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## SUMMARY

Breeding alfalfa varieties for high forage and seed yield production suitable for growing in the New Valley. These field experiments were carried out during three successive seasons 1999/2000, 2000/2001 and 2001/2002 at the Experimental Farm of New Valley Agricultural Research Station, El-Kharga Oasis. The study began by collecting seeds of 14 local alfalfa populations from farmer's fields in the major areas for alfalfa production in the New Valley. Evaluation of the populations for high forage production in experiments (Experiment I), selecting field and hybridization for producing the groups as follows:

1. (b1) original population.
2. (b2) polycross (open pollinated seeds resulting from first selfed (S1) plants).
3. (b3) polycross (open pollinated seeds resulting from second selfed (S2) plants).
4. (b4) open pollinated seeds resulting from plants succeeded in self pollinated (self-fertile plants).
5. (b5) open pollinated seeds resulting plants from plants field in self pollination (self-sterile plants).

These groups were evaluated experimentally for only one year (Experiment II) with selected five populations from experiment I after two years to determine forage green and dry yield production.

6. S1 seeds produced from the first self pollination.
7. S2 seed produced from the second self pollination.
8. PS1 open pollinated seeds from selected plants successes in self pollinated (self-fertile).
9. PS2 (polly cross) open pollinated seeds from self S1 plants.

Evaluation of these groups generated from the 14 alfalfa populations for forage and seed yield production for only one year (Experiment III).

### **Experiment I:**

This experiment was designed by distributing 14 alfalfa populations in randomized complete blocks with four replications to investigate behaviour of populations. 29 cuts were taken during the three studied years and obtained results could be summarized as follows:

1- Plant height (cm) during cutting differ significantly among alfalfa populations at all growing years and seasons. The population 1 gave the tallest plants followed by populations 5, 7, 11 and 14, while the shortest plants were obtained from the other populations. Also, the tallest plants resulted from winter and spring seasons as compared to the other seasons during the studied years.

2- Number of tillers/1/4 m<sup>2</sup> differed significantly among alfalfa populations at all study years and seasons. Population 1 gave the highest values of number of tillers/1/4 m<sup>2</sup> during three years followed by populations 5, 7, 11 and 14 at the second and third years. The highest number of tillers resulted from winter season in the second and third years, while in the first year the highest number of tillers was obtained from spring season.

3- Fresh leaves/stem ratio differed significantly among alfalfa populations during study years, the populations 1, 5, 7, 11 and 14 gave the highest values of fresh leaves/stem ratio during seasons and study years. Winter season gave the highest values compared to the other seasons, while the autumn season gave the lowest values of fresh leaves/stem ratio at all years.

4- Dry leaves/stem ratio, populations 7 and 14 gave the highest values of dry leaves/stem ratio at all study years, while populations 1, 5 and 11 gave the highest values of leaves/stem ratio at the first and third years. The winter season gave the highest values of leaves/stem ratio at all study years, while the summer and autumn seasons recorded the lowest values at the second and third years.

5- Green forage yield production, significant differences among alfalfa populations during all study years and seasons. Population 1 gave the highest green forage yield at all study and total of years (189.59 ton/fed.) followed by populations 7, 11, 14 and 5, respectively. The lowest forage yield was resulted from populations 2 and 12. The first year gave higher yield than the second and third year (61.30 ton/fed.). Winter season gave the highest forage yield at the second and third years, while spring was the best in the first year. The lowest forage yield was obtained from autumn season in the third year.

6- Dry forage yield: Significant differences among alfalfa populations were detected during study years and growth seasons except autumn season at third year. Population 1 gave the highest forage yield at all seasons and total of years (45.99 ton/fed.) followed by populations 5, 7, 11 and 14. The highest dry forage yield was obtained from the first year (14.95 ton/fed.), while in the lowest production (5.21 ton/fed.) resulted from the third one. Summer season resulted in the highest production at the first and second years, then followed by spring in the third year. The lowest yield was obtained from last cut in autumn in the third year.

7- Crude protein percentage: Significant differences among populations at all years and seasons under study were detected. Populations 5, 11 and 14 gave the highest mean values of crude protein during study years and means of three years, while the lowest mean value was obtained from

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population 4 without any significant differences with populations 12 and 13. The first and second years gave the highest mean values of crude protein, while the lowest mean values were obtained from the third year. Winter season gave the highest mean values of crude protein percentage at all study years, while the summer season resulted in the lowest production.

8- Crude fiber percentage: Population 5 gave the lowest mean values of crude fiber at all seasons and years followed by populations 1, 7, 11 and 14 at the second and third years. The highest mean values of crude fiber resulted from the third year and summer seasons. The first year had the lowest in crude fiber percentage and winter season during study years.

9- Ash percentages: varied significantly between alfalfa populations during all seasons and study years. Populations 11 and 14 produced the highest ash percentage at all years and mean of years followed by populations 1, 5 and 7 at the second and third years. Populations 12 and 13 gave the lowest ash percentage in the first and second year, respectively, while populations 3 and 8 had the lowest ash% at the third year. The first year in summer gave the lowest mean values of ash percentage, while the highest ash percentage was obtained from the second year in winter season.

10- Ether extract (EE): varied significantly between alfalfa populations during study years and seasons. Population 7 gave the highest (EE) at all seasons and mean of years followed by populations 11 and 14 in the second and third years. EE percentage decreased from the first to the third years. Winter season gave the highest mean values of EE percentage, while the lowest mean values of EE percentage were obtained from summer seasons at all years.

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**Experiment II:**

The experiment was carried out for only one year (2002) with the objective of evaluating the groups at the field of selection and hybridization under five selected populations from experiment I after two years for obtained genotypes characterized with high forage yield and quality. 10 cuts were taken during this year and the obtained results could be summarized as follows:

1- Plant height (cm) was significantly different among populations (t), groups (b) and interaction effect between populations and groups seasons. Population (t11) gave the tallest plants at all seasons. Moreover, b3 (polycross) open pollinated seed resulting from second self (S2) plants) gave the tallest plants. Also, the genotype b3 for t11 gave the tallest plants during different seasons, while the shortest plants were obtained from b1 (original population). Summer season had the tallest plants as compared with the other seasons, while winter had the shortest plants at all years.

2- Number of tillers/1/4 m<sup>2</sup>: significant differences among populations, groups and interaction effect between populations and groups were detected. Population (t11) gave the highest number of tillers during seasons and mean of year (101.91 tillers/1/4 m<sup>2</sup>), while the t14 gave the lowest number of tillers at mean of year (89.27 tillers/1/4 m<sup>2</sup>). The group (b3) gave the highest number of tillers, while the lowest number of tillers were obtained from b1. No significant differences were detected between b4 and b5. The genotype b3 for t11 was the highest number of tillers, while the lowest number of tillers was obtained from genotype b3 for t14 at winter and spring seasons. The summer season gave the highest number of tillers at the year (107.98 tillers/1/4 m<sup>2</sup>), while winter season had the lowest number of tillers during year (59.55 tillers/1/4 m<sup>2</sup>).

3- Fresh leaves/stem ratio: varied significantly between populations, groups and interaction effect between populations and groups at all seasons and mean of year. Population (t11) gave the highest values of fresh leaves/stem ratio at all seasons as well as mean of year (68.58%) as well as t1 in winter and spring seasons, while the lowest values of leaves/stem ratio resulted from population (t7) and (t11) in summer season. No significant differences were detected between b4 and b5, but b3 produced the highest values of leaves/stem ratio. While the lowest values of leaves/stem ratio was obtained from b1. Genotype b3 for t11 was superior during seasons and mean of year as well as for t1 in spring season. Genotype b1 for t7 gave the lowest values of leaves/stem ratio in summer and for t14 in autumn seasons.

4- Dry leaves/stem ratio: population (t11) had the highest values of dry leaves/stem ratio during seasons and mean of year (49.66%) as well as t1 and t7 in spring season and t14 in autumn season. While the lowest values of leaves/stem ratio resulted from t5 at spring and summer seasons. Significant differences were detected among groups except for b4 and b5. b3 had the highest values of leaves/stem ratio compared the other groups, while b1 gave the lowest values of leaves/stem ratio. Genotype b3 for t11 gave higher leaves/stem ratio than the other genotypes, while the lowest values of leaves/stem ratio were obtained from genotype b1 for t5 at winter and spring seasons. The highest values of leaves/stem ratio resulted from autumn season, while the lowest values of dry leaves/stem ratio was obtained from winter season (39.79%).

5- Green forage yield (ton/fed.): significant differences among populations, groups and interaction effect between populations and groups during seasons as well as total of year have been detected. The total yield for populations varied from 50.29 to 56.57 ton/fed. during



year. Population (t11) was superior in green forage yield during all seasons and total of year, while the lowest forage yield resulted from t14 at winter and spring seasons as well as total of year. Total forage yield for groups ranged from 47.43 to 59.11 ton/fed. of year. The highest green forage yield resulted from group (b3) at all seasons and total of year, while b1 gave the lowest green forage yield. Genotype b3 for t1 and t11 gave the highest forage yield at all seasons and total of year, while genotype b1 for t14 gave the lowest green forage yield at all seasons as well as total of year. The highest forage yield resulted from summer season (18.09 ton/fed.), while the lowest forage yield was obtained from winter season (7.53 ton/fed.) during the year.

6- Dry forage yield (ton/fed.): population (t11) gave the highest dry forage yield at all seasons and total of year, while the lowest dry forage yield was obtained from t14 at winter and spring seasons. Also, t7 in summer and autumn seasons, group (b3) gave the highest dry yield at all seasons and total of year. There were no differences between b4 and b3 in dry forage yield at all seasons, while b1 gave the lowest dry yield during seasons. Genotype b3 for t11 gave the highest dry yield at all seasons and total of year, while the lowest dry yield was obtained from genotype b1 for t11 in winter season and b1 for t14 at spring and autumn seasons. Summer season gave the highest dry yield during year, while the lowest dry yield was obtained from winter season during year.

7- Crude protein percentage: There was significant differences between alfa;fa populations, groups and interaction effect between populations and groups. Population (t5) gave the highest values of crude protein percentage during spring, summer and autumn seasons as well as mean of year. t4 and t11 had the best values at winter season, while t14 gave the lowest values of crude protein percentage during winter, spring and

autumn seasons as well as mean of year. Group (b3) gave the highest values of crude protein during all seasons and mean of year, while the lowest values of protein percentage was obtained from b1. There was no significant differences between b4 and b5 in crude protein percentage at all seasons. Genotype b3 for t1 and t5 gave the highest values of crude protein percentage at all season, while genotypes b1 and b4 under t11 gave the lowest values of crude protein percentage during study year. Also, winter season had the highest mean values of protein percentage, while the lowest protein percentage was obtained from summer season.

8- Crude fiber percentage: There were significant differences among populations, groups and interaction effect between populations and groups. Population (t14) had the highest mean values of fiber percentage at all seasons, while the lowest values of fiber percentage was obtained from t11. Group (b1) gave the highest values of fiber percentage, while the lowest values of fiber percentage resulted from b3. Also, there was no differences between b4 and b5 in fiber percentage at all seasons. Genotypes b1 and b4 under t14 gave the highest values of crude fiber percentage, while genotype b3 for t11 gave the lowest values of crude fiber percentage during all seasons. Summer season had the highest values of fiber percentage, while the lowest values of fiber percentage was obtained from winter season during study year.

9- Ash percentage: populations 7 and 11 gave the highest values of ash percentage, while the lowest values of ash percentage resulted from t1 and t14 in winter and spring seasons. Group (b3) had the lowest at all seasons and mean of year, while b1 gave the lowest values of ash percentage during all seasons. Genotype b3 for t11 gave the highest values of ash percentage in winter and spring seasons, while b3 for t7 had the best in spring and autumn seasons. Genotype b1 for t5 gave the

lowest values of ash percentage at all seasons and mean of year. Winter season gave the highest values of ash percentage, while the lowest values of ash percentage resulted from autumn season.

10- Ether extract (EE%) had significant differences among populations at all seasons. Populations 11 and 14 (t11 and t14) gave the highest values of EE% at winter and spring seasons, while t5 gave the lowest values of EE% in winter and spring seasons as well as mean of year. There were significant differences among groups at all seasons, b3 was the best in this year, while b1 and b5 gave the lowest values of EE% at spring and summer seasons. The genotype b3 for t7 gave the highest values of EE% at winter, spring and autumn seasons, but b3 for t14 was the best in EE% at summer season, while genotype b1 for t7 gave the lowest values of EE% at spring, summer and autumn seasons as well as mean of year. Winter season was the best in EE% compared with the other seasons. The lowest values of EE% resulted from summer season.

### **Experiment III:**

The experiment was carried out for one year (2002) only with objective of evaluating of S1, S2 and parent plants PS1 (open pollinating selected plants succeeded in self pollination) and PS2 (open pollinated seeds (polycross) from S1 plants). These groups were evaluated under 14 populations for seed and forage yields. Three forage cuts were taken and seed yield was obtained from the same year. The obtained results could be summarized as the following:

#### **A. Forage yield:**

1- Plant height (cm) had significant differences among populations during the three cuts as well as mean of cuts. Populations 5, 7, 11 and 14 gave the tallest plants at all the three cuts as compared to the other populations, while the shortest plants were resulted from t8 and t9 at all

cuts. Third cut had the tallest plants, while the shortest plants resulted from first cut. Moreover, there were significant differences between groups for plant height. PS2 had the tallest plants during the three cuts and mean of cuts, while the shortest plants were obtained from S2 at all the three cuts and mean of cuts. Genotype PS2 for t1, t5, t7, t11 and t14 had the tallest plants at all the three cuts. On the other hand, genotype S2 for t2, t6, t8 and t9 had the shortest plants at all the three cuts.

2- Number of tillers/plant had significant differences among populations, groups and interaction effect between populations and groups during three cuts and mean of cuts. Populations 1, 2 and 5 gave the highest values of number of tillers/plant during first and second cuts, while t14 gave the highest number of tillers/plant at third cut, while the lowest number of tillers/plant was obtained from t8. Mean of third cut gave the highest number of tillers/plant, while the first cut had the lowest number of tillers/plant. Group S2 gave the lowest number of tillers/plant at all three cuts and mean of cuts, while the highest number of tillers resulted from PS2. Genotype PS2 for t1, t2 and t5 gave the highest number of tillers/plant at first and second cuts and number of cuts, while PS2 for t14 was the best in third cut. On the other hand, genotype S2 for t6, t8 and t9 gave the lowest number of tillers/plant at all cuts and mean of cuts.

3- Leaves/stem ratio varied significantly among populations (t), groups and interaction effect between populations and groups. Data showed that t7, t11 and t14 had the best leaves/stem ratio at mean of cuts, while t4, t10 and t12 had the lowest values of leaves/stem ratio at mean of cuts. Leaves/stem ratio increased from first to third cut. Data showed that PS2 had the highest leaves/stem ratio, while the lowest leaves/stem ratio resulted from S2 at all three cuts and mean of cuts. Moreover, the same data showed that genotype PS2 for t1, t5, t7, t11 and t14 had the best in

leaves/stem ratio compared with the other genotypes. On the other hand, genotype S2 for t6, t9, t10 and t12 had the lowest values of leaves/stem ratio at mean of cuts.

4- Green forage yield (gram/plant) indicated significant differences among populations (t), groups and interaction effect between populations and groups at total of cuts. Green forage yield for populations ranged from 395 to 461.62 gram/plant at total of cuts. Data showed that t5, t7, t11 and t14 gave the highest green forage yield/plant, while the lowest green forage yield/plant resulted from t4 at total of cuts. Green forage yield/plant increased from first to third cut. Data showed that group S2 gave the lowest green forage yield/plant compared with the other groups. On the other hand, PS2 had the best values in green forage yield/plant at all the three cuts and total of cuts. Genotype PS2 for t5 had the highest forage yield at first cut and total of cuts, while PS2 for t11 gave the highest forage yield/plant at third cut.

5- Dry forage yield (gram/plant): Data showed significant differences among populations, groups and interaction effect between populations and groups on dry forage yield/plant. Dry yield for populations ranged from 83.33 to 100.44 gram/plant at total of cuts. t5, t7, t11, t13 and t14 had the highest dry yield/plant at total of cuts. Dry forage yield/plant increased from first to third cut. PS2 gave the highest, while S2 gave the lowest dry yield/plant at the three cuts and total of cuts. Also, the genotype PS2 for t5 and t7 gave the highest, while genotype S2 for t6, t8 and t9 gave the lowest dry yield/plant at the three cuts as well as total of cuts.

#### **B. Seed yield:**

1- Number of tillers/plant had significant differences among populations (t), groups and interaction effect between populations and groups. Mean

number of tillers/plant for populations ranged from 14.04 to 17.15 by mean 15.47 tillers/plant. Data showed that t1, t5, t7, t11 and t14 gave the highest, while the lowest number of tillers was obtained from t6, t8 and t10. Also, PS2 had higher number of tillers than other groups, while S2 had lower number of tillers/plant than other groups. Data showed that genotype PS2 for t5 and t7 gave the highest, while genotype S2 for t6 gave lower number of tillers/plant than other genotypes for all populations.

2- Number of racemes per plant: Data showed that t1, t5, t7, t11 and t14 gave the highest, while the lowest number of racemes was obtained from t6 and t10. Mean number of racemes per plant for groups ranged from 75.5 to 127.5 racemes/plant. PS2 gave the highest number of racemes/plant, while the lowest was obtained from S2. It showed that genotype PS2 for t1, t5 and t14 had the highest number of racemes per plant, while genotype S2 for t6, t9, t10 and t12 had lower number than other genotypes.

3- Number of flowers/raceme had significant differences among populations (t), groups and interaction effect between populations and groups. Data showed that t7, t11 and t14 had the highest number of flowers per raceme, while the lowest obtained from t4, t9 and t10. It showed that PS2 had the highest mean number of flowers/raceme (15.66 flowers/raceme), while S2 produced the lowest mean number of flowers/raceme (5.76 flowers/raceme). The genotype PS2 for t1, t7, t11 and t14 produced the highest number of flowers/raceme, while the lowest number of flowers/raceme obtained from genotype S2 for t3, t4 and t6.

4- Number of pods/raceme differed significantly among populations, groups and interaction effect between populations and groups. Mean number of pods/raceme for populations (t) ranged from 5.01 to 10.60 by

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mean 7.28. It showed that t5, t7, t11 and t14 had the highest number of pods/raceme, while t2, t3 and t4 were the lowest numbers. Number of pods/raceme for groups ranged from 3.71 to 11.93. It is clearly that the highest number of pods resulted from PS2, while the lowest numbers were obtained from S2. Genotype PS2 for t11, t5, t7 and t14 achieved the highest number of pods/raceme. On the other hand, genotype S2 for t2, t4, t6, t8 and t9 had the lowest numbers.

5- Number of pods/plant: Data showed that the highest number of pods/plant was achieved from t5, t7, t11 and t14, while t3 and t4 had the lowest numbers. Also, the group PS2 had the highest numbers, while the S2 recorded the lowest number of pods/plant. Genotype PS2 for t5, t7, t11 and t14 had higher number of pods/plant than the other genotypes, while the lowest numbers obtained from genotype S2 for t4, t6, t9 and t13.

6- Number of seeds/pod varied significantly among populations (t), groups and interaction effect between populations and groups. Data showed that the highest number of seeds/pod resulted from t1, t5, t7, t11 and t14, while t2, t9 and t13 gave the lowest numbers. It is clearly that mean number of seeds/pod for groups ranged from 3.05 to 5.84 seeds/pod. PS2 gave the highest numbers, while the lowest numbers were achieved from S2.

7- Seed yield (gram/15 plants) varied significantly among populations (t), groups and interaction effect between populations and groups. Seed yield for populations varied from 68.63 to 148.88 gram by means 105.93 gram/15 plants. However, the highest seed yield resulted from t1, t5, t7, t11 and t14, while lower seed yield obtained for t4. Seed yield for groups ranged from 46.86 to 182. gram/15 plants. PS2 gave the highest yield, while the lowest yield was achieved from S2. Data showed that genotype

PS2 for t7 and t11 recorded the highest seed yield which gave 259.5 and 257.5 gram/15 plants, while the lowest resulted from the genotype S2 for t4, t6, t8, t9, t10, t12 and t13.

## **Conclusion and Recommendations**

It could be concluded from our study that:

- 1- Highest yield (green and dry) for alfalfa crop was obtained during winter and spring seasons in every year under study.
- 2- In general, the best local alfalfa populations 1, 5, 7, 11 and 14 which gave the highest green and dry forage yield, quality, crude protein, ash, ether extract and the lowest fiber percentage.
- 3- In regard to the obtained genotypes, b3 (polycross) was the best genotype which gave the highest green and dry forage yield quality. It is clear that polycross plants produced from two cycles of selfing which were more better than those obtained from one cycle for all mentioned parameters.
- 4- The highest seed yield was obtained from PS2 (open pollinated seeds from one cycle self plants). Therefore, more studies are required using the superior populations and b3 and PS2 genotypes in the breeding programs for achieving more improvement.