Growth and Yield Analysis for Fifteen White Maize (Zea Mays L.) Genotypes Developed in Egypt

1S.E. Sadek, 2M.A. Ahmed and 1A.M.M. Abd El-Aaal

1Maize Research Program, Field Crops Research Institute, Agriculture Research Centre, Giza, Egypt.
2Field Crops Research Department, National Research Center, Dokki, Giza, Egypt.

Abstract: In two field experiments were carried out at Gemmeiza (Gharbia governorate) and Sids (Bani Sweif governorate) Agricultural Research Stations in summer season of 2004, eight parental inbred lines, i.e. Gm.2, Gm.4, Gm.14, Gm. 18, Gm.21 Gm.22, Gm.27 and Sd.63, as well as seven Gemmeiza single crosses, i.e. Gm.21, Gm.22, Gm.23, Gm.24, Gm.25, Gm.26 and Gm.27 to study growth and yield analysis in these genotypes. The obtained Results revealed that Significant differences were obtained between the parental inbred lines and their seven maize single crosses under study for all eight of the in growth parameters at 55, 70 and 85 days after planting except for number of active leaves / plant at 55 and 85 days, SLA at 85 days and number of ears / plant at 70 days after planting, which were in significant. Plant grain yield and most of its component characters were significantly differed among the eight inbred lines and their seven single crosses under study. Harvested maize grain yield can be increased by growing single crosses 21, 24, 25, 26 and 27 that characterized by their highest mean values from growth characters and grain yield and its components compared with the parental eight inbred lines and the other two Gemmeiza single crosses 22 and 23.

Key words: White maize(Zea mays L.) genotypes, growth and yield

INTRODUCTION

Genotypes differences in growth characters and grain yield and its components of maize crop may enable plant breeders to select for most promising combiners in their breeding programs. Maize growers can select the good hybrids such as single and three way crosses. Maize cultivars differed in growth characters1-10. In addition, maize genotypes differed in grain yield and its components3,4,9-12. The aim of this work is to investigate growth and yield analysis of eight parental inbred lines as well as their seven single crosses of white maize.

MATERIALS AND METHODS

Fifteen different white maize genotypes were used in this study i.e eight female and male parental inbred lines as well as seven single crosses (see Table 1).

All of these genetic materials in (Table 1) except male inbred line Sids 63 were developed at Gemmeiza Agricultural Research Station during the period from 1983 to 1995 summer seasons by S.E. Sadek et al, national maize breeding program, Field Crops Research Institute (FCRI), Agricultural Research Center (ARC), Ministry of Agriculture, Egypt. These fifteen genotype were planted in summer season of 2004 at both Agricultural Research Stations, Gemmeiza (Garbia governorate or middle delta region) and Sids (Bani Sweif or middle Egypt region) in crossing Blocks and demonstration fields in two field experiments, Randomized Complete Block Design (RCBD) with six replications. Three replicates were assigned for growth analysis and the others for grain yield and its components. The experimental unit consisted of seven row each of five meters length and 70 cm in width. Maize kernels were planted in hills 25cm apart at a rate of 12 kg/fed. Normal cultural practices of growing maize, i.e. fertilization, irrigation and weed control… etc were done as recommended. Plants were thinned to one plant per hill before the first irrigation. Nitrogen fertilizer rate was 120 kg N/fed. in the form of urea (46 % N) and was applied in two equal doses before the first and second irrigation (21and 35 days after sowing). Planting dates were 15th June in season of 2004 at both Gemmeiza and Sids Stations, and 18th of respectively. The following growth attributes were recorded on three samples of five guarded plants, each was taken randomly at 55, 70 and 85 days after planting: plant height “cm”, stem diameter “cm”, number of active leaves/ plant, number of ears/ plant,
stem + sheets dry weight “g/plant”, blades dry weight “g/plant”, ears dry weight “g/plant”, 4th leaf blade area “cm2” and blades area “cm2/plant” were calculated according to the method described by Bremner and Beavenuti and Belloni[1]. Specific leaf weight “mg/cm2” (SLW) was estimated according to the method described by Pearce et al[18], meanwhile, leaf area index (LAI) was calculated as Watson[15]. Furthermore, number of days to 50 % silking and plant pollination were recorded.

At harvest date, kernels, straw and biological yields per plant, number of ears/plant, ear height “cm”, ears weight/plant “g”, ear length “cm”, ear diameter “cm”, number of rows/ear, number of kernels/row and 100 kernels weight “g”, were determined from the middle rows of the plot for ten guarded plants. Moreover, Relative Photosynthetic Potential (RPP) for biological and grain yields and vegetative organs were estimated according to the method described by Vidovic and Pokorny[19]. Again, crop index and harvest index, as well as, migration coefficient were calculated according to Abdel-Gawad et al.[20].

Combined analysis of the two growing seasons data was carried out according to procedure outlined by Snedecor and Cochran[10]. For comparison between means L.S.D. at 5 % level was used.

### RESULTS AND DISCUSSIONS

#### A- Growth analysis : There were significant differences between the eight parental Gemmeiza inbred lines; Gm.2, Gm.4, Gm.14, Gm.18, Gm.21, Gm.22, Gm.27 and Sd.63, as well as the seven white Gemmeiza single crosses under study 21, 22, 23, 24, 25, 26 and 27 in growth characters, i.e. plant height, stem diameter, stem + sheets dry weight/plant, blades dry weight/plant, ear dry weight per plant, 4th leaf blade area, blades area/plant, LAI and SLW at 55, 70 and 85 days after planting, as well as, number of plant active leaves at 70 days, number of ears/plant at 85 days, and SLA at 55 and 70 days after sowing (Table 2). Plant height, stem diameter, number of active leaves/plant, blades dry weight/plant, 4th leaf blade area, blades area/cm² and LAI increased up to 70 days after planting and decreased at 85 days after planting, meanwhile, number of ears/plant and ears dry weight/plant tended to increase with advance of age up to 85 days after planting. Data illustrated in Table (2) indicated that SC.24 had the highest maize plant height at 55, 70 and 85 days, plant ears dry weight, blades area per plant and LAI, meanwhile, SC.25 proved to have the greatest mean values from stem diameter, number of active leaves/plant, stem + sheets dry weight/plant, blades dry weight/plant, and 4th leaf blade area, compared with the parental eight inbred lines Gm.2, Gm.4, Gm.14, Gm.18, Gm.21, Gm.22, Gm.27 and Sd.63, as well as the other single crosses. 21, 22, 23, SC.24, 26 and 27 respectively. Regarding number of ears/plant, SLW and SLA we can be concluded that inbred line Gm.18 at 70 days and Gm.14 at 85 days proved to have the greatest values from number of ears/plant, Gm.2 gave the greatest SLW at 55 days, meanwhile, inbred lines Gm.18, Gm.22 produced the highest SLA at 70 days as, compared with other genotypes under study; lines Gm.2, Gm.4, Gm.14, Gm.21, Gm.27, Sd.63, as well as single crosses SC.21, SC.22, SC.23, SC.24, SC.25, SC.26 and SC.27 respectively (Table 2). With respect to number of days to 50 % silking and number of days to 50 % pollination, Gm.2, Gm.18 and Sd.63 had the greatest values from these to measurements compared with the other parental inbred lines; Gm.4, Gm.14, Gm.21, Gm.22, Gm.27, as well as the single crosses 21, 22, 23, 24, 25, 26 and 27. (Table 3). The genotypes differences in growth attributes in this study are in harmony with those obtained by Gardner et al[9], Ahmed and Sadek[12], Sadek et al[3], Saneoka[7], Clarke et al[8], Sundy et al[9] Zaki et al[8], Ahmed and Hassanein[9] and El-Koomy[10]. In addition, the differences between maize genotypes herein may be attributed to the photosynthetic activity in the leaves, i.e. internal factor and/or to the differences in light distribution on leaf surface of the crop canopy resulted from differences in leaf arrangement and to the differences in chlorophyll content and photosynthesis enzymes activity[10,19], to the differences in stomatal conductance values[10,20].

#### B- Yield and its components: There were significant differences between the eight parental inbred lines Gm.2, Gm.4, Gm.14, Gm.18, Gm.21, Gm.22, Gm.27, Sd.63 and the seven white Gemmeiza single crosses 21, 22, 23, 24, 25, 26 and SC.27 in plant height, ear height, ear length, ears dry weight/plant, number of kernels/row, 100 kernel weight, grain yield/ plant as well as; straw and biological yields/plant, RPPveg., RPPbio. and RPPcrop. (Table 3). On the other hand, the differences in number of ears/plant failed to reach the significant level at 5 %. Moreover, data reported in (Table 3) revealed that the inbred line Gm.2 had the highest value from 100 kernels weight and migration coefficient, among the studied inbred lines meanwhile, Gm.18 gave the greatest RPPbio. among the studied lines, whereas, Gm.27, significantly exceeded the other inbred lines Gm.2, Gm.4, Gm.14, Gm.18, Gm.21,
Table 2: Genotypes differences between the parental eight white inbred lines and their seven maize single crosses in growth parameters. (Average of Gemmeiza and Sids location 2004 summer seasons).

<table>
<thead>
<tr>
<th>Age</th>
<th>Line/Gm.2</th>
<th>Line/Gm.4</th>
<th>Line/Gm.14</th>
<th>Line/Gm.21</th>
<th>Line/Gm.22</th>
<th>Line/Gm.27</th>
<th>Line/Gm.31</th>
<th>Line/Gm.63</th>
<th>SC 21</th>
<th>SC 22</th>
<th>SC 23</th>
<th>SC 24</th>
<th>SC 25</th>
<th>SC 26</th>
<th>SC 27</th>
<th>L.S.D at 5% Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>140.00</td>
<td>128.33</td>
<td>153.33</td>
<td>116.67</td>
<td>116.67</td>
<td>98.33</td>
<td>153.33</td>
<td>121.00</td>
<td>201.67</td>
<td>199.17</td>
<td>220.83</td>
<td>218.34</td>
<td>238.00</td>
<td>205.00</td>
<td>197.50</td>
<td>204.17</td>
</tr>
<tr>
<td>70</td>
<td>145.00</td>
<td>193.33</td>
<td>162.20</td>
<td>171.17</td>
<td>171.17</td>
<td>192.00</td>
<td>210.00</td>
<td>180.00</td>
<td>257.50</td>
<td>267.50</td>
<td>265.00</td>
<td>293.33</td>
<td>290.00</td>
<td>255.83</td>
<td>274.17</td>
<td>6.02</td>
</tr>
<tr>
<td>85</td>
<td>150.00</td>
<td>188.34</td>
<td>151.60</td>
<td>165.00</td>
<td>165.00</td>
<td>180.10</td>
<td>205.00</td>
<td>164.17</td>
<td>247.50</td>
<td>250.00</td>
<td>264.17</td>
<td>275.83</td>
<td>268.34</td>
<td>241.67</td>
<td>266.33</td>
<td>4.25</td>
</tr>
<tr>
<td>55</td>
<td>2.23</td>
<td>2.22</td>
<td>2.47</td>
<td>2.47</td>
<td>2.47</td>
<td>2.33</td>
<td>2.40</td>
<td>2.27</td>
<td>2.40</td>
<td>2.45</td>
<td>2.90</td>
<td>2.32</td>
<td>2.60</td>
<td>2.60</td>
<td>2.60</td>
<td>0.02</td>
</tr>
<tr>
<td>70</td>
<td>2.60</td>
<td>2.30</td>
<td>2.47</td>
<td>2.67</td>
<td>2.67</td>
<td>2.47</td>
<td>2.20</td>
<td>2.60</td>
<td>2.60</td>
<td>2.67</td>
<td>3.17</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>0.04</td>
</tr>
<tr>
<td>85</td>
<td>2.14</td>
<td>2.27</td>
<td>2.40</td>
<td>2.38</td>
<td>2.38</td>
<td>2.17</td>
<td>2.58</td>
<td>2.27</td>
<td>2.49</td>
<td>2.67</td>
<td>2.53</td>
<td>2.60</td>
<td>2.03</td>
<td>2.03</td>
<td>2.03</td>
<td>0.03</td>
</tr>
<tr>
<td>55</td>
<td>14.00</td>
<td>12.33</td>
<td>14.00</td>
<td>14.00</td>
<td>14.00</td>
<td>12.67</td>
<td>14.00</td>
<td>12.50</td>
<td>16.00</td>
<td>15.33</td>
<td>15.30</td>
<td>15.50</td>
<td>16.67</td>
<td>15.83</td>
<td>16.00</td>
<td>n.s</td>
</tr>
<tr>
<td>70</td>
<td>15.00</td>
<td>13.00</td>
<td>15.33</td>
<td>15.33</td>
<td>15.33</td>
<td>13.33</td>
<td>15.33</td>
<td>15.30</td>
<td>17.33</td>
<td>16.67</td>
<td>16.00</td>
<td>18.00</td>
<td>18.00</td>
<td>18.00</td>
<td>18.00</td>
<td>0.33</td>
</tr>
<tr>
<td>85</td>
<td>10.67</td>
<td>11.40</td>
<td>12.17</td>
<td>11.67</td>
<td>11.67</td>
<td>11.00</td>
<td>12.84</td>
<td>11.83</td>
<td>12.59</td>
<td>12.00</td>
<td>12.83</td>
<td>13.00</td>
<td>14.00</td>
<td>12.83</td>
<td>13.00</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Number of ears/plant

| 55  | 1.00       | 1.00       | 1.21       | 2.00       | 2.00       | 1.00       | 1.00       | 1.17       | 1.18   | 1.03   | 1.33   | 1.11   | 1.05   | 1.17   | 1.17   | 0.05       |
| 70  | 1.37       | 1.21       | 1.67       | 1.67       | 1.25       | 1.20       | 1.67       | 1.00       | 1.33   | 1.33   | 1.19   | 1.19   | 1.17   | 1.45   | 1.17   | 0.05       |
| 85  | 2.00       | 1.96       | 3.16       | 3.16       | 3.16       | 3.16       | 3.16       | 3.16       | 3.16   | 3.16   | 3.16   | 3.16   | 3.16   | 3.16   | 3.16   | 0.05       |
and RPP_{w} mean white, SC.27 exceeded the other genotypes under study in biological yield/plant, straw yield/fed, biological yield/fed, and RPP_{w}, SC.21 produced the greatest ear diameter, however, however, number of rows/ear, Gm.2 exceeded the other eleven genotypes under study in migration coefficient.

The results of genotypes differences in yield and its components may be due to the differences in genetic structure between the fifteen maize genotypes in this study, and to the widely differences between maize genotypes for mineral concentrations[8], also to the differences in light distribution of leaf surface of the crop canopy resulted from the differences in leaf arrangement and to the differences in chlorophyll content and photosynthesis enzymes activity[10,19] and the differences in stomatal conductance values[10,20], in addition, to the differences between genotypes in partitioning of photosynthates towards economic yield[18,9]. Moreover, the significant superiority of the white maize single crosses 21, 24, 25, 26 and 27 than the other two single crosses 22, 23 may be due to that the highest yielding cultivars had more vigorous system for generation reducing potentials during plant growth than did the less productive genotypes and the higheryielding genotypes had a higher photosynthetic electron transport chain potential, which is a genetical character, than the lower yielding genotypes[21]. Again, their greatest number of kernels may be cause of their large yield as such ears are more effective sink for the carbohydrate synthesized in the leaves with fewer and larger kernels[22].

It is noteworthy to mention that the genotypes differences in yield and its components in this study are in harmony with the results obtained by Costa and Campos[11], Ahmed and Sadek[12], Sadek et al[13], Begna et al[14], Zaki et al[15], Ahmed and Hassanein[16] and El-Koomy[17].

REFERENCES


