Precision Farming
BANANA
With Jain Technology™

Jain Irrigation Systems Ltd.
Small Ideas. Big Revolutions.®

Banana is one of the most important fruit crops grown in India. The banana culture in India is as old as our civilization. Bananas were grown in Southern Asia even before the prehistoric periods and the world's largest diversity in banana population is found in this area. It is generally agreed that all the edible bananas and plantains are indigenous to the warm, moist regions of tropical Asia comprising the regions of India, Burma, Thailand and Indo China. India leads the world in banana production with an annual output of about 16,820 thousand M.T. from 680,000 ha. Within India, Tamil Nadu leads in total area and production with 2514729t from 71088 ha.

The productivity is very low, the National average is 14t/ac when a high-tech yield of 50 t/ac is possible.

Habit of the Plant

Banana is an annual crop that can be ratooned by judicious selection of suckers and maintaining a follower crop. Under drip irrigation two ratoons can be taken for every fresh planting. The advent of Tissue Culture generated planting material has revolutionized banana cultivation.

Climatic Requirement of Banana

Banana is a humid tropical plant growing well in a temperature range of 10 to 40 °C. Low temperatures during flower emergence can be a problem. It grows up to an altitude of 1500m. Wind velocity of more than 80 kmph will damage the crop especially at the bearing stage. An average rainfall of 100mm per month is good for the crop.

State	Latitude	Temp °N	Region °C	Rainfall (cm)
Andhra Pradesh	16-18	16-43	Coastal	100
			Telangana	81
			Rayalaseema	68
Assam	25-27	16-38	-	252
Bihar	22-25	10-46	-	137
Karnataka	14-28	13-18	Coastal	326
			South	124
			North	69
Kerala	10-14	16-38	-	301
Maharashtra	19-22	13-41	-	92
Tamil Nadu	10-12	16-41	-	102
Uttar Pradesh	25-28	7-43	East	102
			West	96

Soil Management

Banana can be grown in all types of soil that have good water holding capacity. Ill drained and poorly aerated soils are not suitable. Soil should be at least 1m in depth. Soil pH should be less than 8.0. In slightly alkaline soils (pH 7.5 to 8.0) banana wilt disease does not occur.

State	Soil Type
Maharashtra Coastal Areas Plains	 Sandy soil Black cotton soil
Tamil Nadu Cauveri Delta Hill slopes	 Clay soil; Alluvial Loamy type
Central India Gangetic delta	 Alluvial soil
Andhra Pradesh	Alluvial, clay
Kerala Coastal area Plain & Low hill slope	 Sandy loam tract Red latterite

Soil amendments may be used to correct the soil to get required pH. The quantity of gypsum to be applied in different cases are as mentioned below. A soil test is compulsory before deciding on soil amendment.

Soil pH	Gypsum(t/ac)
7.4 to 7.8	1.0
7.9 to 8.4	2.0
8.5 to 9.0	3.6

To bring soil pH to 6.8

The powdered gypsum is mixed well with soil and irrigated to stagnation for 48-72hrs. Later the water is leached out by drainage and allow for drying before ploughing.

Land preparation

The land is prepared by deep ploughing and harrowing and soil is brought to a fine tilth. Farmyard manure is added at 100 cart loads per hectare at the time of ploughing.

If green manure crop is raised in the field, cut and incorporate it by primary ploughing one month before planting banana.

Banana varieties

The banana belongs to the family Musaceae.

Cultivars

There are about 300 recorded cultivars of banana. The important cultivars are described below.

Poovan (TN)- Tall, medium fruit size, yellow skin; good keeping quality. Average bunch 15 kg.

Nendran (Kerala)- Comes under plantain. Dual purpose cultivar; good keeping quality, bunch not compact; average buch 15 kg.

Kanchkela (WB) - Culinary variety; tall , bunch weight 15 kg.

Harichal (Bombay green) (MS)- Semi-tall; large fruit with thick skin; good keeping quality; Average bunch weight 20 kg.

Hill banana (Virupakshi) (TN)- Perennial; susceptible to bunchy top and leaf spot. Average bunch weight 12 kg.

Rasthali (TN)- Amruthapani (AP) Rassabale (Karntaka) Tall table variety; medium size fruit; susceptible to Panama wilt; easy dropping of fruits from bunch. Average bunch weight 15 kg.

Safed velchi (south India and MS)- Intercrop in coconut fields; medium size plants; small fruits.

Kannan (Kerala)- Slender medium height; good taste and keeping quality; firm pulp.

Chakkarakeli (AP coast and Orissa)- Yellowish green highly priced fruits. Immune to Panama wilt.

Karpuravalli (Sugandhi) (TN and AP)- Popular table variety; hardy and vigorous; immune to Panama wilt and leaf spot.

Bontha - Culinary variety; with thick rind.

Vamankeli (Basrai) - Widespread distribution; dwarf plants; heavy bunches; fruits with pale yellow flesh.

Tissue culture banana

Tissue culture (TC) plants of variety Grand Naine is available. Jain irrigation Company supplies secondary hardened ready to plant TC plants to farmers. They have the following characteristics:

- High Yield
- Long Cylindrical fruits with less curvature
- Less sweet than conventional types
- Good keeping quality
- Attractive yellowish green colour at maturity
- Internationally acceptable, both as fresh fruit and in processed form
- Pulp to peel ratio is high and suitable for processing

Plant Spacing

Traditionally banana is panted at,

- 1.65 mx 1.65 m (for Basrai)
- 1.8m x 1.8 m (for Poovan, Amruthapani and Robusta).
- For TC plants of variety Grand Naine a spacing of 1.82 m x 1.52 m (6' x 5') is recommended with 3614 plants per hectare.

Planting seasons in different States in India

States	Season of planting
Maharashtra	August-December
Tamil Nadu	April-December
Kerala	November-January May-September
West bengal	August-December March-April
Bihar	July-October
Andhra Pradesh	December-April (East Godavari) August-September (West Godavari)
Gujrat	August-January
Assam	May-September
Karnataka	April-June September-March
Tripura	August & September

Planting

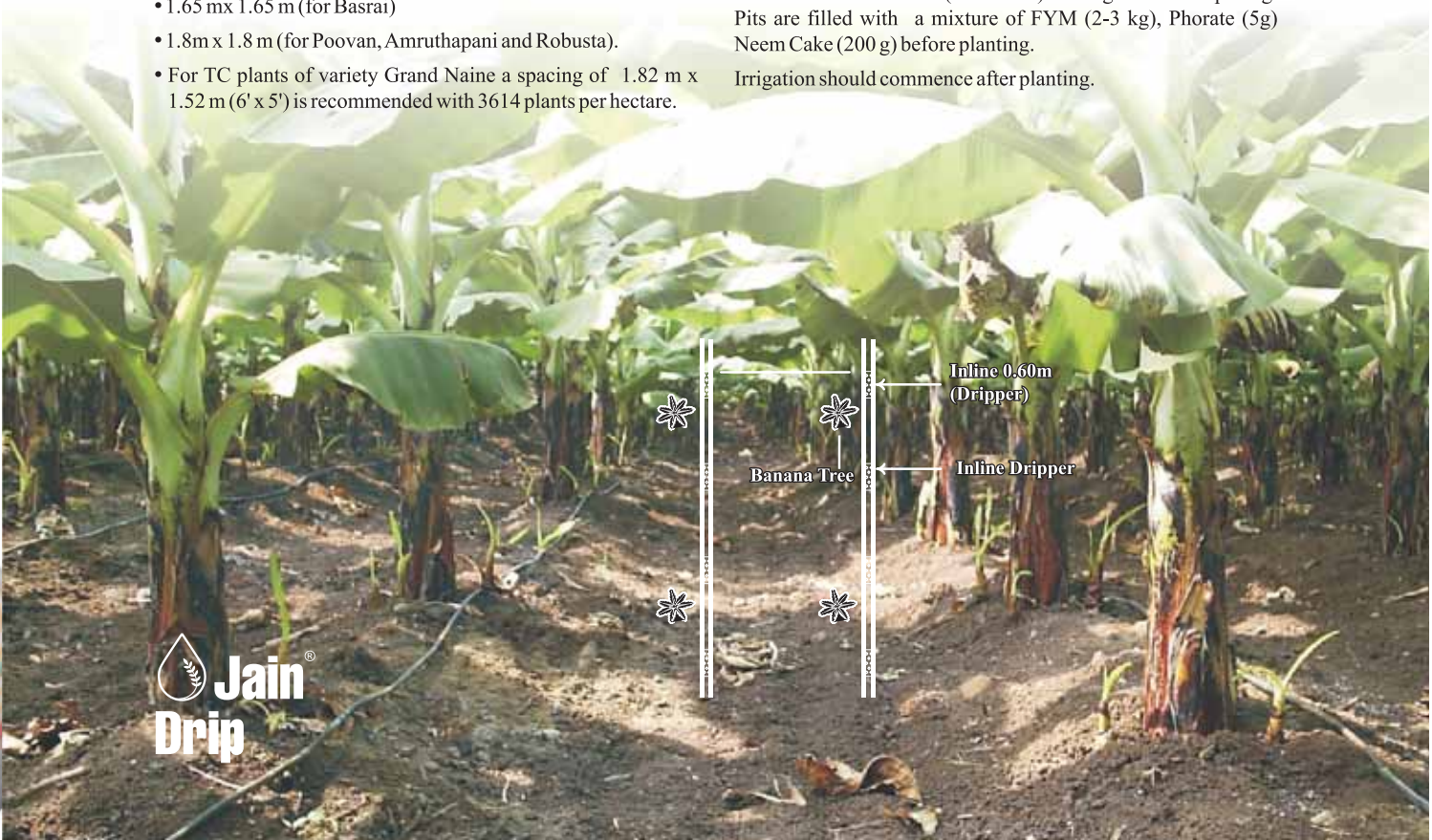
In banana, the material commonly used for planting is sucker. Sword suckers have a well-developed base with narrow sword-shaped leaf blades at the early stages.

The second type is the water sucker with broad leaves, which do not produce a healthy banana clump and should not be selected.

In case of TC plant, Secondary hardened plant lets are planted. Split open the polybag and remove the plant carefully with the ball of earth intact. Place the plant in the centre of the pit without disturbing the roots. Deep planting should be avoided. While planting, soil around each plant should be pressed well. In case of TC plant the ball of earth around the base of the plant should not break while planting.

Pits of 0.3 x 0.3 x 0.3 m (1' x 1' x 1') are dug at desired spacing. Pits are filled with a mixture of FYM (2-3 kg), Phorate (5g) Neem Cake (200 g) before planting.

Irrigation should commence after planting.



Irrigation management

Water requirement of Banana in liters per day per plant

Month	Water (lpd)	Month	Water (lpd)
June (planting)	05	October (Planting)	04-06
July	04	November	04
August	05	December	04
September	06	January	05
October	08-10	February	06
November	08	March	10-12
December	06	April	14-16
January	09	May	18-20
February	11	June	18
March	16-18	July	16
April	20-25	August	12

The rainfall events are very erratic & therefore not adjusted on a daily basis. The general recommendation is that if rainfall exceeds 10mm in any one day suspend drip irrigation for the next 2 to 3 days.

Drip system layout

Both online and inline drip systems are found to be suitable for Banana. The drip laterals are spaced at the relevant row spacing. Each plant is provided with 2 drippers (online) placed on either side of the trunk on the lateral. In case of inline the entire strip (row of banana plants) are wetted by placing drippers at 60 cm or 75 cm (based on soil texture) along the drip line.

Fertilizer Management

Tissue culture banana is a modern phenomenon of banana cultivation hence it should be supported with other hi-tech inputs like drip irrigation and fertigation. Tissue Culture banana plants do not have any store food material unlike suckers. Hence the plants should be nourish by doing fertigation immediately after 5 days from planting up to 315 days.

Fertigation Schedule

A. Conventional Fertilizers

Days after planting	Source	Quantity (g/plant)	Quantity/acre and Fertigation rate
Basal dose	SSP## MOP##	125 105	181.5 152.5
30 days	Urea	62	90 (3kg/ day)
75 days	Urea SSP##	62 125	90 (3kg/ day) 181.5
125 days	Urea SSP##	62 125	90 (3kg/day) 181.5
165 days	Urea MOP	62 105	90 (3 kg /day) 152.5 (5kg /day)
210 days	Urea	62	90 (3kg/day)
255 days	Urea MOP	62 105	90 (3kg/day) 152.5 (5 kg /day)
300 days	Urea MOP	62 105	90(6kg/day) 152.5 (10kg/day)

the basal dose and the SSP in the top dressings should be applied directly to the soil.

B. Water Souble Fertilizer

Time of Application	Fertilizer Grade	Total Qty. (kg)	Quantity (kg/Acre/Day)
5 days to 65 days	Urea 12:61:0	82.60 60.00	1.02 0.17
Ater 65 days to 125 days	Urea 12:61:0 0:0:50 MgSO4	135 40.00 100 75.00	1.62 0.50 1.25 0.62
After 135 days to 165 days	Urea 0:0:50	65.00 60.00	1.62 1.50
After 165 dyas to 315 days	Urea 0:0:50	150 300	0.75 1.50

The above tabe are given as guide line, it will vary as per soil type climate.

Micro nutrients

Micronutrient deficiencies in Banana and their remedies

Zinc

Chlorosis in strip. Chlorotic bands parallel to veins. Young leaves totally chlorotic. Stunted plants, bunched foliage.

Soil Application of 50-100 g Zinc Sulphate per plant. Foliar spray of 5g/l water Zinc Sulphate.

Iron

Deficiency in young leaves. Turn straw yellow with green veins. Leaf tip burning appearance, General Chlorosis.

Spray of 5 gm/ l water of Ferrous sulphate.

Boron

Cholorotic streaks perpendicular to the veins. Incomplete leaf formation. Flower formation inhibited. Bunch size reduced.

Spray boric acid 5gm/l two times; 120 days after planting and at bunch emergence.

Intercropping in Banana plantation

Intercrops such as vegetables, pulses, onion etc. can be grown in the inter row space of banana till the canopy closes, for first 3-4 months. An additional dripline is to be provided for irrigating these intercrops to maximize productivity.

Benefits of Drip irrigation for Banana

- Increases yield up to 50%, from 57 t/ha under flood irrigation to 87t/ha under drip.
- Reduces water used for irrigation up to 70%
- Increased fertilizer uptake by plants and increased fertilizer use efficiency.
- Consequently a reduction of up to 30% of applied fertilizer from the recommended dose is possible.
- Reduces NO3-nitrogen leaching (thereby nitrate pollution) by 50% when fertigation is practised.
- Allows fertilizer application as per the physiological need of the crop.
- Controls weed growth as water is applied only to the root zone.
- Allows for intercropping during the first 3 months.
- Saves labour cost.
- Saves power consumption

Jain® Drip

Weeding/Earthing up

- Weeding is done either through a light digging of surface soil, by mulching or by manual weeding. Presently, in commercial banana gardens, weedicides, are also used extensively to control the weeds.
- Pre-emergence application of Diuron at 4kg a.i/ha was effective in checking both monocot and dicot weed growth. Diuron treatment did not reduce banana quality.
- Among the post-emergence sprays, the combination of Diuron and Gramaxone at 4 kg/ha and 1.5 l/ha gave good control of weed population.
- Earthing up should be done during the rainy season to provide drainage, and to avoid waterlogging at the base. During summer and winter, the plants should be in furrow and on ridges during rainy season.

IPM for Banana

- Avoid injury to roots and pseudostem to refuse entry of disease agents to the plant.
- Treat suckers in Carbendazim solution at planting
- Eradicate any virus infected plant and burn them
- Practice clean cultivation practices.

Major Diseases of banana and their control measures

Panama wilt (*Fusarium oxysporum):*

Yellowing & withering of leaf, entire foliage wilt in 2-3 days, emittance of rotten fish smell when cut, brown & red streaks are seen on pseudostem.

Avoid injury to root, eradication of infected plants, liming of infected pits, dipping suckers in carbendazim 1g/l before planting followed by bimonthly drenching.

Sigatoka leaf spot *(Cercospora musae):*

Small lesions on the leaf parallel to vein, some spots develop to form dark, brown to black linear oblong area, eye shaped spots may appear.

Destruction of infected leaf desuckering and optimal spacing, spraying of 1ml/l carbendazim, 1ml/l Bordeaux mixture and dithane M-45 at 15 days interval.

Bunchy top *(Virus):*

Size of the leaf is reduced, rosseting of reduced leaves, dark green streak along the vein, dark leaves.

Eradication of infected plants spray systemic insecticides like-Metasystox or Nuvacron @ 1.25ml/l to control the vector.

Anthracnose *(Gloeosporium musarum):*

Circular black,sunken spots surrounded by yellow halo, premature ripening.

Spraying chlorothanil 2g/l at 15 days interval is effective.

Mosaic *(Mosaic virus):*

Light green streak run parallel to veins, loss of green colour of the leaves and mosaic patch appear.

Treating suckers at 40 deg.C for 1day followed by treatment with120ppm (120mg/l) Aurefungin.

Bacterial wilt *(P. solanacearum):*

Less rapid wilting, discolouration, blackening of the suckers, bacterial oozing & drooping of the leaves.

Can be minimized by exposing soil to sunlight, eradication of infected plants.

Insect pests of Banana and their control measures

Rhizome weevil *(Cosmopolitus sordidus):*

Rhizome is infested.

Application of phorate 20g or neem cake 200g/ pit.

Nematode *(Radpholus similis):*

Black lesion in the root, decaying of root and stunted growth of plant.

Application of furadon 10g or Phorate 5g or neem cake 200g per pit.

Desuckering

- Suckers which are produced by the plant in excess, are removed periodically to ensure better growth and bunch development of mother plant.
- In perennial system of banana culture, the 'setting of followers' at proper time will ensure good ratoon crop to the banana growers.

Denavelling

- The part of the inflorescence which consists of male flowers only, should be removed. This part is more often pruned off in many places, where intensive and efficient cultivation is practiced.

Covering of bunches

- Bagging is a cultural technique used by planters in the French West Indies, Latin America, Africa, Australia, etc., particularly, where export bananas are grown. It is strongly recommended to our growers.
- The main purposes are the protection of bunches against cold, sun scorching, against attack of thrips and scarring beetle.

Harvesting

Bananas are harvested at various stages of its maturity depending upon the purpose for which it is cultivated, such as culinary, table purpose etc., and distance to the market (3/4 full maturity in Robusta for distant markets, while full maturity for local market etc.). Banana can be stored at a temperature 0f 13 oC and RH 85-90 for about 3 weeks before ripening.

Yield ranges from 12-25 kg/bunch. It ranges from 25-40 kg/bunch for Tissue culture plants of Grand Naine.

Dos

- Ensure good drainage in the field.
- Adopt drip irrigation.
- Prepare pits and fill it with the mixture as recommended.
- Compulsorily apply organic manure as per recommendation.
- Select high yielding, disease and pest tolerant variety suitable for each location.
- Practice drip irrigation from the beginning of the orchard.
- Strictly follow the irrigation schedule given by the engineer.
- Follow the drip system maintenance schedule given by the engineer.
- Compulsorily weed/ inter-cultivate, timely operation helps in crop growth.
- Follow fertigation schedule as given by the engineer.
- Follow the precautions while operating the drip system as explained by the engineer.
- Apply micronutrient as and when needed.
- Follow disease and pest control measures timely and effectively.
- Apply sprays in the evening or early morning only.

Don'ts

- Don't over irrigate the crop at anytime.
- For fertigation don't mix solid fertilizers and dissolve them together. Prepare individual solutions and mix them for application.
- Don't make a fire in the field with Drip system.
- Don't use the fertigation unit for bulky organic manure and fertilizers that are not soluble in water.
- Don't add solid fertilizer from the bag directly to the fertilizer tank. Prepare solution separately and pour the solution to the fertilizer tank. Prepare solution only in plastic buckets. Don't use metal container.
- Don't stir the solution with naked unprotected hand. Use wooden spoon or stick.
- Don't heat the fertilizer solution to increase solubility.
- Don't spray the crop under hot sunlight.

Crop yields depend on climate, soil and management and therefore can't be guaranteed by the company.

Jain Drip — More Crop Per Drop®

Jain Irrigation Systems Ltd. — *Small Ideas. Big Revolutions.®*

More Crop per Drop

Jains Mobile App

Tel: +91-257-2258011; **Fax:** +91-257-2258111; **E-mail:** jisl@jains.com; **Website:** www.jains.com;
Toll Free: 1800 599 5000

Jain Drip | Jain Pipes | Jain PE Pipes | Jain Sprinklers | Jain Tissue-Culture | Jain Greenhouse | Jain Solar Pump | NUTRICARE | NAANDANJAIN — A JAIN IRRIGATION COMPANY