Assiut J. of Agric. Sci., 43(3)June (1-17)

Selection for earliness index in two segregating populations of Egyptian cotton (G. barbadense L.) under late planting

[1]-Hassaballa, E. A.,-[1] E. E. Mahdy,[2]- A. A. Mohamed
And Aly . A .M. [2]
[1]Fac Agric, Assiut Univ, Assiut, Egypt
[2]Agric Res. Center

Abstract:

Two cycles of pedigree selection for earliness index were achieved in two segregating populations of Egyptian cotton (*G. barbadense* L.) under late planting condition. The genetic materials were the F_2, F_3, F_4 and F_5-generations of the crosses Giza 90/Giza 85 (pop. I), and Giza85/Giza70(pop.II).The phenotypic coefficient of variation (CV) of earliness index was large in the F_2-generation and accounted for 18.19 and 34.75% in pop. I and in pop. II; respectively. However, the CV% of the respective parents were very low reflecting their purity. Broad sense heritability of earliness index was very high (0.99 and 0.98) and unreliable in the F_2-generations, which resulted in high expected genetic advance of 32.49 and 61.A44% from the mean for pop. I and pop. II; respectively. After two cycles of selection the retained genetic coefficient of variability was sufficient for further cycles of selection, and was 16.20 and 11.32% for pop. I and pop. II; respectively, with very large estimates of broad sense heritability.However, the realized heritability and parent-offspring regression were 0.4214 and 0.1610 for pop. I, and 0.3649 and 0.1372 for pop. II; respectively. In pop. I, the direct observed gain was significant ($P<0.01$) from the bulk sample (12.25%) and from the better parent (14.17%). Three superior families No.56,1 and 234 were isolated from pop. I and exceeded significantly the better parent and the bulk sample in earliness index and correlated traits. In pop. II, two superior families No. 130 and No. 174 showed significant direct gain in earliness index of 10.82 and 15.91% from the bulk sample, and 6.70 and 11.60% from the better parent, respectively. Family No. 130 showed significant ($P<0.01$) correlated gain from the better parent of 62.08,67.54,35.92,4.15and 9.63% for seed cotton yield/plant, lint yield/plant,number of bolls/plant, seed index and lint index; respectively.

Introduction

Cotton is the most important fiber crop in the world. Cotton production in Egypt faces some constraints, notably the apparent

Received on: 12/6/2012 **Accepted for publication on**: 30/6/2012
Referees: Prof. Dr. Ateif.Abou alwfaa, Prof. Dr.Mazher.M.Fawzy

delay by farmers in sowing cotton to gain complete winter crop before cotton. Date of planting has been pushed back for at least one month beyond March;the optimum time for sowing.Therefore,Egyptian cotton breeders have to develop new cultivars adapted for late planting after early winter crops and early wheat cultivars.Narayanan *et al*. (1987) used disruptive mating and selection for earliness on three base populations. Disruptive selection and mating curtailed the days to first boll opening up to 25 days. Abdalla (1990) studied four measures of earliness to select early mature and high yielding lines. The results indicated that, first sympodial node and earliness index were the best criteria for selection for early mature high yielding lines. Abo El-Zahab and Amein (1996a,b) reported that Egyptian cotton genotypes do differ in their response to the stress of late planting. Their results promoted the concept of considering cotton as an alternative second crop in the traditional wheat-maize double crops production system.El-Ameen (1999) studied the direct and correlated response for earliness under favorable and drought stress conditions in yield and yield attributes of three Egyptian cotton populations. Mahdy *et al*. (2001) indicated that pedigree selection was better than selection and intermating at late planting. El-Defrawy and El-Ameen (2004), Mahdy *et al*. (2006and2007)practiced election for earliness index at early and late planting.Mahdy *et al*. (2009) isolated families by selection at late planting which exceeded the better parent by 9.35%. The present work aimed to study the efficiency of pedigree selection for earliness index and its effects on cotton yield and its attributes.

Materials and Methods

The present study was carried out at Assiut Univ. Exp. Farm during the four summer seasons of 2008 to 2011. The basic materials consisted of two F_2- populations stemmed from crosses between four Egyptian cotton varieties (Gossypium barbadense L). Population I (PoPI) stemmed from the cross (Giza-90 x Giza-85) and population II (PoP II) from (Giza-83 x Giza-70).Season 2008; F_2-generation: The two aforementioned populations in the F_2 generation were sown on May, 1st in spaced plants, in rows 60 cm apart and 40 cm between hills within a row. After full emergence three weeks after planting, the hills were thinned to one plant /hill. In the four seasons the recommended cultural practices for cotton production were adopted throughout the growing season, except for nitrogen fertilization. Half of the recommended dose of nitrogen for cotton production was added after thinning and before the first irrigation. Data were recorded on 307 and 247 plants from pop I and II; respectively. At the end of growing season two picks were done on single plants. The recorded traits in all seasons were; seed-cotton yield/plant, g., lint yield/plant, g., lint percentage, number of bolls /plant, boll weight, g, seed index, lint index, earliness index (measured as weight of the first pick / weight of the two picks), and days to first flower . The best 30 and 25 plants for earliness index from pop I and pop II, respectively were saved. After ginning, five seeds from each of the 307 plants of pop I, and from each of the 247 plants of pop II were bulked to give an unselected bulk sample for each population. In season 2009; F_3-generation; the selected plants from pop I and pop II, along with the two parents and the unselected bulk sample were sown on May, 1st in two separate experiments. A randomized Complete Block Design of three replications was used. The plot size was one row, 4 m long, 60 cm apart and 40 cm between hills within a row. After full emergence, seedlings were thinned to one plant per hill. After the two picks the best 20 plants from the best 20 families for earliness index were saved from each population. Season 2010, F_{4-} generation: The weather was very hot in this season all over the country, and the infestation of boll worms was very heavy. Hence, data were not recorded, and the two experiments were repeated in the next season of 2011 in the F_5 – generation. In season 2011; F_{5-} generation; sowing date was on May, 1st, 2011. Experimental design and the plot size were as the previous season. Each experiment involved the selections, the two parents and the unselected bulk sample. Data were subjected to proper statistical analysis according to Steel and Torrie (1980).

Genotypes means were compared using Revised Least Significant Differences test (RLSD) according to El-Rawi and Khalafalla(1980).The henotypic (pcv %) and genotypic (gcv %) coefficients of variability were calculated as outlined by Burton (1952). The phenotypic (σ^2p), genotypic (σ^2g) variances, and heritability in broad sense (H) were calculated according to Walker (1960). Narrow sense heritability was calculated as parent-offspring regression according to Smith and Kinman (1965). Realized heritability (h^2) was calculated as; $h^2 = R / S$ (Falconer, 1989); where R = response to selection and S = selection differential.

Results and Discussion

1- Description of the base populations:

The characteristics of the two base populations (Table 1) indicated sufficient coefficient of variability in the F_2 of pop. I (18.91%) and in pop. II (34.75%) in the criterion of selection; earliness index. The coefficient of variability (CV) of the other traits ranged from 6.12 to 46.39% in pop. I, and from 12.03 to 46.35% in pop. II for days to first flower and lint yield/plant; respectively. Otherwise, the CV of all traits of the four parents was very low, except for lint index reflecting the high purity of the parents. Broad sense heritability estimates were very high except for lint index in pop. I (0.57) which was intermediate. In consequence, high and unreliable estimates were obtained for expected gains in percentage of the F_2-mean.

2- Pedigree selection for earliness index:

2.1- Variability and heritability estimates:

Mean squares of the selected families for earliness index and the other traits were significant ($P<0.01$) after two cycles of selection in the two populations (Table 2). The pcv and gcv of earliness index were 16.25 and 16.20% for pop. I, compared to 11.53 and 11.32% for pop. II; after two cycles of selection. Such genetic variability in the two populations was sufficient for further cycles of selection for earliness index. The close estimates of gcv and pcv resulted in very high unreliable estimates of broad sense heritability, which reached to 99.41 and 96.41% for pop.I and II; respectively. This could be due to two main causes; firstly, evaluation of the selected families at one site for one season inflated the families mean squares by the confounding effects of the interactions among families, years and location. The second cause is the preponderance of dominance and overdominance in the early segregating generations.

Otherwise,the realized heritability of earliness index in pop. I was 0.4214. Likewise, narrow sense heritability as calculated from regression of offspring on parents was 0.1610 (Table 2). The great and wide differences between broad sense heritability estimates as calculated from the expected mean squares, realized heritability and parent offspring regression could be due to the two main causes mentioned before, in addition to that the realized heritability and parent offspring regression depend only upon the additive variance; the variance transmitted from generation to generation. The only criticism of realized heritability estimates in this research is the calculation of the selection differential in a season and genetic gain in another season, in which the genotype by environment interaction could affect these estimates. Heritability estimates from parent-offspring regression could also be affected by genotype-environment interaction, in which the parents and offspring were grown in two different seasons. Generally, it could be concluded that the realized heritability and regression of offspring on parent's estimates were more reliable than the broad sense heritability estimates. In pop.II, the realized heritability estimate and parent-offspring regression were low compared to the very high estimates (96.45%) of broad sense heritability of earliness index.The gcv of the other traits ranged from 5.84 for lint percentage to 28.42% for lint yield/plant in pop.I, and from 6.14 to 25.05% in pop.II for the same respective traits. Heritability estimates in broad sense of the correlated traits were very high in the two populations. Singh *et al*. (1995) found significant genotypic differences for all traits in the F_3 and F_4-generations. Lioyd and Bridges (1995) practiced selection at conventional and late plantings and found significant genotypic variation for all traits. Nassar *et al*. (1998) reported broad and narrow sense heritability for days to first flower of 46.63 and 8.11% in a cross and 31.74 and 11.5% in another cross. Mahdy *et al*. (2006) indicated that the gcv after two cycles of selection for earliness index ranged from 16.06 and 19.16%.

2.2- Means and observed gain:

2.2.1- Means and direct observed gain for earliness index: Mean earliness index ranged from 68.51 to 91.08 with an average of 80.81% for pop.I (Table 3), and from 54.33 to 89.05 with an average of 75.39% for pop.II (Table 6). Such wide variability is sufficient for further cycles of selection for earliness index at late planting.The direct observed gain from the unselected bulk in pop. I (Table 4) was significant (P<0.01) for 16 families, ranged from 6.46 for family No. 227 to 27.18% for family No. 234 with significant (P<0.01) average of 12.25%. Furthermore, 17 out of the 20 selected families for earliness index showed significant (P<0.01) observed gain from the better parent (Table 5) and ranged from 2.74 to 29.36% with a significant (P<0.01) average of 14.17%. The observed gain from the bulk sample in pop.II (Table 7) indicated that 12 families exceeded significantly (P<0.05 to P<0.01) the bulk sample in earliness index. The increase in earliness index ranged from 3.17% for family No. 101 to 22.02% for family No. 87 with an average of 3.30%. However, only eight of these families (Table 8) showed significant (P<0.05 to P<0.01) observed gain from the better parent Giza 83 ranged from 3.13% for family No. 89 to 17.48% for family No. 87 with negative average of -0.41%.These results indicate that pop.I (Giza 85 x Giza 90) (Long staple x Long staple cotton) was more responsive to selection for earliness index than pop.II (Giza 83 x Giza 70) (Long staple x extra long staple). This may be due to that Giza 70 is more adapted to the northern Delta of Egypt than Giza 83. Furthermore, the retained genetic variability in earliness index in pop. I (Giza 85 x Giza 90) was (16.20%) more than in pop.II(Giza 83 x Giza 70), which was 11.32%(Table 2).

2.2.2- The correlated gains in population I (Giza 85 x Giza 90): Selection for earliness index in pop.I in general increased seed cotton yield/plant, seed index and decreased days to first flower

(Table 3). Seed cotton yield/plant ranged from 42.35 to 99.70 with an average of 69.76 g. compared to 69.50 and 65.09 g/plant for the bulk sample and the better parent Giza 90. Lint yield/plant ranged from 14.10 to 37.12 with an average of 22.79g. The average of the 20 selected families was less than the bulk sample in lint yield/plant, lint percentage, number of bolls/plant and lint index. But, the average in general masked the superiority of many families, which the plant breeder seeks for.The correlated gain in seed cotton yield/plant as calculated from the bulk sample (Table 4) was significant ($P<0.01$) for eleven families and ranged from 3.22 to 43.45%. These families showed significant ($P<0.01$) observed gain from the better parent Giza 90 which ranged from 10.22 to 53.17%. Also, 7 and 10 families for lint yield/plant, one and two for lint percentage, 8 and 12 for boll weight, 5 and 3 for number of bolls/plant, 16 and 15 for seed index, 8 and 9 for lint index and 12 and 17 families for days to first flower showed significant correlated observed gains from the bulk sample and the better parent; respectively (Tables 4 and 5).It should be indicated that two cycles of selection for earliness index in pop. I; resulted in many superior early and high yielding families. The best superior family was family No. 56 which showed direct and indirect genetic gains of 26.52 and 28.68% for earliness index, 43.45 and 53.17% for seed cotton/plant, 55.70 and 70.28 for lint yield/plant, 8.51 and 11.13% for lint percentage, 29.59 and 37.85% for boll weight, 10.69 and 5.45% for number of bolls/plant, 10.58 and 10.10% for seed index, 25.68 and 29.74% for lint index and -10.04 and -17.72% for days to first flower from the unselected bulk sample and the better parent; respectively.Furthermore,families No. 1 and No. 234 were also promising superior families.

2.2.3-The correlated gains in populationII(Giza83xGiza70):The correlated gains accompanied selection for earliness index as calculated from the bulk sample and the better parent are presented in Tables 7 and 8.The average correlated gains were not significant and negative for seed cotton yield/plant (-1.4%), lint yield/plant (-1.25) and boll weight (-4.11%) from the bulk sample. Also negative correlated gains as calculated from the better parent for lint percentage were -0.58% for boll weight; -9.35% and for lint index; -9.82%. However, it was significant for seed cotton and lint yield/plant and accounted for 9.44 and 8.51%; respectively. Most of the families which showed positive and high direct observed gain in earliness index in pop. II; showed adverse negative correlated gains in yields and some other traits. However, two families, No. 130 and No. 174 showed significant ($P<0.01$) direct gain in earliness index, and correlated gains in most traits. The promising family No. 130 showed correlated observed gains of 46.02 and 52.46% from the bulk sample, and 62.08 and 67.54% from the better parent for seed cotton and lint yield/plant; respectively.It should be indicated that the two populations responded differently to selection of earliness index, and pop.I (Giza 85 x Giza 90) was more responsive to selection than pop.II (Giza 83 x Giza 70). **Narayanan *et al.* (1987)** noted that two cycles of disruptive mating and selection for earliness curtailed the days to first boll opening up to 25 days. **Abdalla (1990)** in the Sudan indicated that the first sympodial node and earliness index were the best criteria for selection for early high yielding lines with good fiber quality. **El-Ameen (1999)** indicated that the correlated responses in seed cotton yield/plant and lint yield/plant were better when selection practiced for days to first flower under stress than under favorable condition. Mahdy *et al.* (2001) after two cycles of selection for days to first flower, found increase in earliness of -4.28 and -2.84% at early and late plantings. Mahdy *et al.* (2006) after two cycles of selection for earliness index in two populations at early and late plantings, obtained early families than the earlier parent by 15.28%, and out yielded the better parent by 27.96% in seed cotton yield/plant, 15.55% in lint yield/plant, 37.5% in number of bolls/plant in the first population at early planting. In late planting, the best family was earlier and out yielded the better parent in yield. Similar, results were obtained in the second population.Mahrous(2008)indicated that selection at late planting can isolate new adapted lines to late planting.

References

Abdalla,A.B.1990.Selection for Early maturityin (*G.barbadenseL.)* .Proc.4thConf.Agron., Cairo,1516Sept,vol.1:339347

Abo El-Zahab, A.A., and M.M. Amein. 1996a. Intra-cultivar selection in Egyptian cotton for late planting cropping system.Proc.7thConf. Agron., Cairo Univ. 9-10 Sept., 305-319.

Abo El-Zahab, A.A., and M.M. Amein. 1996b. Aspects of selection for tolerance to stress of late planting system in cotton. Proc. 7th Conf. Agron., Cairo Univ. 9-10 Sept., 321-337.

Burton, G.W. 1952. Quantitative inheritance in grasses. 6th Internat.Grassland Cong. Proc., 1: 227-238.

EL-Ameen,T.M. 1999. Selection under stress conditions for yield and quality attributes in Egyptiancotton.Ph.D. Thesis, Assiut Univ., Egypt.

EL-Defrawy, M.M. and T.M. EL-Ameen. 2004. Selection for earliness in Egyptian cotton(*Gossypiumbarbadense* L.*)* Assiut J. of Agric. Sci., 35: 95-108

ElRawi,K.,andA.M. Khalafalla. 1980. Design and Analysis of

Agricultural Experiments, El Mousel Univ., Iraq.

Falconer, D.S.1989. Introduction to Quantitative Genetics, 3rd Ed. Longman. John Wiley & Sons, New York.

Lioyd M. O., and B.C. Bridges. 1995. Breeding cotton for conventional and late planted production system. Crop Sci., 35: 132 – 136.

Mahdy, E.E., A.A. Ismail, H.Y. Awad, and A.A. Mohamed. 2001. The relative merits of breeding and modified recurrent selection in improving earliness in two segregating populations of Egyptian cotton (*G. barbadense* L.). The 2nd Plant Breed. Conf. Oct. 2, Assiut Univ. 80-101.

Mahdy,E.E.,A.A.Mohamed,.Z. Elhifny, and H. Mahrous. 2006. Pedigree selection for earliness index in two populations of Egyptian cotton. Minia J.of Agric. Res. & Devolp., 26: 485-506.

Mahdy, E.E., A.A. Mohamed, M.Z.Elhifny,andH.Mahrous. 2007. Selection for seed cotton yield in early and late sowing dates of Egyptian cotton. Minia J.of Agric. Res. & Devolp., 27: 1-22.

Mahdy,E.E., G.M.K. Hemaida; F.M.F.Abd El-Motagally and A.Mostafa.2009.

Response to selection for yield under late sowing date in two populations of Egyption cotton. Assiut J.of Agric. Sci., 40 (Special Issue): 1-25.

Mahrous, H. 2008. Selection for earliness and lint yield in early and late plantings in some populations of Egyptian cotton. Ph. D. Thesis, Assiut Univ., Egypt.

Narayanan, S.S., P. Singh, and V.V. Singh. 1987. Disruptive selection for earliness in Upland cotton.Indian J. Agri. Sci., 57: 444-446.

Nassar, M.A.A , A.E. Hossam EL-Dein , M.M.Awaad and H.H.M.EL-Adly.1998. Genetical studies of earliness measurements in two intraspecific crosses of cotton.Adv.Agric.Res; 3:395-411.

Singh, B., G.S. Chahal, and T.H. Singh. 1995. Efficiency of different selection criteria for the improvement of seed cotton yield in early segregating generations of (*Gossypium hirsutum L.*). Crop Improv. 22: 61-64. (C.F. Plant breeding Abst.67: 1868, 1997).

Smith, J. D. and M. L.Kinman. 1965. The use of parent offspring regression as an estimator of heritability . Crop Sci.,5 : 595-596.

Steel, R.G.D. and J.H. Torrie. 1980. Principle and Procedures of Statistics. A Biometrical approach 2nd Ed., McGraw-Hill Book Company, New York. U.S.A.

Walker, J. T. 1960. The use of a selection index technique in the analysis of progeny row data . Emp. Cott. Gr. Rev., 37: 81-107.

الانتخاب لمعامل التبكير في عشيرتين انعزاليتين من القطن المصري (Gossypium barbadense L) في الزراعة المتأخرة

أ.د/السيد عبد السلام حسب الله ،أ.د/عزت السيد مهدى،
د/ ابو القاسم عبد الراضى محمد،السيد/ أحمد محمد على

أجريت دورتين من الانتخاب المنسب علي عشيرتين انعزاليتين من القطن المصري (جوسيبوم باربادنس ل.) لتحسين معامل التبكير تحت ظروف الزراعة المتأخرة. وكانت المواد الوراثية هي الجيل الثاني والثالث والرابع والخامس للعشيرتين. العشيرة الأولي ناتجة من التهجين بين جيزه (90) × جيزه (85) والثانية من التهجين بين جيزه (83) × جيزه (70) . وكان معامل الاختلاف لصفة التبكير في الجيل ال ثاني 18.19% للعشيرة الأولي ، 34.75% للعشيرة الثانية. وعلي العكس من ذلك فكان معامل الاختلاف في الآباء منخفض جداً مما يعكس نقاوة هذه الآباء. وكان معامل التوريث بالمعني العام لصفة معامل التبكير عالية جداً في الجيل الثاني وصلت إلي 0.99 ، 0.98 للعشيرتين مما نتج عنه تحسين وراثي متوقع من انتخاب أفضل 10% من النباتات وصل إلي 32.49 ، 61.44% من المتوسط للعشيرة الأولي والثانية علي الترتيب. وبعد دورتين انتخابيتين كان معامل الاختلاف الوراثي كافياً لدورات انتخابية أخري ووصل إلي 16.20 ، 11.32 للعشيرة الأولي والثانية علي الترتيب ، كما كانت تقديرات معامل التوريث لصفة معامل التبكير عالية جداً . وبالعكس من ذلك كان معامل التوريث المحقق ومعامل التوريث من انحدار الأبناء علي الآباء منخفضاً وكان 0.4214 ، 0.1610 في العشيرة الأولي ، 0.3649 ، 0.1372 في العشيرة الثانية علي الترتيب. في العشيرة الأولي كان التحسين الوراثي المباشر معنوياً جداً من العينة العشوائية (12.25%) ومن الأب الأكبر (14.17%) . أمكن عزل ثلاثة عائلات مبشرة تزيد معنوياً عن العينة العشوائية والأب الأكبر في صفة معامل التبكير والصفات المرتبطة. وفي العشيرة الثانية أمكن عزل عائلتين مبشرتين هما رقم 130 ، رقم 174 واللتان أعطا تحسين وراثي في معامل التبكير وصل إلي 10.82 ، 15.91% من العينة العشوائية ، 6.7 ، 11.60% من الأب الأعلي علي الترتيب . وقد أعطت العائلة رقم 130 تحسين وراثي مرتبط ومعنوياً عن الأب الأكبر وصل إلي 62.08 ، 67.54 ، 35.92 ، 4.15 ، 9.63% لصفات محصول الزهر ، محصول الشعر / نبات ، عدد اللوز علي النبات ، معامل البذرة، معامل الشعر ، علي الترتيب.