COTTON

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INTRODUCTION

Domestic cotton has a unique origin and history among cultivated crops. The wild ancestors of modern cotton species were perennial vines that inhabited several distinct geographic areas, including Africa, Arabia, Australia and Mesoamerica (Mexico & Central America).
Five distinct species of cultivated cotton were developed: Egyptian, Sea Island, American Pima, Asiatic and Upland.
Wild cotton is a tropical perennial plant with an indeterminate fruiting habit, meaning that it continues to produce new foliage even after it begins to create seed, and can grow very tall under conditions of unrestrained growth. Despite its inherent perennial growth habit, however, cotton is managed as an annual crop plant. Continued vegetative growth after flowering diverts the plant's energy away from lint and seed production, promotes boll rot and makes cotton crops difficult to harvest.
Potential yields vary with varieties and climate; however, with proper irrigation management, yields in Israel reach 6-7 ton/ha (lints & seeds) and 2-2.5 ton/ha (lints).
Growth regulators, such as mepiquat chloride, can be applied to cotton to slow internode elongation, especially for well-fertilized irrigated cotton.
For successful cotton growth, the following conditions are necessary:
1. Long growing period of 180-200 days with no frost
2. Sufficient ground moisture
3. Plenty of light—cloudiness of above 50% inhibits growth
4. Relatively high temperature

CLIMATE

Cotton grows in various climates in latitudes from 47° North to 30° South. Germination temperature is 18-30°C, with a minimum of 14°C and a maximum of 40°C. Optimal temperatures for growth are 27-32°C. Growth problems occur if temperatures drop to below 12° at night. If temperatures remain above 38° for an extended period, this can cause the flowers and bolls to fall off.

SOIL AND WATER

Cotton grows in a large variety of soils, with best results in alluvial soils. Sandy soils and poor drainage are not conducive to growing cotton. The pH range is wide: 5–9.5, optimum 6.5–7.5. Cotton is resistant to salinity, compared to other main crops. However, salinity levels above 7.0 dS/m will result in yield decrease.
Water requirements are determined by climate and soil. The irrigation regime has a large influence on the vegetative growth rate, starting from the 70th–80th day. Exaggerated growth lowers the yield. Maximal yield occurs when the plant shows a slight water stress. For this reason, it is common to start watering cotton after a quantity of water from the ground has been used up, allowing depletion of 40-50% of the available moisture, up to 90 cm depth. Irrigation usually begins with the first bud or first flower. Up to that point, the plant uses the winter water or water provided to maintain the moisture level at sprouting time.
During the boll enlargement and fiber elongation phase, the development of the fiber is very sensitive to adverse environmental conditions. Low water availability, extremes in temperature and nutrient deficiencies (especially potassium) can reduce the final fiber length. The quantity of water needed for the whole season is 360-900 mm.

WASTE WATER EFFLUENT

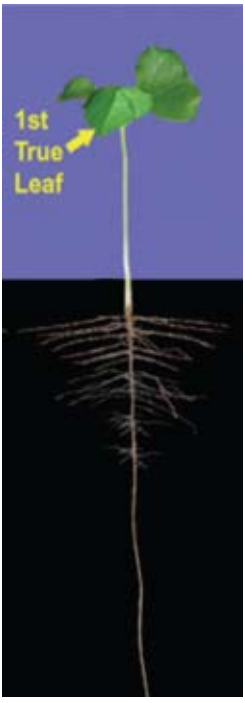
Irrigating cotton with recycled effluent water has been implemented a great deal in Israel. NaanDan Jain has adapted the design of a range of products and irrigation systems in order to benefit the use of this water.
The high level of nitrate in the effluent water helps to save fertilizers and cost.

PLANT DENSITY

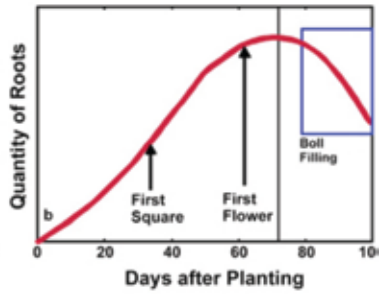
The common spacing between rows is 75–100 cm, although with some cotton crop varieties and dense planting methods, spacing between rows can be 40–50 cm.
Plant spacing within each row is 10–60 cm, according to local practices and conditions.

PLANTING AND GERMINATION

Cotton emerges the quickest from warm, moist soil (A rule of thumb for planting cotton is that the soil temperature at 10cm deep should be at least 18^0 C for 3 consecutive days, with warm temperatures in the forecast).
Low temperatures (below 15^0C) or less than adequate soil moisture may hinder germination by slowing metabolic processes. Root growth dominates the growth of the cotton plant during germination and seedling establishment. In fact, the taproot may be as deep as 25cm by the time the seed (cotyledons) emerge. This is a critical time for the development of the root system. low soil pH, water stress, and hard pans all inhibit root growth and development .
A common and recommended practice is to irrigate before planting to wet through to the expected depth of rooting. (For fertile deep soil, this is 100 cm.)



Germination and early seedling development.



Comparison of Root Quantity and Cotton Growth Stage:

Roots begin to decline after flowering as the cotton plant shifts its energy from root to boll development.

PHENOLOGY OF THE COTTON PLANT

Growth stages	Range (days)	Average (days)
Planting to emergence	5–20	10
Emergence to square	27-60	32-50
Square to first bloom	20-27	23
First bloom to peak bloom	26-45	34
Bloom to open boll		
• Early and mid-season bloom	45-65	50-58
• Late season bloom	55-85	60-70
Total growing season	120-210	150-195

(Source: El-Zik and Frisbie, 1985)

The contribution of a single fruiting structure to the overall yield of the cotton plant depends largely upon its position on the plant. First position bolls are heavier and are produced in higher quantities than bolls at any other position. In cotton populations of 9 plants per meter of row, first position bolls contribute from 66 to 75 percent of the total yield of the plant, while second position bolls contribute 18 to 21 percent.

FERTILIZERS AND FERTIGATION

The main period of fertilizer uptake by the plant is from start of flowering till the stage at which the bolls start opening.
For years, the recommended quantity of fertilizer was 100–180 kg per hectare of pure nitrogen, 20–60 kg per hectare of phosphorous and 50–80 kg per hectare of potassium. It is accepted that 60% of these quantities are used up by the time the plants are 100 days of age.
With the increase of yields through drip irrigation, it has been found that to achieve higher yields, the quantities of fertilizer should be greater.

Fertilizers quantity guide line
(Note: An NPK soil analysis is recommended before planting.)

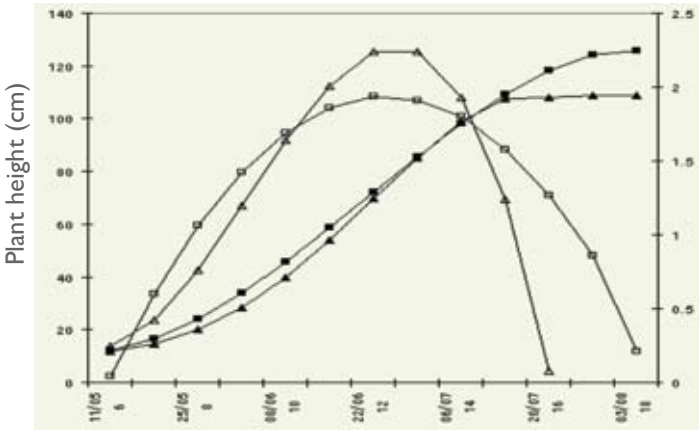
	N	P_2O_5	K_2O
Kg/Ha	300	80	200-250

Today it is common practice to apply at least 300 kg of pure nitrogen, giving 100 kg at the beginning and the rest through irrigation. Avoid excess nitrate levels at the end of the season, which can affect the defoliation before mechanical harvest. Add quantities of potassium and phosphorous according to needs indicated in soil tests.
According to another approach, best yields are achieved by fertilizing proportionally, with the limits of 25–50 ppm of nitrogen and potassium in water.

IRRIGATION MANAGEMENT

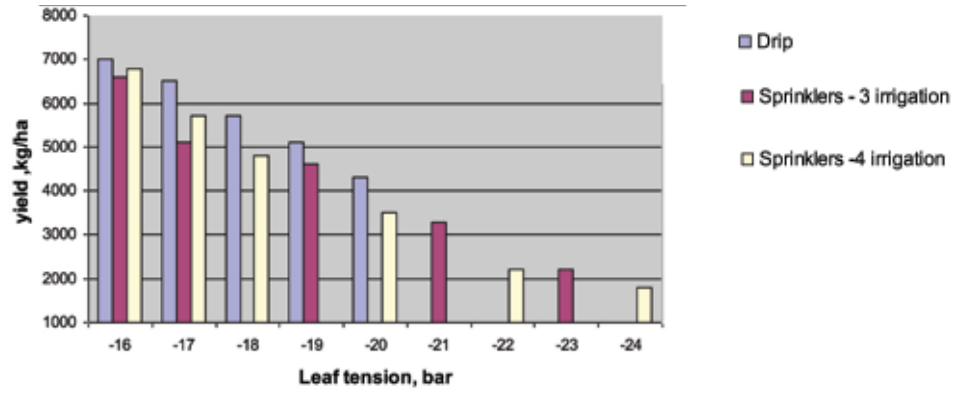
Irrigation management and scheduling methods are based on climatic conditions, the class A pan evaporation, and the vegetative model of the daily crop growth rate (daily elongation of the internodes and plant height). The target is to keep optimal ratio growth of productive parts and vegetative parts.
Too little water causes water deficit, associated with fruit-forming abscission and lower yields. On the other hand, irrigating too frequently may cause excessive vegetative growth, not associated with higher yields.
Using a "pressure chamber" (measuring the water tension in the leaf) is a practical method that aids irrigation management control.

PLANT HEIGHT AND OPTIMAL DAILY GROWTH RATE WITH 2 TYPES OF WATER QUALITY



Excessive vegetative growth

COTTON YIELDS VS. WATER LEAF POTENTIAL



CROP FACTORS* AND GROWTH PERIODS

(Note: The actual factors can vary slightly according to local variety.)

	Establishment	Vegetative growth	Blooming	Fruit set	Harvest
No. of days	15-20	25-35	60-70	30-70	15-20
Crop factor	0.4-0.5	0.7-0.8	1.05-1.2	0.8-0.9	0.65-0.7

* For calculating water quantity to be applied multiple the daily Evapo-transpiration (Et) by the crop factor.

The delay at the beginning of the first irrigation allows tilling of the soil and weeding, as well as water conservation.
The first irrigation under a drip system starts only 8–10 weeks after planting.
With certain varieties, first irrigation takes place about 7–10 days before flowering, while with other varieties, first irrigation starts when the square reaches 1–2 cm.
During this first drip irrigation, it's important to connect the wetted "onion" at a depth of 15 cm
With Pressure Chamber measurements the optimal time to start irrigation is when the water tension in the leaves is 14-18 centibars . A delay in irrigation beyond these dates lowers the yield.

IRRIGATION METHODS

The three popular irrigation methods are Furrow Irrigation, Drip and Sprinkler Irrigation. In this brochure we'll discuss the more efficient systems: drip & sprinklers.

DRIP SYSTEM

The concept of limited wetted area under a drip system leaves the cotton plant a smaller volume of soil to absorb the required minerals.
Accordingly, a continuous application of fertilizers directly to the wetted volume, through the dripper (fertigation), is essential.
The main advantage of the drip system is water saving, while increasing yields.
The positioning of the driplines is one lateral for two cotton rows.
Common row spacing is 75–100 cm.
The dripper spacing on the lateral is 50-75 cm, according to soil type and crop cycle.
Where germination solution are based on the drip system (no rain or sprinklers), one lateral per row is recommended (or a shift concept can be used).

Irrigation intervals

Common intervals between irrigation are 2-4 days depending on soil type, cotton variety and growing stage.

Subsurface irrigation (SDI)

Consideration of SDI can contribute to agro-technical advantages such as weeds control and labour saving. It is require special design and implementation practices. For more information contact NDJ local office.

NAANDANJAIN'S RANGE OF SOLUTIONS FOR DRIP IRRIGATION

PC drippers for long- run and undulating fields

AmnonDrip & TopDrip HD

1.1-2.2 l/h dripper
Operating at low pressure for energy saving
Available as hard tubing for laying and retrieving system

Thin- wall type-**TopDrip** PC/AS dripper & **TalDrip**,
for subsurface applications (SDI)
Diameter 16-23 mm

SPRINKLERS IRRIGATION

Irrigation with sprinklers is characterized by long intervals and larger water quantity per irrigation.
The seasonal water requirements of 400–500 mm (for the Mediterranean climate) is divided over 3-5 doses.
First irrigation dose should occur about 10 days before the first flower, at moisture depletion of 40-50% up to 90 cm depth. Final irrigation dose should occur at 25% open bolls.
Cotton plant growth control is done in a similar way to that used with the drip system—using a "pressure chamber" for height control and testing soil moisture with a tensiometer.


5022 SD


6025 SD


5035SD


280

NAANDANJAIN RANGE OF SOLUTIONS FOR SPRINKLER IRRIGATION

Three major solutions are available
1. IrriStand system (permanent low- pressure system) 5022SD, 6025SD (spacing up to 15 m)
2. Solid- set system with 3/4 " sprinkler 5035SD (spacing up to 20 m)
3. Supplementary irrigation with 2" gun sprinkler 280 (spacing up to 60 m)

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NaanDanJain is committed to finding the ideal solution for your cotton crop, tailored to your local climatic conditions, soil, water properties, and budget. Contact our office or your local dealer for further information.

All information should be used only as a guideline. For specific recommendations contact your local agronomist.

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