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مكتب وزير الدولة لشؤون التنمية الإدارية
مركز مشاريع ودراسات القطاع العام

# Project FAO - TCP/LEB/6612 (A) : Strenthening Agricultural Research (Sugar Beet Production).

Republic of Lebanon
Office of the Minister of State for Administrative Reform
Center for Public Sector Projects and Studies
(C.P.S.P.S.)

## First Mission Report
## 11-22 April, 1998

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## Summary and conclusions.

Sugar beet is cultivated primarily in the Bakaa plains, under substantial subsidy of the Government . The Crop is sold to the only factory of the country. Sandy-clay and clay loam soil are the dominant type of the soil of the region. where a semi- and high mechanization system are used and extensive irrigation is pricticed.

From the visits of the farmers fields. reviewing of the current methods of sugar production , analyzing processing data from the last three years and discussion with the farmers and the authorities in charge with the sugar beet research , production and processing , the following matters could be suggested:

1. As a result of the problems in the seed bed preparation and undesirable irrigation timing , a very poor seedling emergence (mostly 30-40%) in the field in which pelted monogerm seed was used have been recorded. As a 16 cm seed sowing spacing is practiced in the se fields, this would result in poor plant establishment with low sugar yield production. Therefore, it was recommended that due to the mentioned conditions ,the effect of seed sowing spacing of 5,8 and 12 cm on plant establishment and sugar yield to be studied in these areas. This study have been already started in three different field of the region (Tal-Amara Station, Baalbeck and Kab-Eliass). The out-put Data of these experiments will be analyzed and reported in my second mission of the TCP project in 20-30th July.

2. It is recommended that a small l percentage of the price of the imported sugar and that produced within the country to be allocated into the sugar beet research and in particular for running breeding programs for releasing new and full y adaptable , and high yielding cultivars within the country.

3. Training of the technical staff and therefore. upgrading their knowledge is really the key for further improvement of sugar beet production in the country. Having consider this important matter. it is to be recommended that using different sources . such as TCP for training and the possible sources which mentioned in the item 2., short and long term training course to be arrange for the staff . overseas and within the country. As the similarity in climatic and also the level of expertise in sugar beet production concerned . Sugar Beet Research Institute of the I.R. Iran would be a good choice among the others.

4. From the sugar beet processing data of the last agronomic , 1997-1998 , it could be suggested that the root product which was submitted and processed in the sugar beet factory during the first 21 days of processing (starting from 11th Sept. , almost 50000 tons ) have not been physiologically matured (where the average sugar content of this period was significant less than those processed later) . It is therefore recommended that on the bases of ten days interval, 50-100 randomly selected root s f from particular field s in three different areas of Bakaa region to be collected by Tal-Amaraa Research Station and be analyzed in the sugar factory for sugar content and the extracted juice purity.

5. Without having an active and logical extension and education system. we can not see the out put of any research in the farmers field. As sugar beet is a strategic crop for the country it is recommended that under supervision of Director General of the Agricultural Research Institute, a sugar beet Research and extension unit to be established in the Tal-Amara Station.

6. Analysis of the sugar beet processing data from the factory suggested that , disappointingly, More than 4% of sugar content of the product have not been recovered. As reduction of just 1% of this loses could result in production of more than 2750 tons of extra sugar from the same amount of the crop, it therefore, recommended that in my next mission a meeting with expert from research, extension , agricultural economy department and also one of the technical staff of the sugar beet factory to be held and the important issue of the sugar loses to be discussed, and the best ways of tackling this problem to be introduced to the Government of Lebanon.

## I. Introduction

### Objective of the project

The objective of the assistance is to strengthen the technical capabilities of the Agricultural Research Institute to design and implement specific priority research programmes for increasing and improving the production of horticultural crops.

### Terms of reference

Under the supervision of the Chief, Crop and Grassland Service (AGPC), the guidance of the Director-General of the Agricultural Research Institute (ARI), and in collaboration with the Director of the Tal-Amara Agricultural Research Station and his technical staff, the Consultant in Sugar Beet Production will perform the following duties:

First visit (Planting season)

1. review the current methods followed for producing sugar beet in Lebanon, and evaluate their impacts on the yield and quality (sugar content), with emphasis on the varieties, cropping cycle, fertilizer use and irrigation;
2. assist in the identification of the factors affecting the sugar beet production in Lebanon;
3. prepare a research programme for improving sugar beet production in Lebanon through the introduction of high-yielding varieties and modern agricultural production techniques suitable for the local conditions;

4. provide on-the-job training for the technical staff of the Tal-Amara Agricultural Research Station on modern techniques for producing sugar beet;
5. formulate a programme for the training of Lebanese technicians on tissue culture techniques and advise on suitable institutions for its implementation;
6. prepare and submit to Ministry of Agriculture, ARI and the FAO Representative, a technical report on the mission's findings and recommendations;

## II. Activities undertaken

The work visit was performed under supervision of the chief, Crop and Grassland Service (AGPC), guidance of the Director-General of the Agricultural Research Institute (ARI) and in collaboration with the Director of Tel-Amara Agricultural Research Station (T-ARS) and the Technical staff. To fulfill the terms of references and duties of the mission, the following activities were performed:

### 1 - Meetings and discussion with authorities and the technical staff, in charge of sugar beet production.

After having a tour visit to sugar beet production area of Bekaa plain and discussion with farmers who had problem in plant emergence, and also visiting experimental site in T-ARS, the following meetings were performed.

1.1- Meetings with Dr. Khalil Khazzaka, Director General of ARI.

1.2- Dr. Georges Mansour, Director of Studies and coordination, Ministry of Agriculture.

1.3- Mr. Said Mays, Director of Sugar Beet Cooperative.

1.4- Technical staff of T-ARS. several meetings

During these meetings the current situation of sugar beet research and production: sugar recovery in the only factory of the country: the constrains. role of research. education and extension in the improvement of quality and quantity of sugar beet crop were discussed.

It is to be noted that in the tour visit Mr. Salah Hajj Hassan. a senior agronomist at T-ARS and the coordinator of the mission was my counter part.

## 2 - Review of current methods of sugar beet production in Lebanon

### *2.1 - Sugar beet production area of Lebanon, and the yield in the last three years.*

Bekaa plain (the marked area in Annex, Fig. 1) is the most developed agricultural region of Lebanon with medium to big scale holdings, dominated by the cultivation of potato, onion. vegetables, cereals and sugar beet. Irrigation extensively used and semi to high mechanization is practiced.

Sugar beet is cultivated primarily in the Bekaa plain under substantial government subsidy and the entire crop is sold to the only refining factory in the country.

Sugar beet processing data from the last three years (Table. 1 below) indicates a relatively consistence sugar beet production in Lebanon, where the average of total root production was 270 000 tons. Having an average of 14-15%, sugar content (S.C.) of the root ranging from 13.99-14.91 percent. Data in Table.1

also illustrates that, from the average S.C. of 14.5%, just 10.64% of sugar of the roots are extracted and the rest of 4.18% could not be recovered and therefore, accounted as sugar loses in the refining process. The following factors could be associated with this losses:

1- Association of high amount of impurities in the extracted juice, such as potassium, sodium and nitrogen which could be resulted from: over-use of chemical fertilizer; harvesting physiologically immature plants, and genetical characteristic of the cultivar used .

2- Problems in the refining process: Having said the importance of monitoring refinery process in a appropriate way, and using suitable agronomical methods for reduction of the impurities in the extracted juice, it would not be difficult to reduce this losses. To be note that by reducing just 1% of the 4.18% loses, around 2700 tons of extra sugar could have been recovered from the produced crop.

Review of current methods of sugar beet production, visiting a significant number of farmers field and also review of the available from previous years and those provided by sugar beet factory for the year 1995-1998; suggest that, by improving research, education and, in particular extension it is quite possible to increase crop yield and improve quality of the products.

| Agrono-mic Year | Cultivated land (ha) | Root yield (ton) | Sugar content S.C (%) | Sugar produced (ton) | Percentage of sugar recoverry (Randoman) (%) | Sugar content-Randoman % |
|---|---|---|---|---|---|---|
| 1995-96 | 6000 | 260000 | 14.64 | 26000 | 10.0 | 4.69 |
| 1996-97 | 6000 | 275000 | 13.99 | 28000 | 10.18 | 3.81 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1997-98 | 6000 | 270000 | 14.91 | 29540 | 10.81 | 4.05 |
| Average | 6000 | 270000 | 14.51 | 27848 | 10.34 | 4.18 |

Table.1: Processing data from sugar beet produced in the last 3 years. Data provided by the sugar beet factory.

*2.2- Problem associated with selection of sugar beet cultivars used by the farmers.*

Selection of the most adaptable, high yielding and pest resistance cultivars is the first requirement for sugar beet production. It is therefore, usual in the most sugar beet producing countries that, before any cultivars should be used by farmers, they must be checked under different climatical conditions of the country for desirable characteristics. However, in Lebanon this is not the case as the seeds from different companies are imported and sold to farmers without conducting the required yielding and quality control. It is to be mentioned that, every year.

Department of Crop Production of T-ARS conducts experiments as to compare yield, S.C. and pest resistancy of the imported cultivars. However, there are some cultivars used by farmers which have not been tested at all. In addition, despite lots of efforts being made, the collected data are not used by decision makers as to whether seed from a given cultivar should be imported or not. To improve research for introduction of high-yielding cultivars and therefore, increase in sugar production of the country, it is recommended that:

2-2.1 - Agricultural Research Institute to be appointed by the Government as the responsible agency for evaluation and, verification of cultivars, and permission for importation of seed from any country.

2-2.2 - As research on the area of sugar production benefits all parties in charge, Government, farmer cooperative and sugar beet factory, it is recommended that a small percentage of the price of imported sugar and that produced within the country to be allocated for improvement and rehabilitation of research system, education and extension of sugar beet and in particular, releasing new high-yielding cultivars in Lebanon.

2.2.3- It is well established that sugar content could not be used as a reliable bases for quality test of sugar beet cultivates. The purity and final recovery of sugar from the crop should be used the bases. As in the current research for varital comparison in T-ARS only S.C. is used for quality check, it is recommended that. the required set of equipments for purity test should be provided to the station. It is also recommended that along with the imported cultivars released in EUROPEAN countries, cultivars released in the semi-arid and dry countries (such as Iran) also to be tested in Lebanon.

*2.3 - Poor emergence and low plant establishment in the field where precision drill sowing system is used.*

The quality and quantity of sugar produced from sugar beet is strongly dependent on optimizing plant spacing in the field. Poor seed germination and, in particular, low plant establishment. has long been a real problem in sugar beet production, particularly in precision drill sowing system, designed to omit thinning, which is time consuming process. with high labor cost. There is large body of data in the literature demonstrating clear effect of plant density on root and sugar yield. It is established that wider plant spacing in sugar beet gives larger root with a greater crown, containing a lower percentage of sucrose and a

higher percentage of impurities resulting in the reduction of final sugar recovery. On the other hand, owing to competition between plants, the tuber which are produced in a dense spacing are too small to be used in sugar beet factory and most of the plant growth is attributed to the top ground growth, with a low S.C. and high impurity.

No published work on plant density effect on sugar production was found in Lebanon. However, it has been documented worldwide that (Kern, 1976; Smith and Martin, 1977; Echoffetal., 1991; M. Dehghan-Shoar, 1992) 15-20 cm spacing generally resulted in highest gross sucrose and, estimated sucrose yield.

It is well known that having monogerm seed with a good potential of seedling emergence and plant establishment is the key for producing adequate density and uniformly distributed plants. This is a very important factor especially in the case of sugar production in semi-arid and dry areas. It has been shown that, despite sowing monogerm seed with a 95% laboratory germination (ISTA, 1987), the rate of establishment was less than 50% of the seed sown. (M. Dehghan-Shoar, 1992).

In the Bekaa region farmers used to plant monogerm seed with space of 16 cm, with a generally accepted assumption that with this spacing sufficient number of established plant could be produced. Visiting a number of farmer's field and recording the percentage of newly emerged seedings (at 1-2 true leaves stage) showed that as a result of indesirable seed bed preparation and problem in irrigation, poor seedling emergence is a common problem in the fields in which monogerm seed were planted. This could cause serious reduction of the sugar yield in these fields. It should be mentioned that, in one field with very poor emergence (around 10% of seed sown gave established plants, plate.1), it was found that the farmer used monogerm pelleted seed which as a result of

being stored for an unknown period of time appeared to be aged. Disappointingly, no date of production and expiry date and even germination percentage (as the requirements for seed trading) was recorded on the seed bag. Therefore, it is recommended that through using a good extension service, the farmers should be informed in order to avoid using old stored seeds, or seeds with unknown history.

It is also advisable to the Ministry of Agriculture to establish a seed control laboratory, preferably under responsibility of Agricultural Research Institute, to control quality of the seed before to be sowing by farmers. Is is also recommanded through appropriate extension programme, both to farmers and technicians, the importance of on-time irrigation and a good preparation of seed bed.

In Bekaa plain, field with light soil had low percentage of emergence ranging from 30-40%. However, in a few field with relatively heavier soil and a good seed bed preparation, the maximum of 60% emergence of the monogerm seed was recorded (Plate.2). As the optimum plant spacing is to be around 15-20 cm, even in the field with the maximum emergence of 60% this spacing could not be achieved. Therefore, it is recommended to reduce the seed sowing rate of 16 cm on the row. Seed spacing of 5-8cm in the light soil and 8-12cm in the heavy soil with good seed bed preparation might be the best choice. However, this need further research work before drawing any conclusion.

To initiate this research and instruction of the technical staff of T-ARS for defining actual effect of seed spacing on seedling emergence, plant establishment and sugar yield, two experimental plans were designed for conducting in T-ARS (anex.1) and in the field of two farmers (Annex.2), one in Keb-Elias and the other in Baalbek. The experiment in Keb-Elias is under way

and the other would be implemented very soon. In my second and the third mission, findings of these experiments will be reported.

It should be mentioned that over use of seed was observed in some fields in which multigerm seed was planted. Although the farmers of these fields would not face the poor plant establishment mentioned in the precision drill sowing system, the costly thinning process is needed in these fields. Therefore, it was suggested to the technical staff of T-ARS to try convince farmers to limit the use of multigerm seed. This could be achieved by applying extension programme to encourage farmers to adjust their seed drilling machine for sowing less seed (8cm aport on the row).

3 - On-Job training of technical staff of the crop production department of T-ARS on the subject of sugar beet seed quality control.

During this training session, the importance of seed quality control was discussed and the standard germination test by International Seed Testing Association (ISTA, 1987) for sugar beet and also vigour test methods, developed by the Seed Technology Department of SBSI (Sugar Beet Seed Research Institute of I.R. of Iran) were introduced and practiced. The summary discussion and the practical work, was as follow:

- The terms "germination" is internationally used to express the percentage of emerged seedling from the seed sown under an optimal condition,in which the seeds are placed within the standard pelleted paper and germinated at 25°c and RH. of more than 95%.

As the actual conditions for seed germination and seedling growth in the field could be quite different from those in the standard method of testing, the germination test result may not be equal or even correlated with the field results. where the climalical conditions, soil type, seed bed preparation and water availability could varied from site to site (M. Dehghan-Shoar, 1992). However, seed germination result could well be used as an indicator for seed development and seed physiological maturity.

It has been found that despite for the germination vigour test results (percentage of the emerged seedling of the seed planted under sub-optimal or under stress conditions; for example: cold, wet clay soil) could be well related to results of plant establishment in the field. Using seed samples of 45 cultivars in this training, a simple vigour test with 2 replications was demonstrated

(plates 3.a & 3.b). Data from this vigour test and those from the fields (see Annex 1-2) would help the staff to adaptan appropriate system by which a suitable seed spacing measure for different area to be achieved.

Plate 3.a: Demonstrating a simple vigour test, using plelled monogerm seed in soil

Plate 3.b: Vigour test experiment. In this experiment with two Replication vigority of the seed from 45 cultivars will be assessed.

4 - Sugar beet maturity and assessment of the suitable harvesting time of.

When sugar beet root get into the stage where the sugar content and purity is of the highest level in life cycle of the plant, it is called that the plant is physiologicaly matured (communly used ripened). This is the best time for recovery of sugar contained in the root. Although genelical characteristics of a given cultivar determine time of maturity, other factors such as environmental condition, soil type and fertility and irrigation could influence time of physiological maturity. For example, in light soil and semi-dry conditions the crop reaches the maturity earliear than that in heaver soil. Having regard to these factors time of harvest should be assessed on the bases purity and S.C. of the extracted Juice from sugar beet root. Early or late harvesting may result in a lower sugar recovery. Data from processing of sugar beet crop in the sugar beet factory in the year agronomic 1997-1998 (Fig. 2 & 3) suggesting that there was an increasing trend in S.C. and purity of sugar beet crop submitted to the factory from the first of root processing (11th Spt. 1997) until the end of processing (7th Jan. 1998). The most important point to be noted here is that, S.C. of the submitted root within the period of 11th September until 10th of Oct. (the first 20 days of processing, (Fig. 2&3) was much lower than the latter submitted root crop. From this data, it could be hypothesised that, the sugar beet crop harvest earlier and submitted to the factory in this period (around 50,000 tons) was not mature enough at the harvest and thus, if was harvested 20 days latter it could have had produced more sugar and likely better Juice purity. To check this hypothesis, it is recommended that, in a 10 days interval bases in this year, randomly selected root samples of 50-100 from particular field in three area of sugar production of Bekaa to be collected by T-ARS Technical staff and S.C. and juice purity of the crop to be determined on the sugar beet factory.. The out-put data would be very usefull for testing the hypothesis. The