## India's Only One-Stop-Hitech Integrated Agricultural Shop

**First we help farmers to produce**


Research & Development


Agricultural Training & Guidance


Wasteland Development & Water Harvesting


Tissue Cultured Plants & High Quality Seeds


Water Well Casing & Screen Pipes


PVC, HDPE Pipes & Fittings


Drip & Sprinkler Irrigation System


Liquid & WSS Fertilizers


Bio Pesticides & Fertilizers


Green & Shed Houses

**Then we purchase fruits & vegetables**

**Finally Process them for Export**


Dehydration


Pulp, Puree & Concentrate


Domestic Market

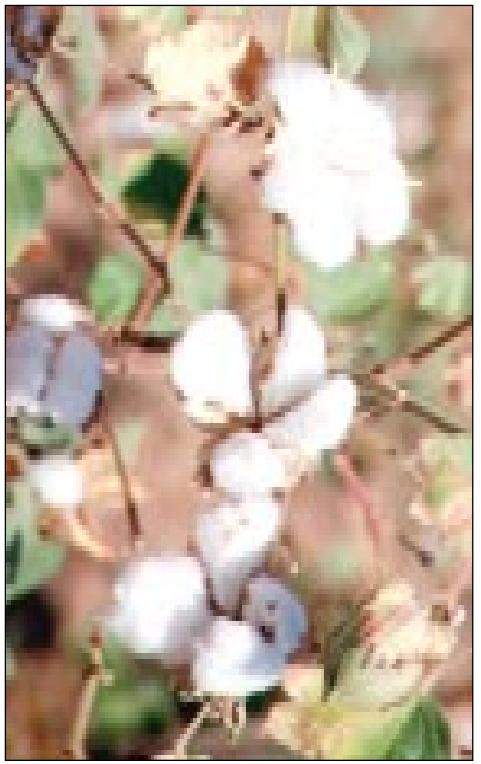

Export Market


**Jain Irrigation Systems Ltd.**
Jain Plastic Park, N. H. No.6, P. O. Box 72, Jalgaon - 425 001.
Tel : 0257-250011/22, Fax: 0257-251111/22, Tlx : 0753 254 JISL IN,
E-mail: PlasticPark@jains.com, Internet: http://www.jains.com


3/BANANABK/222000/SVJ

Jain Pipes | Jain Drip | Jain Sprinklers | Jain Liquid Fertilizer | Jain Tissue-Culture | Jain Green-Houses | Jain Valves | Jain Solar

# COTTON AND MICRO IRRIGATION



**Jain Irrigation Systems Ltd.**
Jalgaon

*पाणी हेच जीवन ...* | *Water is life...* | *जल ही जीवन...*

# CONTENTS*



***Disclaimer :** The package of practices given in this booklet is based on limited experimental data and need not be applicable to all cotton growing areas. Therefore, the company does not guarantee the production levels mentioned here in every location where the package is adopted.

# COMMUNICATION CHANNEL


Visit us at : http://www.jains.com

**Plants:**

**Jalgaon**
**Jain Plastic Park**
Tel: 0257-250011/22,
Fax: 0257-251111/22,
Tlx: 0753 -254 JISL IN,
0753 -201 JAIN IN,
Cable: JAIN DRIP,
E-mail: PlasticPark@jains.com
**Jain Agri Park, Jain Hills**
Tel: 0257-260011/22,
Fax: 0257-261111/22,
Tlx: 0753-210 JPCL IN,
Cable: JAIN DRIP.
E-mail: AgriPark@jains.com
**Jain Food Park, Jain Valley**
Tel: 0257-260033/44,
Fax: 0257-261144,
Tlx: 0753-255 JAIN IN,
Cable: JAINS.
E-mail: FoodPark@jains.com
**Khammam** (Granite Plant)
Tel: 08742-25626, 26269,
Fax : 08742-24688, 26265,
Tlx: 08201-203 GGPL IN.
E-mail:ggl_khm_kmm@sol.net.in
**Sendhwa** (Pipe Plant)
Tel: 07281-22325/24,
Tlx: 0735-6407 JPCL IN,
Cable: JAINS.

**Offices :**

**Ahmedabad**
Tel: 079-6421704, 6421612,
5711388 (Godown),
Fax: 079-6421612,
Tlx: 0121-6176 JISL IN.
**Ahmednagar**
Tel: 0241- 355780,
(Godown) 550169, 357120,
Tlx: 0143-225 JAIN IN,
Cable: JAIN PIPE.
**Amravati**
Tel: 0721-671486, 674737,
Fax: 0721-670363(PP),
Tlx: 0721-233 JAIN IN,
Cable: JAIN DRIP.
**Anantpur**
Tel: 08554-24866(R)
**Aurangabad**
Tel: 0240-335482,
Fax: 0240-336122 PP,
Tlx: 0745 377 JAIN IN,
E-mail:JainAurangabad@vsnl.com
**Bangalore**
Tel: 080-5361257,
Fax: 080-5548921.
E-mail: Kataria@bgl.vsnl.net.in
**Baramati**
Tel: 02112-43302.
**Baroda**
Tel: 0265-398107,
Fax: 0265-3987078 PP.
**Chennai**
Tel: 044-6440332, 6444388,
Fax: 044-6443879,
Tlx: 041-24038 JPCL IN.
**Davangere**
Tel.: 08192-61938,
Fax: 08192-54797 PP
**Hyderabad**
Tel: 040-3240835, 3242814,
3234816, Fax:040-3231849,
Tlx: 0425-2221 UBAS IN,
Cable: UBAS,
E-mail:Supvsr@O3ubas.icnet.vsnb.in
**Indore**
Tel: 0731-513189, 286011,
Fax: 266011/365589(Godown),
Tlx: 0735-6407 JPCL IN,
Cable: JAIN PIPE.
E-mail: jainindr@bom4.vsnl.net.in
**Jabalpur**
Tel: 0761-320467, 310968,
Fax: 324415, Cable: JAIN PIPE.
**Jaipur**
Tel: 0141-379401,
Fax: 0141-365739,
Tlx: 0365-2167 RAVI IN.
E-mail: prakashj@datainfosys.net
**Jain Shop - Jalgaon**
Tel: 0257-220077/8/9/80,
Fax: 0257-221177, Cable: JAINS.
E-mail: jisl@jains.com
**Jain Showroom - Jalgaon**
Tel: 0257-220066, Cable:Jains,
E-mail: jisl@jains.com
**Mumbai** (Corporate Office)
Tel: 022-2610011, 2620011, 670011,
Fax: 022-2621177, 2641177,
Cable: Papain Expo,
Tlx: 011-82521 JAIN IN,
E-mail: JainMumbai@jains.com
**Nagpur**
Tel: 0712-521096,
Fax: 0712-528145,
Tlx: 0715-7456 NBC IN
**Nanded**
Tel: 02462-74046,
Fax: 32640,
Tlx: 07901-222 JAIN IN,
Cable: JAIN PIPE.
**Nasik**
Tel & Fax : 0253-592718, 590915.
Cable: JAIN DRIP.
Tlx: 0752-223 JAIN IN
**New Delhi**
Telfax: 011- 6466065,
Tlx: 031-71186 JPCL IN,
Cable:SAVE WATER,
E-mail: jisldel@ndb.vsnl.net.in
**Ongole**
Tel: 08592-34025.
**Palakkad**
Tel.: 0491-540425, 533178 PP
E-mail: lnkumaragy@mcdecom.net
**Pandharpur**
Tel: 02186-22631 PP.
**Pune**
Tel: 020-5434872,
Fax: 020-5434873,
Tlx: 0145-7701 JAIN IN.
**Sangli**
Tel: 0233-333477, 332194,
Fax: 0233-332194,
Tlx: 0193-217 JAIN IN,
Cable: PAPAIN EXPO.
**Solapur**
Tel: 0217-57220,
Fax: 0217-314442 PP,
Tlx: 0795-245 JISL IN.
**Thane**
Tel: 022-5412757/5412758,
Fax: 022-5412758.

# Jain Group

From a very humble beginning in 1963 as a Trading Company, Jain Group has blossomed into an Agriculture Infrastructure company, second to none in the Country, by the sheer dint of invincible determination and dedication of a **Great Visionary Shri. Bhavarlal Hiralal Jain, the Founder Chairman of the Group, who has appropriately been awarded the "CRAWFORD REID MEMORIAL AWARD" by the IRRIGATION ASSOCIATION of USA,** for his significant achievements in promoting proper Irrigation Techniques and fostering major advancements in the Industry outside the United States.

Jain Irrigation Systems Ltd., the flagship company of the Group, is the pioneer and market leader in Micro Irrigation industry in the country and has covered over 4.5 lakhs acres of land under Drip Irrigation with over 45 different crops.

Jain Irrigation Systems Ltd., extended its activities into hi-tech agro related ventures like Tissue Culture Plants, Green House Construction, Water Soluble Solid/liquid fertilizers, Bio-pesticides and Bio-fertilizers. Conservation being the main thrust in the Company's activities, it went into the manufacture of Solar Water heating system as well as Eco-friendly PVC door/window profiles and PVC/Polycarbonate/ Acrylic sheets for various applications replacing wood.

As a forward integration, Jain Group, diversified into food processing and have two state-of-the-art plants with a capacity of 120 MT each per day(the largest in Asia) for processing vegetables and fruits. Jain Irrigation Systems Ltd., is the only company in the country to have a Research and Development farm spanning over 1000 acres of land which is the only one of its kind recognized by the Govt. of India in Private Sector for agriculture related activities and experiments on various agronomic and irrigation practices in line with International Practices.

The Company's main thrust is to totally modernize the Irrigation application practices in India with a view to improve the Quality, Production, Conservation and also to find a niche in the world export market for the Indian produce. With this in mind**, the Company today, is totally equipped to develop, virtually from Concept to Commissioning of Agro Irrigation Projects on any type and size of land anywhere within the Country or abroad, taking up the jobs on a turnkey basis to complete and hand over on a time bound schedule.**

**THE MISSION IS TO LEAVE THIS WORLD BETTER THAN WE FOUND IT.**

**STATUS**

Cotton is the most important plant fibre and is used for many purposes, but especially for clothing. Cotton, in a way, is a gift of Indian sub-continent to human civilization. India is growing cotton and manufacturing yarns and cloth from the very olden days. India was also a big exporter in cotton as early as 2500 years ago. Even today despite keen competition from advanced countries (USA,Egypt), Indian cotton textiles are highly valued for their beauty, durability and quality.

Cotton cultivation, its trade, processing, manufacture, export of raw cotton and cotton textile goods and cotton seed oil provide means of livelihood to an estimated 60 million people in India. Areawise India ranks top in the world having largest acreage of about 7.6 million hectares.

**WORLD COTTON STATISTICS 1997 - 98.**

| Country | Production Million (Mt) | Consumption Million(Mt) |
|---|---|---|
| India | 2.6 | 2.85 |
| China | 4.4 | 4.8 |
| U.S.A. | 4.12 | 2.5 |
| Russia | N.A | N.A |
| Pakistan | 1.53 | 1.50 |
| Brazil | N.A | 0.75 |
| World | 19.89 | 19.49 |

*(Source : International cotton advisory committee)*

**STATEWISE COTTON AREA, OUTPUT AND YIELD 1997-98.**

| State | Area 000 ha | Production 000 bales | Average lint yield Kg/ha. |
|---|---|---|---|
| Maharashtra | 3139 | 1753 | 95 |
| Gujarat | 1479 | 2758 | 317 |
| Andhra Pradesh | 898 | 1300 | 246 |
| Punjab | 727 | 941 | 220 |
| Madhya Pradesh | 517 | 932 | 306 |
| Karnataka | 518 | 985 | 323 |
| Haryana | 638 | 1129 | 301 |
| Rajasthan | 645 | 867 | 229 |
| Tamilnadu | 248 | 402 | 276 |
| Others | 54 | 780 | 246 |
| Total | 8863 | 11145 | 214 |

*(Source :- Ministry of Agriculture)*

**COTTON GROWING ZONES IN INDIA**

Cotton is divided into four major groups i.e. Arboreum, Herbaceum, Hirsutam and Barbedense.

1. Northern Hirsutam region

   Comprising Punjab, Haryana, Rajasthan and part of UP accounts for 25% of cotton growing area producing 30% of the national output. The average productivity of cotton in this region is high ranging from 250-300 Kg Lint/ha. This is a predominantly irrigated cotton area.

2. The Central Hirsutam - arboreum - herbaceum region

   This includes mainly Gujarat, Maharashtra and MP, with 58% of the area and 49% of the national production. This region produces predominantly rainfed cotton, but increasingly being brought under irrigation. The productivity ranges from 100 - 315 Kg lint/ha.

3. The Southern Hirsutam - Barbedense region

   Comprising of AP, Karnataka, and Tamilnadu. This region accounts for 19% of the area and 24% of the production with 282 Kg lint/ha productivity.

**CONSTRAINTS FOR COTTON PRODUCTION IN INDIA**

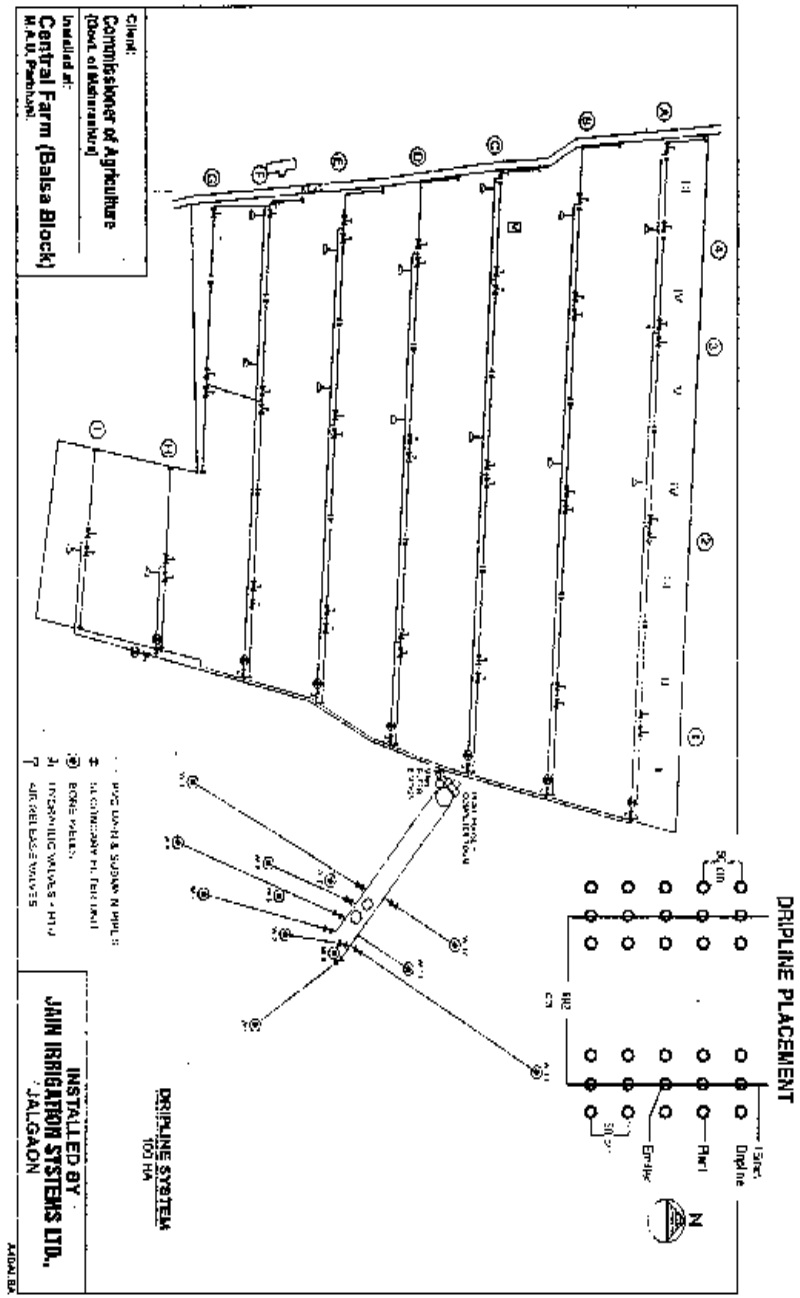
India has the highest acreage of cotton in the world but very low lint yield per hectare. In India, more than 70% of the area of cotton is without irrigation. In addition to irrigation, following are some constraints in increasing production of cotton in India.

- Limited area under irrigation
- Inefficient irrigation practices. (Poor Water management)
- Poor seed quality and non-availability of improved and hybrid varieties of seed.
- Poor agronomical practices.
- Heavy pest and diseases (plant protection techniques).
- Lack of extension education.
- Imbalanced nutrition of crop.

Among the various constraints quoted above poor and inefficient water management, improper plant protection and poor fertigation practices contributes more.

**AREA UNDER IRRIGATED COTTON IN INDIA**

| Year | Total area Million ha | Irrigated area Million ha | % area irrigated |
|---|---|---|---|
| 1951-52 | 6.56 | 0.58 | 09.00 |
| 1956-57 | 8.05 | 0.93 | 12.00 |
| 1961-62 | 7.72 | 1.08 | 14.00 |
| 1966-67 | 7.83 | 1.23 | 16.00 |
| 1971-72 | 7.78 | 1.95 | 25.00 |
| 1980-81 | 7.82 | 2.10 | 27.00 |
| 1987-88 | 6.40 | 2.10 | 33.00 |
| 1991-92 | 7.70 | 2.60 | 33.10 |
| 1992-93 | 8.00 | 2.70 | 33.20 |




Field layout of the Automated Drip Irrigation System



## CLIMATE

Seventy percent cotton is rainfed. Cotton is grown on rainfall varying from 500 to 1000 mm with high degree of fluctuations of temperature during the growth phase. Temperature between 25 to $30^0$C is favourable for better growth. Clear sunshine & proper moisture level during boll formation is required. Moisture stress from 60 days to 120 days directly reduces the yield. More sunshine and warm humid climate favours the growth of the crop. Low temperature at boll opening creates problem in harvest.

## SOIL

Irrigated cotton should be grown on medium black to deep black soil having pH range between 6 to 8. Saline soils are not suitable for cotton cultivation. Soil should have proper drainage. The depth of soil should not be less than 20 to 25 cm.

## SOIL PREPARATION

The preparation of good flat bed is very important. This can be done by ploughing & disc harrowing. Ploughing should be followed by harrowing operation making the fine til soil particle. For advanced method of drip irrigation soil should be well prepared. Add 4 to 5 tons of well decomposed FYM or compost before last harrowing. In the soils having termites or whitegrub, add 750 to 1000 Kg/ha of Neem cake along with FYM.

## CROP ROTATION

Cotton should be followed by crops like hybrid sorghum, sugarcane, maize, banana etc. Cotton should not be followed by cotton as it increases the pest and disease problems.

## IMPROVED AND HYBRID VARIETIES OF COTTON

For irrigated cotton the varieties from G. hirsutam species should be preferred. Also hybrids of Hirsutam x Hirsutam or Hirsutam x Barbadense may be preferred. There are number of varieties that are recommended for growing in India.

Regionwise they are,

a) Northern Region : LH1134, LH1556, H-4, H-6, MECH-1 etc.

b) Central Region : H-4, JKHY-1, H-6, PKV HY-2, NHH-44, MECH-1, SHAKTINATH, RCH-2

c) Southern Region : DCH-32, Varlaxmi, Savita, Suvin, HB224, MCU5 etc.

**SEEDS**

Only certified and tested seeds should be used for irrigated cotton. Delinted seed is preferred. 2.5 to 3 Kg seed per hectare should be used. Seed should be treated with Thiram or Bavistin. Extra seeds should be utilised for gap filling. Raise the seedling for gap filling in polybags. Fill the gaps during rainy season. Plant population between 7 to 8 thousands per hectare is optimum.

**SPACING**

Under Micro Irrigation (MIS) Crop geometry may vary to economise the drip system (Fig 1). However optimum population per hectare of irrigated hybrid varieties is considered between 7000 to 8000 per hectare.

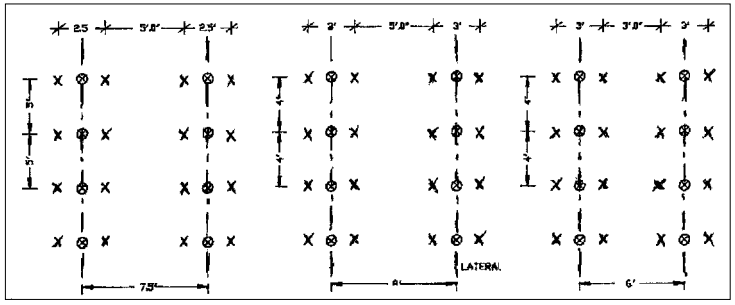



**Fig.1 - Different Planting Spacing**

Considering the soil type & varietal characters, spacing in pair row planting can be 2.5' x 5' x 5' or 3' x 4' x 3'. Spacing of 4' x 3' (Heavy Soil) & 3' x 3' (Medium Soil) are adopted in Single row system.

**PLANTING SEASON / TIME**

Irrigated cotton should be planted before the onset of monsoon so that desired vegetative growth of the plant is achieved. Planting season varies in various regions.



While designing the fullautomatic drip irrigation system for cotton at Parbhani the following technical points were taken into consideration,

1. Daily water requirement of cotton and total irrigated area.
2. Requirement, availability, use and management of irrigation water
3. Soil type and topography.
4. Drip system which is fully controlled thru computers. The irrigation project was launched at Central Balsa Farm, Marathwada Agriculture University, Parbhani after studying the above points.

   Water was collected in a storage tank of 5 lac litres capacity from 11 tubewells present within a range of 1 Km from the Central Balsa Farm. In the room adjacent to the three 50 H.P. tank, H.P. motors installed. At a time 2 pumps supply 2.5 lac liters per hour thru the computer control panel to the auto backflush 250 $m^3$ capacity filter. At his point 2 fertilizer injection pumps, quick pressure relif valve and hydrometers are installed.

   The whole area is connected with a network of Jain PVC Pipes. In this Main lines of 225 mm - 90mm and 6 $Kg/Cm^2$ pressure are laid out 4 feet deep. For submains 90mm, 4 $Kg/Cm^2$ pipes were laid down at 3 feet depth.

   100 Hectare area is divided into 18 blocks and each block is given one Jain Screen Filter for safety.

   Each submain in the block is provided with twin head hydraulic valves with Radio

## CASE HISTORY OF A COMPUTERISED AUTOMATIC DRIP IRRIGATION PROJECT

| | | | |
|---|---|---|---|
| 1. | Customer | : | Commissioner of Ariculture, Pune. (Govt. of Maharashtra) |
| 2. | Site | : | Balsa Farm, Maharashtra Krishi Vidyapeeth, Prabhani. |
| 3. | Consultant | : | Agriculture Development Company (International) Ltd., (Agridev.), Isreal. |
| 4. | Contractor | : | Jain Irrigation Systems Ltd., Jalgaon. |
| 5. | Area | : | 100 ha. (247 Acres) Cotton. |
| 6. | Cost | : | Rs. 77250/- per hectare (Turn-key basis) |
| 7. | Row spacing | : | 1.92 m. |
| 8. | Soil | : | Black Soil (Heavy) |
| 9. | Water Source | : | Water received from 11 tube wells stored in a tank of 5 Lac litres. |
| 10. | Irrigation Systems | : | Fully automatic computerised Jain Irrigation System. |
| 11. | Area of one Plot | : | 25 Acre. |
| 12. | Area under one submain | : | 5.8 Acre. |
| 13. | Sequence & Time to complete | : | 10 x 2 = 20 Hours/day. |
| 14. | Irrigation Water required | : | Minimum 50 Lac litres / day. |
| 15. | Lateral | : | 16mm dripper line (1mm thickness) |
| 16. | Dripper spacking and flow | : | 0.50 m. and 2.2 Litres / Hour (at 1 Kg/Cm$^2$ Pressure) |
| 17. | Lateral Spacing | : | 1.92 m. |
| 18. | Lenght of Dripper Line | : | 75 m at one side of submain. |
| 19. | Main Pipe | : | Jain PVC Pipe 225, 180, 160, 140 and 90mm (6 Kg/Cm$^2$) |
| 20. | Main Filter Unit | : | Fully automatic with backwash (Spinklin) Capacity - 2.5 Lac Litres/Hour. |
| 21. | At the beginning quick pressure relief valve, hydrometers, twin head hydraulic valves and air release valves. | | |
| 22. | Auto System | : | Central computer control - Motorola. |



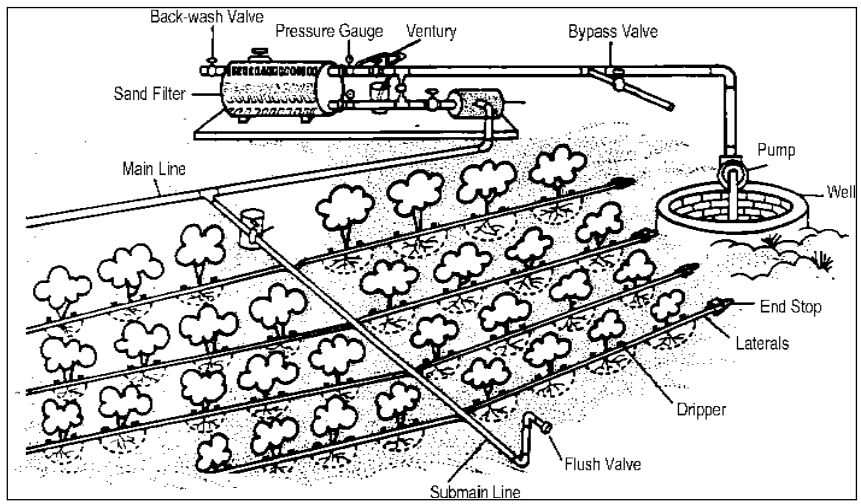
1) Central Zone : Mid May to 1st week June sowing.
2) Northern Zone : April - May sowing.
3) Southern Zone : Grown in 3 seasons, Kharif (June-July), Rabi (Sept-Oct.), and Summer (Jan-Feb) sowing.

Planting time has high importance in irrigated cotton cultivation. Delayed planting reduces the yield (20-25%). The crop suffers from pest attack as well. Importance of timely sowing has been successfully proved in various Agricultural Universities in India. More detailed work has been carried out on this aspect. The above sowing dates have been recommended.

## IRRIGATION

### What is Micro / Drip Irrigation ?

Micro / Drip Irrigation is described as regulated and show application of irrigation water through emitters or orifices at frequent intervals near the rootzone of plant, over a longer period of time.




**Jain Drip System Layout**

### Principles of Micro / Drip Irrigation

Micro / Drip irrigation is the term used to describe the method of irrigation which is characterised by the following features.

1. Water is applied at a low rate
2. Water is applied over a long period of time.
3. Water is applied at frequent intervals.
4. Water is applied via a low pressure delivery system.

**ADVANTAGES OF DRIP IRRIGATION**

1. Drip Irrigation increases yield of cotton. On an all India basis an yield increase of 27% is recorded (INCID,1994). There are individual farmers cases where yield was doubled by drip irrigation when compared to the yield obtained under furrow / flood irrigation methods.

   Research into the reasons for such yield increases under drip systems has shown that - yield increases as the interval between water application is decreased even if the total amount of water applied is unchanged. During heavy fruiting mild water stress associated with intermittent irrigations triggered deterioration of the root system which is irreversible. Only high frequency, low intensity drip irrigation can prevent such cyclic water stress.

2. Drip irrigation makes it possible to grow cotton in all types of soils. Even in a light or shallow soil in which water storage is inadequate to supply the crop over an extended irrigation cycle as is the case with furrow or flood irrigation, drip irrigation provides an opportunity to raise good, high yielding cotton crop.

3. Because it eliminates intermittent water stress, drip irrigation allows the crop to approach its production potential for more days of the season thus resulting in higher yields.

4. Drip irrigation is suitable in any type of land / soil management system - flat, ridge and furrow, and bed and furrow systems.

5. Early planting and establishment of cotton crop is important as part of IPM and for high yields. Drip irrigation proves to be a boon in such situations, especially when the monsoon plays truant.

6. Drip irrigation helps in taking up a summer crop of cotton in Tamil Nadu, even



| | | |
|---|---|---|
| 13. Insecticide spray | : | 12 spray Endosulphan<br>+ Rogor - 50 ml each<br>- Monocil + Ripcard - 40 + 30 ml<br>- Sevin - 30 gm in 16 l of water<br>- Metasystox 40 ml in 15 l of water<br>- Cyambush 10 ml in 15 l of water |
| 14. Other chemical | : | Plantozyme (9 spray) @ 15 ml for 10 l of water |
| 15. Date of 1st picking started | : | Oct. 1st week |
| 16. Irrigation schedule (daily) | : | May - 2 hrs, June - 2 hrs, ( 8 l /m / day)<br>July to Sept. - 2 hrs per day plus whenever no rains for a week period, i.e. 8 l /m/day |
| 17. Avg. No. of Bolls / plant | : | 200 |
| 18. Avg. wt. of bolls | : | raw cotton 7gm |
| 19. Height of plant | : | 5' |
| 20. Yield obtained (Qt./Acre) | : | 19 |
| 21. Avg. Price (Rs./Qtls) | : | 2000/- |
| 22. Total gross income (20x21) | : | 38000/- per acre or (1,90,000 for 5 acres) |

**[III] Advantages of drip irrigation observed by farmer**

| | | |
|---|---|---|
| 01. Increase in yield | : | 100 % (including ratoon crop) |
| 02. Water saving | : | 70% |
| 03. Fertilizer cost saving | : | 50% |
| 04. Pesticide cost saving | : | Not observed |
| 05. Labour saving | : | 60% |
| 06. Quality of product | : | Superior than other cotton fields |
| 07. Maturity | : | Early by 15 days |
| 08. General yield level | : | 10 qtls / acre under flood irrigation |

The 1,90,000 gross income easily covers for the cost of drip installation in the first season itself.

## CASE STUDY OF COTTON CROP GROWN UNDER

## DRIP IRRIGATION SYSTEMS IN MAHARASHTRA STATE (1995-96)

**[I] Primary Information**

| | | |
|---|---|---|
| 01. | Name of farmer & address | : Shri Pralhad Deoram Sapkale<br>At Post-Karanj, Tal & Dist- Jalgaon. |
| 02. | Total Area | : 50 acre |
| 03. | Irrigated land | : 50 acre |
| 04. | Source of Irrigation | : open wells |
| 05. | No. of wells & pumps details | : 2 open wells, 1st well - 15 HP<br>& 2nd well - 25 HP |
| 06. | General cropping pattern | : Cotton, Jawar, Bajra, Wheat |

**[II] Crop Details (Under Drip Irrigation)**

| | | |
|---|---|---|
| 01. | Season & date of planting | : Kharif - 25/05/95 |
| 02. | Area | : 5 acre |
| 03. | Variety | : RCH - 2 |
| 04. | Spacing | : 5' x 5' |
| 05. | Plant Population | : 1742/acre |
| 06. | Seed rate | : 450 gm/acre |
| 07. | Details of drip irrigation<br>date of installation | : lateral 12mm at every 5' & 1<br>dripper or 4 LPH / plant |
| 08. | Cost of system | : Rs.90,000/- for 5 acres |
| 09. | System supplied by | : Directly from company, JISL |
| 10. | Soil type | : Heavy clay soil |
| 11. | Fertilizer used, doses & time | : 23:23:0 - 300 kg (30 days) for total area<br>19:19:19 - 300 kg (60 days) for total area<br>8:8:8 - 600 kg (70 days onward) |
| 12. | No. of weeding & | : 2 weeding & 2 hoeing<br>interculture operation |



in the water scarce southern districts, because the use of drip saves water upto 53% as compared to any other method of irrigation.

7. It is now an accepted fact that drip system of irrigation increses yield of the crop and reduces water used by the crop thus resulting in higher water use efficiency. Alongwith the use of drips for irrigation, if fertigation is also done through the drip system, the efficiency of fertiliser use will enhance both by the saving of fertiliser and by virtue of higher yields. Plant nutrients are applied near the rootzone in very small quantities along with water. This eliminates losses of nutrients due to extraneous forces as it happens in the broadcasting method of fertiliser application. Application through drip system saves 35% on the cost of fertiliser also.
8. Drip irrigation results in early and uniform maturity of the crop and improved quality of kapas.
9. Because of the uniform distribution of water to each plant in the field the growth of plants will be more uniform.
10. Application of water close to the rootzone keeps weed growth under control. It also reduces the incidence of pests and diseases as the foliage is not wetted and the dry canopy conditions are maintained.

**Jain Drip System on Cotton**

**Installation of Drip Irrigation**

After careful survey, design the system for cotton either in paired row planting method or alternate row system whichever is feasible, economical & acceptable to the farmer. Various types of emission devices like a) On line drippers b) In line drippers or c) Line source tubing can be used.

System should be installed well before appropriate planting time so that the crop can be grown on drip method from the beginning.

Cotton production system all over the world is divided into dryland rainfed or irrigated with supplementary or full irrigation. Rainfed is defined as cotton which is grown where rains are common throughout the season. Water relations of cotton were reviewed by Jordan (1983) & by Bielorai et al. (1983). The average quantity of water used by the plant during the season can vary between 750 mm to 1200 mm for irrigated cotton, including rainfall. However the hybrids having maturity of 6-8 months require 900-1000 mm. Though comsumption is different in different areas depending on climatological factors, the water used during the growing season follows similar trend in all locations. Evapotranspiration is low early in the season where the plant is small and the root system is shallow. The roots usually penetrate the soil into about 2 meters under unrestricted conditions. Root penetration is often limited by the depth of the soil wetting. Under favourable moisture conditions root growth 1-2 cm per day as seen in the figure (Fig 2).

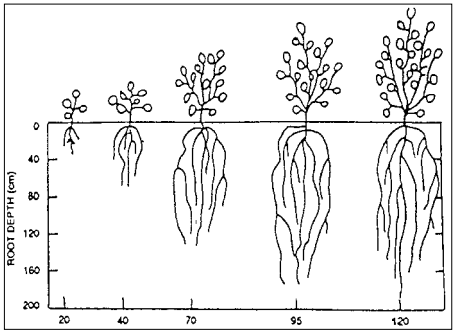



**Fig.2 - Root dimensions and depths at different stages of growth**



use of pesticides, economically high yields are obtained.

The cultural methods are - removal of cotton plant residue from the field at harvest, deep ploughing in the summer to expose hibernating pupae / larvae early sowing of cotton, uniform timing of sowing in one zone and use of a single variety (maturity uniformity) over the entire area of the zone etc. Mechanical means include collection and destruction of eggmasses (e.g. Spodoptera sp.)

**PICKING & STORAGE**

Cotton can be harvested in total 4 to 5 pickings depending on the variety & climate. Start the picking when 40-50 % bolls are open. Pick the cotton from fully matured & completely open bolls. Picking should be done in the morning time and cotton should be stored in open air space.

**YIELD**

Yield depends on the management practices with the adoption of advance technology for growing cotton. Cotton crop can give 50-60 quintal/ha yield of kapas under drip irrigation.

In addition to the major nutrients 3 - 4 foliar applications of magnesium, sulphur, boron, iron, zinc will increase the yield.

**PLANT PROTECTION**

Cotton is highly susceptible to a number of pests & diseases. Pest & disease problem can greatly reduce the crop yield. Hence proper knowledge of pest, identification of pest and pesticides to be used is required. The various pest that infest the crop from the seedling till harvest are (a) Sucking Pests (Jassids, Aphids, Thrips, Whiteflies, Mites), (b) Leaf eating caterpillers (Semiloopers, leaf rollers, leaf chewing caterpillers), (c) bollworms (Pink, spotted and American bollworms) and (d) Cotton bugs (dusky cotton bugs, red cotton bug).

Amongst diseases black arm, anthracnose, alternaria & boll rot are commonly observed in cotton. For effective plant protection, following schedule may be followed;

| Stage of crop | Pest & Diseases | Pesticides to be used |
|---|---|---|
| At planting | Sucking pest | Phorate or any systemic granular pesticide to be used @ 10 kg/ha. |
| 15-20 days | Jassids, white flies spotted bollworm leaf spot | Monocrotophos or Carbaryl orQuinolphos + Copper Oxychloride (COC) |
| 30-45 days | Jassids, Bollworm (spotted), Leaf spot | Monocrotophos or Carbaryl or any Pyrethroid group insecticide + C O C. |
| After 60 days | Spotted bollworm American bollworm & leaf eating caterpiller | Monocrotophos or Endosulphan or insecticide from Pyrethroid group spray for 2-3 time as per the incidence. |
| 75-90 days | As above | As above |
| 90-100 days | White flies, Jassids Pink Bollworms, red cotton bugs | Use Acephate for white fly. Mix it with above chemicals. |

Integrated pest management (IPM) principles have to be followed for sustained and successful management of pests of cotton. This involves pest surveillance, using insect traps or pheromone traps; use of biological agents for control (like trichogramma) and use of biopesticides (like Nuclear polyhedrosis virus or Bt gene) in appropriate combination or rotation with chemical pesticides. Additionally, cultural and mechanical means of control should be adopted so that with minimum



The rate of vegetative development is low in early growth periods until flowering, then it becomes considerably faster. Cotton normally needs good moisture supply during flowering & boll setting. Excess moisture during the early stage of development results in excessive vegetative growth at the expense of reproductive growth. This generally happens in flood or furrow methods of irrigation. Required & precise quantity of irrigation as per the growth phase is possible only with drip irrigation. During the phase of flowering & boll setting cotton is sensitive to water deficit, moisture content should not be allowed to drop below 20-30% of available water in the main root zone. Results of many experiments have shown (Shalhevet et al. 1981) that 70-80% of the water is removed by cotton from a soil depth of 90 cm. Therefore it is recommended in cotton to wet not more than 60-90 cm of the soil depth. This again is best possible under drip irrigation.

Estimated water requirement for cotton is given below.

**A) Pair Row Planting (3' X 5' X 5')**

Lateral to lateral distance - 8' (2.43 m) (May planting)

| Month | Water/day/meter length (l) |
|---|---|
| May (planting) | Germination irrigation by running drip system for 12-24 hrs. |
| May | 8 |
| June | 7 |
| July | 6 |
| August | 6 |
| September | 6 |
| October | 10 |
| November | 9 |
| December | 9 |

**B) Single row method - 4' x 3' Spacing**

| Month | Water/day/meter length (l) |
|---|---|
| May | 5 - 6 |
| June | 4 - 5 |
| July | 4 - 5 |
| August | 4 - 5 |
| September | 5 - 6 |
| October | 6 - 7 |
| November | 6 |
| December | 6 |

These values are given as guidelines only. They will vary from area to area and with different spacings.

## INTERCULTIVATION

Timely weeding or use of weedicide will minimise the weed population. If soil preparation is properly done before sowing, then intercultivation with hoeing etc. should be minimum in drip irrigation. In pair row planting interspace between two pair rows can be intercultivated by small implements. Mulching can be done in irrigated cotton.

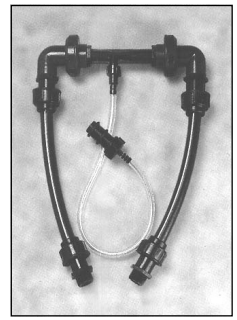
## FERTILISER DOSES AND FERTIGATION

The application of major nutrients like N, P, K and trace elements like iron, boron, magnesium, sulphur, zinc plays a vital role in cotton production. Balanced and timely application K gives better result. Though cotton does not appear to be an exhaustive crop, when grown intensively, high yielding varieties need abundant supply of available nutrients. Nitrogen, Phosphorus, Potassium and Magnesium are the major nutrients essential for cotton. In India, experiment data reveals that on an average 100 - 125 Kg N, 60 - 75 Kg of P2 O5, 80 Kg of K2O per hectare are recommended. However, it is always advisable to calculate the N, P, K doses after soil analysis report. Under traditional fertilizer application, the entire dose of P & K are added as basal dose and Nitrogen into 3 - 4 split doses. Traditional fertilizer is to be placed well deep into 4 - 5 cm, below the soil near wetted area of the dripper.

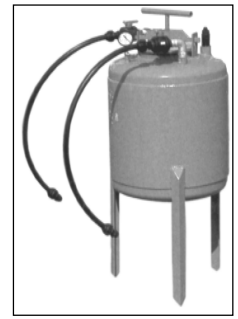


## FERTIGATION

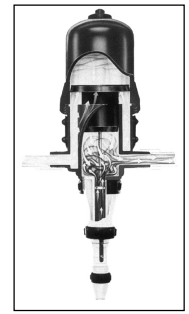
Fertigation is a recent technology in fertilizer application. Total soluble fertilizer grades or liquid grades are passed through system daily, alternate day or weekly. This improves uptake efficiency of fertilizer. Jain Irrigation have introduced various types of liquid & water soluble solid (WSS) grades to be injected through the drip system. Ventury, Fertilizer Tank and Fertigation pump are the different fertigation equipments.



**Ventury**



**Fertilizer Tank**



**Injector pump**

Following grades can be recommended for optimum yield.

**DOSES OF LIQUID FERTILIZER / ha**

| Period of Application (Days) | Grade to be used | Qty. required per ha/day (Kg) |
|---|---|---|
| 5 - 30 | 6 :12 : 6 | 25.000 |
| 31 - 60 | 12 : 0 : 12 | 13.750 |
| 61 - 100 | Urea | 2.250 |

**DOSES OF WATER SOLUBLE FERTILIZER / ha.**
**Dose - 120 : 60 : 70**

| Period of Application (Days) | Grade to be used | Qty. required per ha/day (Kg) |
|---|---|---|
| 5 - 30 | 18 : 44 : 0<br>+<br>13 : 0 : 46 | 4.500<br>+<br>3.250 |
| 31 - 60 | 19 : 19 : 19 | 4.400 |
| 61 - 100 | 13 : 0 : 46<br>+<br>Urea | 1.400<br>+<br>1.750 |