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SUMMARY

This investigation was carried out during 2001/2005 seasons at the Agric. Exper. Farm of El-Mattana Stn., Agricultural Research Center. The materials used in this study were four hundred families in the F_3-generation of two populations. In F_4-generation, 227 and 183 families were grown for population I and II, respectively. These families had sufficient seeds to grow in 3 replications in this generation. 20% of these families were grown in F_5 and then the superior 10-families were selected and grown in F_6 for each selection criterion. The main objective of this study were: 1) to detect the indirect selection criteria for seed yield using the regression analysis and coefficient of determination (R^2), 2) to assess the relative efficiency of early single trait selection for yield and some of it's components, as well as for early combined two traits selection for yield and days to 50% flowering across two cycles of selection, 3) to compare the relative responses of selection for yield in late generation (F_5) with two cycles of selection in the F_4 and F_5, 4) to study the effect of these methods of selection on gene associations of all studied traits for the two segregating lentil populations. The results could be summarized as follows:

1- The analysis of variance revealed that the F_4-families differed significantly for all studied traits in the two base populations, reflecting the genetic differences among the F_4-families.

2- High gcv values were recorded for biological yield/plant (25.43 and 25.00%), number of pods/plant (8.50 and 6.75%), weight of pods/plant (36.39 and 33.34%), seed yield/plant (40.77 and 36.98%) and harvest index (25.22 and 24.29%) in base population I and II; respectively. These results coupled with high estimates of heritabilities in the two base populations.

3- High correlations were recorded between seed yield/plant and each of biological yield/plant (0.746 and 0.734), number of pods/plant (0.824 and 0.850), weight of pods/plant (0.971 and 0.973) and harvest index (0.802 and 0.724) for base population I and II, respectively. Otherwise, seed yield/plant was weakly correlated with each of days to 50%, plant height and number of branches/plant in both base populations.

4- The coefficient of determination (R^2) revealed that weight of pods/plant was superior trait in it's contribution (0.943 and 0.946) for seed yield/plant, followed by number of pods/plant (0.680 and 0.722), harvest index (0.642 and 0.525) and biological yield/plant (0.557 and 0.539) in base population I and II; respectively, reflecting the large contributions of these traits in seed yield of lentil, and could be used as a selection criteria to improve yield beside direct selection for seed yield *per se*.

5- Entries mean squares were highly significant in the two populations after first and second cycles of selection for all studied traits except number of branches/plant in both analyses of selected families alone and with bulk sample, parents and the check cultivar Giza 9 under all selection criteria.

6- After two cycles of selection for seed yield/plant, means of the 10-selected families ranged from 6.40 to 10.73 g compared to 6.57 g for ILL2501 and 6.43 g for ILL2573 in population I. Also, they ranged from 7.17 to 12.43 g compared to their respective parents ILL2501 (6.57 g) and ILL7164 (6.8 g) in population II.

7- The genotypic coefficients of variation (gcv) for seed yield/plant decreased from 40.77 and 36.98 in the F_4 to 26.49 and 20.85 after one cycle and to 13.48 and 16.09% after two cycles of selection in

population I and II, respectively. The same trend could be found for correlated traits.

8- The values of broad sense heritability were high for all studied traits except number of branches/plant after one and two cycles of pedigree line selection for seed yield/plant in both populations. It was, for example, 94.02 and 88.43 after one cycle and 84.38 and 94.54% after two cycles of selection for seed yield/plant in population I and II; respectively.

9- The observed direct responses after two cycles of pedigree line selection for seed yield/plant were 31.38, 29.98, 31.38 and 38.41 in population I and 39.72, 37.35, 38.78 and 51.38 in population II as measured from mid-parent, better parent, bulk sample and check cultivar Giza 9; respectively. The positive direct response in seed yield was correlated with positive indirect responses of number and weight of pods/plant, indicating the importance of the two traits in increasing seed yield. Otherwise, it associated with negative indirect response for days to 50% flowering.

10- The overall means of the 10 superior selections after two cycles of selection for seed yield/plant were 8.54 and 9.34 g for population I and II, respectively, and exceeded significantly the check cultivar Giza 9 (6.17 g). In population I, the two superior families, i.e., No. 200 and No. 90 ranked the first and second for seed yield and yielded 10.73 and 9.37 g, respectively, surpassed highly significant the check cultivar Giza 9. Furthermore, they were significantly earlier than the check cultivar by 6 to 7 days.

In population II, the best two selected families after two cycles of selection, No. 77 and No. 105 out yielded the check cultivar by 101.45 and 27.28%, respectively, but, they were later in

maturity. Three families, No. 164, 147 and 67 significantly out yielded Giza 9 by 66.45, 56.73 and 44.25% and were not significant late in flowering than it. Families No. 124 and 83 were significantly earlier than Giza 9 and out yielded it by 56.07 and 37.76%, respectively.

11- In the F_4-generation before selection, the correlation between seed yield/plant and each of biological yield, number of pods/plant, weight of pods/plant and harvest index was positive and exceeded 0.75. Two cycles of selection for seed yield/plant increased its correlation with number and weight of pods/plant and number of branches/plant and also, increased correlations among these traits. Otherwise, selection for seed yield converted the correlation of days to 50% flowering with the above traits to negative; slight, low or intermediate.

12- Wide range in weight of pods/plant was obtained after two cycles of selection in both populations. Weight of pods/plant ranged from 7.57 to 12.97 in population I and from 7.03 to 15.33 g in population II. Genotypic coefficient of variation was high after the first cycle (F_5) and decreased rapidly after the second cycle (F_6) from 23.64 to 11.80% in population I. The same trend was observed in population II. Broad sense heritability estimates were 84.90 and 95.30% after two cycle of selection in pop. I and II; respectively.

High direct responses after two cycles of selection for weight of pods/plant were coupled with positive indirect in seed yield/plant which recorded 30.29, 31.69 and 28.74% in population I and 37.65, 39.08 and 51.70% in population II as differences from the better parent, bulk sample and check cultivar, respectively.

Eight out of the 10 families in population I , and 9 in population II surpassed significantly the check cultivar for weight of pods and seed yield/plant. This results explain the strong positive correlation between seed yield and weight of pods/plant which was close to the unity in the two populations. Moreover, the highest two selected families (No. 200 and No. 90 in pop. I, and No. 124 and No. 83 in pop. II) in weight of pods/plant were the highest in seed yield/plant.

13- After two cycles of selection for number of pods/plant, selected families ranged from 181.0 to 369.33 and from 226.0 to 445.67 in pop. I and II, respectively. Gcv decreased from 39.55% in F_4 to 21.89 in F_6 after two cycles of selection for number of pods/plant in pop. I. The same trend was observed for pop. II. Broad sense heritabilities were high and reached to 98.54 and 94.42% after two cycles of selection for pop. I, and II; respectively. High direct responses in number of pods/plant were accompanied with high indirect responses for weight of pods/plant, seed yield/plant and harvest index in both populations.

The overall means of 10-superior selections after the two cycles of selection for number of pods/plant were 267.17 and 303.47 for pop. I and II; respectively and exceeded significantly their respective parents, the bulk samples and Giza 9. Eight and all superior families of population I and II, respectively, surpassed significantly Giza 9. The families No. 200 and 90 in pop. I and 124 in pop. II surpassed significantly in yield and earlier than Giza 9. Under the selection for number of pods/plant, seed yield/plant showed strong positive correlation (close to unity) with weight of pods/plant and high with biological yield/plant and number of branches/plant after two cycles of selection.

14- Narrow ranges (2.67-3.33 and 3-3.33), gcv (2.76 and 4.32) and low heritability (14.40 and 61.62%) were recorded after two cycles of selection for number of branches/plant in pop. I and II, respectively. Consequently, the correlated responses in seed yield/plant were negative as measured from mid-parents, better parent and bulk sample and very low and positive (2.27%) from Giza 9 in pop. I. Otherwise, it was high and positive and accounted for 38.86, 36.62, 38.04 and 50.57% in population II, respectively.

No selected families surpassed the check cultivar Giza 9 in both populations after two cycles of selection for number of branches/plant.

Four and eight selected families exceeded significantly the check cultivar Giza 9 in yield in pop. I and II, respectively. Family No. 90 in pop. I was significantly earlier (65 days) than check cultivar Giza 9 (71.67 days) and surpassed it significantly in yield. The correlation between seed yield and each of branches, biological yield, number of pods were positive and high and close to unity with weight of pods/plant in the two populations after two cycles of selection for number of branches.

15- Days to 50% flowering ranged from 69.67 to 68.67 and from 62 to 71.33 days after two cycles of selection for this trait in pop. I and II, respectively. Values of gcv for days to 50% flowering decreased from 8.84 and 9.73% after one cycle to 2.57 and 4.60% after two cycles of selection in pop. I and II, respectively. Otherwise, the gcv was high for biological yield (19.64%), number of pods/plant (32.26%), weight of pods/plant (29.47%), seed yield/plant (33.52%) and harvest index (21.13%) in population I. Selection for days to

50% flowering lowered broad sense heritability in pop. I from 94.4 to 61.89% and from 95.12 to 87.05% in pop. II.

The direct responses for days to 50% flowering after two cycles of selection were -15.52, -14.97, -17.13 and -8.65% in pop. I ,-14.57, -13.64, -19.23 and -7.21% in pop. II as measured from the mid-parent, better parent, bulk sample and check cultivar, respectively, resulting in new genotypes earlier than respective parent, bulk sample and check cultivar Giza 9. Negative correlated responses were recorded for seed yield/plant after two cycles of selection for day to 50% flowering. These results were in line with the correlation values. The families No. 200 and 90 in population I and No. 150 in population II were earlier and out yielded Giza 9 by 73.90, 56.69 and 38.89%, respectively.

16- After two cycles of combined selection for seed yield/plant and days to 50% flowering, the range in seed yield plant 3.6-9.73 g coupled with 61.67-84.67 days to flowering in pop. I and 3.27-8.53 g coupled with 61.0-83.62 days in pop. II after one cycle, and of 5.83-10.73 g coupled with 64.0-74.33 days in pop. I and 6.53-10.27 g coupled with 64.67-75.67 days to flowering in pop. II after two cycles of combined selection were found.

Moreover, gcv was reduced from the first to the second cycles for both traits in both populations. Heritability estimates of seed yield/plant increases from 89.93 and 65.90% in first cycle to 90.45 and 86.67% after the second cycle for pop. I and II, respectively. Otherwise, it decreased from 94.73 and 94.70 after one cycle to 84.59 and 82.57 after two cycles for pop. I and II, respectively for days to 50% flowering.

The direct response in seed yield/plant accounted for 14.48 and 31.12% of Giza 9 after the second cycle in pop. I and II, respectively. The increased in seed yield accompanied with increase in earliness. The direct response in days to 50% flowering reached -14.43 and -5.68% in pop. I and -15.50 and -2.93% in pop. II after two cycles as a deviation from bulk sample and check cultivar, respectively. The promising families No. 90, 200 and 165 in pop. I significantly outyielded Giza 9 by 51.86, 73.90 and 24.80% and two of them were earlier than it by 5-6 days. Families No. 73, 83, 131, 164, 71 and 124 in pop. II exceeded significantly the check for seed yield/plant. Two of them (No. 83 and 124) were earlier significantly than their parents, bulk sample and check Giza 9.

17- After one cycle (F_5) of late selection for seed yield/plant, narrow range of 8.63 to 10.73 g express less g.c.v. of 5.73% and low heritability of 61.40% obtained after one cycle of late pedigree selection in pop. I. In pop. II, the estimates of range, g.c.v. and heritability were larger than of population I and recorded 8.8-12.43, 10.27% and 89.60%, respectively. It could be concluded that the late selection resulted less genetic variability among selected families component to early one. Direct response in seed yield/plant were 40.77, 39.27, 40.77 and 48.30% in pop. I and 50.49, 47.94, 49.48 and 63.05% in pop. II as measured from the mid-parent, better parent, bulk sample and Giza 9, respectively, after one cycle of late selection for seed yield/plant. Observed direct responses of one cycle of late selection were higher than two cycles of early selection for seed yield/plant by more than 9% and 10% as measured from parents, bulk and Giza 9 in pop. I and II, respectively.