
S_2X(203X65)	69.8	121.7	-	10.5	26.6	49.9
S_2X(203X160)	70.2	130.1	-	10.8	23.4	52.4
S_2X(203X176)	66.2	139.7	-	10.0	21.5	56.9
S_2X(203X177)	66.2	134.5	-	11.2	23.2	57.4
			Year X Season X Genotype			
Y_1XS_1X8	57.3	110.7	-	10.3	17.1	31.6
Y_1XS_1X45	53.0	119.6	-	9.7	18.0	49.1
Y_1XS_1X65	61.0	117.8	-	10.7	19.5	65.5
Y_1XS_1X66	56.7	150.3	-	12.0	20.5	70.0
Y_1XS_1X75	60.7	99.2	-	9.0	16.0	40.0
Y_1XS_1X111	52.3	115.6	-	9.3	16.2	51.1
Y_1XS_1X157-1	56.0	113.1	-	10.0	15.9	47.3
Y_1XS_1X157-2	53.0	125.9	-	9.7	15.3	55.7
Y_1XS_1X160	55.7	117.8	-	12.7	15.3	35.1
Y_1XS_1X176	59.3	118.7	-	10.3	19.7	47.1
Y_1XS_1X177	61.3	137.4	-	9.3	16.4	49.7
Y_1XS_1X186	61.3	119.6	-	11.0	16.7	54.0

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Year X Season X Genotype			
Y_1XS_1X203	53.0	128.1	-	9.0	13.2	54.0
$Y_1XS_1X(8X65)$	55.3	172.7	-	11.3	19.3	72.7
$Y_1XS_1X(8X160)$	55.0	158.2	-	12.0	18.7	77.3
$Y_1XS_1X(8X176)$	56.0	166.0	-	11.3	20.9	67.7
$Y_1XS_1X(8X177)$	56.3	165.2	-	10.3	16.6	60.5
$Y_1XS_1X(45X65)$	58.3	135.5	-	10.0	18.6	57.9
$Y_1XS_1X(45X160)$	53.7	145.5	-	10.3	18.7	63.9
$Y_1XS_1X(45X176)$	53.7	158.3	-	10.7	18.5	72.7
$Y_1XS_1X(45X177)$	54.0	181.6	-	11.0	19.4	82.7
$Y_1XS_1X(66X65)$	55.3	148.0	-	11.0	21.4	67.1
$Y_1XS_1X(66X160)$	53.7	168.9	-	11.0	21.4	74.6
$Y_1XS_1X(66X176)$	54.7	132.7	-	10.3	20.0	47.9
$Y_1XS_1X(66X177)$	56.0	172.0	-	11.0	20.2	67.1
$Y_1XS_1X(75X65)$	56.0	146.5	-	11.0	19.7	65.7
$Y_1XS_1X(75X160)$	53.3	162.7	-	11.0	17.9	77.8
$Y_1XS_1X(75X176)$	54.0	153.0	-	11.0	21.0	70.5
$Y_1XS_1X75X177)$	54.3	161.3	-	11.0	17.2	78.7
$Y_1XS_1X(111X65)$	53.7	143.4	-	11.0	19.4	73.7
$Y_1XS_1X(111X160)$	52.7	175.1	-	12.0	17.6	81.4
$Y_1XS_1X(111X176)$	57.3	158.7	-	11.0	17.9	64.4
$Y_1XS_1X(111X177)$	56.0	160.0	-	11.3	17.8	67.1
$Y_1XS_1X(157\text{-}1X65)$	56.7	151.5	-	10.7	17.4	78.6
$Y_1XS_1X(157\text{-}1X160)$	53.3	170.5	-	11.3	18.0	77.7
$Y_1XS_1X(157\text{-}1X176)$	55.7	153.9	-	11.0	17.3	66.9
$Y_1XS_1X(157\text{-}1X177)$	52.7	171.0	-	11.3	17.9	70.7
$Y_1XS_1X(157\text{-}2X65)$	55.7	158.1	-	11.0	18.9	78.9
$Y_1XS_1X(157\text{-}2X160)$	52.3	158.5	-	11.3	16.2	77.4

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
Y_1XS_1X(157-2X176)	55.7	125.1	-	11.0	16.9	61.6

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			Year X Season X Genotype			
Y_1XS_1X((157-2X177)	52.7	162.3	-	11.0	16.3	73.0
Y_1XS_1X(186X65)	57.7	154.0	-	12.3	21.2	74.7
Y_1XS_1X(186X160)	56.3	141.0	-	10.3	19.4	57.6
Y_1XS_1X(186X176)	56.7	164.2	-	11.0	19.1	74.7
Y_1XS_1X(186X177)	55.3	186.0	-	11.0	21.0	79.0
Y_1XS_1X(203X65)	53.3	157.5	-	11.0	18.9	74.6
Y_1XS_1X(203X160)	53.0	148.3	-	10.3	16.8	72.0
Y_1XS_1X(203X176)	52.3	159.9	-	11.0	16.1	73.9
Y_1XS_1X(203X177)	53.0	175.1	-	11.3	18.1	76.6
Y_1XS_2X8	67.7	158.8	-	13.0	28.0	73.6
Y_1XS_2X45	67.7	100.7	-	9.7	26.2	39.4
Y_1XS_2X65	73.3	127.9	-	10.3	30.2	61.6
Y_1XS_2X66	71.7	150.0	-	13.3	31.3	79.9
Y_1XS_2X75	66.7	112.1	-	10.7	25.6	43.0
Y_1XS_2X111	66.3	112.6	-	10.7	27.1	44.6
Y_1XS_2X157-1	65.3	132.2	-	11.3	25.6	60.6
Y_1XS_2X157-2	67.0	94.8	-	10.7	21.5	34.4
Y_1XS_2X160	72.0	132.1	-	11.3	29.0	44.1
Y_1XS_2X176	73.3	161.0	-	12.7	27.7	76.7
Y_1XS_2X177	72.7	154.7	-	11.0	28.1	61.6
Y_1XS_2X186	72.3	140.7	-	13.0	27.8	68.1
Y_1XS_2X203	67.7	123.6	-	10.3	24.5	44.7
Y_1XS_2X(8X65)	71.3	144.7	-	12.7	28.7	59.3
Y_1XS_2X(8X160)	66.7	165.9	-	12.7	27.6	71.5
Y_1XS_2X(8X176)	70.3	169.7	-	13.3	28.5	79.9
Y_1XS_2X(8X177)	69.0	185.4	-	13.0	28.0	83.4

Y_1XS_2X(45X65)	68.3	154.6	-	11.3	30.4	69.6
Y_1XS_2X(45X160)	66.3	145.4	-	11.7	27.2	65.1

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			YearXSeason X genotype			
Y_1XS_2X(45X176)	66.0	160.5	-	11.7	27.2	69.4
Y_1XS_2X(45X177)	69.0	153.2	-	11.3	26.5	69.9
Y_1XS_2X(66X65)	71.0	119.8	-	11.0	28.3	48.3
Y_1XS_2X(66X160)	67.0	142.2	-	12.0	28.5	55.6
Y_1XS_2X(66X176)	71.3	171.0	-	12.7	30.8	79.7
Y_1XS_2X(66X177)	71.7	151.1	-	12.7	28.9	62.6
Y_1XS_2X(75X65)	69.0	136.5	-	11.7	27.8	59.9
Y_1XS_2X(75X160)	69.0	138.1	-	12.3	26.6	62.5
Y_1XS_2X(75X176)	68.3	169.3	-	12.7	27.9	79.0
Y_1XS_2X(75X177)	70.3	166.6	-	12.7	29.1	77.6
Y_1XS_2X(111X65)	66.0	140.9	-	12.3	29.5	63.0
Y_1XS_2X(111X160)	67.7	152.9	-	12.7	27.1	67.0
Y_1XS_2X(111X176)	68.7	156.1	-	12.7	30.0	67.8
Y_1XS_2X(111X177)	69.3	167.9	-	13.0	26.9	70.6
Y_1XS_2X(157-1X65)	67.3	155.7	-	13.0	28.4	78.0
Y_1XS_2X(157-1X160)	70.7	150.1	-	12.3	29.7	69.7
Y_1XS_2X(157-1X176)	69.3	149.3	-	12.7	28.6	67.7
Y_1XS_2X(157-1X177)	66.0	167.3	-	13.0	27.1	78.5
Y_1XS_2X(157-2X65)	66.3	141.4	-	12.7	27.2	70.6
Y_1XS_2X(157-2X160)	69.7	158.4	-	13.0	25.3	74.1
Y_1XS_2X(157-2X176)	67.0	171.6	-	13.7	25.9	81.1
Y_1XS_2X(157-2X177)	71.3	138.0	-	12.0	25.4	65.9
Y_1XS_2X(186X65)	67.0	143.0	-	12.3	30.3	71.9
Y_1XS_2X(186X160)	70.7	144.5	-	11.3	28.7	46.4

Y_1XS_2X(186X176)	68.0	150.9	-	13.0	30.4	66.3
Y_1XS_2X(186X177)	65.7	169.0	-	13.7	29.8	79.3
Y_1XS_2X(203X65)	70.0	123.0	-	13.0	31.0	50.0
Y_1XS_2X(203X160)	65.7	148.7	-	11.7	30.5	67.8

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			<u>YearXSeason X genotype</u>			
Y_1XS_2X(203X176)	63.0	153.6	-	11.7	27.2	66.3
Y_1XS_2X(203X177)	66.3	163.7	-	12.3	27.2	81.1
Y_2XS_1X8	55.7	93.1	-	8.5	22.4	24.0
Y_2XS_1X45	56.0	132.4	-	11.1	22.1	47.4
Y_2XS_1X65	57.0	140.1	-	12.2	24.9	66.2
Y_2XS_1X66	59.0	132.6	-	11.2	25.9	48.0
Y_2XS_1X75	54.0	94.5	-	8.5	20.8	33.4
Y_2XS_1X111	54.0	105.7	-	10.3	21.6	38.6
Y_2XS_1X157-1	55.7	141.1	-	11.0	20.7	55.3
Y_2XS_1X157-2	57.7	103.5	-	9.3	18.0	31.0
Y_2XS_1X160	54.3	135.9	-	10.9	22.2	50.6
Y_2XS_1X176	56.0	151.4	-	11.0	22.5	58.7
Y_2XS_1X177	56.0	160.2	-	12.2	22.3	63.3
Y_2XS_1X186	54.3	107.7	-	9.9	22.3	45.6
Y_2XS_1X203	54.0	145.9	-	11.1	19.5	59.0
Y_2XS_1X(8X65)	55.3	146.0	-	10.0	23.7	53.6
Y_2XS_1X(8X160)	55.3	154.9	-	11.6	22.9	54.1
Y_2XS_1X(8X176)	55.7	135.4	-	10.1	24.7	34.0
Y_2XS_1X(8X177)	55.7	147.5	-	10.9	22.3	59.0
Y_2XS_1X(45X65)	56.7	137.1	-	10.4	23.3	54.0
Y_2XS_1X(45X160)	54.0	140.5	-	10.7	22.1	54.8
Y_2XS_1(45X176)	53.7	158.1	-	10.8	22.8	56.2

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
Y_2XS_1X(45X177)	55.7	144.0	-	10.5	22.2	48.9
Y_2XS_1X(66X65)	55.0	160.7	-	11.7	24.6	67.3
Y_2XS_1X(66X160)	53.0	155.1	-	11.2	25.0	58.2
Y_2XS_1X(66X176)	54.3	140.5	-	10.0	25.0	46.4
Y_2XS_1X(66X177)	56.3	105.8	-	10.5	24.7	38.4
Y_2XS_1X(75X65)	56.7	136.3	-	10.7	23.8	54.6
			YearXSeason X genotype			
Y_2XS_1X(75X160)	55.3	139.0	-	10.9	23.0	54.4
Y_2XS_1X(75X176)	56.7	132.8	-	10.9	24.1	46.8
Y_2XS_1X(75X177)	53.7	133.7	-	10.7	22.7	49.6
Y_2XS_1X(111X65)	54.3	129.7	-	10.9	24.5	46.4
Y_2XS_1X(111X160)	53.7	151.1	-	11.4	22.4	52.8
Y_2XS_1X(111X176)	56.0	134.7	-	10.1	24.3	42.2
Y_2XS_1X(111X177)	53.0	144.6	-	11.0	22.6	46.9
Y_2XS_1X(157-1X65)	56.3	133.1	-	10.9	22.9	52.9
Y_2XS_1X(157-1X160)	54.7	155.3	-	10.8	23.8	55.1
Y_2XS_1X(157-1X176)	56.7	151.0	-	11.9	23.1	51.4
Y_2XS_1X(157-1X177)	55.3	142.2	-	10.3	22.5	46.8
Y_2XS_1X(157-2X65)	55.3	151.5	-	10.7	22.9	59.5
Y_2XS_1X(157-2X160)	56.0	136.9	-	11.5	21.3	55.6
Y_2XS_1X(157-2X176)	57.7	138.9	-	11.3	21.4	54.6
Y_2XS_1X(157-2X177)	55.0	145.6	-	10.9	20.9	57.1
Y_2XS_1X(186X65)	57.7	136.9	-	11.9	25.7	45.5
Y_2XS_1X(186X160)	54.7	138.0	-	10.8	24.3	52.3
Y_2XS_1X(186X176)	55.3	144.6	-	11.7	19.4	63.9
Y_2XS_1X(186X177)	56.0	164.6	-	11.9	25.0	60.8
Y_2XS_1X(203X65)	53.7	157.5	-	11.0	21.2	74.6
Y_2XS_1X(203X160)	53.0	146.7	-	12.1	23.5	66.9
Y_2XS_1X(203X176)	53.3	133.8	-	10.1	23.3	41.9

Y_2XS_1X(203X177)	54.3	162.9	-	11.0	21.8	51.7
Y_2XS_2X8	71.7	122.3	-	11.0	18.2	44.7
Y_2XS_2X45	73.0	98.5	-	10.7	23.1	47.5
Y_2XS_2X65	71.0	104.7	-	11.0	19.9	58.8
Y_2XS_2X66	69.0	129.7	-	11.7	18.5	65.0
Y_2XS_2X75	70.3	104.0	-	10.0	17.8	43.1

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			YearXSeason X genotype			
Y_2XS_2X111	68.3	133.0	-	9.7	17.1	51.6
Y_2XS_2X157-1	72.7	104.3	-	10.0	16.6	29.9
Y_2XS_2X167-2	69.0	92.5	-	11.7	19.6	57.1
Y_2XS_2X160	73.0	114.3	-	11.7	18.3	62.9
Y_2XS_2X176	74.7	175.9	-	12.0	18.3	90.7
Y_2XS_2X177	70.7	124.3	-	11.3	19.0	73.0
Y_2XS_2X186	72.3	121.5	-	10.7	18.9	61.9
Y_2XS_2X203	69.0	94.6	-	8.3	14.7	34.2
Y_2XS_2X(8X65)	71.0	134.4	-	7.3	17.2	58.5
Y_2XS_2X(8X160)	76.3	95.7	-	10.7	18.1	26.1
Y_2XS_2X(8X176)	72.3	138.1	-	10.3	16.1	49.7
Y_2XS_2X(8X177)	69.0	164.8	-	8.7	12.9	67.4
Y_2XS_2X(45X65)	76.7	101.8	-	9.7	19.4	28.7
Y_2XS_2X(45X160)	74.0	114.4	-	9.7	20.1	31.4
Y_2XS_2X(45X176)	73.0	130.3	-	11.0	22.2	47.5
Y_2XS_2X(45X177)	70.0	133.7	-	9.0	17.6	51.7
Y_2XS_2X(66X65)	73.0	133.2	-	10.3	18.5	49.5
Y_2XS_2X(66X160)	67.3	105.7	-	10.0	17.4	35.9
Y_2XS_2X(66X176)	71.7	150.8	-	9.7	17.2	55.8
Y_2XS_2X(66X177)	70.3	123.0	-	9.3	14.8	47.1
Y_2XS_2X(75X65)	75.7	117.9	-	9.7	20.0	42.7
Y_2XS_2X(75X160)	70.7	109.0	-	11.0	21.0	41.1

Y_2XS_2X(75X176)	68.3	151.6	-	8.3	13.4	61.7
Y_2XS_2X(75X177)	73.0	144.5	-	10.0	21.8	48.0
Y_2XS_2X(111X65)	66.3	136.8	-	9.7	20.8	63.0
Y_2XS_2X(111X160)	69.3	162.4	-	9.7	16.9	72.6
Y_2XS_2X(111X176)	69.7	168.9	-	11.7	20.9	72.5
Y_2XS_2X(111X177)	70.0	158.2	-	9.7	23.8	57.8

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			YearXSeason X genotype			
XS_2X(157-1X65)	71.3	96.0	-	9.3	21.0	35.0
Y_2XS_2X(157-1X160)	75.7	132.4	-	9.7	19.1	55.5
Y_2XS_2X(157-1X176)	73.7	115.9	-	11.7	23.1	41.4
Y_2XS_2X(157-1X177)	68.7	153.0	-	10.0	20.1	52.6
Y_2XS_2X(157-2X65)	73.0	149.3	-	10.0	17.5	50.3
Y_2XS_2X(157-2X160)	72.7	120.1	-	10.0	19.0	38.9
Y_2XS_2X(157-2X176)	75.0	145.3	-	11.7	20.2	43.8
Y2XS2X(157-2X177)	69.7	129.0	-	11.0	19.9	39.4
Y2XS2X(186X65)	73.0	123.7	-	11.0	19.3	58.1
Y2XS2X(186X160)	71.0	161.8	-	11.0	18.8	69.6
Y2XS2X(186X176)	74.7	129.7	-	10.7	19.1	52.7
Y2XS2X(186X177)	67.7	147.5	-	11.0	22.9	37.2
Y2XS2X(203X65)	69.7	120.3	-	8.0	22.2	49.7
Y2XS2X(203X160)	74.7	111.6	-	10.0	16.3	37.0
Y2XS2X(203X176)	69.3	126.0	-	8.3	15.8	47.4
Y2XS2X(203X177)	66.0	105.3	-	10.0	19.1	33.6
Over all mean	62.7	140.7	97.9	11.0	22.0	58.3
Parent over all mean	63.3	123.8	97.9	10.7	21.3	52.4

Table 8. Continued.

Genotype	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
			YearXSeason X genotype			
Hybrid overall mean	62.4	146.7	98.0	11.1	22.3	60.4
C.V.%	3.8	12.4	4.3	9.2	10.3	19.4

Y_1 = 2002
Y_2 = 2003
S_1 = Summer
S_2 = Winter

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year			
Y_1	1.4	13.6	89.5	80.8	20.7	72.6
Y_2	1.1	13.4	79.9	84.1	19.9	65.9
			Season			
S_1	-	13.4	77.6	-	22.2	63.2
S_2	-	13.6	91.9	-	18.4	75.2
			Year X Season			
Y_1 X S_1	1.3	-	80.5	78.3	-	62.1
Y_1X S_2	1.3	-	98.6	83.2	-	83.0
Y_2 X S_1	1.2	-	74.7	87.2	-	64.3
Y_2X S_2	1.0	-	85.1	81.0	-	67.0
			Genotype			
8	-	12.7	65.3	-	17.4	48.7
45	-	14.1	70.7	-	19.1	58.7
65	-	13.4	62.0	-	21.4	41.4
66	-	13.4	58.8	-	19.7	59.3
75	-	12.8	57.9	-	19.5	45.8
111	-	12.1	61.9	-	21.1	49.5
157-1	-	13.2	53.3	-	16.9	43.9
157-2	-	13.4	42.8	-	15.2	34.8
160	-	13.3	59.4	-	19.3	43.8
176	-	13.4	60.7	-	16.8	49.5
177	-	13.3	52.5	-	19.9	41.1
186	-	12.6	60.5	-	18.6	48.4
203	-	12.7	59.4	-	20.2	49.1
8X65	-	12.6	104.8	-	22.7	85.2
8X160	-	13.9	82.2	-	17.9	64.4
8X176	-	13.9	86.6	-	18.6	71.5
8X177	-	13.8	100.2	-	20.1	73.2

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Genotype			
45X65	-	13.7	88.4	-	21.4	79.9
45X160	-	13.5	89.4	-	19.8	74.9
45X176	-	14.2	101.0	-	20.3	86.0
45X177	-	14.0	105.3	-	19.0	88.3
66X65	-	12.9	78.3	-	19.6	63.5
66X160	-	12.6	107.7	-	22.8	88.5
66X176	-	13.5	108.5	-	21.9	94.3
66X177	-	13.9	92.7	-	22.1	80.5
75X65	-	14.5	96.5	-	20.9	75.6
75X160	-	14.7	99.1	-	20.0	87.3
75X176	-	12.9	111.2	-	20.7	92.7
75X177	-	14.3	119.4	-	22.2	90.9
111X65	-	14.3	118.7	-	23.7	98.8
111X160	-	13.4	104.8	-	19.4	65.5
111X176	-	13.7	86.1	-	23.6	85.6
111X177	-	13.4	110.6	-	22.0	91.8
157-1X65	-	13.4	88.6	-	19.8	75.0
157-1X160	-	13.1	72.6	-	17.3	67.1
157-1X176	-	13.0	82.9	-	18.5	71.5
157-1X177	-	13.6	82.8	-	20.8	68.9
157-2X65	-	14.6	84.9	-	20.4	69.6
157-2X16	-	13.8	83.8	-	16.5	70.0
157-2X176	-	13.3	86.9	-	19.9	72.8
157-2X177	-	13.6	71.9	-	18.3	59.4
186X65	-	13.2	83.7	-	23.4	66.3
186X160	-	13.4	87.9	-	23.6	70.4
186X176	-	14.1	90.1	-	22.4	78.0
186X177	-	14.3	105.9	-	20.7	80.4

Table 8. Continued

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Genotype			
203X65	-	13.7	79.6	-	24.1	48.0
203X160	-	13.1	84.1	-	20.1	69.0
203X176	-	13.2	94.1	-	21.0	77.9
203X177	-	14.1	112.2	-	22.4	94.9
			Year X Genotype			
Y_1X8	1.8	13.2	75.8	-	19.2	53.3
Y_1X45	1.7	13.8	71.1	-	18.4	57.5
Y_1X65	1.7	13.2	63.2	-	20.2	37.1
Y_1X66	1.7	13.2	55.1	-	20.8	62.7
Y_1X75	1.5	12.8	59.3	-	21.0	45.3
Y_1X111	2.0	11.8	64.2	-	19.7	51.6
Y_1X157-1	1.7	13.3	57.2	-	16.9	43.7
Y_1X157-2	1.0	13.2	30.0	-	14.3	25.2
Y_1X160	1.5	14.2	66.8	-	19.8	45.4
Y_1X176	1.5	13.0	59.3	-	15.7	49.2
Y_1X177	1.5	12.7	51.1	-	20.5	35.7
Y_1X186	1.5	11.8	56.6	-	21.2	43.7
Y_1X203	1.0	13.0	51.1	-	20.2	43.0
Y_1X(8X65)	1.3	13.7	105.1	-	21.1	86.3
Y_1X(8X160)	1.3	14.3	85.7	-	20.3	71.0
Y_1X(8X176)	1.7	14.3	118.1	-	20.7	99.4
Y_1X(8X177)	1.3	14.2	101.4	-	20.3	69.7
Y_1X(45X65)	1.2	13.8	101.2	-	21.6	87.1
Y_1X(45X160)	1.0	13.3	96.8	-	21.7	79.5
Y_1X(45X176)	1.2	14.2	93.0	-	21.6	78.0
Y_1X(45X177)	1.2	14.3	89.4	-	19.6	75.4
Y_1X(66X65)	1.2	12.8	87.9	-	19.9	72.5
Y_1X(66X160)	1.5	13.3	126.0	-	24.9	101.2

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Genotype			
Y_1X(66X176)	1.5	13.7	120.5	-	21.3	98.9
Y_1X(66X177)	1.3	13.7	111.9	-	23.9	90.4
Y_1X(75X65)	1.3	14.8	109.0	-	21.6	86.5
Y_1X(75X160)	1.3	14.5	107.2	-	20.7	88.7
Y_1X(75X176)	1.3	15.0	123.8	-	21.8	99.6
Y_1X(75X177)	1.3	14.0	106.7	-	21.7	82.9
Y_1X(111X65)	1.5	14.3	130.9	-	24.6	107.6
Y_1X(111X160)	1.3	13.7	93.5	-	18.8	71.5
Y_1X(111X176)	1.7	14.7	123.9	-	22.3	96.3
Y_1X(111X177)	1.2	13.2	93.7	-	20.3	77.9
Y_1X(157-1X65)	1.3	13.8	89.5	-	20.0	74.4
Y_1X(157-1X160)	1.3	12.7	85.0	-	20.7	70.0
Y_1X(157-1X176)	1.3	12.8	82.0	-	18.0	73.5
Y_1X(157-1X177)	1.2	13.8	95.6	-	19.9	81.5
Y_1X(157-2X65)	1.3	14.5	87.1	-	21.0	76.6
Y_1X(157-2X160)	1.0	13.2	77.8	-	16.3	64.2
Y_1X(157-2X176)	1.3	14.0	88.8	-	18.8	71.9
Y_1X(157-2X177)	1.0	13.7	65.6	-	16.6	53.6
Y_1X(186X65)	1.7	13.0	99.3	-	22.8	78.0
Y_1X(186X160)	1.8	13.2	92.3	-	24.8	74.2
Y_1X(186X176)	1.5	15.0	137.3	-	26.4	111.6
Y_1X(186X177)	1.3	14.5	97.5	-	21.8	75.1
Y_1X(203X65)	1.7	13.5	85.7	-	24.1	62.4
Y_1X(203X160)	1.5	13.0	99.8	-	22.8	85.0
Y_1X(203X176)	1.2	13.8	110.1	-	22.3	97.9
Y_1X(203X177)	1.2	14.5	108.5	-	22.7	93.1
Y_2X8	1.0	12.2	54.8	-	15.6	44.2
Y_2X45	1.0	14.3	70.3	-	19.9	60.0

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Genotype			
Y_2X65	1.0	13.7	60.8	-	22.5	45.8
Y_2X66	1.0	13.8	62.6	-	18.6	56.0
Y_2X75	1.0	12.7	56.6	-	18.1	46.4
Y_2X111	1.0	12.3	59.6	-	22.6	47.5
Y_2X157-1	1.0	13.0	49.4	-	16.9	44.1
Y_2X157-2	1.2	13.7	55.5	-	16.2	44.5
Y_2X160	1.0	12.5	52.0	-	18.9	42.2
Y_2X176	1.0	13.8	62.1	-	17.8	49.8
Y_2X177	1.0	13.8	53.9	-	19.8	46.6
Y_2X186	1.2	13.3	64.4	-	15.9	53.1
Y_2X203	1.0	12.3	67.6	-	20.1	55.1
Y_2X(8X65)	1.3	11.5	104.6	-	24.3	84.1
Y_2X(8X160)	1.3	13.5	78.7	-	15.5	57.8
Y_2X(8X176)	1.0	13.5	55.1	-	16.5	43.5
Y_2X(8X177)	1.5	13.3	99.0	-	19.9	76.7
Y_2X(45X65)	1.2	13.5	75.7	-	21.2	72.7
Y_2X(45X160)	1.0	13.7	82.1	-	18.0	70.3
Y_2X(45X176)	1.0	14.2	109.1	-	19.0	94.0
Y_2X(45X177)	1.2	13.7	121.2	-	18.4	101.2
Y_2X(66X65)	1.2	13.0	68.8	-	19.3	54.5
Y_2X(66X160)	1.2	11.8	89.5	-	20.7	75.9
Y_2X(66X176)	1.2	13.3	96.6	-	22.4	89.8
Y_2X(66X177)	1.0	14.2	73.6	-	20.3	70.6
Y_2X(75X65)	1.2	14.2	84.0	-	20.1	64.7
Y_2X(75X160)	1.0	14.8	90.9	-	19.2	86.0
Y_2X(75X176)	1.0	10.8	98.5	-	19.7	85.8
Y_2X(75X177)	1.0	14.5	132.1	-	22.8	99.0

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Genotype			
Y_2X(111X65)	1.0	14.3	106.5	-	22.8	90.0
Y_2X(111X160)	1.0	13.2	78.7	-	19.9	59.6
Y_2X(111X176)	1.3	12.7	93.0	-	24.9	75.0
Y_2X(111X177)	1.2	13.7	127.5	-	23.7	105.7
Y_2X(157-1X65)	1.0	13.0	87.8	-	19.7	75.7
Y_2X(157-1X160)	1.2	13.5	60.3	-	17.9	64.2
Y_2X(157-1X176)	1.3	13.2	83.8	-	19.0	69.2
Y_2X(157-1X177)	1.0	13.3	70.1	-	21.7	56.2
Y_2X(157-2X65)	1.2	14.7	82.7	-	19.8	62.5
Y_2X(157-2X160)	1.2	14.5	98.7	-	16.8	75.8
Y_2X(157-2X176)	1.2	12.7	85.0	-	20.9	73.7
Y_2X(157-2X177)	1.2	13.5	78.3	-	20.0	65.3
Y_2X(186X65)	1.5	13.3	68.2	-	23.9	54.5
Y_2X(186X160)	1.2	13.7	83.4	-	22.3	66.5
Y_2X(186X176)	1.0	13.2	43.0	-	18.5	44.3
Y_2X(186X177)	1.0	14.2	114.2	-	19.7	85.7
Y_2X(203X65)	1.2	13.8	73.6	-	24.1	33.6
Y_2X(203X160)	1.0	13.2	68.3	-	17.5	53.1
Y_2X(203X176)	1.2	12.5	78.0	-	19.8	57.9
Y_2X(203X177)	1.3	13.7	116.0	-	22.2	96.7
			Season X Genotype			
S_1X8	-	11.7	59.4	-	17.1	37.0
S_1X45	-	14.5	61.3	-	20.6	52.7
S_1X65	-	14.0	64.5	-	25.2	36.9
S_1X66	-	13.5	56.8	-	21.5	46.8
S_1X75	-	11.3	52.7	-	22.1	42.1
S_1X111	-	12.0	49.9	-	22.3	40.2
S_1X157-1	-	12.8	41.4	-	17.8	34.8

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Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Season X Genotype			
S_1X157-2	-	13.0	48.7	-	15.1	39.1
S_1X160	-	13.0	56.1	-	21.7	40.1
S_1X176	-	13.2	53.2	-	17.6	41.0
S_1X177	-	12.2	43.0	-	22.5	33.1
S_1X186	-	12.5	56.0	-	18.9	44.2
S_1X203	-	12.5	56.5	-	21.5	47.9
S_1X(8X65)	-	13.3	101.1	-	23.7	86.2
S_1X(8X160)	-	13.8	66.1	-	18.7	55.3
S_1X(8X176)	-	13.3	80.5	-	20.7	68.6
S_1X(8X177)	-	13.3	83.5	-	23.0	56.6
S_1X(45X65)	-	13.3	77.7	-	22.8	66.1
S_1X(45X160)	-	13.5	75.2	-	21.5	61.0
S_1X(45X176)	-	14.0	83.7	-	22.8	72.5
S_1X(45X177	-	13.8	90.1	-	21.4	78.3
S_1X(66X65)	-	13.0	82.8	-	24.3	70.0
S_1X(66X160)	-	13.0	124.2	-	28.6	102.4
S_1X(66X176)	-	13.3	116.0	-	27.4	95.8
S_1X(66X177)	-	13.3	100.7	-	24.2	82.9
S_1X(75X65)	-	14.5	84.0	-	23.0	72.6
S_1X(75X160)	-	14.0	99.9	-	22.6	87.0
S_1X(75X176)	-	14.7	100.0	-	21.4	82.3
S_1X(75X177)	-	14.2	85.4	-	22.0	71.2
S_1X(111X65)	-	14.3	106.7	-	26.1	88.8
S_1X(111X160)	-	13.3	68.8	-	21.6	58.7
S_1X(111X176)	-	13.3	88.6	-	24.8	71.5
S_1X(111X177)	-	13.2	81.4	-	25.3	68.5
S_1X(157-1X65	-	13.5	73.8	-	21.1	61.6

S_1X(157-1X160)	-	13.3	85.6	-	23.9	74.4

Table 8. Continued.

Genotype	Ears Per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Season X Genotype			
S_1X(157-1X176)	-	13.0	68.7	-	20.5	59.9
S_1X(157-1X177)	-	12.8	73.4	-	20.9	60.6
S_1X(157-2X65)	-	15.0	79.9	-	21.6	66.7
S_1X(157-2X160)	-	13.7	77.9	-	17.5	65.7
S_1X(157-2X176)	-	13.0	72.4	-	21.1	61.0
S_1X(157-2X177)	-	13.2	72.5	-	20.5	59.2
S_1X(186X65)	-	13.0	86.0	-	26.7	72.7
S_1X(186X160)	-	13.5	79.5	-	25.4	65.0
S_1X(186X176)	-	13.7	84.1	-	24.4	69.4
S_1X(186X177)	-	14.3	103.7	-	22.4	83.3
S_1X(203X65)	-	13.8	100.9	-	24.0	53.8
S_1X(203X160)	-	12.8	78.9	-	21.9	65.0
S_1X(203X176)	-	13.5	85.6	-	22.7	72.7
S_1X(203X177)	-	13.7	85.0	-	23.9	74.1
S_2X8	-	13.7	71.2	-	17.7	60.5
S_2X45	-	13.7	80.1	-	17.6	64.7
S_2X65	-	12.8	59.5	-	17.6	46.0
S_2X66	-	13.3	60.8	-	17.9	71.9
S_2X75	-	14.2	63.2	-	17.0	49.6
S_2X111	-	12.2	73.9	-	20.0	58.8
S_2X157-1	-	13.5	65.1	-	16.0	53.0
S_2X157-2	-	13.8	36.8	-	15.4	30.6
S_2X160	-	13.7	62.7	-	17.0	47.5
S_2X176	-	13.7	68.2	-	15.9	58.0
S_2X177	-	14.3	62.0	-	17.3	49.1
S_2X186	-	12.7	65.0	-	18.2	52.6

S_2X203	-	12.8	62.3	-	18.9	50.2

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
<u>Season X Genotype</u>						
S_2X(8X65)	-	11.8	108.6	-	21.7	84.2
S_2X(8X160)	-	14.0	98.3	-	17.1	73.6
S_2X(8X176)	-	14.5	92.6	-	16.6	74.3
S_2X(8X177)	-	14.2	116.9	-	17.3	89.8
S_2X(45X65)	-	14.0	99.2	-	20.0	93.7
S_2X(45X160)	-	13.5	103.7	-	18.1	88.7
S_2X(45X176)	-	14.3	118.3	-	17.8	99.5
S_2X(45X177)	-	14.2	120.6	-	16.6	98.3
S_2X(66X65)	-	12.8	73.9	-	14.8	57.0
S_2X(66X160)	-	12.2	91.3	-	17.0	74.7
S_2X(66X176)	-	13.7	101.1	-	16.3	92.9
S_2X(66X177)	-	14.5	84.8	-	19.9	78.2
S_2X(75X65)	-	14.5	109.0	-	18.8	78.6
S_2X(75X160)	-	15.3	98.2	-	17.3	87.7
S_2X(75X176)	-	11.2	122.3	-	20.1	103.1
S_2X(75X177)	-	14.3	153.4	-	22.5	110.6
S_2X(111X65)	-	14.3	130.7	-	21.3	108.8
S_2X(111X160)	-	13.5	103.4	-	17.1	72.4
S_2X(111X176)	-	14.0	128.3	-	22.4	99.8
S_2X(111X177)	-	13.7	139.9	-	18.7	115.1
S_2X(157-1X65)	-	13.3	103.4	-	18.5	88.5
S_2X(157-1X160)	-	12.8	59.7	-	14.7	59.8
S_2X(157-1X176)	-	13.0	97.2	-	16.5	83.1
S_2X(157-1X177)	-	14.3	92.3	-	20.8	77.2
S_2X(157-2X65)	-	14.2	89.9	-	19.3	72.4
S_2X(157-2X160)	-	14.0	89.7	-	15.6	74.3

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
S_2X(157-2X176)	-	13.7	101.5	-	18.6	84.6
S_2X(157-2X177)	-	14.0	71.4	-	16.0	59.7

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Season X Genotype			
S_2X(186X65)	-	13.3	81.4	-	20.1	59.8
S_2X(186X160)	-	13.3	96.3	-	21.7	75.7
S_2X(186X176)	-	14.5	96.1	-	20.5	86.5
S_2X(186X177)	-	14.3	108.1	-	19.0	77.5
S_2X(203X65)	-	13.5	58.4	-	24.2	42.1
S_2X(203X160)	-	13.3	89.2	-	18.4	73.0
S_2X(203X176)	-	12.8	102.5	-	19.3	83.1
S_2X(203X177)	-	14.5	139.5	-	21.0	115.7
			Year X Season X Genotype			
Y_1XS_1X8	1.7	12.3	60.5	-	20.8	27.2
Y_1XS_1X45	2.0	14.7	57.5	-	21.7	46.4
Y_1XS_1X65	1.3	14.7	55.0	-	25.9	19.4
Y_1XS_1X66	1.7	13.7	49.4	-	23.6	34.0
Y_1XS_1X75	1.3	11.3	40.6	-	22.1	29.2
Y_1XS_1X111	1.7	12.0	52.3	-	22.4	37.0
Y_1XS_1X157-1	1.3	12.7	32.1	-	18.1	23.9
Y_1XS_1X157-2	1.0	13.0	31.8	-	14.9	24.6
Y_1XS_1X160	1.3	13.3	58.6	-	22.1	34.9
Y_1XS_1X176	1.7	13.0	38.3	-	15.4	27.2
Y_1XS_1X177	1.3	11.0	36.8	-	24.0	21.0
Y_1XS_1X186	1.3	12.0	40.6	-	217	28.5
Y_1XS_1X203	1.0	12.7	40.7	-	20.5	30.5
Y_1XS_1X(8X65)	1.3	13.7	108.1	-	23.6	88.4
Y_1XS_1X(8X160)	1.0	14.3	59.9	-	19.7	48.7
Y_1XS_1X(8X176)	1.7	14.0	120.4	-	23.0	48.7
Y_1XS_1X(8X177)	1.0	13.3	89.2	-	23.4	49.6

$Y_1XS_1X(45X65)$	1.0	13.3	66.1	-	21.3	52.9
$Y_1XS_1X(45X160)$	1.0	13.3	81.9	-	22.5	64.8

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Season X Genotype			
$Y_1XS_1X(45X176)$	1.0	13.7	86.0	-	25.3	68.6
$Y_1XS_1X(45X177)$	1.0	15.0	87.5	-	23.4	67.8
$Y_1XS_1X(66X65)$	1.0	13.0	89.6	-	23.6	72.2
$Y_1XS_1X(66X160)$	1.0	14.0	154.7	-	30.9	126.9
$Y_1XS_1X(66X176)$	1.3	13.3	104.2	-	27.1	83.9
$Y_1XS_1X(66X177)$	1.3	14.0	138.0	-	28.2	108.6
$Y_1XS_1X(75X65)$	1.3	14.7	92.4	-	23.1	76.2
$Y_1XS_1X(75X160)$	1.0	14.0	109.4	-	23.5	88.7
$Y_1XS_1X(75X176)$	1.7	15.7	118.3	-	23.0	91.4
$Y_1XS_1X(75X177)$	1.0	14.0	86.2	-	23.4	67.6
$Y_1XS_1X(111X65)$	1.3	15.0	130.5	-	27.7	105.3
$Y_1XS_1X(111X166)$	1.3	13.3	77.1	-	22.2	65.9
$Y_1XS_1X(111X176)$	1.3	14.0	99.6	-	23.8	76.3
$Y_1XS_1X(111X177)$	1.3	13.0	82.8	-	24.4	48.1
$Y_1XS_1X(157\text{-}1X65)$	1.0	14.0	64.4	-	21.7	48.1
$Y_1XS_1X(157\text{-}1X160)$	1.0	13.3	84.2	-	26.7	68.6
$Y_1XS_1X(157\text{-}1X176)$	1.3	12.7	73.8	-	20.4	60.0
$Y_1XS_1X(157\text{-}1X177)$	1.0	13.0	73.1	-	21.0	60.0
$Y_1XS_1X(157\text{-}2X65)$	1.0	14.3	66.5	-	20.4	55.3
$Y_1XS_1X(157\text{-}2X160)$	1.0	13.3	69.1	-	17.6	54.9
$Y_1XS_1X(157\text{-}2X176)$	1.7	13.3	90.9	-	21.2	71.4
$Y_1XS_1X(157\text{-}2X177)$	1.0	13.3	75.2	-	20.6	60.6
$Y_1XS_1X(186X65)$	1.7	13.3	98.6	-	25.5	78.3
$Y_1XS_1X(186X160)$	2.0	13.3	89.1	-	26.5	68.7
$Y_1XS_1X(186X176)$	1.0	14.0	116.5	-	26.0	91.1

$Y_1XS_1X(186X177)$	1.0	14.7	110.3	-	23.5	80.3
$Y_1XS_1X(203X65)$	1.3	14.0	100.9	-	24.0	82.7
$Y_1XS_1X(203X160)$	1.0	13.0	80.8	-	22.6	66.3

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Season X Genotype			
$Y_1XS_1X(203X176)$	1.0	13.3	76.0	-	21.4	63.7
$Y_1XS_1X(186X177)$	1.0	13.7	99.8	-	24.5	84.0
Y_1XS_2X8	2.0	14.0	91.0	-	17.7	79.3
Y_1XS_2X45	1.3	13.0	84.7	-	15.0	68.6
Y_1XS_2X65	2.0	11.7	71.4	-	14.6	54.7
Y_1XS_2X66	1.7	12.3	60.7	-	17.9	91.3
Y_1XS_2X75	1.7	14.3	77.9	-	19.9	61.3
Y_1XS_2X111	2.3	11.7	76.0	-	17.0	66.1
Y_1XS_2X157-1	2.0	14.0	82.2	-	15.6	63.5
Y_1XS_2X157-2	1.0	13.3	28.1	-	13.7	25.7
Y_1XS_2X160	1.7	15.0	75.0	-	17.5	56.0
Y_1XS_2X176	1.3	13.0	80.4	-	16.0	71.2
Y_1XS_2X177	1.7	14.3	65.4	-	17.1	50.4
Y_1XS_2X186	1.7	11.7	72.6	-	20.8	59.0
Y_1XS_2X203	1.0	13.3	61.5	-	19.9	55.6
$Y_1XS_2X(8X65)$	1.3	13.7	102.0	-	18.6	84.2
$Y_1XS_2X(8X160)$	1.7	14.3	111.4	-	20.9	93.3
$Y_1XS_2X(8X176)$	1.7	14.7	115.7	-	18.4	100.1
$Y_1XS_2X(8X177)$	1.7	15.0	113.5	-	17.3	89.8
$Y_1XS_2X(45X65)$	1.3	14.3	136.3	-	21.9	121.3
$Y_1XS_2X(45X160)$	1.0	13.3	111.6	-	20.8	94.2
$Y_1XS_2X(45X176)$	1.3	14.7	99.9	-	18.0	87.4
$Y_1XS_2X(45X177)$	1.3	13.7	91.4	-	15.7	83.1
$Y_1XS_2X(66X65)$	1.3	12.7	86.2	-	16.1	72.7
$Y_1XS_2X(66X160)$	2.0	12.7	97.2	-	18.9	75.4

Y$_1$XS$_2$X(66X176)	1.7	14.0	136.7	-	15.6	113.9
Y$_1$XS$_2$X(66X177)	1.3	13.3	85.8	-	19.5	72.3
Y$_1$XS$_2$X(75X65)	1.3	15.0	125.6	-	20.2	96.9

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Season X Genotype			
Y$_1$XS$_2$X(75X160)	1.7	15.0	105.0	-	17.9	88.6
Y$_1$XS$_2$X(75X176)	1.0	14.3	129.3	-	20.5	107.8
Y$_1$XS$_2$X(75X177)	1.7	14.0	127.0	-	20.0	98.2
Y$_1$XS$_2$X(111X65)	1.7	13.7	131.3	-	21.6	109.9
Y$_1$XS$_2$X(111X160)	1.3	14.0	109.8	-	15.4	77.1
Y$_1$XS$_2$X(111X176)	2.0	15.3	148.2	-	20.7	116.3
Y$_1$XS$_2$X(111X177)	1.0	13.3	104.6	-	16.1	90.1
Y$_1$XS$_2$X(157-1X65)	1.7	13.7	114.5	-	18.2	100.7
Y$_1$XS$_2$X(157-1X160)	1.7	12.0	85.8	-	14.6	71.4
Y$_1$XS$_2$X(157-1X176)	1.3	13.0	90.3	-	15.6	87.6
Y$_1$XS$_2$X(157-1X177)	1.3	14.7	118.0	-	18.9	103.0
Y$_1$XS$_2$X(157-2X65)	1.7	14.7	107.6	-	21.6	97.9
Y$_1$XS$_2$X(157-2X160)	1.0	13.0	86.6	-	14.9	73.5
Y$_1$XS$_2$X(157-2X176)	1.0	14.7	86.8	-	16.4	72.4
Y$_1$XS$_2$X(157-2X177)	1.0	14.0	55.9	-	12.6	46.5
Y$_1$XS$_2$X(186X65)	1.7	12.7	100.0	-	20.1	77.6
Y$_1$XS$_2$X(186X160)	1.7	13.0	95.4	-	23.1	79.8
Y$_1$XS$_2$X(186X176)	2.0	16.0	158.1	-	26.8	132.1
Y$_1$XS$_2$X(186X177)	1.7	14.3	84.7	-	20.0	69.9
Y$_1$XS$_2$X(203X65)	2.0	13.0	70.5	-	24.2	42.1
Y$_1$XS$_2$X(203X160)	2.0	13.0	118.8	-	23.0	103.6
Y$_1$XS$_2$X(203X176)	1.3	14.3	144.2	-	23.1	132.1
Y$_1$XS$_2$X(203X177)	1.3	15.3	117.2	-	20.9	102.2
Y$_2$XS$_1$X8	1.0	11.0	58.4	-	13.5	46.9
Y$_2$XS$_1$X45	1.0	14.3	65.1	-	19.5	59.0

Y_2XS_1X65	1.0	13.3	74.0	-	24.5	54.3
Y_2XS_1X66	1.0	13.3	64.2	-	19.3	59.6
Y_2XS_1X75	1.0	11.3	64.7	-	22.0	54.9

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Season X Genotype			
Y_2XS_1X111	1.0	12.0	47.5	-	22.1	43.4
Y_2XS_1X157-1	1.0	13.0	50.7	-	17.5	45.6
Y_2XS_1X157-2	1.3	13.0	65.5	-	15.3	53.5
Y_2XS_1X160	1.0	12.7	53.7	-	21.3	45.4
Y_2XS_1X176	1.0	13.3	68.2	-	19.9	54.9
Y_2XS_1X177	1.0	13.3	49.2	-	21.0	45.3
Y_2XS_1X 186	1.3	13.0	71.4	-	16.1	59.9
Y_2XS_1X203	1.0	12.3	72.2	-	22.4	65.4
Y_2XS_1X(8X65)	1.7	13.0	94.0	-	23.8	84.0
Y_2XS_1X(8X160)	1.7	13.3	72.2	-	17.6	61.8
Y_2XS_1X(8X176)	1.0	12.7	40.6	-	18.3	38.5
Y_2XS_1X(8X177)	2.0	13.3	77.8	-	22.6	63.6
Y_2XS_1X(45X65)	1.3	13.3	89.3	-	24.2	79.2
Y_2XS_1X(45X160)	1.0	13.7	68.5	-	20.6	57.2
Y_2XS_1X(45X176)	1.0	14.3	81.4	-	20.4	76.3
Y_2XS_1X(45X177)	1.3	12.7	92.7	-	19.4	88.7
Y_2XS_1X(66X65)	1.3	13.0	76.0	-	25.1	67.8
Y_2XS_1X(66X160)	1.3	12.0	93.8	-	26.3	77.9
Y_2XS_1X(66X176)	1.3	13.3	127.0	-	27.7	107.6
Y_2XS_1X(66X177)	1.0	12.7	63.4	-	20.3	57.2
Y_2XS_1X(75X65)	1.3	14.3	75.6	-	22.8	69.0
Y_2XS_1X(75X160)	1.0	14.0	90.5	-	21.7	85.3
Y_2XS_1X(75X176)	1.0	13.7	81.7	-	19.7	73.2
Y_2XS_1X(75X177)	1.0	14.3	84.3	-	20.7	74.9
Y_2XS_1X(111X65)	1.0	13.7	83.0	-	24.6	72.4

$Y_2XS_1X(111X160)$	1.0	13.3	60.4	-	20.9	51.5
$Y_2XS_1X(111X176)$	1.7	12.7	77.7	-	25.7	66.6
$Y_2XS_1X(111X177)$	1.3	13.7	80.0	-	26.2	71.3

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Season X Genotype			
$Y_2XS_1X(157\text{-}1X65)$	1.0	13.0	83.3	-	20.5	75.2
$Y_2XS_1X(157\text{-}1X160)$	1.3	13.3	86.9	-	21.1	80.2
$Y_2XS_1X(157\text{-}1X176)$	1.3	13.3	63.6	-	20.6	59.9
$Y_2XS_1X(157\text{-}1X177)$	1.0	12.7	73.7	-	20.8	61.1
$Y_2XS_1X(157\text{-}2X65)$	1.3	15.7	93.3	-	22.7	78.1
$Y_2XS_1X(157\text{-}2X160)$	1.3	14.0	86.6	-	17.3	76.6
$Y_2XS_1X(157\text{-}2X176)$	1.0	12.7	53.9	-	21.1	50.6
$Y_2XS_1X(157\text{-}2X177)$	1.3	13.0	69.8	-	20.5	57.7
$Y_2XS_1X(186X65)$	2.0	12.3	73.5	-	27.8	67.1
$Y_2XS_1X(186X160)$	1.3	13.7	69.8	-	24.3	61.4
$Y_2XS_1X(186X176)$	1.0	13.3	51.8	-	22.8	47.6
$Y_2XS_1X(186X177)$	1.0	14.8	97.0	-	21.3	86.3
$Y_2XS_1X(203X65)$	1.3	13.7	100.9	-	24.0	24.9
$Y_2XS_1X(203X160)$	1.0	12.7	77.1	-	21.2	63.7
$Y_2XS_1X(203X176)$	1.3	13.7	95.1	-	24.0	81.8
$Y_2XS_1X(203X177)$	1.7	13.7	70.2	-	23.3	64.3
Y_2XS_2X8	1.0	13.3	51.3	-	17.7	41.6
Y_2XS_2X45	1.0	14.3	75.4	-	20.3	60.9
Y_2XS_2X65	1.0	14.0	47.7	-	20.6	37.3
Y_2XS_2X66	1.0	14.3	60.9	-	17.9	52.7
Y_2XS_2X75	1.0	14.0	48.5	-	14.2	37.8
Y_2XS_2X111	1.0	12.7	71.7	-	23.0	51.5
$Y_2XS_2X157\text{-}1$	1.0	13.0	48.0	-	16.4	42.5
$Y_2XS_2X157\text{-}2$	1.0	14.3	45.5	-	17.1	35.4
Y_2XS_2X160	1.0	12.3	50.3	-	16.4	39.0

Y_2XS_2X176	1.0	14.3	56.0	-	15.8	44.7
Y_2XS_2X177	1.0	14.3	58.7	-	17.6	47.9
Y_2XS_2X186	1.0	13.7	57.3	-	15.7	46.2

Table 8. Continued

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Season X Genotype			
Y_2XS_2X203	1.0	12.3	63.0	-	17.8	44.8
$Y_2XS_2X(8X65)$	1.0	10.0	115.1	-	24.8	84.2
$Y_2XS_2X(8X160)$	1.0	13.7	85.1	-	13.4	53.9
$Y_2XS_2X(8X176)$	1.0	14.3	69.5	-	14.8	48.5
$Y_2XS_2X(8X177)$	1.0	13.3	120.2	-	17.3	89.8
$Y_2XS_2X(45X65)$	1.0	13.7	62.0	-	18.1	66.1
$Y_2XS_2X(45X160)$	1.0	13.7	95.7	-	15.4	83.3
$Y_2XS_2X(45X176)$	1.0	14.0	136.8	-	17.7	111.7
$Y_2XS_2X(45X177)$	1.0	14.7	149.8	-	17.4	113.6
$Y_2XS_2X(66X65)$	1.0	13.0	61.5	-	13.5	41.3
$Y_2XS_2X(66X160)$	1.0	11.7	85.3	-	15.2	73.9
$Y_2XS_2X(66X176)$	1.0	13.3	65.4	-	17.1	71.9
$Y_2XS_2X(66X177)$	1.0	15.7	83.7	-	20.3	84.1
$Y_2XS_2X(75X65)$	1.0	14.0	82.3	-	17.5	60.4
$Y_2XS_2X(75X160)$	1.0	15.7	91.4	-	16.8	86.7
$Y_2XS_2X(75X176)$	1.0	8.0	115.3	-	19.7	98.4
$Y_2XS_2X(75X177)$	1.0	14.7	179.8	-	24.9	123.0
$Y_2XS_2X(111X65)$	1.0	15.0	130.0	-	21.1	107.7
$Y_2XS_2X(111X160)$	1.0	13.0	96.8	-	18.9	67.7
$Y_2XS_2X(111X176)$	1.0	12.7	108.3	-	24.1	83.3
$Y_2XS_2X(111X177)$	1.0	14.0	175.1	-	21.3	140.0
$Y_2XS_2X(157\text{-}1X65)$	1.0	13.0	92.3	-	18.8	76.2
$Y_2XS_2X(157\text{-}1X160)$	1.0	13.7	33.6	-	14.8	48.2
$Y_2XS_2X(157\text{-}1X176)$	1.3	13.0	104.1	-	17.4	78.6
$Y_2XS_2X(157\text{-}1X177)$	1.0	14.0	66.5	-	22.7	51.3

Y_2XS_2X(157-2X65)	1.0	13.7	72.1	-	17.0	46.9
Y_2XS_2X(157-2X160)	1.0	15.0	92.8	-	16.2	75.0
Y_2XS_2X(157-2X176)	1.3	12.7	116.1	-	20.7	96.8

Table 8. Continued.

Genotype	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling percentage	100-seed weight (g)	Yield per plant (g)
			Year X Season X Genotype			
Y_2XS_2X (157-2X177)	1.0	14.0	86.9	-	19.5	72.9
Y_2XS_2X(186X65)	1.0	14.0	62.8	-	20.0	42.0
Y_2XS_2X(186X160)	1.0	13.7	97.1	-	20.4	71.6
Y_2XS_2X(186X176)	1.0	13.0	34.1	-	14.2	41.0
Y_2XS_2X(186X177)	1.0	14.3	131.4	-	18.0	85.1
Y_2XS_2X(203X65)	1.0	14.0	46.2	-	24.2	42.2
Y_2XS_2X(203X160)	1.0	13.7	59.6	-	13.8	42.4
Y_2XS_2X(203X176)	1.0	11.3	60.9	-	15.5	34.0
Y_2XS_2X(203X177)	1.0	13.7	161.9	-	21.1	129.2
Over all mean	1.3	13.5	84.7	84.4	20.3	69.2
Inbred over all mean	1.3	13.1	58.9	80.3	18.9	47.2
Hybrid over all mean	1.3	13.6	94.1	83.2	20.8	77.2
C.V.%	30.5	9.2	27.	9.0	17.3	31.4

Y_1 = 2002
Y_2 = 2003
S_1 = Summer
S_2 = Winter

Table 8. Continued

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness%	Cob length (cm)	Cob diameter (cm)	Yield (t\h)
			Year			
Y_1	12.2	406.5	3.5	14.6	3.9	-
Y_2	12.7	377.8	3.6	12.9	3.8	-
			Season			
S	12.0	385.0	3.6	-	3.8	3.0
W	11.9	399.3	3.5	-	3.9	3.3
			Year X Season			
Y_1XS_1	12.6	414.8	3.7	-	3.9	3.3
Y_1XS_2	11.9	398.2	3.3	-	3.9	3.0
Y_2XS_1	11.5	355.2	3.5	-	3.7	2.7
Y_2XS_2	11.9	400.4	3.7	-	3.9	3.6
			Genotype			
8	12.5	321.3	3.2	11.3	3.6	1.6
45	10.0	387.0	3.7	14.6	3.9	2.2
65	11.8	412.7	3.8	14.4	3.8	1.5
66	13.3	419.6	3.5	14.7	3.8	2.0
75	10.7	326.0	3.3	12.2	3.7	2.0
111	10.7	385.2	3.6	11.9	3.7	1.8
157-1	11.5	273.7	3.6	10.0	3.6	1.4
157-2	10.8	268.6	4.1	9.6	3.4	1.6
160	11.3	343.1	4.5	12.0	3.7	1.7
176	12.6	384.7	3.7	14.4	3.5	1.9
177	11.2	380.8	3.7	12.0	3.7	1.7
186	12.2	332.1	3.7	13.2	3.5	1.9
203	10.5	318,3	4.2	12.1	3.6	1.3
8X65	12.0	450.9	4.5	14.9	4.0	3.8
8X160	12.8	357.8	3.3	12.4	3.7	2.8
8X176	12.3	387.7	3.4	13.3	3.8	3.7
8X177	12.6	398.5	3.4	14.7	3.9	3.5

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness%	Cob length (cm)	Cob diameter (cm)	Yield (t\h)
			Genotype			
45X65	11.1	427.5	3.4	14.4	4.0	3.4
45X160	11.3	381.9	3.3	14.1	3.9	3.5
45X176	11.6	438.0	3.6	14.6	3.9	4.1
45X177	11.4	409.3	3.4	13.7	3.9	4.3
66X65	11.9	449.0	3.6	13.4	3.8	3.1
66X160	11.8	440.6	3.5	15.3	3.7	3.9
66X176	11.7	457.6	2.9	16.4	3.9	4.4
66X177	11.5	390.5	3.6	15.2	4.1	4.9
75X65	12.5	398.9	3.7	13.9	4.0	3.4
75X160	12.3	405.9	3.4	15.4	3.9	3.9
75X176	12.6	353.3	2.7	15.5	3.8	3.9
75X177	12.1	466.0	3.3	14.5	4.2	4.2
111X65	11.8	438.2	3.3	15.6	4.1	4.9
111X160	12.5	399.7	3.4	13.2	3.9	3.4
111X176	12.1	422.5	3.4	15.3	4.1	4.1
111X177	12.6	441.7	3.8	15.1	4.0	4.1
157-1X65	12.8	386.2	3.9	12.5	3.8	3.0
157-1X160	12.4	378.8	3.5	13.4	3.7	3.3
157-1X176	12.6	388.3	3.4	13.3	3.9	3.3
157-1X177	11.9	349.7	3.6	13.0	3.9	3.0
157-2X65	12.8	428.4	3.6	12.0	4.0	3.3
157-2X160	12.3	365.4	3.4	13.4	3.7	3.3
157-2X176	12.8	373.7	3.4	14.3	3.8	3.5
157-2X177	12.3	366.9	3.7	12.5	3.7	2.9
186X65	12.8	425.4	3.3	15.6	3.8	3.3
186X160	11.2	416.4	3.4	14.8	3.8	3.5
186X176	13.1	412.6	3.8	14.6	3.9	3.9
186X177	13.5	437.3	3.9	14.5	3.9	3.8

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness%	Cob length (cm)	Cob diameter (cm)	Yield (t\h)
			Genotype			
203X65	11.9	460.1	3.5	14.9	4.0	3.0
203X160	11.8	403.6	3.4	13.2	3.7	3.2
203X176	10.8	351.8	3.8	13.4	3.8	2.7
203X177	12.0	401.4	4.0	14.5	4.2	4.5
			Year X Genotype			
Y_1X8	-	344.4	3.3	12.5	3.7	1.2
Y_1X45	-	327.0	3.9	15.4	3.7	1.7
Y_1X65	-	411.6	3.2	17.0	3.9	1.1
Y_1X66	-	474.4	3.1	16.8	3.9	1.6
Y_1X75	-	315.4	3.4	13.2	3.7	1.5
Y_1X111	-	364.0	3.6	12.4	3.7	1.3
Y_1X157-1	-	266.4	3.3	10.5	3.6	1.0
Y_1X157-2	-	244.2	4.2	9.2	3.4	1.3
Y_1X160	-	330.5	4.6	12.3	3.8	1.2
Y_1X176	-	363.6	3.9	14.5	3.3	1.4
Y_1X177	-	407.2	3.8	12.1	3.6	1.2
Y_1X186	-	359.3	3.7	14.5	3.5	1.4
Y_1X203	-	299.4	4.3	12.2	3.6	1.1
Y_1X(8X65)	-	467.8	3.3	16.0	3.9	3.9
Y_1X(8X160)	-	381.7	3.2	13.0	3.8	2.8
Y_1X(8X176)	-	453.4	2.9	16.2	4.1	5.2
Y_1X(8X177)	-	412.7	3.6	15.1	4.1	3.2
Y_1X(45X65)	-	455.8	3.6	15.6	4.1	3.0
Y_1X(45X160)	-	404.8	3.2	14.3	3.9	3.4
Y_1X(45X176)	-	499.0	4.1	15.0	3.9	3.7
Y_1X(45X177)	-	428.6	4.0	14.5	3.9	3.8
Y_1X(66X65)	-	450.4	3.7	14.0	3.9	3.3
Y_1X(66X160)	-	489.9	3.0	17.3	4.0	4.8

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness%	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Genotype			
Y_1X(66X176)	-	490.3	2.8	17.4	3.9	4.1
Y_1X(66X177)	-	448.4	3.3	16.6	4.1	5.4
Y_1X(75X65)	-	422.7	3.9	14.4	4.1	3.4
Y_1X(75X160)	-	431.9	3.4	16.2	3.9	3.9
Y_1X(75X176)	-	477.5	3.1	17.1	4.2	3.9
Y_1X(75X177)	-	481.8	3.2	14.8	4.1	3.4
Y_1X(111X65)	-	464.9	3.3	16.0	4.1	5.2
Y_1X(111X160)	-	418.6	3.4	14.4	3.9	3.6
Y_1X(111X176)	-	425.9	3.3	16.0	4.2	4.2
Y_1X(111X177)	-	424.4	3.9	14.3	3.8	3.1
Y_1X(157-1X65)	-	421.6	3.7	13.1	3.9	2.9
Y_1X(157-1X160)	-	420.8	3.4	14.1	3.7	3.4
Y_1X(157-1X176)	-	389.0	3.5	13.0	3.8	3.4
Y_1X(157-1X177)	-	371.0	3.6	13.5	3.9	3.6
Y_1X(157-2X65)	-	402.1	3.6	12.4	4.0	3.4
Y_1X(157-2X160)	-	355.8	3.4	14.2	3.6	3.4
Y_1X(157-2X176)	-	336.5	3.8	13.8	3.8	3.5
Y_1X(157-2X177)	-	372.9	3.9	12.3	3.6	2.4
Y_1X(186X65)	-	450.3	2.7	17.0	3.7	3.7
Y_1X(186X160)	-	422.7	3.1	16.1	3.9	4.0
Y_1X(186X176)	-	454.2	3.2	18.0	4.1	5.9
Y_1X(186X177)	-	444.7	3.6	15.9	3.9	3.8
Y_1X(203X65)	-	460.1	3.3	15.0	4.0	4.2
Y_1X(203X160)	-	407.1	3.3	14.9	3.9	4.5
Y_1X(203X176)	-	385.4	3.3	15.6	4.1	3.1
Y_1X(203X177)	-	414.4	3.7	15.1	4.1	3.9
Y_2X8	-	298.2	3.2	10.1	3.4	1.9
Y_2X45	-	446.9	3.5	13.7	4.1	2.6

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness%	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Genotype			
Y_2X65	-	413.9	4.3	11.8	3.7	1.9
Y_2X66	-	364.7	3.9	12.5	3.8	2.5
Y_2X75	-	336.1	3.2	11.2	3.7	2.5
Y_2X111	-	406.4	3.7	11.3	3.7	2.2
Y_2X157-1	-	281.0	3.8	9.5	3.5	1.8
Y_2X157-2	-	292.9	4.0	10.0	3.5	1.9
Y_2X160	-	355.6	4.3	11.6	3.6	2.1
Y_2X176	-	405.7	3.4	14.4	3.8	2.4
Y_2X177	-	354.5	3.7	11.9	3.8	2.3
Y_2X186	-	304.8	3.7	11.8	3.6	2.5
Y_2X203	-	337.2	4.1	12.0	3.6	1.6
Y_2X(8X65)	-	434.0	4.6	13.8	4.0	3.6
Y_2X(8X160)	-	333.9	3.4	11.8	3.5	2.9
Y_2X(8X176)	-	321.9	4.0	10.4	3.4	2.2
Y_2X(8X177)	-	384.2	3.3	14.4	3.7	3.7
Y_2X(45X65)	-	399.2	3.2	13.1	3.9	3.8
Y_2X(45X160)	-	358.9	3.5	13.8	3.8	3.5
Y_2X(45X176)	-	427.0	3.1	14.1	4.0	4.5
Y_2X(45X177)	-	389.9	2.9	12.9	4.0	3.9
Y_2X(66X65)	-	447.6	3.5	12.9	3.7	3.0
Y_2X(66X160)	-	391.3	3.9	13.3	3.4	3.1
Y_2X(66X176)	-	424.8	3.0	15.3	3.9	4.7
Y_2X(66X177)	-	332.5	3.8	13.9	3.9	4.4
Y_2X(75X65)	-	375.0	3.6	13.3	3.9	3.4
Y_2X(75X160)	-	379.9	3.5	14.6	3.8	3.8
Y_2X(75X176)	-	229.2	2.3	13.9	3.3	3.9
Y_2X(75X177)	-	450.2	3.5	14.1	4.2	4.9
Y_2X(111X65)	-	411.5	3.2	15.3	4.0	4.5

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness%	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Genotype			
Y_2X(111X160)	-	380.9	3.5	12.1	3.8	3.2
Y_2X(111X176)	-	419.1	3.5	14.7	4.0	3.9
Y_2X(111X177)	-	458.9	3.6	15.8	4.1	5.0
Y_2X(157-1X65)	-	350.8	4.1	11.9	3.6	3.1
Y_2X(157-1X160)	-	336.9	3.6	12.7	3.7	3.2
Y_2X(157-1X176)	-	387.7	3.3	13.5	4.1	3.3
Y_2X(157-1X177)	-	328.4	3.6	12.4	4.0	2.4
Y_2X(157-2X65)	-	454.7	3.6	11.7	4.1	3.2
Y_2X(157-2X160)	-	375.1	3.5	12.5	3.8	3.1
Y_2X(157-2X176)	-	390.9	3.1	14.9	3.9	3.5
Y_2X(157-2X177)	-	361.0	3.6	12.8	3.9	3.4
Y_2X(186X65)	-	400.5	3.9	14.1	3.8	2.9
Y_2X(186X160)	-	410.2	3.8	13.5	3.7	3.1
Y_2X(186X176)	-	371.1	4.4	11.3	3.6	2.0
Y_2X(186X177)	-	429.9	4.2	13.1	3.8	3.7
Y_2X(203X65)	-	460.1	3.6	14.7	4.0	1.8
Y_2X(203X160)	-	400.1	3.5	11.5	3.5	1.9
Y_2X(203X176)	-	318.2	4.3	11.3	3.5	2.4
Y_2X(203X177)	-	388.3	4.3	13.8	4.1	5.1
			Season X Genotype			
S_1X8	11.0	231.8	3.1	9.4	3.2	1.6
S_1X45	11.0	353.3	4.0	14.5	3.8	2.2
S_1X65	12.2	383.3	3.6	14.4	3.9	1.5
S_1X66	13.0	375.9	3.4	15.1	3.8	2.0
S_1X75	10.3	278.4	3.3	10.3	3.5	2.2
S_1X111	11.3	386.1	3.6	11.8	3.6	1.8
S_1X157-1	12.0	252.6	3.5	9.4	3.4	1.3
S_1X157-2	11.3	225.3	4.2	8.9	3.4	1.6

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness%	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Season X Genotype			
S_1X160	11.8	311.6	4.6	11.0	3.5	1.9
S_1X176	12.5	338.4	4.1	13.7	3.4	2.0
S_1X177	11.3	334.3	3.8	10.8	3.5	1.5
S_1X186	12.0	295.2	3.8	11.7	3.3	2.0
S_1X203	11.7	316.4	4.0	12.8	3.6	1.0
S_1X(8X65)	12.0	463.8	3.4	15.7	3.4	4.4
S_1X(8X160)	13.7	388.4	3.4	12.2	3.7	2.8
S_1X(8X176)	11.5	372.9	3.5	13.2	3.8	3.5
S_1X(8X177)	12.5	405.0	3.3	14.4	3.9	3.2
S_1X(45X65)	11.2	419.6	3.9	14.7	3.9	3.1
S_1X(45X160)	11.5	382.5	3.6	13.9	3.9	3.0
S_1X(45X176)	11.8	447.8	3.9	14.6	3.9	3.3
S_1X(45X177)	11.5	419.6	3.7	13.3	3.8	3.7
S_1X(66X65)	12.2	500.7	3.4	14.4	4.1	3.6
S_1X(66X160)	12.3	515.7	2.9	17.4	4.0	4.6
S_1X(66X176)	11.0	451.4	2.7	17.3	3.9	5.0
S_1X(66X177)	11.3	431.2	3.6	16.0	4.1	4.4
S_1X(75X65)	12.7	423.0	3.7	14.0	4.0	3.8
S_1X(75X160)	12.3	418.9	3.2	16.0	4.0	3.8
S_1X(75X176)	12.5	385.3	3.3	15.7	3.9	3.7
S_1X(75X177)	12.2	406.8	3.7	13.3	3.9	3.5
S_1X(111X65)	12.2	435.6	3.3	15.3	4.0	4.5
S_1X(111X160)	12.7	405.1	3.6	13.3	3.8	3.1
S_1X(111X176)	11.8	424.9	3.5	15.1	3.9	3.7
S_1X(111X177)	12.5	417.0	4.0	13.6	3.8	3.1
S_1X(157-1X65)	12.5	360.5	4.2	11.7	3.6	2.4
S_1X(157-1X160)	12.5	398.4	3.3	14.2	3.8	3.7
S_1X(157-1X176)	12.5	366.5	3.8	12.8	3.8	2.8

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness%	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Season X Genotype			
S_1X(157-1X177)	11.8	329.0	3.9	11.6	3.6	2.6
S_1X(157-2X65)	13.0	427.3	3.6	11.9	4.1	3.3
S_1X(157-2X160)	12.3	345.5	3.7	13.6	3.7	2.6
S_1X(157-2X176)	12.5	360.7	3.5	14.6	3.7	2.8
S_1X(157-2X177)	11.8	380.5	4.0	12.7	3.7	3.1
S_1X(186X65)	13.3	436.5	3.3	16.2	3.8	3.9
S_1X(186X160)	12.0	375.9	3.6	15.0	3.7	3.0
S_1X(186X176)	13.2	368.2	3.4	14.1	3.9	3.3
S_1X(186X177)	13.0	451.2	4.0	15.0	4.0	3.6
S_1X(203X65)	11.8	478.3	3.6	14.7	4.0	2.9
S_1X(203X160)	12.0	386.0	3.3	13.7	3.7	2.6
S_1X(203X176)	11.0	389.5	4.0	14.1	3.9	3.1
S_1X(203X177)	12.0	412.1	3.9	15.3	4.1	3.9
S_2X8	14.0	410.7	3.4	13.2	3.9	1.5
S_2X45	9.0	420.6	3.4	14.7	3.9	2.1
S_2X65	11.3	442.2	4.0	14.4	3.7	1.6
S_2X66	13.7	463.3	3.6	14.2	3.8	2.1
S_2X75	11.0	373.6	3.3	14.1	4.0	1.7
S_2X111	10.0	384.3	3.7	12.0	3.8	1.7
S_2X157-1	11.0	294.8	3.6	10.6	3.7	1.5
S_2X157-2	10.3	312.0	4.0	10.3	3.4	1.6
S_2X165	10.7	374.6	4.3	12.9	3.8	1.5
S_2X176	12.7	430.9	3.2	15.2	3.7	1.9
S_2X177	11.0	427.3	3.6	13.2	3.9	1.9
S_2X186	12.3	368.9	3.5	14.6	3.8	1.8
S_2X203	9.3	320.2	4.3	11.4	3.7	1.7
S_2X(8X65)	12.0	438.0	4.5	14.2	3.9	3.2
S_2X(8X160)	12.0	327.2	3.2	12.6	3.7	2.9

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Season X Genotype			
S_2X(8X176)	13.0	402.4	3.4	13.3	3.8	3.9
S_2X(8X177)	12.7	391.9	3.5	15.1	3.9	3.7
S_2X(45X65)	11.0	435.3	3.0	14.1	4.1	3.7
S_2X(45X160)	11.0	381.2	3.1	14.2	3.9	3.9
S_2X(45X176)	11.3	428.3	3.3	14.6	4.0	4.8
S_2X(45X177)	11.3	398.9	3.1	14.1	4.0	5.0
S_2X(66X65)	11.7	397.3	3.8	12.4	3.5	2.7
S_2X(66X160)	11.3	365.5	4.1	13.1	3.4	3.2
S_2X(66X176)	12.3	463.8	3.1	15.5	4.0	3.8
S_2X(66X177)	11.7	349.8	3.6	14.5	4.0	5.4
S_2X(75X65)	12.3	374.8	3.7	13.7	4.0	2.9
S_2X(75X160)	12.3	392.9	3.6	14.8	3.8	3.9
S_2X(75X176)	12.7	321.4	2.0	15.2	3.7	4.1
S_2X(75X177)	12.0	525.3	2.9	15.6	4.4	4.8
S_2X(111X65)	11.3	440.9	3.3	16.0	4.1	5.3
S_2X(111X160)	12.3	394.4	3.3	13.2	3.9	3.6
S_2X(111X176)	12.3	420.0	3.3	15.6	4.3	4.4
S_2X(111X177)	12.7	466.4	3.6	16.5	4.1	5.1
S_2X(157-1X65)	13.0	411.9	3.6	13.3	3.9	3.6
S_2X(157-1X160)	12.3	359.2	3.7	12.6	3.6	2.9
S_2X(157-1X176)	12.7	410.1	3.1	13.7	4.0	3.9
S_2X(157-1X177)	12.0	370.4	3.3	14.4	4.3	3.3
S_2X(157-2X65)	12.7	429.5	3.5	12.2	4.0	3.3
S_2X(157-2X160)	12.3	385.4	3.2	13.1	3.7	4.0
S_2X(157-2X176)	13.0	386.7	3.4	14.0	4.1	4.2
S_2X(157-2X177)	12.7	353.4	3.5	12.3	3.8	2.7
S_2X(186X65)	12.3	414.3	3.3	15.0	3.7	2.7

S_2X(186X160)	10.3	456.9	3.2	14.6	3.9	4.0

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Season X Genotype			
S_2X(186X176)	13.0	457.1	4.1	15.1	3.9	4.6
S_2X(186X177)	14.0	423.5	3.8	14.0	3.8	3.9
S_2X(203X65)	12.0	441.8	3.3	15.0	4.0	3.1
S_2X(203X160)	11.7	421.3	3.5	12.7	3.7	3.8
S_2X(203X176)	10.7	314.1	3.6	12.7	3.7	2.3
S_2X(203X177)	12.0	390.7	4.1	13.6	4.3	5.1
			Year X Season X Genotype			
Y_1XS_1X8	-	-	3.5	11.7	3.6	1.5
Y_1XS_1X45	-	-	3.9	16.7	4.0	2.4
Y_1XS_1X65	-	-	2.9	17.8	4.2	1.1
Y_1XS_1X66	-	-	3.1	17.8	4.2	1.8
Y_1XS_1X75	-	-	4.1	11.7	3.7	1.6
Y_1XS_1X111	-	-	3.7	12.3	3.8	1.9
Y_1XS_1X157-1	-	-	3.6	9.2	3.5	1.3
Y_1XS_1X157-2	-	-	3.4	9.7	3.7	1.3
Y_1XS_1X160	-	-	4.5	12.1	3.7	1.9
Y_1XS_1X176	-	-	4.4	14.8	3.1	1.4
Y_1XS_1X177	-	-	4.5	10.9	3.4	1.1
Y_1XS_1X186	-	-	4.0	12.0	3.3	1.5
Y_1XS_1X203	-	-	4.2	13.5	3.6	1.1
Y_1XS_1X(8X65)	-	-	3.3	16.0	4.1	4.7
Y_1XS_1X(8X160)	-	-	3.6	11.8	3.8	2.6
Y_1XS_1X(8X176)	-	-	3.0	16.5	4.4	5.2
Y_1XS_1X(8X177)	-	-	3.7	14.8	4.1	2.6
Y_1XS_1X(45X65)	-	-	4.3	14.7	3.9	2.2
Y_1XS_1X(45X160)	-	-	3.7	13.1	3.9	3.4
Y_1XS_1X(45X176)	-	-	4.2	15.5	4.0	3.7

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
Y_1XS_1X(45X177)	-	-	4.3	15.2	3.8	3.6

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Season X Genotype			
Y_1XS_1X(66X65)	-	-	3.8	14.0	4.1	3.4
Y_1XS_1X(66X160)	-	-	3.1	19.2	4.2	6.7
Y_1XS_1X(66X176)	-	-	2.8	17.1	3.8	4.5
Y_1XS_1X(66X177)	-	-	3.3	17.6	4.4	5.7
Y_1XS_1X(75X65)	-	-	3.7	14.2	4.0	4.1
Y_1XS_1X(75X160)	-	-	3.5	16.5	4.0	4.7
Y_1XS_1X(75X176)	-	-	3.1	18.3	4.3	4.8
Y_1XS_1X(75X177)	-	-	4.0	13.9	4.0	3.6
Y_1XS_1X(111X65)	-	-	3.2	16.6	4.0	5.6
Y_1XS_1X(111X160)	-	-	3.6	13.8	3.9	3.5
Y_1XS_1X(111X176)	-	-	3.6	15.4	4.1	4.1
Y_1XS_1X(111X177)	-	-	4.2	14.0	3.8	3.5
Y_1XS_1X(157-1X65)	-	-	3.9	11.3	3.8	2.5
Y_1XS_1X(157-1X160)	-	-	3.3	14.1	3.8	3.6
Y_1XS_1X(157-1X176)	-	-	4.1	12.9	3.8	3.2
Y_1XS_1X(157-1X177)	-	-	4.1	12.9	3.8	3.2
Y_1XS_1X(157-2X65)	-	-	4.1	11.6	4.0	2.7
Y_1XS_1X(157-2X160)	-	-	3.5	14.4	3.5	2.9
Y_1XS_1X(157-2X176)	-	-	3.6	15.6	3.6	3.8
Y_1XS_1X(157-2X177)	-	-	4.4	12.9	3.8	3.2
Y_1XS_1X(186X65)	-	-	2.7	16.4	4.0	4.2
Y_1XS_1X(186X160)	-	-	3.3	17.1	4.0	3.7
Y_1XS_1X(186X176)	-	-	3.1	16.9	4.1	4.8
Y_1XS_1X(186X177)	-	-	3.7	17.1	4.2	4.2
Y_1XS_1X(203X65)	-	-	3.8	14.3	4.0	4.4
Y_1XS_1X(203X160)	-	-	3.5	14.4	3.9	3.5
Y_1XS_1X(203X176)	-	-	4.3	15.1	4.0	3.4

$Y_1XS_1X(203X177)$	-	-	3.9	15.8	4.2	4.4

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Season X Genotype			
Y_1XS_2X8	-	-	3.1	13.3	3.8	0.9
Y_1XS_2X45	-	-	3.9	14.1	3.0	1.0
Y_1XS_2X65	-	-	3.6	16.2	3.6	1.1
Y_1XS_2X66	-	-	3.1	15.8	3.6	1.4
Y_1XS_2X75	-	-	2.7	14.7	3.8	1.3
Y_1XS_2X111	-	-	3.4	12.5	3.5	0.7
Y_1XS_2X157-1	-	-	2.9	11.8	3.8	0.7
Y_1XS_2X157-2	-	-	3.9	8.7	3.0	1.2
Y_1XS_2X160	-	-	4.8	12.5	3.9	0.6
Y_1XS_2X176	-	-	3.4	14.1	3.5	1.4
Y_1XS_2X177	-	-	3.0	13.2	3.8	1.2
Y_1XS_2X186	-	-	3.4	17.0	3.6	1.2
Y_1XS_2X203	-	-	4.4	10.9	3.7	0.9
$Y_1XS_2X(8X65)$	-	-	3.2	16.0	3.7	3.2
$Y_1XS_2X(8X160)$	-	-	2.8	14.1	3.8	3.0
$Y_1XS_2X(8X176)$	-	-	2.8	15.9	3.9	5.2
$Y_1XS_2X(8X177)$	-	-	3.2	15.3	4.1	3.7
$Y_1XS_2X(45X65)$	-	-	3.0	16.5	4.3	3.8
$Y_1XS_2X(45X160)$	-	-	2.7	15.5	3.9	3.4
$Y_1XS_2X(45X176)$	-	-	3.9	14.5	3.8	3.7
$Y_1XS_2X(45X177)$	-	-	3.6	13.8	3.9	4.0
$Y_1XS_2X(66X65)$	-	-	3.6	14.0	3.6	3.2
$Y_1XS_2X(66X160)$	-	-	3.0	15.3	3.8	2.9
$Y_1XS_2X(66X176)$	-	-	2.8	17.8	4.1	3.7
$Y_1XS_2X(66X177)$	-	-	3.2	15.5	4.0	5.1
$Y_1XS_2X(75X65)$	-	-	4.0	14.5	4.1	2.7

Y_1XS_2X(75X160)	-	-	3.2	15.9	3.9	3.2
Y_1XS_2X(75X176)	-	-	3.0	15.8	4.2	3.0

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Season X Genotype			
Y_1XS_2X(75X177)	-	-	2.4	15.8	4.2	3.2
Y_1XS_2X(111X65)	-	-	3.4	15.3	4.2	4.8
Y_1XS_2X(111X160)	-	-	3.1	14.9	3.9	3.6
Y_1XS_2X(111X176)	-	-	2.9	16.6	4.3	4.4
Y_1XS_2X(111X177)	-	-	3.7	14.5	3.9	2.8
Y_1XS_2X(157-1X65)	-	-	3.4	14.9	4.0	3.2
Y_1XS_2X(157-1X160)	-	-	3.5	14.1	3.6	3.2
Y_1XS_2X(157-1X176)	-	-	3.0	13.2	3.8	3.5
Y_1XS_2X(157-1X177)	-	-	3.1	14.1	4.0	3.9
Y_1XS_2X(157-2X65)	-	-	3.0	13.2	4.1	4.1
Y_1XS_2X(157-2X160)	-	-	3.4	14.0	3.7	3.9
Y_1XS_2X(157-2X176)	-	-	3.9	12.0	4.0	3.2
Y_1XS_2X(157-2X177)	-	-	3.4	11.6	3.5	1.6
Y_1XS_2X(186X65)	-	-	2.6	17.7	3.4	3.2
Y_1XS_2X(186X160)	-	-	2.9	15.2	3.9	4.2
Y_1XS_2X(186X176)	-	-	3.2	19.0	4.2	7.0
Y_1XS_2X(186X177)	-	-	3.5	14.6	3.7	3.4
Y_1XS_2X(203X65)	-	-	2.8	15.8	4.0	4.0
Y_1XS_2X(203X160)	-	-	3.0	15.3	3.8	5.4
Y_1XS_2X(203X176)	-	-	2.3	16.0	4.1	2.7
Y_1XS_2X(203X177)	-	-	3.4	14.4	4.2	3.3
Y_2XS_1X8	-	-	2.7	7.1	2.9	1.7
Y_2XS_1X45	-	-	4.0	12.2	3.6	2.0
Y_2XS_1X65	-	-	4.3	11.0	3.5	1.9
Y_2XS_1X66	-	-	3.7	12.4	3.5	2.1

Y_2XS_1X75	-	-	2.5	9.0	3.2	2.9
Y_2XS_1X111	-	-	3.4	11.2	3.4	1.7

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Season X Genotype			
Y_2XS_1X157-1	-	-	3.5	9.5	3.4	1.4
Y_2XS_1X157-2	-	-	4.0	8.0	3.1	1.8
Y_2XS_1X160	-	-	4.7	9.9	3.4	1.8
Y_2XS_1X176	-	-	3.8	12.5	3.6	2.5
Y_2XS_1X177	-	-	3.2	10.7	3.5	2.0
Y_2XS_1X186	-	-	3.7	11.4	3.3	2.5
Y_2XS_1X203	-	-	3.8	12.1	3.6	0.9
$Y_2XS_1X(8X65)$	-	-	3.4	15.3	3.9	4.1
$Y_2XS_1X(8X160)$	-	-	3.2	12.6	3.6	3.0
$Y_2XS_1X(8X176)$	-	-	3.9	9.9	3.2	1.8
$Y_2XS_1X(8X177)$	-	-	2.9	14.0	3.7	3.8
$Y_2XS_1X(45X65)$	-	-	3.4	14.6	3.9	4.0
$Y_2XS_1X(45X160)$	-	-	3.4	14.7	3.9	2.6
$Y_2XS_1X(45X176)$	-	-	3.5	13.6	3.7	3.0
$Y_2XS_1X(45X177)$	-	-	3.1	11.4	3.8	3.7
$Y_2XS_1X(66X65)$	-	-	3.0	14.9	4.0	3.8
$Y_2XS_1X(66X160)$	-	-	2.6	15.6	3.8	2.7
$Y_2XS_1X(66X176)$	-	-	2.5	17.5	3.9	5.5
$Y_2XS_1X(66X177)$	-	-	3.8	14.3	3.8	3.0
$Y_2XS_1X(75X65)$	-	-	3.7	13.7	3.9	3.5
$Y_2XS_1X(75X160)$	-	-	2.8	15.5	3.9	3.0
$Y_2XS_1X(75X176)$	-	-	3.5	13.1	3.5	2.5
$Y_2XS_1X(75X177)$	-	-	3.5	12.7	3.9	3.3
$Y_2XS_1X(111X65)$	-	-	3.4	14.0	4.0	3.4
$Y_2XS_1X(111X160)$	-	-	3.5	12.8	3.7	2.8

Y_2XS_1X(111X176)	-	-	3.4	14.9	3.8	3.3
Y_2XS_1X(111X177)	-	-	3.9	13.3	3.8	2.6

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Season X Genotype			
Y_2XS_1X(157-1X65)	-	-	4.4	12.1	3.4	2.2
Y_2XS_1X(157-1X160)	-	-	3.3	14.3	3.8	3.8
Y_2XS_1X(157-1X176)	-	-	3.5	12.8	3.9	2.4
Y_2XS_1X(157-1X177)	-	-	3.7	10.2	3.5	2.0
Y_2XS_1X(157-2X65)	-	-	3.1	12.2	4.1	3.9
Y_2XS_1X(157-2X160)	-	-	3.9	12.8	3.8	2.2
Y_2XS_1X(157-2X176)	-	-	3.4	13.6	3.7	1.9
Y_2XS_1X(157-2X177)	-	-	3.6	12.5	3.6	3.0
Y_2XS_1X(186X65)	-	-	3.8	16.0	3.6	3.6
Y_2XS_1X(186X160	-	-	4.0	13.0	3.5	2.3
Y_2XS_1X(186X176)	-	-	3.7	11.3	3.6	1.8
Y_2XS_1X(186X177)	-	-	4.3	12.8	3.7	2.9
Y_2XS_1X(203X65)	-	-	3.5	15.1	4.0	1.3
Y_2XS_1X(203X160)	-	-	3.0	12.9	3.4	1.6
Y_2XS_1X(203X176)	-	-	3.8	13.2	3.8	2.9
Y_2XS_1X(203X177)	-	-	3.9	14.8	3.9	3.4
Y_2XS_2X8	-	-	3.6	13.1	4.0	2.2
Y_2XS_2X45	-	-	2.9	15.2	4.5	3.2
Y_2XS_2X65	-	-	4.3	12.6	3.9	2.0
Y_2XS_2X66	-	-	4.1	12.6	4.1	2.8
Y_2XS_2X75	-	-	3.9	13.4	4.1	2.0
Y_2XS_2X111	-	-	4.0	11.5	4.0	2.7
Y_2XS_2X157-1	-	-	4.2	9.5	3.6	2.3
Y_2XS_2X157-2	-	-	4.0	11.9	3.8	1.9
Y_2XS_2X160	-	-	3.9	13.3	3.8	2.4

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
Y_2XS_2X176	-	-	3.0	16.3	3.9	2.4
Y_2XS_2X177	-	-	4.3	13.1	4.0	2.6

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Season X Genotype			
Y_2XS_2X186	-	-	3.6	12.2	3.9	2.5
Y_2XS_2X203	-	-	4.3	11.8	3.6	2.4
Y_2XS_2X(8X65)	-	-	5.8	12.4	4.1	3.2
Y_2XS_2X(8X160)	-	-	3.6	11.0	3.5	2.8
Y_2XS_2X(8X176)	-	-	4.0	10.8	3.7	2.6
Y_2XS_2X(8X177)	-	-	3.7	14.8	3.7	3.7
Y_2XS_2X(45X65)	-	-	3.0	11.7	3.9	3.5
Y_2XS_2X(45X160)	-	-	3.5	12.9	3.8	4.4
Y_2XS_2X(45X176	-	-	2.7	14.7	4.2	5.9
Y_2XS_2X(45X177)	-	-	2.7	14.4	4.1	6.0
Y_2XS_2X(66X65)	-	-	4.0	10.9	3.4	2.2
Y_2XS_2X(66X160)	-	-	5.2	11.0	3.0	3.5
Y_2XS_2X(66X176)	-	-	3.4	13.2	3.9	3.8
Y_2XS_2X(66X177)	-	-	3.9	13.4	4.1	5.7
Y_2XS_2X(75X65)	-	-	3.5	12.9	3.9	3.2
Y_2XS_2X(75X160)	-	-	4.1	13.8	3.6	4.6
Y_2XS_2X(75X176)	-	-	1.0	14.6	3.2	5.2
Y_2XS_2X(75X177)	-	-	3.5	15.5	4.6	6.5
Y_2XS_2X(111X65)	-	-	3.1	16.6	4.0	5.7
Y_2XS_2X(111X160)	-	-	3.5	11.5	3.9	3.6
Y_2XS_2X(111X176)	-	-	3.6	14.5	4.2	4.4
Y_2XS_2X(111X177)	-	-	3.4	18.4	4.4	7.4
Y_2XS_2X(157-1X65)	-	-	3.7	11.6	3.8	4.0
Y_2XS_2X(157-1X160)	-	-	4.8	11.0	3.6	2.6
Y_2XS_2X(157-1X176)	-	-	3.2	14.2	4.2	4.2

Y_2XS_2X(157-1X177)	-	-	3.5	14.6	4.5	2.7
Y_2XS_2X(157-2X65)	-	-	4.0	11.1	4.0	2.5

Table 8. Continued.

Genotype	Total leaves/plant	Leaf area (cm^2)	Cob barness %	Cob length (cm)	Cob diameter (cm)	Yield (t/h)
			Year X Season X Genotype			
Y_2XS_2X(157-2X160)	-	-	3.0	12.2	3.7	4.0
Y_2XS_2X(157-2X176)	-	-	2.8	16.1	4.1	5.2
Y_2XS_2X(157-2X177)	-	-	3.6	13.0	4.1	3.9
Y_2XS_2X(186X65)	-	-	4.0	12.2	4.1	2.2
Y_2XS_2X(186X160)	-	-	3.5	14.0	3.9	3.8
Y_2XS_2X(186X176)	-	-	5.0	11.3	3.6	2.2
Y_2XS_2X(186X177)	-	-	4.0	13.4	3.9	4.5
Y_2XS_2X(8X65)	-	-	3.8	14.3	4.0	2.2
Y_2XS_2X(8X160)	-	-	4.0	10.0	3.6	2.3
Y_2XS_2X(8X176)	-	-	4.9	9.3	3.3	1.8
Y_2XS_2X(8X177)	-	-	4.7	12.8	4.3	6.8
Over all Mean	12.0	392.1	3.6	13.7	3.8	3.1
Parent over all mean	11.6	350.2	3.7	12.5	3.7	1.7
Hybrid over all mean	12.2	407.3	3.5	14.2	3.9	3.6
C.V.%	6.6	21.5	17.6	15.3	9.6	34.8

Y_1 = 2002
Y_2 = 2003
S_1 = Summer
S_2 = Winter

Phenotypic variability for all characters can be summarized as follows:

4.1.1. Days to 50% tasselling:

Individual analysis of variance indicated that, the differences among the entries were significant (Table 5). In addition the across seasons analysis (Table 6). revealed significant difference among genotypes for years, seasons, years x seasons, genotypes, years x genotypes, seasons x genotypes and years x seasons x genotypes.

The mean of days to 50% tasselling was 55.4 in summer 2002, 55.3 in summer 2003, 68.7 in winter 2002 and 71.4 in winter 2003. The overall mean for the summer was 55.4 and 70.1 days for winter.

In summer 2002, the earliest days to 50% tasselling 52.3, was reached by inbred line 203, and the latest 61.2, by inbred line 177.In summer 2003, the earliest genotypes were 66x160 and 203x160, which attained 50% tasselling in 50 days and the latest one ,was line 176, which took 59 days to reach 50% tasselling.

In the winter of 2002, the earliest entry was 203x176, which reached its 50% tasselling in 64 days and the latest one was line 65, which attained its 50% tasselling in 73.0 days. In the winter of 2003, the earliest entry was 203x177, which reached its 50% tasselling in 66 days and the latest one was 45x65, which attained its 50 tasselling in 76.7 days. The coefficient of variations for this character were 4.4, 3.0, 3.6, 3.6% for summer 2002, summer 2003, winter 2002 and winter 2003 respectively (Table 7).

For years, days to 50% tasselling was 62.0 days in 2002 and 63.3 in 2003. For seasons, days to 50% tasselling was, 55.3 in the summer and 70.0 in the winter. The significance of the interaction of years x seasons, showed that the longest period to 50% tasselling was 71.4, days obtained during the winter of 2003 and the shortest period was 55.2, resulted during the summer of 2003. Among the genotypes, the longest days to 50% tasselling was 65.8, given by line 176 and the shortest one 50.5, scored by the hybrid 203 x 176. The interaction of years x genotypes, revealed that, the earliest days to tasselling 57.7, was reached in 2002 by the hybrid 203x176, while the latest one 67.2, was reached in 2002 by inbred line 65. Similarly the interaction of seasons x genotypes, showed that, the shortest period to 50% tasselling was 52.8, reached during the summer, by the hybrid 203x176, while the longest one of 64.0, was reached during the winter, by inbred line 176. The interaction of years x seasons x genotypes, showed that, the shortest period in 50% tasselling 52.3, was achieved during summer of 2002 by the entries 111, 157-2 x160, 203 x 176 and the longest one 76.7, was reached during winter of 2003 by the hybrid 45 x 65. Combined across seasons, showed that the coefficient of variation for this character was 3.8% (Table 8).

4.1.2. Plant height (cm):

Analysis of variance (Table 5), showed that, the variation in plant height among the 13 parental lines and their 36 hybrids over the four seasons, was significant. Also, the across seasons analysis (Table 6), revealed significant difference between years, seasons, years x seasons, genotypes, years x genotypes, seasons x genotypes, years x seasons x genotypes. The mean plant height was 148.5, 139.0, 147.4 and 127.8cm in summer 2002, summer 2003 winter 2002 and winter 2003, respectively. Plant height, in summer 2002, ranged between 102.7cm, recorded for line 75, and 183.8cm, scored by the hybrid 186 x177. In summer 2003, it ranged from 91.9cm, recorded for line 8, to 162.9cm, expressed by line 177. In winter 2002, this trait varied from 96.6cm, obtained by line 157-2, to 181.7cm, achieved by the hybrid 8x177. In winter 2003, it varied from 92.1 cm, recorded for the hybrid 157-1x65, to 180.0cm, scored by line 176. The coefficient of variations for this character were11.4, 11.2, 9.6 and 11.8% for summer 2002, summer 2003, winter 2002 and winter 2003, respectively, (Table 7). The overall mean plant height in across seasons analysis was 104.7 cm, (Table8). For years it was 147.9cm in 2002 and

133.4cm in 2003. For seasons plant height was 143.7cm in summer and was 137.6cm in winter. For years xseasons interaction, the longest plant height of 148.5cm, was obtained during summer 2002. While the shortest one of 127.8cm, was achieved during winter 2003. Among genotypes, mean plant height ranged from 102.7cm, scored by inbred line 75, to 166.8 cm, achieved by the hybrid 186x177. For the years x genotypes interaction, the minimum plant height 98.0cm, was obtained during 2003 from inbred line 157-2 and the maximum one 177.5cm, was obtained during 2002 by the hybrid 186x177. For seasons x genotypes interaction, the minimum plant height of 93.7cm, was obtained during winter by inbred 157-2 and the maximum one 175.3cm, was reached during winter by hybrid 186x177.

For years x seasons x genotypes interaction, the minimum plant height 92.5cm, was obtained during winter 2003 by the inbred line 157-2, while the maximum one 186.0cm, was obtained during summer 2002 by the hybrid 186x177. Combined across seasons, the coefficient of variation for this character was 12.4%.

4.1.3. Days to maturity:

Individual analysis of variance (Table 5), showed that, differences among the evaluated genotypes were significant in the four seasons. In addition the across seasons analysis (Table 6), indicated significant differences between, years, seasons, genotypes and years x seasons, but not significant for years x genotypes, seasons x genotypes, and years x seasons x genotypes. The mean days to maturity was 88.9, 96.1, 102.3 and 104.5 in summer 2002, summer 2003, winter 2002 and winter 2003, respectively. In the summer 2002, the earliest maturing entry 203, which reached its maturity in 79.6 days, and the latest one 176, took 95.3 days to reach maturity.

In the summer 2003, the earliest maturing genotypes was 203, and attained its maturity in 88.7 days, and the latest one line 176, which reached its maturity in 102.1 days. In winter 2002, the earliest maturing was entry 157-2, reached its maturity in 93.6 days and the latest one hybrid 8x65 was reached maturity in 110.4 days.

In winter 2003, the earliest maturing genotypes was line 203, and reached maturity in 96.2 days and the latest entry hybrid 8x65, attained its maturity in 111.6 days.

The coefficient of variations for this character were4.3, 4.1, 4.7 and 3.9% for summer 2002, summer 2003, winter 2002 and winter 2003. respectively, (Table 7). The overall mean days to maturity averaged across seasons was 97.9.

The period to maturity was 95.6 days in 2002, and 100.3 in 2003. Among the genotypes, the earliest genotype (inbred 203) reached maturity in 89.7 days and the latest one (inbred 176) in 104.1 days.For seaons,days to maturity ranged from 92.5 days, was accessed during summer, to 103.4, was expressed during winter. For years x seasons interaction, days to maturity varied from 88.9 days ,was obtained during summer of 2002, to 104.5 days,attained during the winter of 2003. Combined across seasons, the coefficient of variation for this character was 4.3%.

4.1.4. Number of nodes per plant:

Over the four seasons, differences among the 49 genotypes for this character was significant (Table 5). Moreover, the combined analysis (Table 5), showed significant difference among evaluated accessions for years, seasons, genotypes, and years x seasons, years x genotypes and years x seasons x genotypes interaction. The mean number of nodes per plant was 10.8 in summer 2002 and 2003, and 12.2, 10.2, in winter 2002 and 2003, respectively.

The overall mean number of nodes per plant was 10.8 for summer and 11.2 for winter. In the summer 2002, the highest number of nodes per plant 12.7, was produced by inbred line 160 and the lowest one 8.9, by inbred line 75. In summer 2003, the highest number of nodes per plant 12.7, was recorded by inbred line 177 and the lowest one 8.5, revealed by two inbred lines 8 and 75. In winter 2002, the maximum number of nodes per plant was 13.7, and recorded for the hybrid 186x177 and the minimum one 9.6, by inbred line 45. In winter 2003, the maximum number of nodes per plant 11.9, was attained by inbred line 176 and the minimum one 7.3, by the hybrid 8x65. The coefficient of variationS for this character in the individual seasons were 9.8, 9.0, 6.3 and 11.2% for summer 2002, summer 2003, winter 2002 and winter 2003, respectively (Table 7).

Across seasons, the overall number of nodes per plant was 11.8 (Table 8). For years, number of nodes per plant was 11.5 in 2002 and 10.5 in 2003. For seasons it was 10.8 in the summer and 11.2 in the winter. Among the genotypes, the highest number of nodes per plant of 12.1 was produced by inbred line 66 and the lowest one 9.6, by inbred line 75.

For years x seasons, the highest number of nodes per plant was 148.5, produced in summer of 2002 and the lowest one, 127.8 produced in winter of 2003. For years x genotypes interaction, the minimum number of nodes per plant 8.7, was developed during 2003 by hybrid 8x65 and the maximum number 12.7, during 2002 by inbred line 166. For seasons x genotypes interaction, the minimum number of nodes per plant 8.8, was given during summer by inbred line 75, and the maximum number 12.7, during winter by the hybrid 157-2x176. Moreover, for years x seasons x genotypes interaction, the maximum number of nodes per plant of 7.3, was achieved during winter 2003 by the hybrid 8x65 and the maximum number

13.7, during winter 2002 by two hybrids 157-2 x 176 and 186x177. Combined across seasons, showed that, the coefficient of variation for number of nodes per plant was 9.2 (Table 8).

4.1.5. Stem diameter (mm):

Over the four seasons, significant difference was detected among the evaluated accessions for this character. Also the across seasons, showed significant difference among accessions for years, seasons, genotypes, and years x seasons, years x genotypes, seasons x genotypes, years x seasons x genotypes interaction (Table 6).

Mean stem diameter was 18.2, 22.8, 28.0 and 19.0mm in summer 2002, summer 2003, winter 2002 and winter 2003, respectively. In addition, the overall mean stem diameter was 20.5mm in summer and was 23.5mm in winter. In summer 2002, stem diameter ranged from 13.2mm, was expressed by line 203, to 21.3mm, by the hybrid 66x160, while in summer 2003, it ranged from 18.0mm, was achieved by line 157-2 to 25.9mm, by inbred line 66. On the otherhand, stem diameter in winter 2002, varied from 22.0mm, which was achieved by line 157-2 to 31.5mm, by the hybrid 203x65. In winter 2003, it ranged between 12.9mm, was obtained by the hybrid 8x177 to 25.9mm, by line 176.

The coefficient of variations for stem diameter were 8.7, 6.5, 5.9 and 18.8% in summer 2002, summer 2003, winter 2002, and winter 2003, respectively (Table 7).

For years, mean stem diameter 23.1mm, was produced during 2002 and 20.9mm during 2003. For seasons, mean stem diameter 23.5mm, was achieved during winter and 20.5mm, during summer. The overall mean stem diameter averaged across seasons was 22.0mm. For years x seasons interaction, the largest stem diameter of 28.0mm, was achieved during winter of 2002 and the smallest one 18.2mm, during summer of 2002. Among the genotypes the largest stem diameter 24.7mm, was attained by the hybrid 186x177, while the smallest one 18.0mm, by inbred line 203. For years x genotypes interaction, the smallest stem diameter 17.1mm was obtained in 2003, by line 203 and the largest one 25.9mm ,in 2002 by line 66. For seasons x genotypes interaction, the smallest stem diameter of 16.4mm, was attained in summer by inbred line 203 and the largest one 26.8mm, was achieved during winter by inbred line 176. For years x seasons x genotypes, the smallest stem diameter 12.9mm, was achieved in winter 2003 by the hybrid 8x177 and the largest one 31.3mm, was recorded in winter 2002 by the inbred line 66. Combined across seasons, revealed that, the coefficient of variation for this character was 10.3% (Table8).

4.1.6. Plant height to first cob (cm):

Individual analysis of variance (Table 5), indicated significant difference among the evaluated accessions for this character over the four seasons. Also across seasons (Table 6), revealed significant difference for years, genotypes and years x genotypes, seasons x genotypes, years x seasons x genotypes interaction. Non-significant differences were shown for seasons as well as years xseasons interaction. Means of plant height to first cob were 65.5cm in summer 2002, 51.6cm in summer 2003, 65.5cm in winter 2002 and 50.5cm in winter 2003. In the summer 2002, the height to first cob varied from 35.4cm, obtained by inbred line 8, to 81.0cm, was scored by the hybrid 45x177. In the summer 2003, the height to first cob ranged from 23.9cm, scored for the inbred line 8, to 74.5cm, recorded for the hybrid 203x65. In winter 2002, plant height to first cob ranged between 37.0cm, recorded for inbred line 157-2 and 82.6cm, scored by inbred line 66. In winter 2003 it varied from 27.0cm, was attained by the hybrid 8x160, and 89.9 cm, from inbred line 176.

The coefficient of variations for this character in the individual analysis of variance were 15.3, 22.9, 14.1 and 23.8% for summer 2002, summer 2003, winter 2002 and winter 2003, respectively (Table 7).

Across seasons, the overall height to first cob was averaged 58.3cm For years, height to first cob was 51.0cm, in 2003 and 65.5cm in 2002. Among genotypes, the highest length to first cob 68.3cm, was produced by line 176. While the shortest one 39.9cm, was produced by inbred line 75. For years x genotypes interaction, the minimum height to first cob 34.4cm, was recorded during 2003 by inbred line 8 and the maximum one 79.2cm, was obtained during 2002 by the hybrid 185x177. Moreover, for seasons x genotypes, the minimum height to first cob 27.8cm, was achieved during summer by inbred line 8 and the maximum one 83.7cm, was recorded during winter by inbred line 176. For years x seasons x genotypes interaction, height to first cob ranged between 24.0cm, obtained in the summer of 2003 for inbred line 8, to 90.7cm, recorded in the winter of 2003 for inbred line 176. Combined across seasons, the coefficient of variation for this character was 19.3% (Table 8).

4.1.7. Number of ears per plant:

Individual analysis of variance indicated that the differences among the entries for this trait were significant for the summer of both 2002 and 2003, whereas they were not significant for the winter of both years (Table 5). In addition, the across season analysis (Table 6), revealed significant differences between years, years x seasons, years x genotypes and years x seasons x genotypes. On the other hand, differences among seasons, genotypes and seasons x genotypes interaction were not significant.

The mean number of ears per plant was 1.3 in summer 2002 and 1.2 in summer 2003. The overall mean for the summer was 1.3. In summer 2002, the highest number of ears per plant was 2.0, and produced by hybrid 186x160 and the lowest one 1.0, devoloped by 15 entries. In summer 2003, the highest number of ears per plant 2.0, was produced by two crosses 8x177 and 186x65 and the lowest one of 0.8, by two inbred lines 157-1 and 203.

The coefficient of variations for this character were 31.6 and 33.2% for summer 2002 and 2003, respectively, (Table 7).

The overall mean number of ears per plant was 1.4 in 2002 and 1.1 in 2003. For years, x seasons interaction, the maximum number of ears per plant of 1.3, was given during summer and winter of 2002. While the lowest one 1.0, was obtained during winter 2003. For years x genotypes, the highest number of ears per plant was 2.0, which was produced by the inbred line 111 in 2002 and the lowest one of 1.0, was given by several accessions. For years x seasons x genotypes interaction, the highest number of ears per plant was 2.3, obtained by the inbred line 111 during winter 2003, and the lowest one was 1.0, given by several genotypes. Combined across seasons the coefficient of variation for this character was 30.5% (Table 8).

4.1.8. Number of leaves per plant:

Individual analysis of variance (Table 5) indicated significant difference among the entries for this trait. In addition, the across seasons analysis, revealed significant differences for years, seasons, genotypes, years x seasons and seasons x genotypes. However, for years x genotypes and years x seasons x genotypes interactions, the differences were not significant (Table 6).

From the individual season analysis, the mean number of leaves per plant was 12.6 for summer 2002, 11.5 for summer 2003 and 11.9 for winter of both 2002 and 2003. However, the overall mean leaves per plant was 12.1 in summer and 11.9 in winter.

In summer 2002, the number of leaves per plant ranged from 14.6, produced by the hybrid 8x160, to 10.4, expressed by inbred line 45. In summer 2003, it varied from 12.7, produced by hybrid 8 x 177, to 9.7, obtained by line 75. Similarly in winter 2002, the number of leaves per plant ranged from 14.1, produced by hybrid 186x177, to 9.0, expressed by inbred line 45. In winter 2003, it varied from 14.0, produced by line 8 and hybrid 186 x 177, to 9.0, produced by inbred line 45.The coefficient of variations for this character at the individual season analysis were 6.7, 6.9, 5.9 and 6.0% for summer 2002, summer 2003, winter 2002 and winter 2003, respectively (Table 7).

The overall mean number of leaves produced by the plant averaged across seasons was 12.0. For years, number of leaves per plant was 12.2 produced in 2002 and 11.7 obtained in 2003. For seasons, number of leaves per plant was 12.0 produced in summer and 11.9 produced in winter. Moreover, the highest number of leaves per plant of 12.6, was achieved during summer 2002 and the lowest one 11.5, was formed during summer 2003. Among genotypes the highest number of leaves per plant of 13.5, was produced by hybrid 186 x 177, while the smallest one was 10.0, recorded for line 45. For seasons x genotypes interaction, the minimum number of leaves per plant was 9.0, produced in winter by inbred line 45 and the maximum one was 14.0, from inbred line 8. Combined across seasons, showed that, the coefficient of variation for this character was 6.6% (Table 8).

4.1.9. Leaf area (cm^2):

Individual season analysis (Table 5), depicted significant differences among the evaluated genotypes for this character. Also, the across seasons analysis (Table 6) indicated significant differences for years, seasons, genotypes and the interaction of years x seasons, years x genotypes, seasons x genotypes. However, years x seasons x genotypes interaction was not significant. Mean leaf areas were 414.8 for summer 2002, 355.2 for summer 2003, 398.1 for winter 2002 and 398.6cm^2 for winter 2003. Moreover, the overall mean of leaf areas were 385.0cm^2 in summer and 393.5cm^2 in winter. In summer 2002, leaf area varied from 526.3cm^2, which was developed by hybrid 66x160, to 238.1cm^2,was obtained from inbred line 157-1.In summer 2003, it varied from 515.6cm^2, formed by hybrid 66x65, to 143.0cm^2 ,was produced by inbred line 8. In winter 2002, leaf area ranged between 537.5cm^2, was achieved by hybrid 66x176, to 211.4cm^2, produced by inbred line 157-2. In winter 2003, leaf are varied from 546.7cm^2, was expressed by the hybrid 75x177, to 172.2cm^2 ,was produced from hybrid 75x176.

In the individual season analysis, the coefficient of variations were 16.4, 26.1, 15.3 and 25.0% for summer 2002, summer 2003, winter 2002 and winter 2003, respectively. (Table 7).

For years, leaf area was 406.5cm^2, in 2002 and 377.9 cm^2, in 2003. For seasons, leaf area was 385.0cm^2, in summer and was 399.3cm^2, in winter. Moreover, years x seasons interaction showed that, the smallest leaf area was 355.2cm^2 , recorded in summer of 2003, and the largest one was 414.8cm^2, achieved during summer of 2002. Among the genotypes, mean leaf area, varied from 466.0cm2, was obtained from the hybrid 75x177, to 268.6 cm^2 ,was recorded for inbred line 157-2. For years x genotypes interaction, the minimum leaf area 244.2 cm^2, was recorded during 2002 by inbred line 157-2 and the maximum one 490.3 cm^2, was obtained during 2002 by the hybrid 45 x176. For seasons x genotypes interaction, the smallest leaf area 225.3cm^2, was produced in the summer by the inbred line 157-2 and the largest one 515.7 cm^2, was produced during the summer by the hybrid 66 x 160. Combined across seasons, the coefficient of variation for this character was 21.5% (Table 8).

4.1.10. Cob barness %:

In the four seasons, significant differences in percent of cob barness were detected among the different genotypes (Table 5). In addition, the across seasons analysis (Table 6), showed significant differences for years, seasons, genotypes and the years x seasons, years x genotypes, seasons x genotypes and years x seasons x genotypes interaction.

The mean percent of cob barness was 3.7, 3.5, 3.3 and 3.7% for summer 2002, summer 2003, winter 2002 and winter 2003, respectively. In summer 2002, the highest percentage of cob barness was 4.4, produced by four inbred lines 157-2, 160, 176, 177 and the hybrid 157-2 x 177 and the lowest one of 2.8,was given by the hybrid 186x65. In summer 2003, the highest percentage of cob barness 4.7% ,was given by inbred line 160 and the lowest one of 2.5%, was obtained from line 75. In winter 2002, the highest percentage of cob barness of 4.4%, was developed from two inbred lines 160 , 177 and one hybrid, and the lowest one of 2.7%, was showed by the hybrid 186x65. In winter 2003, the highest percentage of cob barness 5.8%, was expressed by the hybrid 8x160 and the lowest one 1.0% was obtained from the hybrid 75x176.

The coefficient of variations, at individual season analysis for this character, were 14.9, 19.9, 16.4 and 18.6% for summer 2002, summer 2003, winter 2002 and winter 2003 respectively. (Table 7).

Across seasons, the overall mean percentage of cob barness was 3.6%. For years, the mean percentage cob barness was 3.5% in 2002 and 3.6% in 2003. While, for seasons, it was 3.6% in summer and 3.5% in winter.

For years x seasons interaction, the maximum percent of cob barness of 3.7%, was achieved in summer 2002 and winter 2003 and the minimum one 3.3%, was recorded in winter of 2002.

Among genotypes, the highest percentage of cob barness of 4.5%, was expressed by inbred line 160 and the lowest one 2.7%, was obtained from the hybrid 75x177.

For years x genotypes interaction, percentage of cob barness varied from 2.3%,which was recorded during 2003 by the hybrid 75x176, to 4.6%, achieved during 2002 and 2003 by inbred line 160 and the hybrid 8x65, respectively.

For seasons x genotypes interaction, the minimum percentage of cob barness 2.0%, was obtained in winter by the hybrid 75x176 and the maximum one 4.6%, was recorded during summer by the inbred line 160. Moreover, for years x seasons x genotypes interaction, the minimum percentage of cob barness 1.0%, was recorded in winter 2003 by the hybrid 75x176 and the maximum one 5.8%, was produced during the winter 2003 by the hybrid 8x65.

Combined across seasons, showed that, the coefficient of variation for this character was 17.6% (Table 8).

4.1.11. Number of kernel rows per cob:

Individual analysis of variance (Table 5) illustrated that, differences among the evaluated genotypes were significant in summer 2002, winter 2002 and winter 2003, but were not significant in summer 2003. moreover, the combined analysis (Table 6) revealed that differences between years, seasons, genotypes, years x genotypes, seasons x genotypes, years x seasons x genotypes were significant.On the other hand the difference were non-significant for the years x seasons interaction. The mean number of kernel rows was 13.5, 13.8 and 13.4 in summer 2002, winter 2002 and winter 2003, respectively.

The overall mean for this trait was 13.6 rows in winter. In summer 2002, the highest number of kernel rows was 15.7, scored for the hybrid 75x176, and the lowest one was 11.0, expressed by inbred line 177. In winter 2002, number of kernel rows per cob varied from 16.0, recorded by the hybrid 186x176, to 11.7, obtained from inbred line 111. In winter 2003 it ranged between 8.0, recorded by hybrid 75x176, and 15.7 given by hybrid 75x160. The coefficient of variations for this trait were 8.9, 9.4 and 12.6% for summer 2002, winter 2002 and winter 2003, respectively, (Table 7).

Averged across seasons, the overall mean number of kernel rows per cob was 13.5. For years, the mean number of kernel rows per cob was 13.6 in 2002 and 13.4 in 2003. For seasons, number of kernel rows per cob was 13.6 in the winter and 13.4 in the summer. Among the genotypes, the highest number of mean kernel rows was 14.7, given by the hybrid 75x160, and the lowest one 12.1, scored by the line 111. At the interaction, years x genotypes, the highest number of kernel rows per cob was 15.0, given by the hybrids 186x176 and 75x176 during 2002, and the lowest one was 10.8, recoded for the hybrid 75x176 in 2003. At seasons x genotypes interaction mean rows per cob ranged between 15.3, obtained from the hybrid 75x160 in winter, and 11.2, given by the hybrid 75x176 in the winter season. At years x seasons x genotypes interaction, mean kernel row per cob ranged between 16.0, expressed by the hybrid 186x176 in winter 2002, and 8.0, scored by the hybrid 75x176 in winter 2003. Combined across seasons, showed that, the coefficient of variation for this character was 9.2% (Table 8).

4.1.12. Cob length (cm):

Individual analysis of variance for this trait (Table 5), indicated significant differences among the entries for cob length in the four seasons. In addition, across seasons analysis (Table 6), showed significant differences between years, seasons, genotypes, years x seasons, years x genotypes, seasons x genotypes and years x seasons x genotypes interaction. The mean cob length was 14.5, 12.8, 14.6 and 12.8cm in summer 2002, summer 2003, winter 2002 and winter 2003, respectively.

In summer 2002, the highest cob length was 19.7cm, given by the hybrid 66x160, and the lowest one of 9.2cm, was achieved from the inbred line 157-1. In summer 2003, the highest cob length 17.5cm, was given by the hybrid 66x176, and the lowest one of 7.1cm, was obtained from inbred line 8. In winter 2002, the highest cob length of 19.0cm, was produced from the hybrid 186x176 and the lowest one 8.9cm, was achieved by the inbred line 157-2. In winter 2003, the longest cob length of 18.6cm, was produced by the hybrid 111x177, and the shortest one 9.0cm, was obtained from the inbred line 157-

1. The coefficient of variations, in individual season analysis for this character were 12.8, 16.2, 12.3 and 18.6% for summer 2002 summer 2003 winter 2002 and winter 2003 respectively (Table 7).

The overall mean cob length in across seasons was 13.7cm . For years, the cob length was 14.6cm in 2002 and 12.9cm in 2003. Among genotypes, cob length varied from 16.4cm, which was recorded for the hybrid 66x176, to 9.6cm, given by the inbred line 157-2.

For years x genotypes interaction, the minimum cob length 9.2cm, was produced in 2002 by the inbred line 157-2, and the maximum one 18.0cm, was recorded in 2002 by the hybrid 186x176. For seasons x genotypes interaction, the shortest cob length 8.9cm, was achieved in the summer by inbred line 157-1, and the longest one 17.4cm, was produced in the summer by the hybrid 66x160. Furthermore, for years x seasons x genotypes interaction, the shortest cob length 7.1cm, was produced in the summer of 2003 from the inbred 8, and the longest one 19.2cm , was produced in the summer of 2002 by the hybrid 66x160. Combined across seasons, the coefficient of variation for cob length was 15.3% (Table 8).

4.1.13. Cob diameter (cm):

Individual analysis of variance (Table 5), indicated significant differences for cob diameter among the evaluated genotypes in the four seasons. In addition, across seasons analysis (Table 6), revealed significant differences for years, seasons, genotypes,years x seasons, years x genotypes, season x genotypes, and years x seasons x genotypes.

The means cob diameter in the individual season were 3.9, 3.7 and 3.9cm in summer 2002, summer 2003, in both of winter 2002 and 2003, respectively. In summer 2002, the cob diameter ranged between 3.1cm, was expressed by inbred line 176, and 4.4cm was produced by the hybrid 8x176. In summer 2003, it varied from 2.9cm, was obtained from inbred line 8, to 4.2cm, produced by the hybrid 157-2x65. In winter 2002, cob diameter ranged between 3.1cm, given by inbred line 157-1, and 4.4cm, produced by the hybrid 111x176. In winter 2003, it ranged between 3.1cm, was devoloped by inbred Line 157-2, to 4.6cm, was produced by the hybrid 75x177. The coefficient of variations for this character in the individual season analysis were 8.5, 8.4, 8.8 and 11.4% in summer 2002, summer 2003, winter 2002 and winter 2003 respectively, (Table 7).

The overall mean cob diameter averaged across seasons was 3.8cm . For years cob diameter was 3.9cm in 2002 and 3.8cm in 2003. While, for seasons, it was 3.8cm in summer and 3.9cm in winter. For years x seasons interaction the largest cob diameter 3.9cm, was obtained during summer 2002 and both winters of 2002 and 2003, and the smallest one of 3.7cm, was obtained during summer 2003. Among genotypes, cob diameter, varied between 3.4cm, which was shown by inbred line 157-2to 4.2cm, obtained from the hybrid 75x177. For years x genotypes interaction, the minimum cob diameter of 3.3cm was produced in 2002, from inbred line 176 and the maximum one 4.2cm, was obtained in 2003, by the hybrid 75x177. For seasons x genotypes interaction, cob diameter varied between 3.2cm, was produced in summer from the inbred line 8 to 4.4cm, was achieved in winter from the hybrid 75x177. For years x seasons x genotypes interaction, cob diameter ranged between 2.9cm, was produced in summer of 2002 by the inbred line 8 to 4.6cm, was produced in winter of 2003 from the hybrid 75x177. Combined across seasons, the coefficient of variation for cob diameter was 9.6% (Table 8).

4.1.14. Cob weight (g):

Individual analysis of variance indicated that, the differences among the entries for this trait were significant for summer 2002 and winter of both 2002 and 2003. Whereas they were not significant for summer 2003 (Table 5). In addition the across season analysis (Table 6) revealed significant differences between years, seasons, years x seasons, genotypes, years x genotypes, seasons x genotypes and years x seasons x genotypes. The mean cob weights were 80.9, 89.0 and 89.7g in summer 2002, winter 2002 and winter 2003, respectively. The overall mean for the winter was 93.9g . In summer 2002, mean cob weight, varied from 32.4g, recorded for the inbred lines 157-1 and 157-2, to 152.7g, given by the hybrid 8x176. In winter 2002, mean cob weight, averaged from 30.4g produced by inbred line 157-2, to 159.0, produced by the hybrid 186x177. In winter 2003, it averaged from 32.6g, accessed by inbred line 157-1, to 185.1g, produced by the hybrid 111x177. The coefficient of variations for this character were 32.4, 26.6 and 24.9% for summer 2002, winter 2002 and winter 2003, respectively (Table 7).

For years, the cob weight was 89.5 in 2002 and 79.9g in 2003. For seasons, cob weight was 91.9 in the winter and 77.6g in the summer. For years x seasons interaction, the heaviest cob weight of 98.6g, was given during the winter 2002 while the lightest one of 74.7g, was produced during summer 2003. Among the genotypes the heaviest mean cob weight was 119.4g, given by the hybrids 75x177 and 157-1x160 and the lightest one of 42.8g scored by inbred line 157-2. For years x genotypes interaction, the heaviest cob weight was 137.3g, which was produced by the hybrid 186x176 in 2002 and the lightest one was 30.0g, which was given by inbred line 157-2 in 2002. For seasons x genotypes interaction, mean cob weight ranged between 153.4g, which was obtained from the hybrid 75x177 in winter, and 36.8g recorded by inbred line 157-2 in winter season For years x seasons x genotypes interaction the cob weight ranged between 209g, was produced in summer 2002 from inbred line 8, to 406g, in winter 2003 from the hybrid 75 x 177. Combined across seasons, the coefficient of variation for this character was 27.9% (Table 8).

4.1.15. Shelling percentage:

Individual season analysis of variance (Table 5), depicted significant differences among evaluated genotypes for shelling percentage in summer 2002 and winter 2003. However, differences in summer 2003 and winter 2002 were not significant. The across seasons analysis (Table 6), indicated significant differences for years and years x seasons. While differences for seasons, genotypes, years x genotypes, seasons x genotypes and years x seasons x genotypes were not significant.

The mean shelling percentage in the individual season analysis was 78.3% in summer 2002, and 81.0% in winter 2003. In summer 2002, shelling percentage varied from 51.7%, was gained by the inbred line 177, to 86.2%, was obtained from the hybrid 111x160. In winter 2003, it ranged between 75.3%, which was expressed by the hybrid 45x177, to 91.0%, given by the hybrid 203x177. In the individual analysis of variance, coefficient of variations for shelling percentage were 6.9% in summer 2002 and 6.0% in winter 2003 (Table 7).

For years, the maximum shelling percentage of 84.1%, was obtained in 2003, and the minimum one of 80.8%, was achieved in 2002. For years x seasons interaction, the maximum shelling percentage of 87.2%, was achieved in summer 2003 and the minimum one 78.3%, was obtained in summer 2002. Combined across seasons, the coefficient of variation for shelling percentage was 9.0%.

4.1.16. 100-seed weight (g):

The individual analysis of variance (Table 5), indicated significant differences among the evaluated genotypes for this character in summer 2002, summer 2003 and winter 2003. However, the differences in winter 2002 were not significant. Also the across seasons analysis (Table 6), revealed significant differences among evaluated genotypes for years, seasons, genotypes, years x genotypes, seasons x genotypes and years x seasons x genotypes . In addition, the differences for years x seasons were not significant. The mean 100-seed weight in the individual season was 22.9, 21.5 and 18.0g , in summer 2002, summer 2003 and winter 2003, respectively. Moreover, the overall mean for this character in summer was 22.2g. In summer 2002, mean 100-seed weight ranged from 15.2g, was scored by the inbred line 157-2, to 30.0g, recorded for the hybrid 66x176. In summer 2003, it varied from 13.5g, was expressed by the inbred line 8, to 27.8g, was recorded for the hybrid 186x65. In winter 2003 the mean 100-seed weight, varied from 13.6 g, was obtained from the hybrids 8x160 and 203x160, to 24.9g, was scored by the hybrid 8x65. The coefficient of variations for this trait in the individual season were 12.9, 10.9 and 19.2% for summer 2002, summer 2003 and winter 2002, respectively (Table 7).

For years, the heaviest 100-seed weight of 20.7g, was produced in 2002, and the lightest one 19.9g, was achieved in 2003. For seasons, the heaviest weight 22.2g, was produced in summer, and the lightest one 18.49, was accessed in winter.Among genotypes, the heaviest weight, 24.1g was recorded for the hybrid 203x65, and the lightest one 15.2g, was yielded by the inbred line 157-2. For years x genotypes interaction, the maximum 100-seed weight of 26.4g, was recorded in 2002 from the hybrid 186x176, and minimum one 14.3g, was achieved in 2002 by the inbred line 157-2. For seasons x genotypes interaction, the heaviest 100-seed weight of 28.6g, was obtained in summer by the hybrid 66x160, and the lightest one 14.7g, was produced in summer from the hybrid 157-1x160. For years x seasons x genotypes interaction, the heaviest 100-seed weight 30.9g, was obtained in summer of 2002 by the hybrid 66x160, and the lightest one 18.6g, was accessed in winter of 2002 from the hybrid 186x65. Combined across seasons, the coefficient of variation for this character was 17.3% (Table8).

4.1.17. Yield per plant (g):

The individual analysis of variances (Table 5), indicated significant differences among the evaluated genotypes for this character in summer 2002 and winter of both 2002 and 2003. However, the differences in summer 2003 were not significant. Also, across seasons analysis of variance, (Table 6) revealed significant differences for years, seasons, years x seasons, years x genotype, seasons x genotypes and years x seasons x genotypes. The mean yield per plant in the individual season was 62.2, 83.0 and 67.7g in summer 2002, winter 2002 and winter 2003, respectively. The overall mean for this character was 75.2g in winter.

In summer 2002, the lowest yield per plant of 19.2g, was recorded for the inbred line 65, and the highest one 125.5g, was given by the hybrid 66x160. In winter 2002, the lowest yield per plant of 26.9g was produced from inbred line 157-2 and the highest one 134.9g, was given by the hybrid 186x176. In winter 2003, the minimum yield per plant of 26.3g, was produced from the inbred line 65, and the maximum one 142.6g was attained by the hybrid 111x177. In the individual analysis of variance, the coefficient of variations for this character were, 34.2, 27.8, and 22.9% in summer 2002, winter 2002 and winter 2003, respectively (Table 7).

The overall mean yield per plant averaged across seasons analysis was 69.2g. For years, yield per plant was 72.6g, produced in 2002, and the lowest one 65.9g, was achieved in 2003. For seasons, yield per plant , was 75.2g, produced during winter, to 63.2g, was obtained in summer. For years x seasons interaction, this character ranged between 83.0g, was obtained in winter of 2002, to 62.1g, attained in summer of 2002.

For years x genotypes interaction, the maximum yield per plant of 111.69g, was given in 2002 by the hybrid 186x176, and the minimum one 25.2g, was achieved in 2002 from the inbred line 157-2. For seasons x genotypes interaction, the maximum yield per plant 195-7g, was given in winter by the hybrid 203x177 and the minimum one 30.6g, was obtained in winter by the inbred line 157-2.

For years x seasons x genotypes interaction, yield per plant varied from 140.0g, which was produced in winter of 2003 by the hybrid 111x177, to 19.4g, given in summer of 2002 by the inbred line 65. Combined across seasons, the coefficient of variation for yield per plant was 31.4% (Table 8).

4.1.18. Grain yield (t/h):

The individual season analysis (Table 5), revealed significant differences among the evaluated genotypes for grain yield (t/h) in the four seasons. In addition, across seasons analysis (Table 6), indicated significant differences between seasons, years x seasons, years x genotypes, seasons x genotypes and years x seasons x genotypes. However, the difference between years were not significant.

The mean grain yield was 3.3, 2.7, 3.0 and 3.6t/h for summer 2002, summer 2003, winter 2002 and winter 2003, respectively. In addition, the overall mean grain yield was 3.0t/h in the summer and was 3.3 in winter. In summer 2002, the lowest grain yield 1.1t/h, was produced from the inbred line 65 and 177, and the highest one of 6.6t/h, scored by the hybrid 66x160. In summer 2003, the lowest grain yield 0.9t/h, was recorded for the inbred line 203, and the highest one 5.5t/h, given by the hybrid 66x160. In winter 2002, the lowest grain yield 0.6t/h, was produced by the inbred line 160, and the highest one 7.0t/h, recorded for the hybrid 186x176. In winter 2003, the lowest grain yield 1.8t/h, was obtained by the hybrid 203x176 and the highest one 7.5t/h ,given by the hybrid 111x177.The coefficient of variations in the individual season analysis for grain yield were , 34.9, 41.5, 39.9 and 22.6% in summer 2002, summer 2003, winter 2002 and winter 2003, respectively (Table 7). The overall mean grain yield averaged across seasons was 3.1t/h. For seasons, the grain yield was 3.0t/h in summer and 3.3t/h in winter. For years x seasons interaction, the grain yield varied from 2.7t/h, was recorded in summer 2003, to 3.6t/h achieved in winter 2003. Among genotypes, the lowest grain yield 1.3 t/h, was given by inbred line 203, and the highest one 4.9t/h, produced by the hybrids 66x177 and 111x65. For years x genotypes interaction, the minimum grain yield 1.0 t/ha, was achieved in 2002 by the inbred line 157-1 and the highest one 5.9t/h, given in 2002 by the hybrid 186x176. For seasons x genotypes interaction, the minimum grain yield 1.0 t/ha was recorded in summer by the inbred line 203 and the maximum one 5.4t/h, produced in winter by the hybrid 66 x 177.

For years x seasons x genotypes, the minimum grain yield 0.6 t/ha, was produced in winter 2002 by the inbred line 160 and the maximum one 7.4 t/ha, produced in winter 2003 from the hybrid 111x177. Combined across seasons,showed that, the coefficient of variation for grain yield ton per hectare was 38.4%.

4.2. Heterosis study:

4.2.1. Manifestation and magnitude of heterosis:

Estimated means of the 18 characters for the parental lines and their 36 single cross hybrids were shown in (Table 8). The magnitude of heterosis exhibited by each hybrid, for the different characters compared to its corresponding mid-parent as well as better parent values were shown in (Table 9). The highest amount of heterosis, was expressed for grain yield (ton per hectare). The heterotic patterns observed for the different characters can be summarized as follows:

4.2.1.1. Days to 50% tasselling:

The overall mean heterosis, for this trait, was -2.6% for the mid- parent value (MPH), and -4.1% for the better parent value (BPH). The highest mid-parent heterosis 1.6%, was given by the hybrid 45x65 and the lowest one -6.1% for the hybrids 186x177 and 203x177. While, the highest better parent heterosis -0.3%, was expressed by the hybrid 157-1x160, and the lowest one -8.6%, was by the hybrid 203x177 (Table 9).

4.2.1.2 Plant height (cm):

The overall mean heterosis, for plant height, was 14.6% for the mid-parent value (MPH), and 8% for the better parent value (BPH).The highest mid-parent heterosis of 32.7%, was given by the hybrid 111x160 and the lowest one 3.1% by the hybrid 66x177. Also, the highest better parent heterosis 28.3%, was given by the hybrid 111x160, and the lowest one 6.1%, by the hybrid 157-1x176 (Table 9).

4.2.1.3. Days to maturity:

The overall mean heterosis, for days to maturity, was -0.9% for the mid-parent value (MPH) and -3.5%, for the better parent value (BPH). The highest mid-parent heterosis 3.3%, was obtained by the hybrid 8x65 and the lowest one -5.5%, for the hybrid 203x177. Moreover, the highest

Table 9. Magnitude of heterosis for the different characters in 36 maize hybrids expressed as percentage of increase over and decrease under mid-parent (MP) or better parent (BP) evaluated at New Halfa in years 2002-2003 (Summer and winter Seasons)

Hybrid	days to 50% tasselling		plant height (cm)		days to maturity		No. of nodes per plant		stem diameter (cm)		plant height to first cob (cm)	
	MP%	BP%	MP%	BP%	MP%	BP%	MP%	BP	MP%	BP%	MP%	BP%
8X65	- 1.7	- 3.6	+22.7	+21.9	+3.3	+1.1	-5.0	-6.4	-1.4	- 6.0	+14.7	-3.1
8X160	-0.1	-0.7	+16.7	+14.9	-4.3	-5.3	+5.0	+0.9	+2.4	+1.8	+24.9	+18.8
8X176	-1.4	-3.4	+11.6	+0.4	-4.2	-7.1	+1.4	-2.0	-5.5	-5.8	+3.5	-15.4
8X177	-2.5	-4.1	+24.9	+15.0	+0.3	-0.8	-1.2	-2.3	-0.1	-7.1	+28.3	+9.2
45X65	+1.6	-0.9	+12.0	+7.8	-3.7	-4.5	-3.0	-6.3	-0.3	-3.0	-3.5	-16.6
45X160	-1.7	-2.8	+14.7	+9.1	-4.0	-4.4	-3.7	-9.0	+1.1	-1.5	+14.4	+12.0
45X176	-4.0	-6.5	+14.8	0.0	-1.7	-3.2	-0.7	-4.1	-2.0	-5.3	+7.7	-10.0
45X177	-2.6	-4.6	+19.2	+6.2	-1.3	-1.7	-1.5	-4.6	-2.3	-4.2	+17.5	+2.3
66X65	-1.9	-3.1	+6.7	-0.2	+0.7	-0.2	-4.6	-8.6	-2.7	-3.6	-9.8	-11.7
66X160	-5.7	-5.5	+7.6	+1.7	-4.0	-4.2	-6.7	-8.3	+2.0	-4.2	-0.9	-14.7
66X176	-3.0	-4.3	+1.8	-2.0	-1.9	-3.6	-9.4	-11.5	-3.2	-3.5	-14.2	-15.9
66X177	-1.6	-2.4	-3.1	-4.3	-1.2	-1.3	-5.5	-9.8	-2.7	-8.0	-15.7	-18.2
75X65	+0.1	-1.9	+19.4	+9.5	-0.8	-4.2	+4.5	-2.7	+4.5	-3.4	+8.3	-11.6
75X160	-2.0	-2.6	+20.6	+9.7	+0.5	-0.8	+6.7	-2.9	+7.3	+4.4	+33.8	+22.3
75X176	-4.0	-6.1	+19.3	-0.1	-2.1	-5.2	+2.0	-6.7	-2.0	-9.9	+19.3	-5.5
75X177	-1.9	-3.6	+22.9	+5.1	+1.9	-0.1	+8.0	+1.1	+9.4	+5.8	+24.8	+2.5
111X65	-4.5	-8.4	+15.1	+12.3	-2.7	-7.1	+4.3	-0.8	+6.8	-0.3	+12.4	-2.4
111X160	-1.9	-4.6	+32.7	+28.3	-1.5	-5.0	+5.8	-1.7	+0.8	-0.9	+44.6	+42.1
111X176	-0.2	-4.4	+15.2	+1.9	-0.1	-5.4	+5.7	-1.3	+4.7	-2.9	-7.6	-9.6
111X177	-1.0	-4.7	+20.9	+9.4	+1.7	-2.0	+7.4	+2.6	+8.6	+6.1	+11.8	-2.1
157-1X65	-1.7	-4.1	+9.3	+9.3	-0.8	-3.9	+1.4	+0.8	+3.6	-5.1	+9.8	-3.0

Table 9. Continued.

Hybrid	days to 50% tasselling		plant height (cm)		days to maturity		No. of nodes per plant		stem diameter (cm)		plant height to first cob (cm)	
	MP%	BP%	MP%	BP%	MP%	BP%	MP%	BP	MP%	BP%	MP%	BP%
157-1X160	+0.8	-0.3	+22.8	+21.7	+1.9	-0.2	-0.6	-5.1	+10.8	+6.9	+33.7	+33.6
157-1X176	-0.5	-3.0	+3.9	-6.1	-0.2	-0.4	+6.9	+2.6	+5.4	-3.9	-2.4	-16.7
157-1X177	-4.9	-6.9	+18.7	+9.9	-1.4	-3.4	+3.5	+1.7	+6.5	+2.1	+12.8	-0.4
157-2X65	-1.6	-4.6	+32.3	+22.4	-3.2	-8.9	+3.7	+0.3	+2.3	-8.5	+20.5	+2.9
157-2X160	-0.7	-1.7	+25.2	+14.8	-0.7	-4.2	+4.3	-1.6	+2.8	-3.4	+32.6	+28.3
157-2X176	+0.1	-3.0	+13.5	-4.3	-1.6	-8.1	+9.3	+3.6	-0.8	-11.9	+9.0	-11.7
157-2X177	-2.0	-4.6	+15.7	-0.3	+2.5	-2.5	+5.6	+2.4	+2.9	-3.9	+13.2	-4.9
186X65	-2.3	-2.7	+13.8	+13.7	-3.9	-4.9	+7.1	+6.6	+7.1	+2.1	+3.9	-.0.7
186X160	-1.9	-3.0	+18.3	+17.0	0.0	-0.1	-4.7	-6.7	+7.0	+6.5	+7.0	+1.6
186X176	-2.9	-3.3	+7.5	-2.9	-0.3	-2.1	+3.1	+0.7	-3.0	-8.2	+2.5	-5.7
186X177	-6.1	-6.1	+25.2	+15.7	-0.6	-0.7	+7.5	+6.7	+15.0	+14.8	+7.4	+3.5
203X65	-2.5	-6.0	+13.6	+13.4	+0.2	-6.0	+3.6	-2.7	+12.2	+1.2	+12.1	-1.3
203X160	-1.2	-3.4	+11.9	+11.0	-0.4	-5.6	+3.4	-5.2	+11.2	+2.8	+26.7	+26.4
203X176	-6.1	-8.6	+4.3	-5.6	-5.5	-12.0	-3.1	-10.7	0.0	-14.0	-1.3	-15.9
203X177	-5.0	-8.1	+13.6	+5.3	+3.2	-3.1	+8.1	+1.8	+9.4	+0.4	+10.6	-1.9
Mean	-2.6	-4.1	+14.6	+7.8	-0.9	-3.5	+1.9	-2.2	+3.3	-1.8	+11.4	+0.5

Table 9. Continued.

Hybrid	Ears per plant		No. of Kernel rows		Cob weight (g)		Shelling Percentage		Seed weight (g)		Yield per plant (g)	
	MP%	BP%	MP%	BP%	MP%	BP%	MP%	BP	MP%	BP%	MP%	BP%
8X65	-3.1	-5.9	-3.5	-6.2	+64.7	+60.5	+3.2	+1.4	+17.0	+6.1	+89.0	+74.8
8X160	0.0	-5.9	+7.1	+4.4	+31.8	+25.9	+4.9	+2.4	-2.6	-7.5	+39.2	+32.2
8X176	0.0	-5.9	+6.7	+3.7	+37.4	+32.6	+6.7	+6.1	+9.0	+7.0	+45.5	+44.0
8X177	+6.3	0.0	+6.1	+3.8	+70.1	+53.4	+3.3	+0.3	+7.9	+1.1	+63.0	+50.2
45X65	-12.5	-12.5	-0.6	-3.0	+33.3	+25.1	+6.7	+4.2	+5.6	0.0	+59.5	+36.0
45X160	-22.6	-25.0	-1.5	-4.1	+37.5	+26.5	+4.6	+1.4	+3.1	+2.6	+46.1	+27.5
45X176	-16.1	-18.8	+3.0	+0.6	+53.8	+42.9	+5.6	+4.3	+13.0	+6.3	+58.9	+46.4
45X177	-9.6	-12.5	+2.4	-0.6	+71.0	+49.0	+6.7	+3.2	-2.7	-4.6	+76.9	+50.4
66X65	-12.5	-12.5	-3.7	-3.7	+29.7	+26.3	+3.4	+0.5	-4.7	-8.5	+26.1	+7.0
66X160	+3.2	0.0	-5.9	-6.2	+82.3	+81.4	+4.4	+0.8	+16.9	+15.9	+71.7	+49.2
66X176	+3.2	0.0	+0.6	+0.6	+81.6	+78.8	+1.6	-0.1	+20.0	+11.6	+73.4	+59.0
66X177	-9.6	-12.5	+4.4	+3.7	+66.6	+57.7	+7.1	+2.9	+11.5	+10.9	+60.3	+35.8
75X65	-5.4	-6.2	+10.8	+8.1	+60.9	+55.6	+6.2	+6.2	+2.1	-2.3	+73.3	+65.0
75X160	-6.6	-6.6	+12.5	+10.0	+68.9	+66.8	+11.4	+10.6	+2.8	+2.2	+94.9	+90.6
75X176	-6.6	-6.6	-1.3	-3.7	+87.4	+83.1	+6.4	+5.1	+14.2	+6.1	+94.5	+87.3
75X177	-6.6	-6.6	+9.6	+7.6	+116.2	+106.1	+4.7	+3.5	+12.7	+11.9	+109.1	+98.4
111X65	-11.8	-16.7	+12.4	+6.8	+91.6	+91.4	+3.8	+0.6	+11.6	+11.0	+117.3	+99.6
111X160	-15.1	-22.2	+5.6	+0.6	+41.9	+39.1	+6.3	+2.4	-4.4	-8.4	+40.5	+32.4
111X176	+9.1	0.0	+7.2	+1.9	+76.9	+75.3	+2.8	-4.6	+24.5	+11.6	+73.0	+73.0
111X177	-15.1	-22.2	+5.9	+1.3	+93.4	+78.8	+1.5	-2.5	+7.2	+4.0	+102.6	+85.5
157-1X65	-12.5	-12.5	+0.9	0.0	+53.8	+42.9	+4.8	+3.4	+3.6	-7.3	+75.9	+71.1
157-1X160	-3.2	-6.2	-1.3	-1.9	+28.3	+22.3	+7.3	+5.1	+6.6	-0.1	+53.1	+52.9
157-1X176	+3.2	0.0	-2.2	-3.1	+45.5	+36.6	+1.9	+1.8	+10.0	+9.5	+53.2	+44.5

Table 9. Continued.

Hybrid	Ears per plant		No. of Kernel rows		Cob weight (g)		Shelling Percentage		Seed weight (g)		Yield per plant (g)	
	MP%	BP%	MP%	BP%	MP%	BP%	MP%	BP	MP%	BP%	MP%	BP%
157-1X177	-16.1	-18.8	+2.8	+2.5	+56.6	+55.5	+5.9	+3.2	+13.2	+4.7	+62.1	+57.0
157-2X65	+3.5	-6.2	+8.7	+8.7	+62.1	+36.9	+5.6	+3.2	+11.6	-4.5	+82.5	+67.9
157-2X160	-7.2	-13.4	+3.4	+3.1	+64.1	+41.1	+6.2	+3.1	-4.4	-14.5	+78.0	+57.5
157-2X176	+7.2	0.0	-0.6	-0.6	+68.0	+43.2	+2.5	+1.4	+24.1	+18.5	+72.8	+47.2
157-2X177	-7.2	-13.4	+1.9	+1.2	+51.0	+37.0	+2.4	-1.1	+4.1	-8.1	+56.5	+44.5
186X65	+18.8	+18.8	+1.3	-1.9	+36.7	+35.0	+3.7	+2.9	+17.0	+9.3	+47.5	+36.9
186X160	+16.1	+12.5	+3.5	+0.6	+46.6	+45.2	+6.4	+4.9	+24.3	+21.9	+52.6	+45.4
186X176	-3.2	-6.2	+7.7	+5.0	+48.7	+48.6	+4.9	+4.4	+27.0	+20.9	+59.3	+57.6
186X177	-9.6	-12.5	+11.0	+8.2	+87.4	+75.0	+8.2	+6.2	+7.7	+4.1	+79.6	+66.1
203X65	+21.4	+6.3	+4.8	+1.9	+31.2	+28.4	-1.8	-6.3	+20.0	+12.6	+6.0	-2.2
203X160	+11.1	0.0	+0.6	-1.9	+41.6	+41.6	+2.5	-2.9	+2.0	-0.1	+48.6	+40.7
203X176	+3.7	-6.6	+1.0	-1.9	+56.6	+54.9	+3.5	+0.2	+13.9	+4.3	+58.1	+57.4
203x177	+11.1	0.0	+8.7	+6.3	+99.8	+89.0	+6.2	+0.2	+12.1	+11.3	+110.4	+93.4
Mean	-2.6	-7.1	+3.6	+1.4	+60.4	+52.5	+4.8	+2.2	+9.9	+4.4	+67.0	+55.1

Table 9. Continued.

Hybrid	No. of Leaves/plant		Leaf area (cm^2)		Cob barness%		Cob length (cm)		Cob diameter (cm)		Yield (t\h)	
	MP%	BP%	MP%	BP%	MP%	BP%	MP%	BP	MP%	BP%	MP%	BP%
8X65	-1.0	-4.0	+22.9	+9.3	+12.7	+4.9	+16.1	+3.5	+7.2	+4.0	+146.2	+143.6
8X160	+8.1	+2.7	+9.2	+4.3	-14.5	-26.2	+6.5	+3.6	+0.9	-0.7	+76.7	+70.5
8X176	-2.3	-2.7	+9.8	+0.8	-0.1	-5.7	+3.1	-8.0	+6.8	+6.3	+112.9	+91.8
8X177	+6.3	+0.7	+13.5	+4.6	-3.6	-9.8	+26.5	-22.9	+7.9	+6.3	+111.2	+100.9
45X65	+1.9	-5.7	+6.9	+2.3	-8.2	-9.3	-0.8	-1.3	+4.4	+3.4	+84.2	+56.5
45X160	+5.9	0.0	+4.6	-1.3	-17.8	-25.0	+6.0	-3.4	+2.5	0.0	+80.9	+60.0
45X176	+2.6	-8.0	+19.7	+13.0	-2.2	-2.5	+0.6	+0.2	+6.0	+1.3	+98.4	+87.7
45X177	+7.9	+2.2	+6.6	+5.8	-7.5	-8.2	+3.4	-5.7	+3.3	+0.7	+1236	100.4
66X65	-5.0	-10.6	+7.9	+7.0	-1.2	-4.9	-7.6	-8.4	-0.7	+0.9	+77.3	55.3
66X160	-3.7	-11.3	+15.5	+5.0	-12.7	-22.2	+14.7	+4.3	-1.8	-3.5	+113.5	+95.0
66X176	-10.0	-12.5	+13.8	+9.1	-19.4	-21.2	+12.7	+11.8	+7.0	+3.0	+121.5	+116.9
66X177	-6.1	-13.8	-0.0	-6.9	-1.6	-4.9	+14.2	+3.8	+8.1	+6.1	+161.1	+141.7
75X65	+11.5	+6.4	+8.0	-3.4	+5.2	-1.3	+4.1	-3.9	+6.1	+4.8	+94.7	+73.1
75X160	+12.5	+9.6	+21.3	+18.3	-12.3	-23.7	+27.6	+26.3	+4.4	+4.1	+113.3	+97.9
75X176	+8.2	0.0	-0.6	-8.1	-23.5	-27.1	+16.2	+7.2	+4.3	+1.8	+100.0	+99.1
75X177	+10.7	+8.2	+31.9	+22.3	-5.5	-10.9	+19.7	+18.7	+12.6	+12.1	+16.3	+112.8
111X65	+4.8	0.0	+9.9	+6.2	-11.9	-13.5	+18.8	+8.4	+8.3	+6.6	+197.2	+176.8
111X160	+14.1	+11.1	+9.8	+3.8	-15.1	-23.0	+11.2	+10.8	+5.0	+5.0	+96.6	+91.5
111X176	+3.9	-4.0	+9.8	+9.7	-7.2	-7.5	+16.7	+6.4	+13.9	+11.5	+119.9	+108.1
111X177	+15.3	+12.7	+15.3	+14.7	+2.9	-1.3	+26.2	+25.2	+7.8	+7.7	+134.5	+109.0
157-1X65	+9.7	+8.5	+12.5	-6.4	+5.5	+2.4	+2.4	+13.3	+2.5	-0.7	+105.1	+97.2
157-1X160	+9.2	+8.0	+22.8	+10.4	-12.8	-21.7	+21.8	+11.9	+1.6	0.0	+116.3	+99.0
157-1X176	+4.5	0.0	+18.0	+1.0	-4.7	-6.2	+8.6	-8.1	+10.3	+9.8	+100.0	+72.4

Table 9. Continued.

Hybrid	No. of Leaves/plant		Leaf area (cm^2)		Cob barness%		Cob length (cm)		Cob diameter (cm)		Yield (t\h)	
	MP%	BP%	MP%	BP%	MP%	BP%	MP%	BP	MP%	BP%	MP%	BP%
157-1X177	+5.2	+3.6	+6.9	-8.2	-0.9	-3.5	+17.9	+8.1	+8.4	+6.8	+89.8	+72.3
157-2X65	+13.7	+9.2	+25.8	+3.8	-9.0	-12.6	+0.1	-16.6	+11.9	+6.1	+112.9	+109.5
157-2X160	+11.7	+9.6	+19.5	+6.5	-19.3	-22.6	+24.0	+11.8	+3.7	-0.2	+101.5	+95.4
157-2X176	+9.4	+1.3	+11.3	-2.9	-11.3	-16.1	+19.3	-0.6	+10.9	+9.0	+101.0	+82.0
157-2X177	+11.4	+9.7	+13.0	-3.6	-4.4	-15.2	+15.8	+4.3	+5.4	+1.6	+76.6	+68.9
186X65	+7.3	+5.5	+14.3	+3.1	-12.1	-13.3	+13.0	+8.0	+2.6	-1.1	+90.8	+70.6
186X160	-4.6	-0.1	+26.0	+21.3	-15.6	-23.2	+17.9	+12.6	+5.9	+3.6	+94.9	+81.8
186X176	+9.1	+4.0	+16.2	+7.3	+2.5	+2.3	+6.0	+1.3	+9.8	+9.7	+104.4	+103.9
186X177	+15.7	+11.0	+22.7	+14.8	+5.2	+4.3	+15.3	+10.1	+7.9	+5.7	+105.9	+94.8
203X65	+7.1	+1.4	+25.9	+11.5	-0.1	-17.4	+12.1	-3.1	+6.9	+4.4	+110.6	+97.2
203X160	+8.8	+5.2	+22.1	+17.7	-21.4	-23.9	+9.6	+9.0	+0.6	-0.2	+113.4	+91.5
203X176	-6.1	-13.9	+0.1	-8.6	-3.1	-9.7	+1.1	-7.1	+6.2	+4.8	+65.8	+39.7
203X177	+10.8	+7.5	+14.8	+5.4	+1.3	-4.7	+20.2	+19.7	+13.7	+12.9	+194.7	+161.6
Mean	+5.8	+2.4	+14.1	+5.5	-6.8	-10.2	+12.3	+3.9	+6 .2	+4.5	+110.4	+97.9

better parent heterosis, ranged between -12.0%, was obtained from the hybrid 203x177, to 1.1%, from the hybrid 8x65 (Table 9).

4.2.1.4. Number of nodes per plant:

The overall mean heterosis, for this character, was 1.9% for the mid-parent value (MPH) and –2.2%% for the better parent value (BPH).The mid-parent heterosis, varied from -9.4%, which was expressed by the hybrid 66x176, to 9.3%, by the hybrid 157-2x176. While, the better parent heterosis ranged from -9.8%, was given by the hybrid 66x177, to 6.7%, by the hybrid 186x177 (Table 9).

4.2.1.5. Stem diameter (mm):

The overall mean heterosis, for stem diameter, was 3.3% for the mid-parent value (MPH) and -1.8%,for the better parent value (BPH).The estimated mid-parent heterosis, ranged from -5.5%, was obtained from the hybrid 8x176, to 15.0%, by the hybrid 186x177. The estimated better parent heterosis, varied between -14.0% ,was produced by the hybrid 203x176, to 14.8%, by the hybrid 186x177 (Table 9).

4.2.1.6. Plant height to first cob (cm):

The overall mean heterosis, for this trait was 11.4%, for mid-parent value (MPH) and 0.5%, for the better parent value (BPH). The highest mid-parent heterosis 33.8%, was expressed by the hybrid 75x160, and the lowest one -17.5%, by the hybrid 66x177. Moreover, the highest better parent heterosis of 42.1%, was given from the hybrid 111x160, and the lowest one -18.2%, from the hybrid 66x176 (Table 9).

4.2.1.7. Number of ears per plant:

The overall mean heterosis, for this character was -2.6% for the mid-parent value (MPH) and -7.0%, for the better parent value (BPH). The highest mid-parent heterosis 21.4%, was recorded from the hybrid 203x65 and the lowest one -22.6%, for the hybrid 45x65. While, the highest better parent heterosis 18.8%, was expressed by the hybrid 186x65, and the lowest one -22.2%, by the hybrid 111x160(Table 9).

4.2.1.8. Number of leaves per plant:

The overall mean heterosis, for number of leaves per plant, was 5.8%for the mid-parent value (MPH) and 2.4%for the better parent (BPH). The mid-parent heterosis, varied from -10.0%, recorded for the hybrid 66x176, to -15.7%, for the hybrid 186x176. While, the better parent heterosis, ranged between -13.9%, accsssed by the hybrid 203x176, to 11.0%, by the hybrid 186x176 (Table 9).

4.2.1.9. Leaf area (cm):

The overall mean heterosis, for leaf area was 14.1% for the mid-parent value (MPH) and 5.5% for the better parent value (BPH). The magnitude of mid-parent heterosis, ranged from -0.6%, was recorded for the hybrid 75x176, to 26.0% for the hybrid 186x160. While, the magnitude of better parent heterosis, varied between -8.6%, obtained for the hybrid 203x176, and 22.3%, for the hybrid 75x177 (Table 9).

4.2.1.10. Percentage cob barness:

The overall mean heterosis, for this character, was -6.8% for the mid-parent value (MPH) and -10.2 for the better parent (BPH) value. The highest mid-parent heterosis 12.7% was recorded for the hybrid 86x165, and the lowest one -23.5%, for the hybrid 75x176. Moreover, the highest better parent heterosis 4.3%, was recorded for the hybrid 186x177, and the lowest one -27.1, for the hybrid 75x176 (Table 9).

4.2.1.11. Number of kernel rows per cob:

The overall mean heterosis, for this character, was 3.6% for the mid-parent value and 1.4% for the better parent value (BPH). The estimated mid-parent heterosis, varied from 11.0%, was given by the hybrid 186x177, to -5.9%, by the hybrid 66x160. While, the estimated better parent heterosis ranged between 10.0%, was obtained by the hybrid 75x160, and –6.2%, by the hybrids 66x160 and 8x65 (Table 9).

4.2.1.12. Cob length(cm):

The overall mean heterosis, for cob length, was 12.3% for the mid-parent value (MPH) and was 3.9% for the better parent value (BPH). The highest mid-parent heterosis was 27.5%, accessed by the hybrid 75x160, and the lowest one was -7.6%, by the hybrid 66x65, while, the highest better parent heterosis was 26.3%, recorded for the hybrid 75x160, and the lowest one -22.95, for the hybrid 8x177 (Table 9).

4.2.1.13. Cob diameter (cm):

The overall mean heterosis, for cob diameter, was 6.2% for the mid-parent value (MBH) and 4.5% for the better parent value (BPH). The maximum mid-parent heterosis was 13.9%, recorded for the hybrid 111x176, and the minimum one -1.8%, for the hybrid 66x160. While, the maximum better parent heterosis was 12.9%, expressed by the hybrid 203x177, and the lowest one 3.5%, by the hybrid 66x160 (Table 9).

4.2.1.14. Cob weight (g):

The overall mean heterosis, for cob weight, was 60.4% for the mid-parent value and 52.5% for the better parent value. The cob weight mid-parent heterosis, varied from 29.7%, which was obtained from the hybrid 66x65, to 116.2%, from the hybrid 75x177. While the cob weight better parent heterosis, ranged between 22.3%, was achieved by the hybrid 157-1x160, and 106.1%, by the hybrid 75x177 (Table 9).

4.2.1.15. Shelling percentage:

The overall mean heterosis, for shelling percentage, was 4.8% for the mid-parent value and 2.2% for the better parent value. The highest mid-parent heterosis 11.4%, was obtained from the hybrid 75x160, and the lowest one -1.8%, from the hybrid 203x65, while the highest better parent heterosis 10.6% was obtained from the hybrid 75x160, and the lowest one 6.6%, from the hybrid 203x65 (Table 9).

4.2.1.16.100-seed weight:

The estimated over all mean heterosis, for this character, was 9.9% for the mid-parent value and 4.4% for the better parent value. The mid-parent heterosis, ranged 27.0%, was given by the hybrid 186x177, to -4.7%, for the hybrid 66x65. While, the better parent heterosis, ranged from 21.9%, was given by the hybrid 186x160, to -14.5%, by the hybrid 157-2x160 (Table 9).

4.2.1.17. Grain yield per plant (g):

The recorded overall mean heterosis, for grain yield per plant was 67.0% for the mid-parent value and 55.1% for the better parent value. The magnitude of mid-parent heterosis, ranged from 117.3%, was obtained from the hybrid 111x65, to 6.0%, from the hybrid 203x65. While, the magnitude of better parent heterosis varied between 99.6%, was given by the hybrid 111x65, to -2.2%, by the hybrid 203x65 (Table 9).

4.2.1.18. Grain yield (t/h):

The overall mean heterosis, for grain yield (t/h), was 110.4% for the mid-parent heterosis and 97.9% for the better parent heterosis. The highest mid-parent heterosis of 194.7% was recorded for the hybrid 203x177, and the lowest one

68.8%, for the hybrid 203x176. While, the highest better parent heterosis 161.6%, was recorded for the hybrid 203x177, and the lowest one 39.7%, for the hybrid 203x176 (Table 9).

4.3.Combining ability:

4.3.1. Analysis of variance:

Analysis of variance for the combining ability (Table 10), indicated significant differences for lines x testers for all the estimated characters. However, the differences for testers and lines were not significant.

4.3.1.1. Days to 50% tasselling:

The highest estimates of GCA effects for the lines was 0.741, produced by the inbred line 8, and the lowest one -1.759, by the inbred line 203. The highest estimates of GCA effects for the testers of 0.574, was given by the tester 65 and the lowest one -0.528, by tester177 (Table11). The highest SCA effect was 63.6, expressed by the hybrid 45X65, and the lowest one was –2.6, by the hybrid 157-1x177 (Table 12). The contribution of general combining ability (GCA) and specific ability (SCA), for this character to the total variation, among the hybrids was 45.8% for the GCA and 45.2% for the SCA (Table 13) .

4.3.2. plant height (cm):

The highest GCA value for the lines was 5.716 , expressed by the inbred line 111 and the lowest one –4.328 , by160. while , the highest GCA value among the testers of 7.20, was given by the tester 177, and the lowest one –6.67, by 65

(Table 11).The highest SCA effect, for plant height, was 88.9, obtained from the hybrid 75X176 and the lowest one –7.600, by 66X160 (Table 12).The contribution of GCA and SCA, for plant height towards the total variation among the hybrids was 55.4% for GCA and was 44.6% for SCA (Table 13).

4.3.3. Days to maturity:

The GCA value for the lines, for days to maturity, ranged from –3.074, was recorded for the inbred line 203, to 1.863, for inbred line 186. While, for testers, varied from –1.023, was accessed by the tester 160, to 0.680. by tester 177 (Table 11). The highest SCA effect, for days to maturity, was 37.6, observed from the hybrid 157-2X176, and the lowest one –2.4, from 66X160 (Table 12). The percentage contribution of GCA and SCA, for this character, towards the total variation among the hybrids, was 49.5%for the GCA, and 50.5% for the SCA (Table 13).

Table 10. Analysis of variance for line x tester analysis including parents for 49 genotypes of maize evaluated for the different characters during Summer and Winter seasons of year 2002 and 2003 at New halfa.

Source of variation	d.f.	Days to 50% tasselling	Plant height	Days to maturity	No. of nodes per plant	Stem diameter (mm)	Plant height to first cob (cm)
Rep	3	3548.62	4517.08	2389.09	34.03	980.27	3275.23
Treat	48	9.83 *	867.66 *	39.19 *	1.25 *	7.69 *	171.39 *
Parent	12	15.48 *	877.14 *	80.78 *	2.29 *	14.79 *	366.76 *
P.V.C	1	45.1 *	20702.87 *	0.04 n.s	4.89 *	39.64 *	1841.81
Crosses	35	6.88 *	297.69 *	26.04 *	0.79 *	4.35 *	56.68 *
Lines	8	28.10 n.s	669.60 n.s	131.39 n.s	4.00 n.s	22.76 n.s	183.73 n.s
Testers	3	3.24 n.s	470.75 n.s	7.15 n.s	0.21 n.s	2.75 n.s	9.53 n.s
L x tester	24	21.76 *	774.04 *	76.68 *	7.99 *	10.31 *	226.03 *
Error	144	4.06	238.94	3.43	0.68	2.97	144.36

* Significant at 0.05 level.

n.s = not significant

Table 10. Continued.

Source	d.f.	Ear per plant	No. of kernel rows	Cob weight (g)	Shelling %	100-seed weight (g)	Yield per plant (g)
Rep	3	2.23	2.36	5053.83	687.36	249.93	4376.75
Treat	48	0.07*	1.36*	1512.09*	23.57*	16.22*	1140.95*
Parents	12	0.07 *	1.08 *	179.60 *	30.29 *	13.13 *	181.88 *
Parents Vs Crosses	1	0.06 *	11.26 *	47431.77 *	332.16 *	148.98 *	34192.78 *
Crosses	35	0.07 *	1.17 *	656.96 *	12.45 *	13.49 *	525.44 *
Lines	8	0.12 n.s	1.24 n.s	1231.49 n.s	8.01 n.s	27.35 n.s	759.28 n.s
Testers	3	0.07 n.s	1.08 n.s	1026.96 n.s	9.21 n.s	20.53 n.s	724.25 n.s
L x tester	24	0.19 *	4.59 *	1676.79 *	57.36 *	31.98 *	1690.54 *
Error	144	0.07	0.93	578.31	19.67	6.57	331.56

* Significant at 0.05 level.

n.s = not significant.

Table 10. Continued.

Source of variation	d.f.	No. of total leaves per plant	Leaf area (cm^2)	% Cob barness	Cob length (cm)	Cob diameter (cm)	Yield (t\h)
Rep	3	9.05	39975.93	2.67	49.38	0.64	3.03
Treat	48	2.39 *	8179.18 *	0.40 *	8.44 *	0.11*	5.33 *
Parent	12	3.76 *	9584.01 *	0.43 n.s	11.31 *	0.07 n.s	0.26 n.s
P.V.C	1	18.25 *	13572.30 *	1.89 *	108.53 *	2.03 *	157.54 *
Crosses	35	1.47 *	4052.58 n.s	0.34 *	4.59 *	0.07 *	2.72 n.s
Lines	8	9.07 n.s	17210.27 n.s	0.77 n.s	25.92 n.s	0.17 n.s	8.69 n.s
Testers	3	0.07 n.s	3110.22 n.s	0.25 n.s	0.92 n.s	0.11 n.s	2.18 n.s
L x Tester	24	3.94 *	10887.97 *	1.26 *	12.61 *	0.19 *	8.64 *
Error	144	0.40	4408.42	0.28	2.73	0.07	3.03

* level of significance at 5%.

n.s = non significant.

Table 11. Estimates of general combining ability effects of testers and lines genotypes for different characters over four environments.

Parent	Days to 50% tasselling	Plant height (cm)	Days to maturity	No. of nodes per plant	Stem diameter (cm)	Plant height to first cob (cm)
Tester						
65	0.574	-6.673	0.070	-0.180	-0.653	-0.428
160	-0.259	-2.276	-1.023	0.082	-0.303	-0.625
176	0.213	1.748	0.273	0.088	-0.048	-0.176
177	-0.528	7.200	0.681	0.010	-0.301	1.230
Line						
8	0.741	5.922	0.655	-0.068	-0.641	0.537
45	0.199	-3.474	0.613	-0.474	-0.022	-2.604
66	0.178	-4.328	1.530	-0.201	0.676	-4.042
75	0.345	-3.198	1.093	-0.112	0.038	0.323
111	-0.947	5.716	-1.220	0.168	0.382	2.675
157-1	0.324	-0.099	0.822	0.157	0.230	0.771
157-2	0.387	-1.249	-2.282	0.338	-1.320	0.983
186	0.533	3.091	1.863	0.472	1.117	1.485
203	-1.759	-2.380	-3.074	-0.279	-0.458	-0.127

Table 11. Continued.

	Ears per plant	No. of kernel rows	Cob weight (g)	Shelling %	100-Seed weight (g)	Yield per plant (g)
Tester						
65	0.044	0.009	-2.574	-0.389	0.946	-3.621
160	-0.012	-0.139	-6.006	0.643	-0.901	-4.138
176	0.026	-0.111	2.548	0.165	-0.058	3.987
177	-0.058	0.241	6.032	-0.419	0.014	3.772
Line						
8	0.111	-0.097	-0.655	-0.452	-0.100	-3.580
45	-0.139	0.195	1.961	1.281	-0.696	5.102
66	0.007	-0.410	2.741	0.239	0.754	4.570
75	-0.055	0.445	12.434	0.183	0.125	9.479
111	0.028	0.069	11.861	-1.079	1.335	8.293
157-1	-0.035	-0.368	-12.337	-0.427	-1.242	-6.531
157-2	-0.076	0.195	-12.210	-0.190	-2.059	-9.207
186	0.132	0.111	-2.206	-0.319	1.689	-3.419
203	0.023	-0.139	-1.591	0.764	1.091	-4.709

Table 11. Continued.

Parent	No. of total leaves/plant	Leaf area (cm^2)	Cob Barness%	Cob length (cm)	Cob diameter (cm)	Yield (t\h)
Tester						
65	0.023	20.966	0.075	-0.096	0.041	-0.297
160	-0.097	-15.354	-0.079	-0.269	-0.127	-0.346
176	0.005	-2.600	-0.146	0.352	0.004	0.508
177	0.070	-3.013	0.150	0.013	0.082	0.135
Line						
8	0.264	-11.111	0.024	-0.341	-0.055	-0.317
45	-0.820	4.334	-0.047	-0.125	0.045	0.056
66	-0.403	24.573	-0.120	0.917	-0.019	0.318
75	0.222	14.969	-0.276	0.631	0.062	0.056
111	0.076	17.577	-0.026	0.650	0.116	0.331
157-1	0.264	-32.188	0.126	-1.144	-0.057	-0.611
157-2	0.389	-26.817	0.061	-1.110	-0.059	-0.520
186	0.514	13.137	0.095	0.702	-0.049	-0.121
203	-0.507	-4.479	0.163	-0.181	0.016	0.808

Table 12. Estimates of specific combining ability effects of F_1 hybrids for different character over four environments.

	Tester			
Line	65	160	176	177
		Days to 50% tasselling		
8	-0.5	-0.3	0.2	-2.3
45	2.8	-1.6	0.6	-1.7
66	2.3	-2.5	0.3	1.0
75	0.3	0.7	4.4	0.5
111	-2.9	0.7	-1.2	-2.4
157-1	-1.0	-1.7	1.2	-3.1
157-2	-1.5	-1.4	2.1	-0.5
186	1.3	1.1	-0.1	0.2
203	-1.0	-0.8	-2.9	-0.2
		Plant height (cm)		
8	3.3	6.9	7.4	5.0
45	10.0	5.7	7.9	5.6
66	9.5	-7.6	84.7	85.5
75	84.7	85.2	88.9	84.9
111	81.5	85.1	-6.4	82.1
157-1	83.4	82.7	85.7	81.3
157-2	82.9	83.1	86.6	-5.8
186	85.8	85.5	84.3	84.7
203	83.5	83.6	81.6	84.2
		Days to maturity		
8	4.8	0.2	0.7	-1.8
45	3.3	-1.1	1.1	-1.2
66	2.8	-2.4	35.8	36.5
75	35.8	36.2	39.9	36.0
111	32.6	36.2	-1.2	33.2
157-1	34.5	33.8	36.8	32.4
157-2	34.0	34.1	37.6	-0.5
186	36.9	36.6	35.4	35.8
203	34.6	34.7	32.6	35.3
		Stem diameter (mm)		
8	-0.1	40.5	39.9	39.5
45	41.6	38.7	42.4	37.9
66	41.1	-1.1	1.1	0.7
75	2.0	-0.5	4.6	2.2
111	-3.4	-0.6	0.2	-1.6
157-1	-1.4	0.0	0.0	-2.9
157-2	0.2	-1.9	0.8	0.8
186	2.1	0.7	1.6	-1.0
203	-0.8	0.9	-3.4	-1.5
		No. of nodes per plant		
8	-0.5	53.0	52.8	51.7
45	53.9	50.8	52.8	50.6
66	52.9	-1.7	1.5	1.6
75	2.1	-0.3	4.7	0.5
111	-2.8	-0.8	-0.4	-1.1

Table 12. *Continued.*

Line	Tester			
	65	160	176	177
	No. of nodes per plant			
157-1	-0.5	0.1	0.2	-2.8
157-2	-1.4	-1.2	0.6	0.2
186	2.6	1.6	1.8	-0.8
203	-0.7	-0.7	-2.7	-1.7
	Plant height to first cob (cm)			
8	0.6	6.1	7.6	2.2
45	2.3	1.1	3.1	0.5
66	3.7	-2.3	3.7	5.4
75	1.7	-2.8	4.1	-0.1
111	-3.8	-1.0	-1.0	1.0
157-1	3.4	-0.3	-2.3	-3.5
157-2	-2.1	-2.2	0.5	-0.4
186	4.7	5.4	1.3	-3.3
203	-1.3	-1.4	-3.7	-1.9
	No. of total leaves/plant			
8	-0.4	52.1	51.8	50.1
45	52.7	49.4	51.5	49.3
66	51.9	-2.0	1.9	1.8
75	1.8	-0.2	4.6	0.5
111	-2.8	-0.6	-0.8	-0.8
157-1	-0.3	-0.2	0.3	-2.9
157-2	-1.5	-1.3	0.9	-0.1
186	2.9	1.8	1.4	-0.7
203	-0.8	-0.8	-2.8	-1.5
	Leaf area (cm^2)			
8	31.2	-371.7	-391.8	-383.3
45	-383.4	-336.7	-339.9	-382.0
66	-362.8	9.4	-3.3	-23.2
75	-12.9	-17.7	37.0	27.7
111	-15.4	3.4	10.6	-5.9
157-1	-25.2	-14.9	-17.2	29.5
157-2	25.7	-13.9	4.8	11.3
186	-2.2	-23.2	-13.3	-18.2
203	31.7	26.4	-15.4	2.5
	Cob barness%			
8	0.4	59.9	60.1	59.2
45	61.4	58.2	60.4	58.3
66	59.8	-1.7	1.1	1.5
75	2.3	-0.1	4.7	0.8
111	-2.4	-1.3	-0.5	-1.6
157-1	-0.6	0.3	0.4	-2.8
157-2	-1.2	-0.8	0.2	0.1
186	2.2	1.5	1.9	0.6
203	-0.7	-0.5	-2.3	-2.2
	Ear per plant			
8	-0.1	62.3	62.2	61.2

Table 12. Continued.

Line	Tester 65	160	176	177
		Ears per plant		
45	63.6	60.6	62.2	60.5
66	62.2	-1.8	1.2	1.3
75	2.1	-0.2	4.9	1.0
111	-2.4	-1.1	-0.6	-1.5
157-1	-0.7	0.1	0.3	-2.6
157-2	-1.0	-0.9	0.3	0.0
186	2.3	1.4	1.7	-0.5
203	-0.5	-0.3	-2.3	-2.0
		Number of kernel rows		
8	-1.0	49.6	50.3	48.4
45	51.2	48.6	50.2	48.2
66	50.0	-1.6	0.9	1.8
75	1.6	-0.2	5.2	0.7
111	-2.4	-1.0	-0.4	-1.8
157-1	-0.3	-0.4	0.3	-2.3
157-2	-1.3	-0.9	0.5	0.2
186	1.9	1.8	1.2	-0.7
203	-0.2	-0.1	-2.3	-1.9
		Cob weight (g)		
8	14.0	-30.0	-30.7	-41.5
45	-38.5	-17.3	-15.3	-27.4
66	-26.4	-1.1	-0.9	-1.4
75	-10.4	-12.0	17.2	13.1
111	-0.1	0.5	0.2	-3.6
157-1	-3.4	-12.4	-11.5	9.7
157-2	11.1	1.5	1.9	0.8
186	0.2	-1.3	-10.8	-12.5
203	11.9	11.8	0.0	-0.4
		Shelling %		
8	-0.6	-20.7	-19.5	-20.5
45	-16.8	-20.5	-18.6	-20.5
66	-20.1	-1.3	-0.2	1.1
75	1.9	0.9	5.3	1.1
111	-2.0	-1.9	0.0	-2.9
157-1	-0.9	-0.2	1.5	-2.3
157-2	-0.9	-0.4	-0.4	0.6
186	0.8	1.2	1.5	0.5
203	-0.1	-0.2	-1.9	-2.8
		100-seed weight (g)		
8	1.9	42.4	41.0	40.7
45	41.8	41.3	44.3	38.5
66	40.7	-0.7	1.7	0.6
75	1.9	-1.5	6.1	2.9
111	-4.0	-2.2	0.5	-0.9
157-1	-1.4	-0.1	-1.0	-1.4
157-2	1.0	-2.4	-0.8	1.1
186	2.8	0.6	1.5	-2.0

Table 12. Continued.

Line	65	160	176	177
			Tester	
		100-seed weight (g)		
203	0.7	1.7	-3.9	-3.1
		Yield per plant (g)		
8	15.3	-15.2	-14.6	-20.6
45	-16.9	-5.1	-0.3	-8.2
66	-5.3	1.9	-4.1	-3.2
75	-7.5	-8.4	11.4	10.1
111	1.1	3.6	3.1	-6.7
157-1	-5.2	-9.5	-7.9	3.9
157-2	8.1	2.7	5.1	3.7
186	-3.0	-3.2	-7.8	-8.9
203	6.0	8.8	1.2	2.7
		Cob length (cm)		
8	1.2	49.5	48.5	47.8
45	50.2	48.9	51.1	47.2
66	49.6	-1.4	1.2	0.4
75	1.4	-0.8	6.0	2.0
111	-3.0	-0.9	-0.2	-1.5
157-1	-1.6	-0.6	-0.3	-1.5
157-2	0.0	-1.4	0.5	0.5
186	2.2	0.5	1.0	-1.3
203	0.6	0.7	-2.9	-1.8
		Cob diameter (cm)		
8	0.1	59.5	59.6	58.5
45	60.9	58.0	60.2	58.1
66	59.6	-1.7	1.0	1.4
75	2.0	-0.3	4.9	0.9
111	-2.2	-1.1	-0.4	-1.6
157-1	-0.7	0.0	0.3	-2.6
157-2	-1.0	-0.7	0.3	0.2
186	2.1	1.4	1.6	-0.7
203	-0.5	0.3	-2.2	-2.0
			Yield (t\h)	
8	0.6	59.9	59.7	58.9
45	61.1	59.0	61.1	58.6
66	59.3	-1.4	1.0	1.0
75	2.0	-0.5	5.4	1.4
111	-2.2	-1.9	-0.2	-1.7
157-1	-1.0	0.0	0.0	-2.1
157-2	-0.6	-0.6	-0.5	0.5
186	2.1	1.1	1.6	-1.0
203	0.1	0.1	-2.1	-2.8

Table 13. Percentage contribution of lines, testers and lines x testers to the total variation among crosses for the different characters.

Character	General combining ability		Specific combining ability (SCA).
	Contribution due to lines	Contribution due to testers	Contribution due to line x tester
Days to 50% tasselling	35.0	10.8	54.2
Plant height (cm)	19.3	36.1	44.6
Days to maturity	43.2	6.3	50.5
No. of nodes/plant	43.6	6.1	50.3
Stem diameter	44.9	14.4	40.7
Ears per plant	41.3	9.3	49.4
Plant height to first cob	27.8	3.8	68.4
No. of total leave/plant	53.0	1.0	46.0
Leaf area	36.4	17.5	46.1
% Cob barness	20.0	16.8	63.2
No. of kernel rows	24.4	7.9	67.7
Cob length	48.4	4.6	47.0
Cob diameter	20.1	34.7	45.2
Cob weight (g)	42.8	13.4	43.8
Shelling percentage	14.7	6.3	79.0
100-seed weight	46.4	13.0	40.6
Yield per plant	33.0	11.8	55.2
Yield ton/hectare	27.3	18.3	54.4

4.3.4 Number of nodes per plant:

The highest GCA effect for the lines, was 0.472. given by the inbred line 186, and the lowest one –0.474, by 45, while, the highest GCA effect for the testers, was 0.088, recorded for the tester 176, and the lowest one of –0.180 for tester 65 (Table 11). The highest SCA effect was 42.2, expressed by the hybrid 45X176, and the lowest one –3.4, by 111X65 and 203X176 (Table 12).The percentage contribution of GCA and SCA for this character, to wards the total variation among the hybrids was 49.7% for GCA and 50.3% for SCA (Table 13).

4.3.6 Stem diameter (mm):

The estimate of GCA, for this character, among the lines varied from –1.320. was given by the inbred line 157-2, to 1.117, by 186. While, the estimate of GCA , among the testers ranged between –0.303, recorded by the tester 160, to 0.653, by tester 65 (Table 11). The maximum SCA effect, for stem diameter, was 42.400 accessed by the hybrid 45X176, and the minimum one 3.400, by 111X65 (Table 12). The percentage contribution of GCA and SCA, for stem diameter, towards the total variation among the hybrids was 59.3% for the GCA and 40.7 for the SCA (Table 13).

4.3.6 Plant height to first cob (cm).

The highest GCA effect, for this character, among the lines was 2.675, given by the inbred line 111, and the lowest one –4.042, by 66. while, the highest GCA effect among the testers 1.230, was expressed by the tester 177, and the lowest one –0.625, by 160 (Table 11).The maximum SCA effect, for height to first cob was 7.6, observed from the hybrid 8X176 and the lowest one –3.800, from 111X65 (Table 13).

4.3.7. Number of ears per plant:

The maximum GCA effect among the lines, for this character was 0.132, given by the inbred line 186, and the minimum one –0.139, by line 45, moreover, the maximum GCA among the testers of 0.044, was recorded from the tester 65, and the minimum one –0.058, from 177 (Table 11). The highest SCA effect was 63.6, expressed by the hybrid 45X65, and the lowest one –2.61 given by 157-1X177 (Table 12). The percentage contribution of GCA and SCA, for this character, to the total variation among the hybrids was 50.6% for the GCA and 49.9% for the SCA (Table 13).

4.3.8 Number of leaves per plant:

The maximum GCA effect among the lines was 0.514, it was accessed by the inbred line 186, and the minimum one of –0.820, by 45. while, the maximum GCA effect, among the testers was 0.070, given by the tester 177 and the lowest one –0.097, by 160 (Table 11). The SCA effect, for this character, varied from –2.900, was given by the hybrid 157-1X177, to 52.700, by 45X65 (Table 12). The percentage contribution of GCA and SCA, for this character, to the total variation among the hybrids was 54.0% for the GCA and 46.0% for the SCA (Table 13).

4.3.9. Leaf area (cm^2):

The highest GCA effect, among the lines, for leaf area was 24.573, given by the inbred line 66 and the lowest one –32.186, by 157-1, while, the highest GCA effect, among the testers was 20.966, given by the tester 65 and the lowest one –15.354, by 160 (Table 11). The maximum SCA effect was 37.0, observed in the hybrid 75x77, and the minimum one –383.4, in 45x65 (Table 12). The percentage contribution of GCA and SCA for this character, towards the total variation among the hybrids was 53.9% for the GCA and 46.1% for the SCA (Table 13).

4.3.10 Cob barness%:

The GCA effect, for this character, among the lines varied between 0.163, was produced by inbred line 203, and –0.276, by 75. While, the GCA effect, among the testers ranged from 0.150, was produced by the tester 177, to –0.146, by 176 (Table 11). The highest SCA effect, for this character, was 61.4, observed in the hybrid 45X65 and the lowest one –2.4, in 111X65 (Table 12).The percentage contribution of GCA and SCA, for this trait, to the total variation among the hybrids was 36.8% for the GCA and 63.2% for the SCA (Table 13).

4.3.11. Number of kernel rows per cob:

The highest GCA effect, for this character, among the lines was 0.445, produced from the inbred line 75, and the lowest one –0.410, from inbrd line 66. While, the highest GCA effect, among the testers 0.241, was produced for tester 177 and the lowest one –0.140, for 160 (Table 11). The SCA effect, for number of rows per cob, varied between 51.2, was given by the hybrid 45X65, to –2.4, by 111X65 (Table 12).The percentage contribution of GCA and SCA, for this character, to the total variation among the hybrids was 53.3% for the GCA and was 47.7% for the SCA effect (Table 13).

4.3.12. Cob length (cm):

The GCA effect among lines for cob length varied from 0.917, accessed by the inbred line 66, and –1.144, by 157-1. While, the GCA effect, among the testers was ranged between 0.352, given by the tester 176, and –0.269, by 160 (Table 11).The maximum SCA effect, for cob lengh was 51.1, scored for the hybrid 45X176, and the minimum one 3.0, for 111X65 (Table 12).The percentage contribution of GCA and SCA, for cob length, to the total variation among the hybrids was 53.0% for the GCA and was 47.0% for the SCA (Table 13).

4.3.13. Cob diameter (cm):

The GCA effect, for cob diameter, among the lines, was ranged between 0.116, produced from the inbred line 111, to –0.059, from 157-1. While, the GCA effect, among testers, was varied from 0.082, achieved by the tester 177, to –0.127, from 160 (Table 11).The maximum SCA effect, for this character, was 60.9, given by the hybrid 45X65, and the lowest one –2.2, by 111X65 (Table 12).The percentage contribution of GCA and SCA, for cob diameter, to the total variation among the hybrids was 54.8%, for GCA, and was 45.2% for the SCA effect (Table 13).

4.3.14. Cob weight:

The highest GCA effect, for cob weight, among the lines was 12.434, was given by the inbred line 75 and the lowest one was – 12.337, expressed by inbred line 157-1. While, the highest GCA, among the testers was 6.032, recorded for the tester 177, and the lowest one was – 6.006, for 160 (Table 11).The maximum SCA effect, for cob weight was 17.2, obtained from the hybrid 75X176, and the minimum one was –14.5, by 8X177 (Table 12).The contribution of GCA and SCA, for cob weight to total variation among the hybrids was 62.2% for the GCA and was 43.8% for SCA (Table 13).

4.3.15. Shelling percentage:

The GCA effect, for shelling percentage, was varied from 1.281, recorded for the inbred line 45, to –1.079, for 111, while, the GCA effect, among the testers was ranged between 0.643, expressed by the tester 160, to–0.419, by 177 (Table 11).The highest SCA effect, for this character, was 5.3, obtained from the hybrid 75X176, and the lowest one, was – 20.7, from 8X160 (Table 12).The percentage contribution of GCA and SCA, to the total variation among the hybrids was 21.0% for the GCA and 79.0% for the SCA (Table 13).

4.3.16. 100-seed weight (g):

The maximum GCA effect, for this charcater, among the lines was 1.689, recorded for the inbred line 186, and the minimum one was –2.059 for 157-2, while the maximum GCA, among the testers was 0.946, achieved by the tester 65, and the minimum one was –0.901, by 160 (Table 12).The percentage contribution of GCA and SCA, for 100-seed weight, towards the total variation among the hybrids was 59.4% for the GCA and 40.6 for the SCA (Table 13).

4.3.17. Yield per plant (g):

The GCA effect, for this character, among the lines was ranged between 9.479, recorded for the inbred line 75, to –9.207, for 157-2. While, the GCA effect, among the testers was varied from 3.987, expressed by the tester 176, to –4.138, by 160 (Table 11).The highest SCA effect, for yield per plant, was 11.7 produced by the hybrid 75X176, and the lowest one –20.5, by by the hybrid 8X177 (Table 12).The percentage contribution of GCA and SCA, for this character, to the total variation among the hybrids, was 44.8% for the GCA and 55.2% for the SCA (Table 13).

4.3.18. Grain yield (t/h):

The maximum GCA effect, for grain yield (t/h), among the lines was 0.808, recorded from the inbred line 203, and the minimum one –0.611, from 157-1. While, the maximum GCA effect, among the testers was 0.508, recorded for the tester 176, and the minimum one –0.297, for 65 (Table 11).The highest SCA effect, for this character, was 61.1, produced from the hybrid 45X65, and the lowest one –2.8, from 203X177 (Table 12). The percentage contribution of GCA and SCA, for the grain yield (t/h), towards the total variation among the hybrids was 45.6% for the GCA and 54.4% for the SCA (Table 13).

CHAPTER FIVE

DISCUSSION

5.1. Days to 50% tasselling:

Significant differences were detected among the evaluated genotypes in days to 50% tasselling at each of the four seasons. Also across seasons analysis revealed significant differences between years, seasons, genotypes and their interactions, indicating the existence of a wide range of variability in the tested genotypes which can be attributed to genetic, environmental factors as well as their interactions. Similar findings were reported by several maize breeders .[Parasad and Singh (1998), Abel and Pollak (1991), Khalafalla and Abdalla (1997a), Badda (1995), Venkatesh *et al*. (2002) and Meseka *et al*. (2003)].

Most of the crosses had negative heterosis values over mid-parent and better parent. Thus, each of these hybrids was earlier than its earliest parent, such negative effect is considered useful, in breeding for early maturing varieties. Castro *et al*. (1968), Kara (2001) and Dickeret and Tracy (2002), reported negative heterosis value.

Combining ability analysis showed significant differences for linesX testers interaction, indicating greater divergence among crosses. Similar findings had been reported by Soliman and Sadek (1999) and Zhao *et al.* (2003)

The contribution of GCA variance (54.2) among the crosses in this character to the total variation was greater than that of SCA , indicating that this trait is controlled largely by additive gene action. The predominance of additive gene action in days to 50%. tasselling in maize were reported by Paul and Debnath (1999), Geetha (2000), Nirla and Jha (2001), Rana and Vinod (2001) and Meseka *et al*. (2003). Among the lines, 111 and 203 had the lowest negative GCA effect, where as, among the testers line 160 and 177 had the lowest negative GCA value. Hence these parents could be useful in production areas with terminal draught stress.

For days to 50% tasselling, 13 hybrids exhibited low negative SCA effects. These hybrids represented all the three possible combinations between parents of high and low GCA effects.

5.2. Plant height:

Significant differences were detected among the tested genotypes at the individual as well as across seasons analysis of variance. Also significant differences were defected between years, seasons and their interactions with the genotypes. Such variability could be attributed to genetic, environmental factors and their interactions. Similar results had been reported by Sindagi *et al*. (1970), Pandey (1974), Ron and Ordous (1987), Galeev *et al*.(1987), Abel and Pollak (1971), Khalafalla and abdalla (1997a), Badda (1995), Kumar (1999), Kumar and Satyanarayana (2001), San-Vicente *et al*.(2001), Jha *et al.* (2002), Vacaro *et al*. (2002), Meseka *et al*. and Yousif *et al.* (2003).

All hybrids, with the exception of 66x177, exceeded the mid-parental value. Positive heterosis over both mid-parental and better parent values for plant height was mentioned by Castro *et al.* (1968), Altinbas (1995), Khalafalla and Abdalla (1997b) and Dickeret and Tracy (2002).

Differences among the progenies of lines x testers were significant, similar results were reported by Soliman and Sadek (1999), Nirla and Jha (2001) and Alamnie *et al*. (2003).

The magnitude of GCA among the lines, as indicated by the mean square of variance of lines, was greater than that of the testers, hence, the contributions of GCA was mostly due to the high variation in GCA among the lines. Tosquy *et al*. (1998) found that, testers had significant effect on height of plant.

The contribution due to GCA was larger than that to SCA (Table 13), indicating that the inheritance of this character was due to GCA effects and largely controlled by additive genetic effects. Similar results were shown by, Martin *et al*. (1997), Geetha (2000), ogunbodede (2000), Niguisse and Zelleke (2001), Nirla and Jha (2001), He *et al*. (2003) and Meseka *et al*. (2003).

The number of lines showing high GCA effects were 5 for this trait (Table 11).Consequently such lines, (186, 111, 18, 176 and 177) might be efficient and prospective in improving plant height of corn. Generally, the highest positive SCA effects for plant height (Table 12) were detected in 24 hybrids, while the lowest negative values were shown in the hybrids 66x160, 111x176 and 157-2x177.

5.3. Days to maturity:

The results revealed significant differences among the evaluated entries in days to maturity at individual season as well as across season analysis. In addition, differences between years, seasons, genotypes and their interactions were significant. Zelleke (2000) and Matho and Ganguly (2001) reported similar results.

About 70% and 100% of the hybrids exhibited negative mid-parent and better parent heterosis for days to maturity, respectively, showing that they were earlier than their specific parents. Such early maturing genotypes would be useful where areas with short season of rain fall.

Mean square due to lines x testers was significant ,indicating divergence among the hybrids for days to maturity. The contribution of GCA and SCA among hybrids were of equal importance for days to maturity indicating that this character was controlled by both additive and non-additive gene actions.

The magnitude and direction of GCA effect (Table 11),showed that, inbreds 176 and 177, among testers, and 66, 75 ,186, among lines, were good general combiners for maturity. Medium and late maturing parents could be utilized in breeding of genotypes with medium to late maturity period. However, tester 160 and lines 111, 157-2 and 203 had the highest negative GCA, indicating that they were the best general combiner for earliness, thus they could be useful in programs directed towards breeding of early maturing varieties in production areas where terminal drought stress is of common occurrence.

The most promising hybrids for breeding programs showed high GCA effects, reflecting the importance of the additivity in the control of days to maturity were 186 x 176 and 66 x 177. while hybrids like 45 x 160 and 157-2 x 177 reflected the importance of additive X recessive one.

5.4. Number of nodes per plant:

Analysis of variance for number of nodes per plant at individual season analysis as well as across analysis, for years, seasons, genotypes and their interactions, revealed significant differences among parents and their crosses.

Combining ability analysis, showed that, the variance due to lines x testers was greater than that due to lines or that due to testers, indicating that the variation among crosses was greatly affected by lines x testers interaction. In fact the contribution of GCA was equal to that of SCA, suggesting that, the envolvement of both additive and non-additive gene effects in controlling of this trait. Among the best cross combinations, the SCA effects of 8 x 176 and 45 x 176 was obtained from low x high general combining parents . It , there for seems that the high SCA effects of these crosses may be due to complimentary type of gene effects.

An examination of the GCA estimates for number of nodes per plant revealed desirable GCA among lines 157-2, 186 and among testers 176 for this trait. Therefore, line 157-2, 186 and 176, were among the studied inbred lines and will be the lines offering the maximum promise in breading for increased number of nodes per plant.

5.5. Stem diameter:

The significant differences in stem diameter, detected among the evaluated genotypes at individual and across seasons analysis, indicate the existence of wide range of variability in the tested material. This variation can be attributed to genetic as well as environmental factors. This finding is in agreement with those obtained by Khalafalla and Abdalla (1997a), Badda (1995) and Jha *et al*. (2002).

Most of the crosses (about 70%) had positive mid-parent heterosis and fewer about 30% had positive better parent heterosis, for stem diameter. This reflecting that, most of the crosses were characterized by thicker stems.

Line x tester analysis shown in (Table 10) indicated the presence of wide genetic diversity among parents and hybrids for stem diameter.

The variance due to lines was higher than those due to lines x testers or testers (Table 10) indicating the presence of great diversity among lines as compared to tester or hybrids for stem diameter.

Line 186, among female parents, and line 65, among male parents, were good combiner parents for high thicker stem diameter.

The contribution of GCA (female and male parents) compared to that of the SCA (females x males) , were of equal magnitude, indicating the importance of both additive and non-additive gene effects in the inheritance of this trait.

The best hybrid combinations for this trait, as indicated by the highest SCA effects, were 8 x 160, 8 x 176, 8 x 177, 45 x 65, 45 x 160, 45 x 176, 54 x 177 and 66 x 65.

5.6. Height to first cob:

The significant differences obtained in height for first cob, among the evaluated genotypes indicate the existence of wide range of variability, which could be attributed to both genetic and environmental factors as well as to their interactions. These results were in accordance with those mentioned by Galeev *et al*. (1987), Khalafalla and Abdalla (1997a), Kara (2001), Kumar and Satyanarayna (2001), Vaccaro *et al*. (2002), Abudeif (2003), Meseka *et al*. (2003), and Yousif et al. (2003).

Combining ability analysis for this character revealed that GCA mean squares for the lines x testers were not significant.

However, the variances due to lines and testers were larger than variance of lines x testers for this character, indicating the importance of additive gene effects in the control of this character.

Sedhom (1994), Dehghanpour *et al*. (1996), Konack *et al*. (1996), Tulu and Ramachandrapa (1998), Chouckan (1999), He *et al*. (1999), Paul and Debnath (1999), Singh (1999) Singh and Singh (1999), Venkatesh and Sarma (1999), and Wu *et al*. (2003) all mentioned that, cob position was mainly controlled by additive gene action. Analysis of GCA effects showed that, from the tester group tester 177 and from the line group, line 11 were the best for GCA effects.

5.7. Number of ears per plant:

The differences among the evaluated entries for this character at Summer seasons, and also years and genotypes as well as their interactions were significant. Several workers reported a high variation in number of ears per plant [Kumar and Satyanarayana, (2001) and Vocaro *et al*. (2002)].

Partitioning of the variance among crosses indicated that, the variance due to the specific combining ability (lines x testers) were significant for number of ears per plant (Table 10).

The relative estimates of the contribution due to GCA and SCA indicated that they had comparable values, suggesting the role of both additive and non-additive gene effects in the inheritance of this trait. Average mid-parent and better parent heterosis for this trait, were negative, suggesting that hybrids produced less ears than their corresponding parents.

Estimates of the GCA effects for this trait, revealed that line 8, 186, 65 and 176 were the best general combiner parents type.

5.8. Number of leaves per plant:

The significant differences observed among the evaluated accessions, in this trait, and their interactions with seasons reflected the presence of the wide range of variability for the number of leaves carried on the stem. This result is in agreement with those reported by Galeev *et al*. (1987), Khalafalla and Abdalla (1997a), Badda (1995) and Jha *et al*. (2002).

Variation among the parents for this trait was expressed in their hybrids, as indicated by the estimates of mid-parent and better parent heterosis. About 80% of the hybrids had positive mid-parent heterosis and 60% of them had positive better parent values. Further investigation of these hybrids for forage production might be rewarding. The combining ability analysis indicated significant difference for lines x testers interaction. Mean squares for lines were large, in comparison with that for testers, thus, lines in general had greater diversity for this character.The relative contribution of GCA was larger compared to that of SCA, emphasizing the role of predominant, additive gene action. Revilla (1999), Desai, and Singh (2001), and Nirla and Jha (2001) reported a pronounced GCA effects for this trait. The best hybrid combinations for this character were 8 x 160, 8 x 176, 8 x 177, 45 x 65, 45 x 160, 45 x 176, 45 x 177 and 66 x 65 (Table 12).

5.9. Leaf area:

The significant differences which were observed among evaluated enteries for this trait, in individual season analysis and across seasons analysis (years, seasons, genotypes and their interactions), could be attributed to environmental factors as well as genotypic factors and their interactions. Similar results were reported by Kumar (1999), Kumar and Satyanarayana (2001) and Yousif *et al*. (2003). Variability among parents was expressed in their hybrids, as indicated by the estimates of a mid-parent and better parent heterosis. About 40% of the hybrids had positive MP heterosis and 75% of them had BP heterosis. The breeding material utilized in the present study, appears to be more suitable for exploitation of heterosis in respect of leaf area. The magnitude of the mean square for the lines was greater than those due to lines x testers (Table 10), indicating a greater diversity amongst the lines for this trait. The percentage of contribution of GCA (53.9%) was greater than that due to SCA (46.1), suggesting that inheritance of this trait was mostly due to additive gene effects. The best general combiners were 45 and 66 among the lines and 65, among the testers.

5.10. Cob barness (%):

The significant differences of this character in the individual as well as across seasons analysis, indicated the role of genetic factors as well as environmental ones and their interactions in the inheritance of this character. (Table 5 and 6).

The mean square of line x tester analysis, (Table 10), showed that, most of the contribution in GCA was mainly due to variation in lines (0.8) than variation due to testers (0.3).The values of the ratio of percent contribution of SCA (63.2): GCA(36.8%) were more than unity showing that this character was governed predominantly by non-additive gene action. These results agree with the reports of Wu *et al*. (2003). The parents 8, 157-1, 157-2, 186, 203 and tester 65, 177 were the best general combiners for the percent of cob barness. In the present investigation the cross combinations of 8 x 160, 8 x 176, 8 x 177, 45 x 65, 45 x 177 and 66 x 65 had envolved all possible combinations between the parents of high and low general combining ability effects.

5.11. Number of kernel rows per cob:

The significant differences detected among the evaluated genotypes in number of Kernel rows in individual as well as across seasons analysis (Tables 5 and 6) indicated variability among them. Variability in number of the kernel row per cob had been reported by Khalafalla and Abdalla (1997a), Badda (1995), Kumar and satyanarayana (2001) and Abudeif (2002). Also the analysis of variance of combining ability for lines x testers (Table 10), showed the existence of variation among the hybrids for this character.

The ratios of percent contribution of SCA (67.7%) to GCA (32.3%), revealed that, non-additive genetic effects were more important than additive one in the inheritance of such character. So through any breeding methods, this character can be exploited easily and that would be useful for the improvement of this character. Table 11, presents information on the best general combiner for number of Kernel rows per cob. Such information should be taken into consideration while formulating a breeding program. The superior hybrid combinations (Table 12) involved at least one high general combiner, as a parent and rarely low x low one.

5.12. Cob length:

The observed differences in cob length among evaluated accessions, in individual as well as at across seasons analysis could be attributed to both genetic, environmental factors and their interactions. Similar conclusions were reported by Pandey *et al*. (1974), Khalafalla and Abdalla (1997a), Badda (1995), Venkatesh *et al*. (2002) and Meseka *et al*. (2003). All hybrids showed positive mid-parent heterosis, while in case of better parent heterosis only 63.9% showed positive value. Positive heterosis for cob length was observed earlier by Debnath (1987). Mean squares due to lines were larger than that due to testers , indicating greater diversity among lines for cob length. The higher magnitude of lines x testers variance indicated more diversity among the hybrids. The relative estimates of percent contribution due to GCA to SCA (53.0% : 47.0%) were almost more than unity and that, reflecting the predominant role of additive gene action in the inheritance of this trait. Similar findings were reported by, Sedhom (1994), Mathur *et al*. (1998), Venkatesh and Sarma (1999), Ogunbodede *et al*. (2000), Geetha (2002), He *et al*. (2003), Wu *et al*. (2003) and Yu *et al*. (2003). In the present studies the hybrids differed widely, and estimate of SCA effect (Table 12), showed that, the hybrids 45 x 176, 66 x 65, 8 x 176, 8 x 177 and 45 x 177 were significantly superior to others in their specific combining ability. The males and females of all these hybrids were of low x high general combining parents except that of the hybrid 66 x 65 which was of high x low combiners.

5.13. Cob diameter:

Significant differences in cob diameter were shown among the evaluated enteries at individual and combined analysis, that reflecting the existence of variability for this trait, and that could be attributed to the influence of both genetic and environmental factors and their interactions. Similar conclusions were mentioned earlier by Khalafalla and Abdalla (1997a), Kara (2001), Venkatesh *et al*. (2002) and Abudeif (2003). Heterosis estimates showed that,about 94% and 78% of the hybrids have positive mid-parent and better parent heterosis respectively. The combining ability analysis of line x tester revealed significant differences for lines x testers (Table 10). The relative magnitudes of percent contribution due to GCA and SCA, showed that, the percent contribution of GCA (54.8%) was more than SCA (45.2%), that indicating the importance of additive gene effect in the inheritance of this trait. Specific combining ability effects, showed that cross 8 x 177 and 45 x 177 were among the superior crosses and both of them of low x high general combiner parents for cob diameter. In the present study there were 5 parents among the lines 45, 75, 111, 203 and 3 and among the testers have positive general combining ability effects (Table 11).

5.14. Cob weight:.

Mean squares obtained from the analysis of variances for evaluated genotypes at individual analysis as well as at across analysis were significant for this trait, indicating the presence of variability which could be attributed to genetic, environmental factors and their interactions. This result support the findings of Khalafalla and Abdalla (1997a), Badda (1995), and Kumar and Satyanarayana (2001). The overall mean heterosis for this character was positive being 60.4% and 52.2% over mid-parental and better parent respectively. Dickeret and Tracy (2002), Khalafalla and

Abdalla (1997b) reported positive average mid-parent and better parent heterotic effects. Considerable general combining ability effects were obtained for cob weight in lines, 75 (14.2), 111 (11.9) , testers, 177 (6.0),and 176 (2.6) (Table 11). The highest desirable SCA effect detected in the hybrid 75 x176 (17.2) reflect the superiority of this hybrid. Also this hybrid consists of high x high general combiner parents for cob weight. The ratio of GCA: SCA (Table 13) variance was, less than one indicating the importance of non-additive gene action in the inheritance of this character. This result was in agreement with those reported by Dehghanpour (1996).

5.15. Shelling percentage:

Significant F values observed for means squares of this character in summer seasons as well as in years and years x genotypes interaction indicated presence of variability for this trait among the evaluated genotypes. Matho and Ganguly (2001) mentioned similar results. Overall mean heterosis was positive for mid-parent heterosis and better parent heterosis, indicating the presence of better hybrids for this trait. The contribution of SCA (79.0%) was considerably greater than GCA (21.0%) suggesting that the non-additive portion of genetic variance was substantial. A comparison of GCA effects revealed that, four lines 45, 66, 75, 203 and two testers 160 and 176, were an excellent general combiners for shelling percentage. Specific combining ability effect was limited in this character among the crosses.

5.16. 100-seed weight:

Significant variation in 100-seed weight was observed among the evaluated accessions at summers (2002, 2003), winter (2003) and across seasons , indicated the presence of variability for this trait. This result was in agreement with those of Khalafalla and Abdalla (1997a), Badda (1995), Mathio and Ganguly (2001) Abudeif (2003) and Meseka *et al*. (2003). Female parents 66, 111, 157-2 and 186 when crossed to male parent 176 produced high mid-parent and better parent heterosis for 100-seed weight. Debnath (1987), Dickeret and Tracy (2002) and Khalafalla and Abdalla (1997b) observed heterosis for 100-seed weight. The ratio of GCA : SCA effects to the total variation among hybrids for 100-seed weight (59.4% : 40.6%) were almost more than one indicating that the inheritance of this trait was due mainly to GCA effects and largely controlled by additive gene effects. Inbred lines 186, 111, 203, 66, 75 and testers 65 and 177 were positive combiner. The present study revealed that line 186, 111, 203 and 65 might be the best parents for improvenment of this character. Hybrids like 45 x 65 and 66 x 65 had quite high specific combining ability estimates. Thus a combination involving one parent having high general combining ability and one with low general combining ability as if had dominant + recessive interaction.

5.17.Grain yield per plant:

The analysis of variance of yield per plant at individual analysis as well as at across season analysis revealed the existence of variability among the evaluated genotypes.Such variability could be attributed to genetic, environmental factors and their interactions. Khalafalla and Abdalla (1997a), Badda (1995) and Abudeif (2003) reported similar finding. About 47% of the crosses exhibited positive mid-parental and better parent heterosis values which exceeded their corresponding averages. Analysis of variance of combining ability revealed significant differences for lines x testers indicating the existence of variation among hybrids. The contribution of SCA to the total variation among hybrids was higher than that due to GCA showing the influence of non-additive gene action in the inheritance of yield per plant. Earlier Almanie *et al*. (2003), showed similar results. In general, line 75, 111, 45, 66 ,and testers 176 ,177 showed better combining ability for yield per plant. Accordingly, exploitation of these inbreds was advocated. It was interesting to notice that the hybrids 75 x 176 and 75 x 177 involved both general combining parents which had shown high specific combining effects and heterosis.

5.18. Grain yield (t/ha):

There is significant variation among the evaluated genotypes at individual season analysis (Table 5), as well as at across season analysis (Table 6). Such variability could be attributed to genetic, environmental factors and their interaction. In general the results of phenotypic variability studies in maize by Khalafalla and Abdalla (1997a), Badda (1995) Chouckan (1999), Kara (2001), Mathio and Ganguly (2001), Vacaro *et al*. (2002), Venkatesh (2002), Meseka *et al*. (2003), and Yousif *et al*. (2003), were in agreement with the present investigations. ANOVA for combining ability (Table 10), showed significant differences for lines x testers indicating variability among hybrids. In respect to grain yield (t/ha), hybrids 111 x 65, 203 x 177 and 66 x 176 had significantly higher grain yield (t/ha) than their mid-parental and better parent averages. Hybrid 111 x 65 being the highest yield hybrid. The contribution of SCA was almost greater than GCA indicating the importance of non-additive gene action in the inheritance of this trait. This finding was in the scope of that previously reported by Mustafa *et al*. (1996), San-Vicente (1998), Chouckan (1999), Kara (2001), San-Vicente (2001), Dehghanpour *et al*. (2002), Sujipirihate (2002), Venugopal *et al*. (2002) and Dodiya and Joshi (2003). For grain yield (t/ha), inbred lines 203, 111, 66, 75, 45, and testers 176 ,177 seemed to be the best combiner for this trait, as was shown by the positive general combining ability effects. The most desirable hybrid combinations, as indicated by their specific combining ability effects, were 8 x 160, 8 x 176, 8 x 177, 45 x 65, 45 x 160, 45 x 176, 45 x 177 and 66 x 65.

CHAPTER SIX

SUMMARY AND CONCLUSION

6. An 9 x 4 line x tester analysis of combining ability for 18 characters in 13 inbred lines of maize was conducted with the aim to obtain informations on, phenotypic variability, heterosis and combining ability.

6.1 The extent of phenotypic variability.

1) A wide range of phenotypic variability was detected among the evaluated genotypes at each of the four seasons, for most of the traits studied, this variability can be exploited in the improvement of this crop.

2) The significant (P>0.05) of years, seasons and the interactions of years with seasons, years with genotypes, seasons with genotypes and years with seasons with genotypes, indicated the importance of genotype x environment interaction. Nevertheless, evaluation over more seasons and years is essential.

3) A great amount of variability as measured by the range of means and the coefficient of variations, was expressed by the different characters, which were also illustrated.

4) in combining ability analysis, mean squares due to lines were larger than that due to testers for all the characters, indicating that, variation in general combining ability effects was mainly due to variation among lines.

5) partioning of mean squares of crosses to lines, testers and lines x testers interactions, revealed significant differences for lines x testers for all characters except plant height to first cob, and that indicating the existence of variation among the crosses.

6.2 Heterosis studies.

1) Marked heterosis was observed in many crosses for most of the characters examined and more pronounced effects were found for cob weight, yield per plant and yield ton per hectare.

2) Over all study of hybrid vigour showed that hybrids, 111 x 65, 203 x 177, 66 x 176, 8 x 65, 111x 177 and 157-1 x 65 possessed maximum desirable characters and were potential for commercial hybrid exploitation.

6.3. Combining ability studies.

1) A comparison of the general combining ability effects, showed that, testers 176 and 177 were the best general combiners for, number of leaves per plant, cob length, cob diameter, cob weight, yield per plant and yield ton per hectare, while among lines the best general combiners for these traits were, line 75 and 111.

2) The present investigation has depicted predominantly non-additive gene action for, days to 50% tasselling, plant height to first cob, number of kernel rows per cob, percent of cob barness, shelling percentage, yield per plant and yield ton per hectare. Also considerable additive gene action was indicated for stem diameter, number of total leaves per plant, leaf area, cob length, cob diameter, cob weight and 100- seed weight. While for number of nodes per plant and days to maturity, both additive and non-additive gene effects were of equal importance.

3) concerning the specific combining ability effects none of the crosses had higher SCA effects for all characters, the crosses, 8 x 65, 8 x 160, 8 x 176, 45 x 65, 45 x 160, 45 x 176, 45 x 177 and 66 x 65 gave higher SCA effect for nine characters (stem diameter, number of

nodes per plant, number of total leaves per plant, number of ears per plant, percent of cob barness, cob length, cob diameter, number of kernel rows per cob and yield ton per hectare.

REFERENCES

Abel, B.C. and pollak, L. M. (1991). Ranks Composition of unadapted maize population by testers and per se evaluations. Crop sci 31: 650-656.

Abou-Deif, M. H. (2003), Inheritance of Yield and its components among F_1 and F_2 maize hybrids. Bulletin of the National Research Center (Cairo) 28 (1), 125-137.

Alamnie, A.; Nayakar,N.Y.; Wali, M. C. and Atanaw, A.(2003). Combining ability, heterosis and per se performance of height characters in maize . Karantaka journal of agricultural sciences16(1), 131-133.

Allard, R.W.(1960). Principles of Plant Breeding. John Wiley and Sons Inc.,New york

Altinbas, M. (1995). Heterosis and Combining ability in maize for grain yield and some plant characters. Anadolu 5 (2), 35-51.

Aquino, p.; Carrion. F.; Calvo. R. and Dagoberto. F. (2000). Selected maize statistics. Cimmyt World Maize Facts and Trends. 45-54.

Badda, A. A. A. (1995). Evaluation of some exotic and local maize (*Zea mays l.*). M. Sc. (Agric.) thesis. Faculty of Agriculture. University of Khartoum. Sudan.

Castro, M. H.; Gardner, C. O. and lonnquist, J. H. (1964). Cumulative gene effects and the nature of heterosis in maize crosses involving genetically diverse races. Crop Sci 8: 97-101.

Choukan, R. (1999). Estimation of combining ability, additive and dominace variances of characters using line x Tester Crosses of maize inbred lines. Seed and plant 15 (1), 47-55.

Choukan, R. (1999. General and Specific Combining ability of ten maize inbred lines for different traits in diallel crosses. Seed and plant 15(3), 280-295.

Darrah, L. L.; Eberheart, S. A. and Pandey, L. H.(1978). Six years of maize selection in Kitale synthetic II, Ecuador 573 and Kital composite A ,using methods of comperhensive breeding system. Euphytica 27:515-518.

Debnath, S. C. (1987). Heterosis in maize (*Zea mays l.*). Bangladesh Journal of Agriculture 12 (3), 161- 168.

Dehghanpour, Z. ; Ehdaie, B.; Moghaddm, M.; Griffing, B. and Hayman, B. I.(1996).Diallel analysis of agronomic characters in white endosperm corn. Journl of Genetics and Breeding 50(4)357-365.

Desai, S. A and Singh, R. D. (2001) Combining ability studies for some morphological, physiological and biochemical traits related to drought tolerance in maize (*Zea mays l.*) Indian Journal of Genetics and Plant Breeding 61 (1), 34-36.

Dhillon, B. S.; Singh, J.; Seth, A. S and Singh. N.N. (1978). Combining ability in maize under varying plant densities. Indian J. of Genetics and Plant Breeding. 38: 304 –312.

Dickert, T. E. and Tracy, W. F. (2002). Heterosis for flowering time and agronomic traits among early open pollinated sweet corn Cultivars. Journal of the American Society for Horticultural Science 127 (5), 793-797.

Dodiya, N. S. and Joshi, N. V. (2003). Heterosis and combining ability for quality and yield in early maturing single cross hybrid of maize (*Zea mays l.*). Crop research (Hisar) 26 (1), 114-118.

Dubey, R. B.; Joshi, V. N. and Pandya, N. K.(2001).Heterosis and combining ability for quality, yield and maturity traits in conventional hybrids of maize (*Zea mays l.*). Indian Journal of Genetics and Plant Breeding 61(4)353-355.

Eberheart, S. A. and Russel, W. A.(1966).Stability parameters for comparing varieties .Crop Sci (6) 36-40.

El-Hosary, A. A.; Mohamed, M. K.; sedhom, S. A. and Abo. El-Hassan, G. K. A. (1997). Performance and Combining ability in diallel crosses of maize. Annals of Agricultural Science . Moshtohor 32 (1), 203-215.

El-Rouby, M. M.; Karim, Y. S. and Nawar, A. A. (1973). Estimation of Genetics variance and its components in maize under stress and non-stress environments and planting date. Egyptian J. of Genetics and Cytology 2: 10 –19.

FAO. (2003). FAO Bulletin of statistics 4 (2), 29-31.

Galeev, G. C.; Guzhov, L. Y. and Segarra, T. I. M. (1987). Modifactory variation in quantitative traits in inbred lines and hybrids of maize. Plant Breeding Abstract 58 (1), 30 (Abstract no.290).

Geetha, K. (2001).Combining ability for grain traits in maize. Madras Agricultural Journal, 87 (7-9),447-449.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Proceedures for Agricultural Research, 4th. Ed. John Wiley and Sons. Inc. New York.

Halluer, A. R and Miranda-Filho, J. B. (1981). Quantitative Genetics in Maize Breeding .First Edition. 1981. lowa State University Press. Ames.

Has, V. (1999). Genetic Analysis of Some Yield Components and Kernel Quality in Sweet Corn. Romanian Agricultural Research. 11 –12, 9 – 15.

He, D. Y. ; Wei, W. G.; Dexiang, L.;Jie, L. J. and Qiang, L. (2003). Analysis of Combining Ability and hereditary parameters of main quantitative character of 10 maize inbred lines. Journal of maize sciences 11 (1), 26-29.

Hede, A. R.; Srinivasan, G.; Stolen, O. and Vasal, S. K.(1999). Identification of heterotic pattern in tropical inbred maize lines using broad-based synthetic testers. Maydica 44 (4), 325-331.

Jha, P. B.; Singh, D. N. and Ghosh, J. (2002). Heterosis and gene action for fodder Yield in maize. Forage research 28 (1), 49-51.

Johanson, G. R. (1973). Diallel analysis of leaf area, heterosis and relationship to yield in maize. Crop sci 13: 178-180.

Kalla, V.; Kumar, R. and Basandrai, A. K. (2001). Combining ability analysis and gene action estimates of yield and yield contributing characters in maize (*Zea mays l.*). Crop Research Hisar 22 (1), 102 – 106.

Kara, S.M. (2001). Evaluation of yield and yield components in inbred maize lines. 1. Heterosis and line X tester analysis of combining ability. Turkish Journal of Agriculture and Forestry 25 (6), 383-391.

Khalafalla, M. M. (1993). Evaluation of Maize Genotypes for General and Specific Combining Ability. M. Sc. (Agric.) thesis, Faculty of Agriculture, University of Khartoum, Sudan.

Khalafalla, M. M. and Abdalla, A. H. (1997a) Performance of Some Maize Genotypes (*Zea mays l.*) and their F_1 hybrids for yields and its components, University of Khartoum. Agric. Sci 5 (2), 56-69.

Khalafalla, M. M. and Abdalla, A. H. (1997b). Heterosis and Combining ability estimates for grain yield and its components in maize genotypes (*Zea mays l.*). University of Khartoum. Journal of Agric. Sci 5 (2) 70-85.

Kim, S. K.; Ajala, S. O. and Brewbaker. (1999). Combining ability of tropical maize germplasm in west Africa. III. Tropical Maize inbreds Maydica 44 (4), 285 –291.

Konack, C.; Unay, A.; Basal, H. and Serter, E. (1999). Estimation of Combining ability effects, heterosis and heterobeltiosis by line x tester in maize. Turkish Journal of field crops 4 (1), 1-9. Kumar, M. N. V.;

Konack, C.; Unay, A.; Basal, H. and Serter, E. (2001). Combining ability and heterotic effects in some characteristics of second crop maize. Turkish Journal of field crops 6 (2), 64 – 70.

Kumar, M.N.V.;Kumar, S. S. and Ganesh, M. (1999). Combining ability studies for oil improvement in maize (*Zea mays l.*). Crop Research Hisar 18 (1) , 93-99.

Kumar, P.P. and Satyanarayana, E. (2001). Variability and Correlation Studies of Full Season inbred lines of maize (*Zea mays l.*). Journal of Research Angrau 29(1),71-75.

Laresh, L. L. B. and Brewbaker, J. L. (1999). Diallel analysis of temperate and tropical pop corns. Maydica 44 (4), 279-284.

Mahmoud, I. M.; Rashad, M. A.; Fahmy, E. M. and Abo dheaf, M. H (1990). Heerosis, combining ability and types of gene action in 6X6 diallel of maize. . Annals of Agricultural Science, Cairo, Special issue 307-317.

Martins, C. S.;and Miranda-Filho, J. B. (1997) Evaluation of Inbred Lines from two maize (*Zea mays l.*) brachytic populations in single crosses following the two factor mating design. Brazilian Journal of Genetics 20 (2), 265-237.

Matho, R. N. and Ganguly, D. K. (2001) .Heterosis and combining ability studies in maize (*Zea mays L.*). Journal of Research, Birsa Agricultural University 13 (2), 197 – 199.

Mathur, R. K.; Chunilal; Bhatnagar, S. K. and Singh, V. (1998). Combining ability for yield, phenological and ear characters in white seeded maize. Indian Journal of genetics and Plant breading 58 (2), 177-182.

Meseka, S. K; Ibrahim, A. S. and Nour, A. M. (2003). Yield Potential of Land Races of Maize in Sudan and the Avenues for their Genetics Improvement . Gezira Journal of Agricultural Science 1 (1), 63-73.

Mickelson, H. R.; Cardova, H.; Pixely, K. V. and Bjarnason, M.S.(2001).Heterotic relationships among nine temperate and subtropical maize populations.Crop Sci 41(4)1012-1020.

Mostafa, M. A. N.; El-Aziz A. A. A.; Mahgoub, G. M. A. and El Sherbiney, H. Y. S. (1996). Diallel analysis of grain yield and natural resistance to late wilt disease in newly developed inbred lines of maize. Bulletin of faculty of Agriculture, University of Cairo 47 (3), 393-403.

Mukherjee, B. K.; Ohawn, and Singh, N. N. (1971). Heterosis in inter varietal Crosses in maize (*Zea mays l.*). Indian J. Agric. Sci 41 (5), 489-493.

Nevado, M. E. and Crossa, H. Z. (1990). Diallel analysis of relative growth in maize synthetics. Crop Sci 30: 549-552.

Niguisse, M. and Zelleke, H. (2001). Heterosis and combining ability in a diallel among eight elite maize populations. African Crop Science Journal 9(3), 471-479.

Nirla, R. B. P. and Jha, P. B. (2002). Combining ability analysis for fodder traits of maize. Range Management and Agroforestry 22 (1) 51 –59.

Ogunbodede, B.; Ajibade, S. R. and Olarojo, S. A. (2000). Heterosis and combining ability for yield and yield related characters in some Nigerian local varieties of maize (*Zea mays l.*). Moor Journal of Agricultural Research 1 (1), 37-43.

Pandey, S. and Gritton, E. T. (1974). Genotypic and phenotypic variances and correlations in peas. Crop Sci 15: 353-355.

Parasad, S. K. and Singh, T. P. (1989). Contribution of characters to divergence in maize. Crop Improvement 16 (2), 141-144.

Paul, K. K.; Debnath, S. C. (1999). Combining ability analysis in maize (*Zea mays l.*). Pakistan Journal of Scientific and Industrial Research 42 (3), 141-144.

Rana, M. K. and Vinod, K. (2001), Combining ability analysis for grain yield , yield components and phenological characters in maize (*Zea mays l.*). New Botanist 28 (1), 39-44.

Revilla, P.; Burton, A.; Malvar, R. A. and Ordas, A. (1999). Relationships among kernel weight, early vigor and growth in maize .Crop science 39(3),654-658.

Robinson, H. F. and Cockerham, C. C. (1961). Heterosis and inbreeding depression in population involving two open pollinated varieties of maize. Crop sci 1: 68 –71.

Rojas, A. B. and Sprague, G. F (1952) A comparison of variance component in corn yield trial. Agron. J. 44: 462 – 466.

Ron, A. M. De. and ordous, A. (1987). Genetic study of non-ear character in maize. Plant breeding Abstract 58 (2), 142 (Abstract. No. 1343).

Sanghi, A. K. (1983). Genetic variances in maize composite "Moti". Indian J. of Genetics and Plant Breeding 43: 180 –184.

San-vicente, F. M.; Bejarano, A.; Marin. C. and Crossa, J. (1998). Analysis of diallel crosses among improved tropical white endosperm maize populations. Maydica 43 (2), 147-153.

San-vicente, F. M.; Bejarano, A.; Marin. C. and Crossa, J. (2001). Heterosis and Combining ability of tropical yellow endosperm maize populations. Agronomia Tropical Maracay 51 (3), 301-318.

Sedhom, S. A. (1994), Genetic Study on Some top Crosses in Maize Under Two Environments. Annals of Agricultural Science, Moshtohor 32 (1), 131-141.

Silva, R. M.; Miranda, F.J. and Da-silva, R. M. (2003). Heterosis expression in crosses between maize populations: ear yield .Scientia- Agricola 60 (3), 519-524.

Sindagi, S. S.; Vishnu, and Singh, D. (1970). Variation and heritability of some Quantitative character in F_2 progenies of intervarietal Crosses of Sorghum . Indian Jornal of Genetic and plant breeding 30: 660-664.

Singh, A. K.; Shahi, J. P.; Singh, J. K. and Singh. R. N. (1998). Combining ability for maturity and height traits in maize (*Zea mays l.*). Annals of Agricultural Research 19 (2), 162-166.

Singh, D. N.; Singh, I. S. (1998). Line X tester analysis in maize (*Zea mays l.*). Journal of Research Birsa Agricultural University 10 (2), 177 – 182.

Singh, R. K. and Chaudhary, B. D.(1977). Biometrical methods in quantitative genetic analysid . Kalyani Publishers. New Delhi .pp.205-214.

Smith, J. S. C.(1984). Genetic variability within U.S. hybrid maize. Multivarite analysis of isozyme data Crop Sci 24:1041-1046.

Soliman, F. H. S. and Sadek, S. E.(1999). Combining ability of new maize inbred lines and its utilization in the Egyptian hybrid program. Bulletin of faculty of Agriculture, University of Cairo 50(1),1-20.

Sprague, G. F. and Tatum, L. A. (1942). General Versus specific combining ability in single crosses of maize. J. Am. Soc. Agron. 34:923-932.

Sujiprihati, S. S; Saleh, G. B. and Ali, E. S. (2001). Combining ability analysis of yield and related characters in single cross hybrids of tropical maize (*Zea mays l.*) SABRAO Journal of Breeding and genetics 33 (2), 111-120.

Terron, A.; Precado, E.; Cardova, H.; Mickelson, H. and lopez, R. (1997). Heterotic patterns of 30 maize lines derived from population 43 SR of Cimmyt Agronomica Mesoamericana 8 (1), 26-34.

Tosquy-Valle, O. H.; CastAnon, N. G.; Sierra, M. M. and Rodriguez, M. FA.(1998). General and specific combining ability of maize lines using single crosses as testers in Veracrus state. Agricultura Technica en Mexico 24(1), 3-10.

Tulu, L. and Ramachandrappa, B. K. (1998). Combining ability of some traits in a seven parent diallel cross of selected maize. (*Zea mays l.*) populations. Crop Research. Hisar 15 (2-3), 232-237.

Vacaro, E.; Barbosa-Neto, J. F.; Pegoraro, D. G.; Nuss, C. N. and Conceicao, L. D. H.(2002). Combining ability of twelve maize populations. Pesquisa Agropecuaria Brasileria 37 (2) 67-72.

Vassal, S. K.; Srinivasan, G.; Pandey, S.; Cardova, H. S.;Han, G. C. and Gonzalez, C.F.(1992).Heterotic patterns of ninty white tropical CMMYT maize lines.Maydica 37(3)259-270.

Venkatesh, S. and Sarma, M.Y. (1999). Genetic analysis of grain yield and its components in some selected inbred line crosses of maize (*Zea mays L.*). New Botanist 26: 1-24.

Venkatesh, S. and Sarma, M.Y.; Sekhar, J. C.; Singh. N. N; Singh. S. B.; Gupta, N. P. and chandel, S. K. (2002). Assessment elite subtropical maize lines using diverse inbred testers. Annals of Agricultural Research 23 (4), 581-588.

Venugopal, M.; Ansari, N. A. and Rao, N.V., (2002). Combining ability studies in maize (*Zea mays l.*). Annals of Agricultural Research 23 (1), 92-95.

Wu, G. C.; Yan. X. and Yan, H. D. (2003). Combining ability analysis on maize inbred lines. Journal of maize sciences 11 (2) 32-36.

Yadav, T. P.; Singh, R. D. and Bhat, J. S. (2003). Genetic Studies under different levels of moisture stress in maize (*Zea mays l.*). Indian Journal of Genetics and Plant Breeding 63 (2), 119-123.

Yousif, D. P.; Ali, H. C. and Baker, R. H.(2003). Estimation of heterosis and combining ability in local maize inbred lines .Dirasat. Agricultural sciences 30 (2), 246-259.

Yurankova, S. I; and Tsitok, N.V. (1989). Features of the expression of heterosis for yield components in first generation maize hybrid. Plant breeding abstract 59(8).

Zelleke, H. (2000). Combining ability for grain yield and other agronomic characters in inbred lines of maize (*Zea mays l.*). indian Journal of Genetics and plant breeding 60 (1), 63-70.
Zhao, B.; Min, Z. H.; Bing, L. X.; Hong, H. W.; Su, C. M.; Wei, L. X. and Ling, C. R. (2003). Analysis and evaluation on Combining ability of 9 maize inbred lines. Journal of maize science 11 (2), 56-58.