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GENERAL CONSIDERATIONS CONCERNING SUGAR BEET CULTIVATION IN ARID REGIONS

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SPECIFICATION FOR ADAPTATION TO THE SARIR PROJECT

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1977

GENERAL CONSIDERATIONS CONCERNING

SUGAR BEET CULTIVATION IN ARID REGIONS

SPECIFICATION FOR ADAPTATION TO THE SARIR PROJECT

(According to IRAT-SATEC Works and Publications About SUGAR BEET CULTIVATION -in Mediterranean Regions-)

JCL - IRAT-SATEC

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Originally, the sugarbeet is a long daylight plant which flourishes in temperate maritime climates where the temperature range is fairly narrow. Normally, its growth cycle spreads over 2 years, but only the first of these years is relevant to industrial-scale sugar production.

It requires deep, rich and neutral or chalky soils. Its natural growth conditions are in the mean temperature range from about 8°C to about 30°-35°.

However, as the result of a considerable effort by plant geneticians, the extension of beet growing during the last ten years shows that it is a most versatile plant : in some cases, even, its growing area extends as far as the sugar-cane belt (in Spain and Morocco).

Nevertheless, each modification in relation to its ecological predilections entails special problems, or reveals hitherto unsuspected qualities.

I - PLANT CHARACTERISTICS

Sugar-beets are a biannuel plant ; the first year, leaves and roots are growing, and, normally, in the second year of growth, the plant produces a flowering-stalk.

Of course, only the first year production is interesting for the industrial sugar production.

- ROOTS

The sugar-beet has a strong tap-root which grows quickly and reaches a depth of 170-200 cm.
When the plant is from six to eight weeks old, two rows of lateral rootlets, develop from within grooves on the opposite sides of the large fleshy root. They form a profusely-branched root system, that is active mainly in the upper soil layer to a depth of 35 cm, and laterally, in a radius, of about 50 cm. Other and stronger roots develop at greater depth, and penetrate into the subsoil. The sugar beet, therefore, possesses an extensive root, that is capable of absorbing water and nutrients both from the superficial soil layer and from the subsoil.

The dry-matter content of the beet increases as the plant develops ; at the time, when the roots are harvested, it will normally reach from 20 to 26 percent. The dry-matter consists mainly of sugars, mostly in the form of sucrose (saccharose). In addition to sucrose, there are other sugars present, such a glucose, fructose... other organic and mineral substances.

The highest concentration of sugars is present in the central fleshy part of the root ; the crown and the top of the root have only low sugar-contents. The sugar content of the commonly grown varieties of sugar beet, has reached 16-20 percent.

Most of the other organic constituents of the beet, are nitrogenous compounds, and the amino-acids cannot be removed from the juice during the sugar extraction process.

Their presence in the juice prevents the crystallization of part of sugar, hence the collective name of "NOXIOUS NITROGEN" for all the nitrogenous compounds that cannot be eliminated from the juice.

There is an increase in the levels of unassimilated nitrogenous compounds in the beet juice, as the amount of fertilizer N applied to sugar beets is increased.

- LEAVES

The leaves grow from the crown in a close spiral, with the oldest leaves on the outside. As the leaves become senescent and die, they are replaced by younger ones. More than half the leaves die during the growing season. Diseases and nutrient deficiencies hasten the process, and, therefore, depress sugar production. As the new leaves are produced at the expense of the sugar reserves of the plant, leaf loss should be prevented as far possible.

- INFLORESCENCE AND FLOWERS

The flowering-stalks develop from the centre of the crown and produce small, narrow leaves. The flowering stalk grows rapidly and branches profusely ; the result is a bushy plant that may reach a height of 2 meters or more.

Cross fertilization and self sterility are the rule, self pollination being extremely rare.

The real seed of the beet is very small, the seed-coat is thin, smooth and dark, and the endosperm is white and mealy.

II - ADAPTATION OF SUGAR BEET CULTIVATION TO THE SOIL AND CLIMATIC CONDITIONS OF SARIR

Sugar beets have a fairly wide adaptibility : they are relatively resistant to cold, withstand drought, and are not overly sensitive to salinity.

- CLIMATE

Sugar beets have no self regulatory mechanism to promete sucrose accumulation, but are dependent upon external stimuli for that. Climatic factors such as light, temperature, and day-lenght, determine, to a great extent the type of grown and the amount of sugar that gets stored in the root.

The SARIR climate can be expected to enable ready adaptation by sugar beet and produce potentially hight yields, providing that allowance is made for the following points :

. the minimal temperatures recorded in December-January-February (6-8°C), imply that varieties not vulnerable to early seeding should be used for sowing in September-October.

. the hight temperatures recorded in summer will be a constraint on the plant's photosynthesis activity, they will prevent lenghty storage of industrial beet, so that :

- harvesting period will be executed after 200 days of vegetative cycle and before summer hight temperature in April May and June.

- Picking will have to proceed at a rate consonant with the factory's intake capacity.

- SOILS

Sugar beet have a fairly large adaptibility to soil conditions. It stands up well to saline soils, being economically productive for salt contents of up to 1.5 percent (8.15 mmhos/cm2). The Sandy soils of SARIR will not be a constraint for the sugar beet cultivation.

III - THE FARMING CALENDAR - VEGETATION CYCLE OF THE SUGAR BEET AT SARIR NORTHERN PHASE PROJECT

This is an essential factor, since it must reconcile some rather conflicting factors :

- the input requirements of the sugar factory,
- the climatic and physical conditions,
- the physiological requirements of the plant.

The input requirements of the sugar factory are fairly constant, whether we consider the length of the manufacturing season or purely technological factors. Nevertheless, account must be taken of the impossibility of storing beetroots in hot climates, meaning that ripening of the crop must be spread over a period throughout the farming estate.

The hot climate and absent rainfall make irrigation essential throughout the whole vegetative cycle of the plant, and lead us to recommend sowing in the autumn. This will make it a possible saving on irrigation water by avoiding the hottest weeks.

Although the fact that the climatic data (especially temperatures) is available, and although we are able to refer to prior experience of beet growing in similar ecological conditions, so that a farming calendar can already be drawn up, it is only after several years of trials with different combinations of sowing and harvesting dates and plant varieties that it will be possible to establish a firm farming schedule with a proper distribution of sowing dates and varieties and enabling the factory to be supplied without interruption throughout the whole manufacturing season, with beet that is technologically suitable, i. e. has the following qualities :

- a yield of not less than 16 percent,
- purity not less than 85 percent,
- seeding less than 10 percent,
- fibrosity less than 40 percent.

3-1 - SOME RELEVANT OBSERVATIONS CONCERNING BEET VARIETIES

The sugar beet is an allogamous plant, so that all varieties constitute populations.

The Germans, who were the first to become interested in extracting sugar from beet, drew up a 3-type classification by reference to sugar content :

Type E : Ertrag (high root yield, low sugar content 16 %)
Type N : Normal (moderate root yield, sugar content 18 %)
Type Z : Zucker (low root yield).

Nowadays, Type Z is rarely cultivated, the most popular types being NZ, N and E.

- Polyploidy

The beet is naturally a Diploid (2 n = 18).

. Tetraploids

By chemical treatment (colchicine) of young diploid plants, seeds with 4 n = 36 chromosomes can be obtained. The plants from these seeds are a late variety, and their dry matter content, sugar yield, and weight, are lower than those of the diploids.

. Triploids

By crossing (4 n) with (2 n) it is possible to obtain a certain proportion of Triploids (3 n = 27), which give higher yields than the parent stock. The weight is increased without any loss of sugar content.

. Polyploids

Polyploid seeds contain a varying proportion of 4 n, 3 n and 2 n chromosome germs. Commercial polyploids must contain at least 60 percent of true polyploids.

- Monogermity

The term "monogerm" when used alone applies exclusively to genetic monogerm varieties, but by extension is wrongly used to apply also to what are known as "induced monogerms".

. Induced or "Technical"monogerms (Precision seeds)

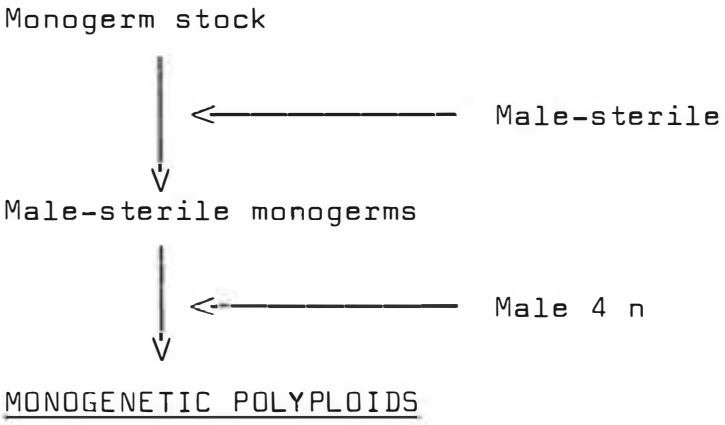
These are seeds obtained by manipulating the glomerules until they have a multigerm proportion of only between 20 and 30 percent. Unfortunately, their germinative potential is fairly small.

. Genetic monogerms

These are monogerm varieties obtained by crossing.

In the early stages, monogenitic stock is rare. Of restricted genetic origin, the roots are small and thickly shaped. The monogerm characteristics (m) is monofactorial and regressive.

To control fertilization and improve the performance of the monogerm stocks, they are crossed with male-sterile stock. When the monogerm and male sterility characteristics are stabilised, polyploidy can be induced by fertilizing with a 4 n male. In this particular case, the female theoretically produces only 3 n seeds.



- Pelleted or naked seeds

Despite polishing and calibration, the seeds never achieve perfect regularity of shape, which makes it difficult to perform controlled or direct sowing with accuracy. To get over this difficulty, seeds are sometimes pelleted with a dose of fungicide and insecticide.

At present, the only advantage of capsulating is that it facilitates mechanical sowing. For the time being, it does not constitute an improvement over raw seeds with regard to pest control treatment.

The choice between capsulated and raw seeds is thus determined

by the type of sowing equipment in use.

. mechanical sowers : possibility of using capsulated seed
. pneumatic sowers : use of raw seed.

Large-scale trials are at present taking place with a view to incorporating in the capsules a systemic insecticide (mainly CARBOFURAN).

- Variety types and mechanisation

Successful cultivation of sugar beet depends mainly on two characteristics of the seed : monogermity and germination potential.

. Beet grown by traditional practices

The sugar beet glomerule (natural seed) is naturally multigermic. Each glomerule contains several seeds and thus produces several plants growing too closely together.
In traditional farming, the glomerules are sown at a rate of between 15 and 20 kg per hectare.
When the plants sprout, the crop line is virtually continuous, and thinning out is necessary until only one plant per 20 to 25 cm is left. This operation is all the more difficult in that the plantlets from a single glomerule grow almost on top of one another and thus have to be separated by hand.

. First improvement factor : Technical monogerms

These "technical" or "induced" monogerms are obtained by manipulating the glomerules. They can be sown using a precision sower, at regular intervals of, say, 5 cm. The thinning out operation is thus greatly simplified, since the level of duplication in the fields, about 20 to 30 percent, means that there is almost invariably an isolated beet growing close to the point where it has to be transplanted. A time saving of about 50 percent is achieved on the thinning out operation.
A further advantage is that the young plants rising separately, do not hinder each other so that thinning out can be spread over a period of 2 or 3 weeks : this enables a smaller labour force to be employed and to concentrate sowing without regard to the thinning-out process.

. Modern sugar beet growing methods : sowing of genetic monogerms

Genetic monogerms are used for direct sowing, when the seeds are implanted at sufficient interval to enable the beet-root to develop, and manual operations are completely avoided (duplication of less then 5 percent).

When performing direct sowing with a genetic monogerm variety, the distance left between seeds must be determined with due regard to the fact that they are in open field conditions. The same seeds, with a germinating power of more than 80 percent in laboratory conditions (commercial deliveries), achieve only between 45 and 60 percent germination according to conditions. In extreme cases, the rate may be as high as 80 percent or as low as 40 percent and less.

Consequently, reckoning successful germination of between 50 and 55 percent of the seeds sown, it is advisable to allow an interval of about 12 to 16 cm between seeds. For an interval between rows of 50 cm, this requires sowing of between 167,000 and 125,000 seeds per hectare, to give a final result of 80,000 plants per hectare or more.

With direct sowing, the land cover is obviously less uniform than with manual thinning out. This is why a larger number of plants per hectare must be obtained, so as to compensate for empty spaces. This irregularity slightly reduces the yield, and this must be offset by the saving of labour costs on thinning out.

- Variety types and farming practices (land preparation prior to sowing)

Even for the same variety, the degree of successful germination in open fields can differ widely according to the quality of land preparation. This is particularly important for direct sowing with genetic monogerm varieties, where the percentage germination directly determines the final yield, with no opportunity for remedial measures.

With controlled sowing, and even more with direct sowing, the seed must be implanted on a soil which is sufficiently worked to provide a suitable germination bed. The seed must be covered by a thin layer of soil ensuring perfect contact. Surface tamping must be avoided, as in conjunction with irrigation water this would form a crust likely to hinder emergence of the plantlets.

When the glomerules are sown at the rate of 15/20 kg per hectare, the number of germs implanted is about 1,500,000.
When "technical" monogerms are sown at intervals of 5 cm, the number falls to 500,000 germs.
With genetic monogerm varieties, at intervals of 12 or 16 cm along the row, there will be only 167,000 or 125,000 germs per hectare respectively.
These discrepancies are considerable, and illustrate the fact that it is not enough merely to use high-quality seed, but that the best possible germinating conditions must also be provided.
In the soil conditions obtaining in the SARIR region -compact, impermeable and salty soils with a high proportion of fine particles (clay and silt accounting for over 70 percent)-these considerations of land preparation prior to sowing will be an important factor when it comes to choosing the varieties to be used.

- Recommended varieties for SARIR project

In a state project like SARIR NORTHERN PHASE, where maximum mechanisation is the rule, we can start the beet operation immediately with very sophisticated varieties such as TECHNICAL or GENETIC MONOGERMS.

3-2 - CROP CYCLES

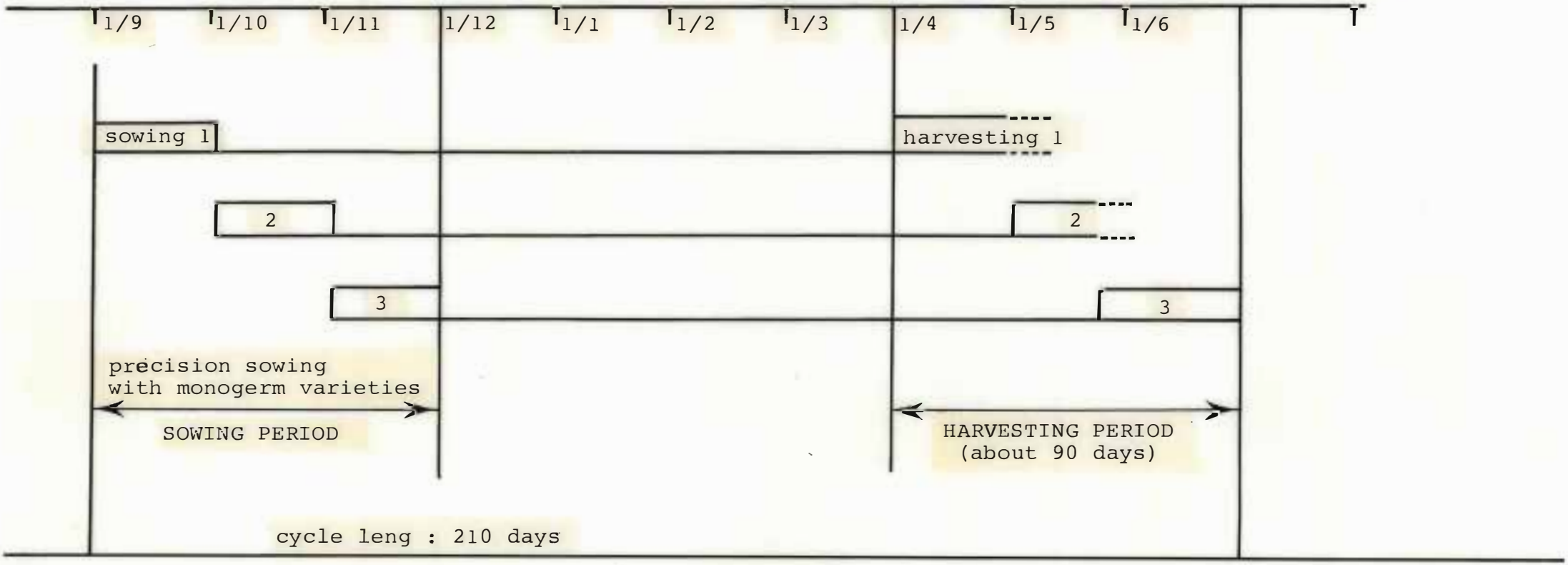
According to our experience of beet cultivation in mediterranean regions we think that beet achieves maturity after a vegetation period of 6 months. If sowing is pread over 90 days, in September/October/November, harvesting will be staggered over a period of about 90 days between 1st April and 30th June. The date on which picking can be started, and thus the start-up of factory production, varies according to the climatic conditions in each year and to the development of the technological qualities of the beet for the factory (saccharose rating not less than 16 %, purity not less than 85 %, etc).

Attention is once more drawn, at this point, to the fact that the temperature highs prohibit storage of the beet for any time, so that picking will have to be performed in step with the crushing capacity of the factory.

AGRICULTURAL SCHEDULE FOR SUGAR BEET CULTIVATION

SOWING PERIOD - VEGETATION CYCLE - HARVESTING PERIOD

SARIR N.P. PROJECT
L.A.R.



1: September sowing

2: October sowing

3: November sowing

The following chart presents the agricultural cycle of beet.

IV - CROP MANAGEMENT

4-1 - SUGAR BEETS IN THE CROP ROTATIONS

Crop rotations influence yield and quality of sugar beets, mainly through their effects on the physical properties of the soil and on the incidence of soil-borne pests and diseases.

Although sugar beets require considerable amounts of plant nutritients for hight yields, they are considered as a fertility-improving crop. The main benefical effects of sugar beet, after growing, are : the weed-free fields and the excellent physical condition of the soil in the entire root-zone.

Sugar beets are usually the first crop in the rotation, or the second if they come after a crop which has received farmyard manure. The only crops, that cannot be sown before or after sugar beets, are those that have soil-borne diseases or pests in common with the beets. The interval between two successive crops of sugar beets, on the same field, should not be less than three years.

4-2 - TILLAGE AND SEED-BED PREPARATION

Sugar beets require a soil in good tilth, clean of weed. A sufficiently compacted seed-bed is essential to ensure rapid and uniform germination.

The physical condition of the soil, is an important factor in the production of sugar beets. Good germination and emergence are highly dependent on good aeration ; water-logging and excessive soil compaction have to be avoided.

4-3 - SOWING

TIME OF SOWING

In dry region with mild winter, such SARIR region, sugar

beets are sown in autumn, the optimal time is from late August to late November.

SEED TREATMENT

Treating seeds with organo-mercuric fongicides, protects the germinating seeds from a number of soil-borne pathogens (Pythium, Rhizoctonia...)

By adding LINDANE or TEMIK or CURATER... to the seed dressing, the seedlings are also protected against soil insects during germination and emergence.

METHOD OF SOWING

Because of the corky layer which covers them, sugar beet seeds have to absorb water to a extent of 120 to 150 percent of their weight for germination. For this reason, ample moisture must be available for satisfactory germination and emergence of sugar-beets.

The normal procedure is to pre-irrigate to the depth of root-zone, cultivate and sow when the soil surface has dried sufficiently, and then apply a light irrigation in order to re-moisten the seed-bed and ensure germination.

RATES OF SEEDING

Two approaches are possible, regarding the amount of seed to be sown :

- Sowing thickly with the traditional seed ball from 15 to 20 kg/ha of polyploid varieties.
- Sowing to a "final stand" i.e. sowing the exact amount of seed required to ensure the optimum number of plants per unit area. Sowing to a final stand will become a practical possibility only after monogerm seeds, precision planter, and pre-emergence weed-control would be successfully developed. This approach will be kept for SARIR Project.

4-4 - PLANT POPULATION

In area that is uniformly occupied by sugar beet from 60 000 to 110 000 plants per/ha, the root yield per unit area

is found to be fairly constant. But in sugar beets, there exists an inverse correlation between the size of beets and the concentration of sugar in them. The Leave/Root ratio is larger in small beets than large ones, hence the photosynthetic apparatus is more extensive in relation to storage in smaller beets, and light is better utilized by their plants.

We already know the inverse relationship between nitrate-nitrogen concentration in beet petioles and sucrose percentage in roots. Apparently, the larger the number of beets per unit area is, the more rapid will be the exhaustion of available soil nitrogen, the lower will be the nitrate nitrogen content of the beets, and the higher will be the sugar content of these beets.

- Experience has shown that for maximum yields of sugar 80 000-100 000 plants/ha are required with between the rows from 50 to 60 cm of width and about 20 cm between the plants within a row.

4-5 - WEED CONTROL

Sugar beets are extremely sensitive to weed competition, in particular during their early stages of growth.

For autumn-sown beets, growth is almost stopped during wither months, and there is a lack of balance between beets and weeds which well developed is the same time. More the intermittent rains do not always timely weeding or inter-row cultivation -hence the importance of starting weed-control before sowing and before winter.

MECHANICAL WEED CONTROL

. Before the sowing, a pre-irrigation followed by cultivation or harrowing, destroys a considerable amount of weed seedlings.

. When the rows can be seen distinctly inter-row cultivation with special equipment should begin.

CHEMICAL WEED CONTROL

Chemical weed control is particularly important when segmented, decorticated or monogerm seed is sown "to a stand". The sparse stand is less able to compete with weeds than is a dense stand sown with normal seed-ball (natural seed).

4-6 - IRRIGATION

Irrigation plays an important role in modifying the yield and quality of sugar beets.

WATER REQUIREMENTS

The estimating procedures of sugar beets evapotranspiration (E. T.) in use today all over the world are generally based on the correlation of measured evapotranspiration with one or more climatic factors.
Evaporation from pan "Classe A" (U.S. Wheather bureau) is the climatic data the most used for estimate the E. T. of sugar beet.

$$E.\ T.\ = Kc\ .\ E.$$

Where E = pan evaporation,
Kc = the crop coefficient,
a variable crop coefficient must be used according to the stage of vegetation.

The data obtained in Algeria from experimentations are quite comparable with Californian data :

Stage of vegetation	Planting	50 % Soil Cover	Total Soil Cover	Harvesting
KC	From 0.2 to 0.5	From 0.5 to 1.0	1.0	

IRRIGATION AND SUGAR

- A moderate water-stress prior to sugar beets harvest increased sucrose concentration and decreased the fresh weight of the roots. During the last irrigations prior to harvest,

markedly increased the percentage of sugar in the beets, so making possible a saving of water without loss in the yield of sugar.

IRRIGATION SCHEDULE

Sugar beets obtain two-third of their total water requirement from the upper soil Layer (0-40 cm) and only one-third from deeper layers. Maintaining an adequate supply of moisture in the 0-60 cm Layer is essential for high yield.

For autumn sowings, a pre-irrigation is applied that wets the soil to a depth of 50 cm. A light irrigation, is needed immediately after sowing for ensuring rapid and uniform germination. At the beginning of emergence, a second light irrigation is given.

After the phase 50 % soil coverage and up to harvest, the number of irrigation required depends on climatic conditions.

Example : Sugar beet sowed in 1st September. (Pan Evaporation)

Stage of Vegetation	1/9 Sowing	15/10 50% Cover	1/12 100% Cover	15/2 Maturation	1/4 Harvesting
evaporation (mean values)	7.2 mm/day	5.0	2.8	5.0	
KC Coefficient crop	0.4	0.7	1.0	0.5	
Water Requirements	3.0 mm/day	3.5	2.8	2.5	

4-7 - FERTILIZATION

The amounts of nutrients required per ton of beets produced are approximately

4 kg of N
1.5 kg of P_2O_5
5.0 kg of K_2O
2.0 kg of CaO
1.8 kg of MgO
2.5 kg of Na_2O

the amount of nitrogen required for a good crop of beets is far in excess of that required for most other annual crops. However, these large amounts of nutrients are normally not exported from the farm : the leaves and tops remain in the field, while the pulp and the molasses remaining after sugar production can be used as animal feed. Farmyard manure should be applied directly to the beets, or preferably, to the crop preceding beets in the rotation.

High yields of sugar depend on an ample supply of N.P.K.

NITROGEN

. In practice, ample nitrogen must be available to the plants troughout their period of growth : it is, however, important that the available nitrogen in the soil, should be practically exhausted more than 100 days before harvesting.

The reduction in sugar percentage, due to excessive nitrogen fertilization, is an approwimately linear function of the nitrate nitrogen in the beet to harvest. Excessive nitrogen fertilization, also, causes an increase in the amount of ash in juice, further reducing purity.

There is, usually, advantage to splitting the nitrogen application by applying half of nitrogen fertilization (120 kg N per ha), at the time of sowing and half just after 50 percent soil coverage. So depletion is practically assured toward harvest.

OTHER FERTILIZERS

The usual rates are 60 kg per ha of P2O5
100 kg per ha of K2O

An application preventively of small amounts of Borax will be necessary.

4-8 - DISEASES AND PESTS

SEEDLING DISEASES

Frequently species of PYTHIUM, RHIZOCTONIA and PHOMA, are involved together. SEED treatment helps to reduce the incidence of these diseases.

ROOT DISEASES

- Crown-Rot :

It is caused by RHIZOCTONIA SOLANI, a soil pathogena which appears on half-grown to nearly mature roots : the crowns decay, and the leaves turn brown and wither, while the fleshy part of the root also decays.

Sugar beet monoculture or quick rotations are favorable to R. SOLANI survival and increase the degree of infection.

- Sclerotium Root-Rot :

"Sclerotium ROLFSII" pathogen usually abounds in moist irrigated soils. The disease, generally, appears when the weather becomes warm in spring, the infested roots are covered with a dense, white mycelium and the leaves turn yellow and die.

Preventive measures consist of no sowing sugar beets after susceptible crops such as grownduts, tomatoes, beans... and the too frequent occurence of beets in the rotation.

LEAF DISEASES

- Sugar beet leaf-spot :

Due to "Cercospora beticola", leaf spot is highly destructive, and is the main disease of sugar beets. The disease

is characteristized by the circular spots that appear on the leaves.

The disease is transmitted in a variety of ways : by seed, by infested crop residues, by a number of weeds. The severity of the disease is favoured by high air-humidity.

Copper-oxychloride and maneb, by spraying, reduce Cercospora leaf-spot.

INSECTS

. Leaf feeding insects as COTTON LEAF WORN "SPODOPTERA LITTORALIS" cause a big damage if it is not properly controlled. In the severe attack by this insect, it causes a complete defoliation of the plant and after that, it feeds the root itself. The cotton leaf worm is spreaded in summer season, specially from May to September.

. The AGROSTIS YPSILON causes damage in the seedlings.

For control, the foliage is thoroughly sprayed with Parathion at the beginning of the oviposition. In order to prevent, extension control measures should be coordinated all over the SARIR region.

4-9 - HARVESTING

Harvesting consists of a number of steps which can be carried out, manually, mecanically, or in a combinaison of both :

TOPPING

The crowns of the root have a very low sugar-content and a high concentration of ash, and have to be removed with the leaves. This topping has to be very carefully executed : if too much is removed, the farmer losses part of his yield ; if too little, he will have to pay a penalty.

REMOVAL OF FOLIAGE

The foliage is chopped by using a flail chopper and incorpored to the soil after harvesting.

LIFTING

Beets may be lifted by using a simple equipment available now which loosens the beets in the soil and brings them out of the soil.

IN THE STADE AREA OF SARIR

A complete mechanization will be suitable, using a combine harvesting machine (Topping + Lifting + ...)

4-10 - BY PRODUCTS

The by product of sugar production from beets are also valuable and can bring considerable contributions to the economy of livestock production.

SUGAR BEET TOPS

Sugar beet tops, consist of the leaves and root crowns. With a complete mechanization of the harvesting, the sugar beet top are crushed and sprayed on the soil for a soil incorporation like green manure. Under good conditions the yield of sugar beet top, may equal or exceed the yield of roots on a fresh-weight basis.

PULP

About three-quarters of a ton of pulp remains for each ton of beet that is processed. The fresh pulp contains 90-95 percent water. This wet pulp after extraction is passed through a screen press that reduces its water content from about 90 to 80 percent. The pressed pulp is, generally, dried at the factory in rotary kilns and then packed and sold as feed.

. One ton of beet processed will give 50 kg of dried pulp.

. Dried pulp contains 90 percent of dry matter, about 0.8 UF/kg, and 4,5 percent of digestible protein.

MOLASSES

Every ton of processed beets produces about 45 kg of molasses containing : 20 % water
60 % carbohydrates
10 % ash
10 % proteins.

Molasses can be added to the pulp, before or during drying at the rate of 25 percent of the dry pulp.

The main use of molasses is as a raw material for the production of alcohol, yeast, acetone and various organic acids.

FACTORY WASTE LIME

Factory waste lime are used as liming for soil improvement.

. The factory produces about 10 percent of waste lime from the total weight of roots processed.

. Waste lime is used with a rate of 4 tons/ha for soil improvement, it contains about 45 percent of CO3 Ca, 15 percent of organic matter and 0.5 percent of nitrogen.