Atelier : "irrigation"

Irrigationof cotton in Israël Production practices and research

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Cotton is grown in the rainless summer (the rainy season is winter). Getting high yields (an average normal yield is nearly 5 tons of seed cotton per ha) here is made possible only by fully irrigating the cotton.

As water supply is limited and irrigation costs high, much has been done here to make water use as efficient as possible.

1.Climate

Cotton is grown in various parts of the country between which rather extreme differences in climate exist. Along the coast, the climate in summer is relatively mild, as compared to that of the inner valleys where temperature gets much higher and relative humidity much lower.

Average annual rainfall varies from 200 mm in the Negev, up to 600 mm or more in the northern parts of the country.

2.Soils

Grumusols (Vertisol) are the soils on which the greater part of Israeli cotton is produced. Most of these are deep Montmorillonite clay soils, having good available water-holding capacity. Cotton is grown also on other soil types, including "marginal" soils where profitable cotton production has been made possible in the last decade only by the introduction of drip irrigation. Much has been studied concerning the irrigation regimes and water requirements necessary for variable environmental conditions.

3.Varieties

Most of the area is planted with SJ-2. In the Bethshean valley Eden 1 (a locally bred Acala variety) is grown. About 8% of the area is grown with Pima - mainly S-5.

4.Water sources

Water is supplied from the National water carrier, from wells and from reservoirs. Some cotton is sucessfully irrigated with brackish water and some with sewage water.

5.Methods of irrigation

Until a few years ago, most of the cotton area was sprinkled. Recently however, less than half of the area has been irrigated by that method, about 42% by dripping systems and about 8% by irrigation machines. Sprinkling systems are usually mobile, the same equipment is used for irrigation in quite a few fields (whole lines are usually mounted on small wheels and after irrigating a plot are pulled by a tractor to the next one).

Dripping systems, on the other hand, are usually static, water application intervals are short and, therefore, a lot more expensive per unit of area.

In spite of the high cost, it has been found in quite a few cases, that irrigating by this method could be profitable as a result of gains in yields per unit of area and quite often also per unit of water.

Real advantage from switching over to dripping has often been achieved when producing under marginal conditions - on shallow, stony, sloping land, or where sprinkling had been poor because of inadequate pressure, windy conditions, etc... In certain regions, dripping has been found profitable where brackish water is used, some extra yield has been achieved by switching over to the method from sprinkling. While on the other hand, drop in yields ensued by drip irrigation on certain calcareous soils located in the hot valley of Beth Shean.

Certain varieties - as Pima S-5, proved to do better under dripping. On the average, some gain in yields is achieved from switching over from sprinkling to dripping. Under various soils and environmental conditions gain in lint yield from dripping may vary all the way from 0 up to 300 or sometimes even up to 500 kg per hectar. When lint yield gain is not high enough (at least 250 kg/ha), there is no justification to switching over from sprinkling to dripping.

It should however be taken into account that benefits from dripping on a farm level may also be indirect, by faciliting improved irrigation in the area still left under sprinkling.

Irrigation machines : in the last few years, various types of irrigation machines have been built and commercially introduced, mainly because considerable labour could be saved by switching over to this method. It has also been found that whenever machines are properly operated, some yield gain over sprinkling could be achieved.

Unfortunately, quite a few machines have not been operated properly, often because of lack of good enough mechanical devices for controlling and correcting deviations in the machine operation.

Most machines are equipped whit spitters for water application, while some others are equipped with open-end or perforated short plastic pipes hanging from the machine at fixed intervals (usually every second row).

Though some studies have been already made on water-soil-plant relationship in various regions and soil conditions, where machines have been operated, still more of those aspects should be studied for faciliting improved machine-irrigation.

Also certain technical operational problems should be solved and better acessories for controlling the operation of the machine should be developped and added to them.

6. Automatization

Automatization and computerization at various levels is now widely used for operating and controlling irrigation systems.

7. Seasonal amounts of water

Seasonal amounts of water for fully irrigated cotton vary considerably according to regional, climatic and soil conditions.

While it is possible to achieve high yields by applying only 350 mm throughout the season in the mild northern part of the coastal region, much more is required ; the further we proceed towards the hotter and drier inner valleys is up to 1,200 mm in the Bethshean valley. Some more water is needed when winter rainfall is not sufficient for wetting down the soil profile deeply enough, mainly where sprinkling is applied.

8. Irrigation policy, yield level and lint quality

Producers should plan for their cotton an irrigation regime that would give the best economic results they can get from the resources (land, water, etc...) they have got at their disposal.

We believe that in order to make some profits, growers should try to get high yields and good quality cotton, but not necessarily aim at getting the highest yields that can be achieved.

Growers sometimes tend to apply to their cotton fields extra amounts of water and fertilizers that would enable them to achieve top yields. By so doing, they often find it difficult to control vegetative growth and their cotton grows very tall. Under certain climatic conditions, yield level and lint quality might be adversely affected in such rank cotton.

At present, with high water costs and low lint prices, one should consider more carefully than ever the irrigation policy he is going to adopt.

Efforts should be made to draw full benefit from irrigation. For that purpose, it should be first properly planned, in accordance with local requirements, as learned from experience gained in past years.

Later on, throughout the season, certain changes may be made if considered necessary and if at all possible.

9. Methods and aids for irrigation decision-making

We have learned that there is no one single method that would be the best for "fine tuning" irrigation under all possible situations and it is always advisable to rely on more than one method for deciding upon timing on irrigation and the amounts of water to be given.

10. Meteorological methods

Class A evaporation pans are widely used in most regions. It has been found long ago that for sprinkled cotton grown on soils wetted to a depth of 150 cm, after full leaf coverage of the soil has been reached, an average coefficient of 0.7-0.8 should be used in most regions of Israël for calculating cotton water requirements from pan evaporation data.

Earlier in the season, before the leaf coverage has fully shaded the soil, the percentage of coverage should be multiplied by the coefficient.

More recent works have shown that under various environmental conditions some other coefficients may prove to be more satisfactory. For the inner hot valley of Bethshean, coefficient of 0.85-0.90 has been found to give best results.

Evaporation pans are widely used. Where soil depth varies considerably, the use of evaporation pans has not proved satisfactory (there, the use of pressure chambers proved to give much better results).

11. Net radiations

It has been recently found that measurement of net radiation may be used as well for calculating irrigation requirements for commercial fields.

12. Methods for determining soil moisture

Gravimetric method for determining soil moisture content is still used by some extension people and growers that are willing to use soil augers for soil sampling. Some use for that purpose tractor operated augers.

Neutron probe is used in one or two regions for determining the soil water deficit before sprinkling commercial cotton. The instrument is usually calibrated for the soil and field in which it is used.

It is not generally agreed upon that the use of Neutron probes in commercial cotton really helps in improving the accuracy of irrigation. Some use of the method has also been made in drip irrigated cotton, but because of the greater variability in the distribution of soil moisture in such fields, its use is more complicated and less accurate.

Tensiometers have been used in a few cases in drip irrigated cotton with very good results, but the equipment is not considered to be very reliable.

It a few experiments, also electrotensimeters have been sucessfully used in combination with plant monitoring.

13. Plant monitoring methods

Pressure chambers for determining the plant water potential are widely used as an aid in irrigation decision making in both drip irrigated and sprinkled cotton.

It has already been stated that where soil depth varies considerably, measurement of plant water potential by a pressure chamber enables to keep a certain water potential and so get much better results from drip irrigation than when aided by evaporation pan data.

The plant water potential that should be followed for achieving best results from irrigation, has been studied in experiments carried out under various environmental conditions and also from experience gathered in commercial production. Under certain conditions, keeping plant water potential at about -14 bar for drip irrigated cotton, proved to give the best results while under other conditions -16 or -17 -18 bar proved to give the best results.

Sometimes, even for same specific fields, some changes in plant water potential from one year to another might prove necessary for getting the best results from irrigation.

Phenomelogical plant monitoring in which systematic data of plant growth and yield development is collected throughout the season, is carried out in quite a few fields, representing various sub-regions.

Considering such data often proves helpful in irrigation decision making.

14. Integration of various methods

Growers prefer using one method or another for aiding themselves in irrigation decision making, but use of one method only might not prove satisfactory and irrigated information gathered from more than one method would give better results.

When, for example, data from an evaporation pan are used, one needs to get also feedback from the field, in order to successfully tune the irrigation of his cotton. In the Bethshean hot valley, the best results have been achieved from use of evaporation pans plus correction according to a pressure chamber.

Use of "irrigation models" that have been developed and are still being improved, that take into consideration all relevant factors (climate, soil, plant and others) that affect cotton production, would probably be followed in the future for irrigation decision making.

When chosing the methods to be used, the costs of labour and how long it takes to get the information needed, should all be considered.

15.Problems incurred in irrigation

When planning to irrigate cotton, it should be taken into account that various problems that have not be encountered with non irrigated cotton may now become harder to cope with.

To mention but a few of these : weed infestation, diseases, certain insects, soil salinization and others.