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CULTURAL PRACTICES AND HYBRIDS ON
MAIZE PRODUCTION IN THE
BEQA'A, LEBANON



A FIELD OF MAIZE

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CULTURAL PRACTICES AND HYBRIDS ON MAIZE PRODUCTION IN THE BEQA'A, LEBANON

by
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INTRODUCTION

The yield of maize has been found to vary greatly with the cultural practices used in its production. Seeds of locally developed open-pollinated varieties are used to plant most of the dunums set aside in the Beqa'a to maize growing. According to Ecimovic and El-Assaad (3) 69,630 dunums of maize were planted in Lebanon in 1960 of which only 2044 dunums were grown in Beqa'a. With the increasing use of grain feeds in the area, especially by the rapidly expanding poultry industry, a great demand for maize has developed. The maize crop is well adapted to this region and produces high yields under irrigation and good management practices.

Research involving cultural practices and hybrids on maize production in Lebanon is very limited. As a result the maize yields obtained by most farmers are relatively lower than those obtained from vegetable and other competitive crops and growers regard maize growing as secondary in importance.

The present study was undertaken to investigate various cultural methods and maize hybrids in order to stabilize and increase the yields. The investigations included: (a) various dates of planting, (b) population studies and (c) hybrids introduced from Europe and United States. The study was

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conducted at the University Farm in the Beqa'a, Lebanon during the 4-year period 1959 to 1962.

MATERIALS AND METHODS

The experiments on maize were conducted at the University Farm located in the northern central Beqa'a plain, Lebanon. The soil is high in clay content, low in organic matter and phosphorus, high in potassium content and is calcareous with a pH of about 8.0. A good seed bed was prepared and land leveled to facilitate uniform irrigation of the plots. The plots were irrigated every seven days throughout the growing season using surface furrows.

The experimental plots received a uniform application of 20 kg. of P_2O_5 and 12 kg. of nitrogen per dunum. The fertilizer was broadcasted and worked into the soil by disking. Also, the maize plots received an additional two applications of 4 kg. each of nitrogen per dunum as a side dressing, one application just before tasseling and the other about one month later. Weeds were controlled by cultivation and hoeing.

The field experiments were laid out on a randomized block or split plot design with each treatment replicated four times. Each plot was made of two rows, five meters long and either 75 cm. or 100 cm. apart depending upon the experiment. Four meters of one of these rows was harvested for forage and the other for grain yield. The planting was made thick and was thinned down to the desired number of plants in each row. Thinning was performed when the plants were about 15 to 20 centimeters tall. Three maize hybrids, SD 604, Ind 620 and AES 808 varying in maturity, were used in the cultural experiments. The yields of the grain were calculated to a 15.5 percent moisture basis and that for the forage and stover on an air-dry basis. Harvesting for forage was done in the late dough stage when the kernels had started to dent and for stover when the plants were mature. The statistical analysis methods used were according to those described by Snedecor (5) and Cochran and Cox (1).

EXPERIMENTAL RESULTS

The data on the grain yields are reported in kilograms and those for the forage and stover in tons per dunum. The results of the various experiments will be discussed under cultural practices and maize variety and hybrids trials.

CULTURAL PRACTICES

1. Date of Planting and Grain Yield

For dates of planting studies maize was planted the middle of March, April, May and June and harvested during September and October in 1961 and 1962. Three hybrids, SD 604, Ind. 620 and AES 808 were used in all the trials. Each hybrid was planted in rows one meter apart to a stand of 5000 plants per dunum.

The average grain yield of the three hybrids planted on the four dates are reported in Table 1 and illustrated in Fig. 1.

Table 1. Effect of dates of planting on grain yield in maize, in kg. per dunum, during 1961 and 1962*.

Date of Planting	Grain yield - kg. per dunum		Average
	1961	1962	
March	1001	987	994
April	889	883	886
May	807	774	791
June	600	614	607
**L.S.D. (5% level)	159	192	109

* Data from M.S. Thesis by S.I. Multi, Faculty of Agr. Sci., Amer. Univ. of Beirut, 1963.

* Average yield of the three hybrids, SD 604, Ind. 620 and AES 808.

** L.S.D. - Least significant difference.

It will be noted that the grain yields in maize decreased as the date of planting was delayed from March to June. On the basis of the 2-year average the yields were 994, 886, 791 and 607 kg. per dunum for March, April, May and June plantings, respectively. Although the maize planted in March produced about one-third more grain than that planted in June, some difficulty was experienced in obtaining a satisfactory stand with the earliest planting. Since the soil temperatures in March are usually not optimum for maize germination some replanting was necessary in order to obtain a complete stand. The three hybrids used varied a few days in relative maturity, but their yields did not vary significantly when planted on the different dates.

2. Date of Planting and Forage Yield

The average data for the forage yield of maize planted on various dates are shown in Table 2.



Fig. 1. Maize planted on different dates.

Table 2. Effect of dates of planting on forage yield in maize, in tons per dunum, during 1961 and 1962.*

Date of Planting	Forage Yield – tons per dunum*		Average
	1961	1962	
March	1.52	1.32	1.42
April	1.81	1.55	1.68
May	1.67	1.53	1.60
June	1.70	1.49	1.60
L.S.D. (5% level)	0.07	0.23	0.15

* Data from M.S. Thesis by Multi. Faculty of Agr. Sci., Amer. Univ. Beirut, 1963.

× Average yield of the three hybrids, SD 604, Ind. 620 and AES 808.

During both of the years of the study the maize hybrids planted in April gave the highest forage yield with an average of 1.68 per dunum. The lowest forage yields were obtained from the plantings made in March with an

average of 1.42 tons per dunum. The 2-year average forage yield from the plantings made in May and June were 1.60 tons per dunum. The 1961 overall forage yields were higher than those obtained in 1962, however, the grain yields (Table 1) for the two years were very much the same. The hybrids did not vary significantly in their forage per dunum under the conditions of the experiment.

3. Date of Planting and Stover Yields

The yields of stover (stalks minus grain and cob) of maize planted on four different dates are reported in Table 3.

Table 3. Effect of dates of planting on stover yield in maize, in tons per dunum, during 1961 and 1962*.

Date of Planting	Stover yield – tons per dunum*		Average
	1961	1962	
March	0.77	0.52	0.65
April	0.75	0.68	0.72
May	1.11	0.86	0.98
June	1.10	0.75	0.93
L.S.D. (5% level)	0.19	0.17	0.12

* Data from M.S. Thesis by Multi. Faculty of Agr. Sci., Amer. Univ. of Beirut, 1963.

× Average yield of the three hybrids, SD 604, Ind. 620 and AES 808.

The data reveal that maize planted in May and June produced more stover than that planted in March or April. As was true with the forage yields, the 1961 crop also produced greater stover yields than the 1962 season. Hybrid AES 808, a later maturing maize, produced the greatest amount of stover with a 2-year average of 0.97 tons per dunum, while Ind 620 and SD 604 produced 0.77 and 0.72 tons per dunum respectively, under the same conditions.

4. Row-Width and Grain Yield

For the row-width trials maize was planted in the middle of April and harvested in September. In all tests three hybrids were used, namely, SD 604, Ind. 620 and AES 808. Each hybrid was planted in rows one meter and three-

fourth meter apart, and each to a stand of 4000, 5000 and 6000 plants per dunum.

The data for the average grain yield, which includes the three hybrids and three plant populations, for maize planted in rows 75 cm. and 100 cm. apart are given in Table 4.

Table 4. Effect of row-width on the grain yield of maize, in kg. per dunum, during 1961 and 1962.

Row-Width cm.	Grain yield - kg. per dunum		Average [×]
	1961*	1962	
75	1226	1047	1137
100	926	821	874
L.S.D. (5% level)	58	92	48

* Data for 1961 from M.S. Thesis by Dowlah, Faculty of Agr. Sci., Amer. Univ. of Beirut, 1962.

× Includes the averages of three hybrids, each with a stand of 4000, 5000, 6000 plants per dunum, for two years.

The data shows that maize planted in 75 cm. rows yields considerably more than that grown in 100 cm. rows. On the basis of the 2-year trials the average grain yield obtained from maize planted in 75 cm. rows was 1137 kg. and that in 100 cm. rows 874 kg. per dunum.

No significant differences were observed in grain yields due to variation of plant populations, 4000, 5000, and 6000 per dunum. The three hybrids used responded uniformly to the 75 and 100 row-width plantings.

5. Row-Width and Forage Yield

The average data for forage yield for maize planted in rows 75 cm. and 100 cm. apart are reported in Table 6.

Forage yields were found to differ significantly between the two row spacings studies. Maize planted in 75 cm. rows produced on the average 1.88 tons while that in 100 cm. rows yielded 1.63 tons of air-dry forage per dunum.

Table 6. Effect of row-width on the forage yield of maize, in tons per dunum, during 1961 and 1962.

Row-Width cm.	Forage yield - tons per dunum		Average
	1961*	1962	
75	1.95	1.80	1.88
100	1.63	1.62	1.63
L.S.D. (5% level)	0.11	0.10	0.07

* Data for 1961 from M.S. Thesis by Dowlah, Faculty of Agr. Sci. Amer. Univ. of Beirut, 1962.

× Includes the averages of three hybrids, each with a stand of 4000, 5000, and 6000 plants per dunum, for two years.

The three hybrids grown responded uniformly to the two row spacings and were not significantly different in their forage yields.

6. Plant Population and Grain Yield

Variations in the plant populations were established by planting the maize thick and thinning to a stand of 4000, 5000 and 6000 plants per dunum. At each population three hybrids were used, namely, SD 604, Ind 620 and AES 808. Also, each hybrid was planted in rows 75 and 100 cm. apart. The maize crop was planted during the middle of April and harvested in September.

In Table 7 are reported the average grain yields of maize when grown at a rate of 4000, 5000 and 6000 plants per dunum.

Table 7. Effect of plant population on the grain yield of maize, in kg. per dunum, during 1961 and 1962.

Plant population per dunum	Grain yield in kg. per dunum		Average [×]
	1961*	1962	
4000	1143	985	1064
5000	1048	958	1003
6000	1039	960	1000
L.S.D. (5% level)	224	126	106

* Data for 1961 from M.S. Thesis by Dowlah, Faculty of Agr. Sci., Amer. Univ. of Beirut, 1962.

× Includes the averages of three hybrids, each planted in rows 75 and 100 cm. apart.

Grain yields were not influenced significantly by maize populations of 4000, 5000 and 6000 plants per during the two years of the study.

7. Plant Population and Forage Yield.

The results for the forage yield for maize grown at the rate of 4000, 5000 and 6000 plants per dunum are give in Table 8.

Table 8. Effect of plant population on the forage yields of maize, in tons per dunum, during 1961 and 1962.

Plant population per dunum	Forage yields in tons per dunum		Average
	1961*	1962	
4000	2.08	1.78	1.93
5000	1.87	1.69	1.78
6000	1.42	1.66	1.54
L.S.D. (5% level)	0.34	0.29	0.20

* Data for 1961 from M.S. Thesis by Dowlah, Faculty of Agr. Sci. Amer. Univ. of Beirut, 1962.

Includes the averages of three hybrids, each planted in rows 75 and 100 cm. apart.

Variations in plant populations resulted in significant differences in maize forage yields. On the basis of the 2-year average the maize plots with 4000 and 5000 plants per dunum yield higher than those with 6000 plants. The three hybrids studied were not significantly different in their forage yields.

8. Cultural Studies and Protein in the Grain

The data for the protein content of the grain of maize planted at four different dates are shown in Table 9.

From the results shown in Table 9 it is evident that a gradual reduction in protein percentage occurred as the planting was delayed. The maize crops harvested from the March and the June plantings contained an average of 10.9 and 10.0 percent protein, respectively.

The protein determinations made by Dowlah (2) showed no significant effect on the protein percentage in the grain due to different plant populations, row spacings and hybrids. However, he found a significant interaction between hybrid x population x spacings. Hybrid AES 808 contained a higher

Table 9. Effect of dates of planting on the protein percentage in maize grain grown in the Beqa'a during 1961 and 1962*.

Date of planting	Protein percentage [×]		Average
	1961	1962	
March	10.9	10.9	10.9
April	10.5	10.5	10.6
May	10.6	10.6	10.6
June	10.1	9.8	10.0
L.S.D. (5% level)	1.0	0.4	0.4

* Data from M.S. Thesis by Mufti, Faculty of Agr. Sci. Amer. Univ. of Beirut, 1963.

[×] Includes the average of three hybrids. SD 604, Ind 620 and AES 808.

protein percentage at the lower rate of planting, while SD 604 and Ind 620 had lower percentage of protein in the grain from the higher planting rates.

Maize Variety And Hybrid Trials

Uniform maize yield trials have been conducted during the 4-year period 1959 to 1962. The varieties and hybrids were introduced from Europe and the United States. Each was planted to a stand of 5000 plants per dunum in rows 100 cm. apart (75 cm. in 1962) during the middle of April. The data for yield and other agronomic characteristics are reported in Tables 10, 11 and 12.

Table 10 presents, the results of 20 medium maturing varieties and hybrids of maize in the Beqa'a during the 3- year period 1959 to 1961.



Table 10. Average data for yields and other agronomic characteristics for 20 medium maturing maize varieties and hybrids grown in the Beqa'a during 1959, 1960 and 1961.

Variety or hybrid	Date		Ear height (cm.)	3-year average yield 1959 to 1961		
	Tasseled	Fodder harvest		Fodder (Tons)	Stover (Tons)	Grain (Tons)
Alaca 427	July 11	Aug. 24	124	1.40	0.73	700
Alaca 428	July 8	Aug. 24	118	1.37	0.67	758
Indiana 252A	July 11	Aug. 26	125	1.53	0.90	873
Indiana 219A**	July 13	Aug. 25	125	1.63	0.93	893
Indiana 620A	July 11	Aug. 30	126	1.83	1.00	918
Indiana 620C	July 15	Aug. 30	125	1.63	1.00	856
Ohio C 92	July 15	Aug. 29	136	1.53	1.17	917
Kansas 1859	July 8	Aug. 26	126	1.47	0.87	793
US 13	July 13	Aug. 29	138	1.63	0.97	901
Alcala 724	July 15	Aug. 30	144	1.80	1.20	812
Alcala 815	July 21	Sept. 1	155	1.97	1.40	750
A.D. 81	July 16	Aug. 30	142	1.90	1.03	936
A.D. 91	July 27	Sept. 7	148	2.00	1.30	702
Texas 26	July 22	Sept. 2	153	2.00	1.53	796
10.393**	July 18	Aug. 30	137	1.87	1.13	824
10.395	July 19	Aug. 31	132	1.87	1.13	836
10.396**	July 22	Sept. 3	127	1.90	1.30	810
10.423	July 18	Sept. 2	137	1.97	1.30	849
10.441	July 16	Aug. 31	138	1.80	1.30	801
10.442	July 17	Sept. 5	146	1.97	1.27	804

* Differences of grain yield less than 120 kg. per dunum are not statistically significant.

** Data for 1961 are estimates.

It will be noted that the varieties and hybrids varied widely in maturity, ear height and yield of fodder, stover and grain. Date of tasseling varied from July 11 to July 27 and date of fodder harvest from August 24 to September 7 for the maize grown during the 1959-61 period. The ear height for Alaca 428 was 118 cm. while that for Alcala 815 was 155 cm. The variety Alaca 428 produced 1.37 tons per dunum of fodder while 2.00 tons were produced by AD 91 and Texas 26. Stover yields varied from 0.67 to 1.53 tons per dunum while the grain yields varied from the 700 to 936 kg. per dunum.

The 3-year trial revealed that the hybrids A.D. 81, Indiana 620A, Ohio C 92 and U.S. 13 produced more than 900 kg. of grain per dunum. It will be noted also that these hybrids tasseled between July 11 to July 16. The maize varieties tasseling later than July 17 did not produce as much grain as those tasseling before that date. However, most of the higher forage yields were obtained from the later maturing varieties such as, A.D. 91, Texas 26, Alcala 815, 10.423 and 10.442.

The 3-year data for 1959-61 for the nine early and medium maturing hybrids are shown in Table 11.

Table 11. Average data for yields and other agronomic characteristics for nine early and medium maturing maize hybrids grown in the Beqa'a during 1959, 1960 and 1961.

Hybrid	Date		Ear height (cm.)	3-year average yield 1959 to 1961		
	Tasseled	Fodder harvest		Fodder (Tons)	Stover (Tons)	Grain (Tons)
S. Dak. 210	July 3	Aug. 14	101	1.10	0.40	746
S. Dak. 220	July 1	Aug. 14	100	1.20	0.40	778
S. Dak. 250	July 2	Aug. 14	113	1.73	0.67	909
S. Dak. 262	July 8	Aug. 14	107	1.20	0.63	930
S. Dak. 270	July 6	Aug. 17	108	1.37	0.63	917
S. Dak. 400	July 7	Aug. 17	111	1.37	0.70	1037
S. Dak. 420	July 9	Aug. 21	112	1.53	0.83	958
S. Dak. 604	July 10	Aug. 22	110	1.70	0.83	959
S. Dak. 622	July 11	Aug. 22	113	1.70	0.97	767

* Differences of grain yield less than 112 kg. per dunum are not statistically significant.

The nine maize hybrids in this trial tasseled from July 1 to July 11 and produced fodder of satisfactory quality from August 14 to August 22 when planted during the middle of April. The highest grain yields were obtained for

the hybrids that tasseled during July 6 to July 10. The hybrids S. Dak. 400, S. Dak. 604 and S. Dak. 420 yielded an average of 1037, 959 and 958 kg. of grain per dunum, respectively, for the 3-year period.

The maize hybrid trials in 1962 included 18 new hybrids and four of the higher yielding ones tested during 1959-61. The yield and other agronomic data for 22 hybrids grown in 1962 are reported in Table 12.

Table 12. Yield and other agronomic data for 22 maize hybrids grown in the Beqa'a during 1962.

Hybrid**	Date		Ear height (cm.)	Fodder yield (Tons)	Stover yield (Tons)	Grain yield (kg.)	
	Tasseled	Fodder harvest				1962*	4-year av. 1959-62
S. Dak. 400	July 11	Aug. 15	135	1.6	0.8	929	1010
S. Dak. 420	July 11	Aug. 15	130	1.6	1.1	1292	1042
S. Dak. 604	July 13	Aug. 22	120	1.8	0.9	1082	990
Ind. 620A	July 14	Aug. 22	135	1.7	1.0	878	908
S. Dak. 27	July 14	Aug. 22	125	1.8	1.1	988	-
S. Dak. 620	July 16	Aug. 22	160	1.8	1.3	1228	-
Sokota 63	July 16	Aug. 22	120	1.7	1.2	946	-
Sokota 66	July 14	Aug. 22	120	1.9	1.2	905	-
Sokota 207	July 12	Aug. 22	140	1.8	0.8	1039	-
Sokota 619	July 12	Aug. 22	150	1.7	1.1	1122	-
Sokota 625	July 14	Aug. 22	125	1.9	1.2	857	-
A.E.S. 808	July 15	Aug. 22	130	1.8	1.3	874	-
A.E.S. 809	July 16	Aug. 22	140	1.9	1.3	786	-
Pioneer 352	July 15	Aug. 22	130	1.8	1.1	885	-
Pioneer 377A	July 10	Aug. 15	130	1.4	0.6	936	-
Pioneer 388	July 9	Aug. 15	125	1.2	0.5	1074	-
Pioneer 395	July 9	Aug. 15	115	1.5	0.5	1096	-
Pioneer 6132	July 9	Aug. 15	110	1.5	0.4	1170	-
Asgrow 11	July 9	Aug. 15	125	1.5	0.7	902	-
Asgrow 66	July 9	Aug. 15	130	1.7	0.8	961	-
Asgrow 77	July 9	Aug. 15	130	1.8	0.7	1243	-
Asgrow 88	July 9	Aug. 15	130	1.4	0.7	899	-

* Differences of yield of less than 185 kg. per dunum are not statistically significant.

** First 18 hybrids were replicated four times and the bottom 4 hybrids were replicated twice.

It will be noted that three of the four maize hybrids, S. Dak. 400, S. Dak. 420 and S. Dak. 604, tested previously, produced satisfactory grain yields in 1962. On the basis of only the one-year grain yield data, the hybrids

Asgrow 77, S. Dak. 620, Pioneer 6132, and Sokota 619 appear very promising. Additional trials, however, are needed for reliable conclusions.

A summary of the maize variety trials reported in Tables 10, 11 and 12 indicates that several satisfactory hybrids are available that will consistently produce from 900 to 1000 kg. of grain per dunum in the Beqa'a. Also, maize hybrids with medium-maturity or those that tassel between July 6 and July 16 (when planted about the middle of April) will produce the highest grain yield. Hybrids that tasseled earlier or later, under the conditions of these experiments, resulted in lower grain yields. All of the hybrids tested produced sound quality grain and no lodging was experienced in any of the experiments.

SUMMARY

Maize trials, involving cultural practices, varieties and hybrids were conducted in the Beqa'a, Lebanon, during the 4-year period 1959-1962.

Grain, forage and stover yields in maize were affected greatly by the date of planting. The grain yields decreased as the date of planting was delayed from March to June. Maize planted in April produced the highest forage yields while the lowest forage yields were obtained from the plantings made in March. Stover yields obtained from May to June plantings were higher than those made in March and April.

Row-width and plant populations influenced grain and forage yields in maize. Maize grown in 75 cm. rows yield considerably more grain and forage than that planted in 100 cm. rows. Variations in populations resulted in significant differences in maize forage yields. Grain yields were not influenced significantly by growing maize plants at the rate of 4000, 5000 plants per dunum.

The percentage of protein in the grain was reduced as the dates of planting were delayed from March to June. The protein content in maize was not influenced by different plant populations, row-spacings and hybrids.

The maize hybrids tested varied widely in maturity, ear height and yield of fodder, stover and grain. Hybrids that tasseled between July 6 and July 16 produced the highest grain yields while those that tasseled between July 16 and July 27 had the highest forage yields. Several adapted maize hybrids were found that consistently produced from 900 to 1000 kg. of grain per dunum.

LITERATURE CITED

1. Cochran, W.C., and Cox, G.M. *Experimental Design*. John Wiley and Sons, Inc. New York. 2nd Ed. 1957.
2. Dowlah, A.B.A.S. Effect of row-width and plant populations on the yield and other characteristics of corn. M.S. Thesis, Faculty of Agricultural Sciences, American University of Beirut, 1962.
3. Ecimovic, J.P., and El-Assaad, Haidar. Sampling census of Agriculture Lebanon, 1960. Ministry of Agriculture R-6:1-75, Beirut, May 1961.
4. Mufti, S.I. Effect of dates of planting on yield and other characteristics in maize. M.S. Thesis, Faculty of Agricultural Sciences, American University of Beirut, 1963.
5. Snedecor, G.W. *Statistical Methods*. Iowa State College Press, Inc. 4th Ed. 1946.

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