IMPROVED CULTIVATION OF WHITE DEHYDRATOR ONION

Jain Irrigation Systems Ltd.
Jalgaon

CONTENTS*

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

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

Inspite of being the second largest onion producing country, India has very low productivity of 11 t/ha. Maharashtra is the leading state accounting for more than 23% of the total area (92600 ha) and 27.5 % of the production with an average yield of 12.1 t/ha. The total area under onion is about 3,95,500 ha with 4.08 million t of production in the country. Onions are used either as salad or condiment or for culinary preparation with other vegetables. It has good medicinal value. Onion contains several anti-cancer agents which have shown to prevent cancer in animals. The beneficial compound called Quercetin present in onion has shown to be a powerful antioxidant. The bulb is rich in sulphur containing organic compounds which imparts the characteristic pungency and aroma. S-alk(en)y1-L-cysteine sulphoxides formed major portion of total organic sulphur.

In India, only fresh market onions are grown and that too mostly red onions. White onions are grown on commercial scale in few states - Maharashtra, Gujarat, that too restricted to few districts. Due to lack of adequate infrastructure, non existence of pre and postharvesting technological inputs as well as dearth of dedicated R & D efforts, the state has only remained as producer of red onions for fresh market. Red onion is not suitable for dehydration and export primarily due to poor quality, low productivity, low solids, low pungency level and high reducing sugars. Dehydrator onions are mostly white, having high solids > 17%; even upto 22-26% total soluble solids (T.S.S.) in some hybrids; comparatively low moisture content < 84%, globe shaped, having small root base with a minimum 70 mm diameter. These onions, usually have longer shelf-life, free from diseases. Many white varieties and hybrids suitable for dehydration are cultivated in Europe and North-America. But they are mostly long-day ones suitable for temperate and sub-tropical long-day conditions. No white varieties / hybrids suitable for short-day, tropical conditions used for dehydration are available in the country. Practically nowhere in the country dehydrator onions are grown. The white varieties grown in the state (approx 10% of the area under onions) have low total soluble solids (less than 13 percent).

In developed countries, the use of dehydrated products of onions in fast food joints, restaurants are increasingly popular due to costly and scarce labour, increased

shelf-life, small volume and less storage space required for the dehydrated product. With a view to select white onion varieties with high solids suitable under short-day tropical conditions, investigations have been carried out using local as well as exotic varieties at the R & D farm for the last 4 years. A number of trials have been carried out to determine the water and fertilizer requirements of selected varieties, minimise loss due to diseases and pests, increase the productivity and yield potential, improve the quality including shelf-life of bulbs and processed dehydrated product.

SITE SELECTION AND SOIL REQUIREMENTS

The selected land should be nearly level, with uniform soil texture and structure; firm and free from clods; with assured irrigation; should be free from weeds as onions do not compete against weeds. Onions are grown on all types of soil such as sandy loam, silt loam and medium deep friable soils with clay fraction not more than 30-35 percent. Soils should be rich in humus with good water-holding capacity. Onion is sensitive to high acidity or alkalinity; prefers pH 6.5 to 7.0. Electrical conductivity above, two millimhos give poor stand, develop poor root system and stunted vegetative growth. In a trial carried out with Jalgaon white under different soil conditions during 1996-98 the average per acre yield in light medium black soil with pH 7 was 33.52 tons/ha while in a sandy loam, saline alkali soil of pH > 8.5 the yield was reduced to almost half 15.62 tons and in the loamy red laterite soil, the yield was 30.06 t/ha.

CLIMATE

Onion grows well in climate with extremes of high or low temperatures. Even though it can be grown under wide range of climatic conditions, 20-25 ^{0}C is optimal for onion seed germination. For vegetative growth lower temperatures, (daily mean 13-21^0 C) and short photoperiod are required while relatively higher temperatures (daily mean 15 - 25^{0}C) and long photoperiod are needed for bulb development. Daily mean above 36^{0}C affect bulb development. Rabi season is most suitable.

VARIETIES

Successful onion production depends on selecting varieties that will grow, bulb, and mature satisfactorily at the given temperatures, day-lengths and other

environmental factors. Onion germplasm in the country has a narrow base. Each onion variety has a critical day length for inducement of bulbing, regardless of temperature or plant size. Short day varieties require day lengths of 12 to 13 hours while long day varieties require 14 to 16 hours. If a variety is exposed to less than the necessary daylength, there will be high percentage of non-bulbing plants. On the other hand, long day and high temperature conditions induce premature bulbing in the nursery stage itself. The varieties commonly grown in India are short-day ones.

About 45 varieties / hybrids, collected from different countries were tried in the first year. More than 160 lines/hybrids/varieties were under study in the second year. On the basis of the results, the varieties / hybrids were short-listed for commercial trial in the R & D farm and in farmer's field. The local varieties of onion used in the trials are - Jalgaon White, Phule White, Safal, Pusa White Flat, Pusa White Round, Agrifound, Hybrids such as BSS 100 etc. amongst the exotic varieties, V12, hybrids such as V7, V11, V16, PS 11390 and Deko 551 are the prominent ones. V12 is short day variety, the bulbs are small to medium, thick, flat, pungent, firm with long shelf-life.

Season

Both Kharif (rainy season July-Dec.) and Rabi (winter Season Oct.-Mar.) crops have been raised. While some of the local varieties have been tried in both the seasons, the exotic varieties and hybrids are cultivated during Rabi only. Hybrids such as PS 11390 and Deko 551 did not develop normal bulbs under Jalgaon conditions being intermediate-day types. While the vegetative growth was excellent, torpedo or bottle shaped bulbs were formed which were not marketable. As indicated earlier, the exotic varieties were rich in total soluble solids ranging between 15 and 18 percent, on an average.

LAND PREPARATION

Deep ploughing in summer was followed by two harrowings. Green manuring with Dhaincha was done in most of the lands. The dhaincha seeds were sown in late June and ploughed back into the soil by mid-August. After harrowing, the soil was

worked with a rotavator. Raised beds of 15 cm height and one metre width and convenient length were prepared by a ridger. A gap of 0.5 m was provided between two beds to facilitate manual transplanting, weeding operations etc.

PLANTING

Onion is cultivated as an intercrop in newly established mango plantations in between two rows of Mangoes which were planted at 15 feet in rows 15 feet apart. Three methods of planting onion was followed.

Picture showing intercrop Onion-Mango

1. Transplanting method

Transplanting by hand ensures more complete stands; weed control is more effective. Seedlings were raised in the nursery on raised beds @ 2-2.5 kg seeds per acre and the seedlings 15 to 20 cms height, transplanted after about 45 days. The seedlings are planted at 10x10 cm on the beds. About 2.80 to 3.0 lakh plant population is maintained to get optimum yield. About 2 - 2.5 kg seeds will produce seedlings sufficient to plant one acre, and 8-10 acres can be transplanted with seedlings raised from one acre nursery.

Cost of raising one acre onion nursery for Kharif crop using local varieties will

be Rs. 18282 and that for Rabi crop using V12 or V11 varieties will be Rs. 35,617/-.

2. Direct sowing in the field by planter

Planter

In each bed, 12 rows of onion seeds were sown at a distance of 10 cm by four planting heads, using 'Gandy' precision planter drawn by tractor. A final stand of 50-60 percent of the seed can be expected with quality seeds. The shallow planting of onion seeds 1/2" deep requires precision placement. Onion seedlings are not strong; In shallow soil, crusting soil surface can interfere with emergence and cause poor stands.

3. Hand-dibbling

Seeds were dibbled on every third bed as the planter cannot work on these beds with mangoes. Thinning of seedlings carried out to maintain uniform stand and population of 2.80 lakhs / acre.

4. Planting of Setts

To harvest onions early in Dec.-Jan, setts can be planted. Onion plants at the stage of development of bulbs of 25 mm dia. were removed and the bulbs stored in cold store after removing the leaves. These setts are planted in September to get early harvest of bulbs. The initial sprouting and vegetative growth was good, and the bulbs were harvested after 3 months of planting. In this method, about 4 months from seed to setts and another 3 months from setts planting to harvest, of bulbs are required; however early harvest during

the season compensates by the high price received for the crop. Amongst the three methods of onion planting tried, the conventional transplanting method showed better results although the labour involved is high (50 ladies per acre). In the dibbling method, initially the labour involved is about 35 per acre, however, additional labour is needed for thinning. In machine sowing of onion, the germination percentage will not be optimum if the soil is not uniformly levelled. Here also, additional labour is needed for thinning. In the later two methods, to maintain the uniformity in stand, the thinned seedlings are to be transplanted in separate plots, it is observed that the depth of planting should be half inch. If it is more, the bulb formation is affected, if it is less the seedlings are exposed. The later two methods are suitable for late sowing as the total duration of the crop is reduced by two weeks.

IRRIGATION

Micro Irrigation is described as regulated and slow application of irrigation water through emitters or orifices at frequent intervals near the root zone of plant, over a longer period of time. Water is applied at a low rate over a long period of time at frequent intervals through a low pressure delivery system. Emitters or drippers are installed at predetermined spacing on LLDPE laterals of various diameters. Jain Drip Systems are designed to provide greater operational ease, highest functional efficiency and minimum maintenance. The system facilitates water application at regular interval thereby maintaining optimum moisture level at the rootzones for a longer period thus preventing moisture stress or shock associated with other methods of irrigation. This promotes optimum plant performance resulting in higher yield and better quality produce. Crop Quality improvement and early maturity is a result of even growth and ripening. Water saving is effected upto 55% as all percolation and evaporation losses are eliminated. Water is applied directly in the root zone, wetting only a fraction of the soil; interspace between the row of plants is not allowed to go beyond the root zone. Jain Drip Systems comprises of a chemical application device to enable addition of soluble fertilizers, systemic plant protection chemical and soil insecticides through the system. Disease control is enhanced under micro irrigation system, because the soil moisture and chemical additive levels can be

closely controlled. Water is distributed more uniformly, permitting efficient water-use and distribution of fertilizer.

Onion under Drip Irrigation

Onion is a shallow rooted crop and the water-holding capacity of the soil should be high. Taking into consideration peak evapotranspiration in May, 8.39 mm / day panfactor 0.7 and maximum crop coefficient 1.1 peak, depth of water required being 6.46 mm / day and peak volume of water required for one ha will be 63800 liters/ day. Different micro irrigation systems were used depending upon the soil type and material availability. Dripper discharge and dripper spacing also depend upon the soil type and lateral movement of water. Turbokey and turbo SC drippers 4 LPH at 2 feet interval were found to be most effective. The polytubes were installed at every 4 feet on submain line. The amount of water required in each irrigation depends on soil type and temperatures during the growing season besides method of application etc. A temporary water stress is given after the establishment of stand to promote deeper root growth. As the onions begin to mature and the tops begin to fall over, irrigation has to be terminated to stop root growth and to allow the outer scales of the bulb to become dry and firm.

The results of irrigation trial carried over two years in the R & D farms indicated that plant height, yield, fresh weight and the total soluble solid content of bulbs, showed a positive relation with the quantity of irrigation water. Irrigation at 60,000 l/ha/day had a marked effect on the growth and yield attributes, resulting in a significant increase in bulb weight. Quality parameters such as total soluble solids (TSS) and

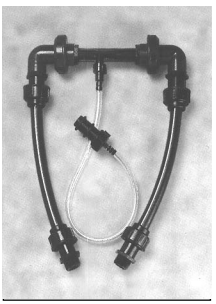
size of the bulb, have been found to be related to irrigation quantity. Total soluble solid content, increased with reduced quantity of irrigation water.

FERTIGATION

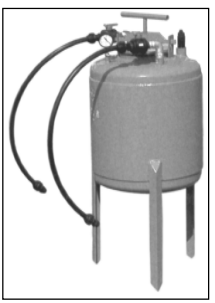
Application of water soluble fertilizers / liquid fertilizer through Drip Irrigation is called Fertigation. It is advanced method of fertilizer application.

Liquid / Water soluble fertilisers

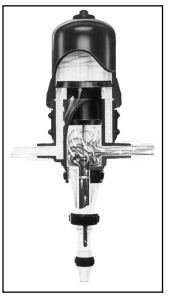
In traditional method, fertilisers are normally used as basal dose and subsequently as top dressing. The full year requirement is split into 1, 2 or 3 doses and these are applied in bulk. Majority of fertilisers go waste due to leaching, volatalisation and fixation in the soil. The traditional fertilisers available in the market are not fully soluble in water and contain insoluble impurities and therefore cannot be applied through the drip system. Jain irrigation systems Ltd. has commissioned the production of liquid as well as water soluble solid (WSS) fertilisers. These fertilisers can be applied through drip irrigation system, the process known as fertigation. Ventury, Fertilizer tank, fertigation pump are the different fertigation equipments.



Ventury



Fertilizer Tank



Fertigation Pump

Advantages of using liquid / water soluble fertiliser

Application of liquid or WSS through MIS, at appropriate stages of growth ensures a regular flow of both water and nutrients resulting in increased growth rates and higher yields. Fertigation can be done at pre-determined schedule according to the developmental and physiological stage of the crop. It improves availability of nutrients and their uptake by roots. Since the fertiliser is greatly diluted in irrigation water, it eliminates the danger of toxicity to the root system. Moreover, labour and fertiliser

saving of upto 20-30% and 30-50% respectively is achieved and the fertiliser-use-efficiency is also enhanced.

FERTIGATION SCHEDULE FOR V12 ONION

a) Total Fertilizer elements required by onion (1 acre crop)

N - 60 kg/acre P - 50 kg/acre K - 80 kg/acre

b) Source of fertilizer

Grade	Kg/acre
SSP (as a basal dose)	100
08:08:08	425
12:00:12	217
MOP	33

c) Schedule of fertigation

Weeks after transplanting	Grade	Kg/Weeks/acre
3rd - 8th	8:8:8	85
9th - 12th	12:00:12	54.25
Once at 9th week	MOP	33.0

Onions require higher levels of N,P and K fertilizers for maximum yields than most other vegetable crops. The shallow roots and dense population of onions make them responsive to fertilizers. Besides nitrogen, phosphorus and potassium, application of zinc, manganese and iron gave good response. It is estimated that about 18 t of onion bulbs/acre remove about 70 kg - N, 25 kg - P_2O_5 and 55 kg of K_2O. The results of trials using liquid fertilizers at different levels have indicated that fertigation at 150:125:200 kg NPK per ha recorded maximum yield and highest cost : benefit ratio (1:2.1) indicating that the V12 cultivar required higher quantities of NPK fertilizers as the vigour and yield recorded under short-day tropical conditions in our soils are more than that of the local white varieties. The quality parameters like average diameter, fresh weight and TSS of the bulbs were also optimum under this treatment. Liquid fertilizer should be given in ten equal split doses at weekly intervals beginning two weeks after transplantation. In plots where fertigation was

delayed, the vegetative growth continued and the neckfall delayed. The yield varied between 33.32 to 49.4 t/ha depending on the variety / hybrid, date of planting and soil type. In another trial using sulphur containing source, ammonium sulphate, superphosphate and sulphate of potash, it was observed that the pungency and total soluble solids increased marginally over those bulbs under the conventional fertilizers.

Green Manuring & Vermicompost

During rainy season late June-early July green manure crops like Dhaincha (Sesbania aculiata) Sunnhemp (Crotalaria juncea) were grown. Seed rate is 20-25 kg/acre. When the plants are about 40-45 days old, the green manure are to be incorporated into the soil. Decomposition of the biomass is quite rapid in about two weeks. Application of vermicompost @ 2t/acre as basal dose before transplanting, improves the texture and water holding capacity of the soil besides being rich in essential nutrient elements.

WEED MANAGEMENT

Small seed weight, an inherently low relative growth rate, a shallow root system of comparatively low density and a canopy of short upright leaves indicate that the onion plant is slow to establish and very susceptible to weed competition. Onions are poor competitors against weeds. The weeds are more serious problem in Kharif crop. The most troublesome weeds observed are *Acalypha sp. Achyranthes aspera, Amaranthus viridis, Anagallis arvensis, Argemone mexicana, Boerhavia diffusa* (Punarnava)*, Chenopodium album, Cyperus rotundus, Cyanodon dactylon, Celosia urgentia, Eupatorium sp. Euphorbia hirta, Euphorbia sp.* (Dudhia)*, Leucas aspera, Martynia annua, Parthenium histerophorus, Solanum xanthocarpum, Sonchus arvensis, Tridax procumbens, Tribulus terrestris, Vernonia cineria* etc. and host of others yet to be identified. Application of Oxyfluorten (Goal) with knapsack sprayer using WFN 62 or WFN 40 nozzles 2 to 3 days immediately before or after planting (at 200-300 ml/acre) in 250 to 300 l of water found effective as a preemergence weedicide. In non-cropped areas like outer bunds, glyphosate (Roundup) at 2 l/ acre was found to be highly effective as a post-emergence weedicide.

However, application of Goal only reduced the density of weed population. Manual weeding was necessary. The growth rate of weeds being faster, any delay in weeding caused damage and shock to onion roots. It was observed that minimum of three weedings were necessary for the Kharif onions while for Rabi, at least two weedings were necessary.

BOLTING

Bolting is the initiation of flowering by the formation of seed stalk. It is highly undesirable in bulb production, but in seed production, early uniform multiple bolting is desired. Each variety has its own bolting characteristics. Low temperature during growth period induce bolting. Larger plants are more likely to bolt than smaller plants of the same age. Bolting was observed during Rabi 1997 even in V12 due to prolonged rain and cold weather. Bolting even upto 25-30% is common in most of the local varieties. Due to bolting weight of the bulb will be reduced and the woody stalk of the inflorescence remains in the core of the bulb which reduces the quality of the bulb and dehydrated product. Bolting is not common during Kharif, however, its intensity is more, i] during Rabi season, ii] when irrigation is given after prolonged water stress, iii] when there is sudden drop in the temperature and iv] due to imbalance in nutrition-higher and /or late application of nitrogen. In general in the varieties V12, V11, no bolting was observed during Rabi.

Thickneck

Occurrence of thickneck with soft bulb is common in local and exotic varieties as a reaction to changed environment with different day-length, cold temperature, unusual rains etc. Thickneck reduces the quality of the bulbs. Too much nitrogen late in the season can cause thickneck and delay in maturity.

Twins / Doubles

The developing bulbs split due to irrigation after a long break, delayed application of nitrogen or higher temperature during the development of bulbs. The marketable quality of the bulbs is reduced due to splits. Such bulbs are also not preferred for dehydration / processing.

Premature bulb development

Once the critical day length is achieved bulbing is initiated. Onion bulbs develop more quickly as temperature increase. When short day onions are grown under long-day conditions or vice-versa, bulbing occurs early in the leaf formation stages. Very small bulbs are formed because of insufficient foliage. Premature bulbing was common in the nursery stage itself, when V12 nursery planting was raised during kharif (June-Aug).

Greening of outer Scales

Green colour of the outer scales of V12 bulbs and local varieties are common when the temperature increases during the later stages of bulb development. Formation of Chlorophyll in the outer fleshy scale may occur when onions are allowed to cure too long or when shoulders of bulbs are exposed to sunlight in the field. Excess and late season applications of nitrogen enhance greening of onions.

HARVESTING

The duration of local varieties is usually about 5 1/2 months i.e. about 45 days in the nursery and 4 months after transplanting in the field. In the case of V12 it is fifteen days more than the local varieties. If sown by planter directly in the field the crop is ready by about 15 days early than the transplanted ones. When the bulbs mature, the green tops weaken just above the bulb and fall over (neckfall). When neckfall begins, irrigation is stopped. When more than 50% of the tops are down, the bulbs are harvested along with leaves by hand-pulling from beds. The harvested plants with bulbs are allowed to cure in the field for about 3-4 days. If harvested during March-April, the plants are arranged in rows in such a way that the bulbs are covered with the leaves of onion plants in the stake. After 3-4 days of curing, the roots and tops are clipped and filled in bags of 35-40 kg capacity. Curing is the drying of neck, roots and outer scale tissue; it is essential to prevent disease infection. Field curing begins when bulbs start to mature. Stopping irrigation, cutting roots, and topping hasten curing. In the dehydration plant, the bags are emptied and machine-graded, down the pick-up rows and packed in bins for washing and further processing.

Yield

The average yield of varieties such as Jalgaon White, Phule White, Safal, Agrifound etc. ranged between 8 t and 13.5 t / acre. However the yield per acre of exotic varieties viz. V11, V12 was higher, ranged between 10 t and 18 t/acre, depending upon the soil conditions and date of planting. The hybrid BSS 214 recorded the maximum yield of 20 t/acre, but the keeping quality was extremely poor.

STORAGE

Proper storage is crucial for retaining bulb quality. Cool, dry and well circulated air will keep onion bulbs in good condition for many months. Critical factors in successful storage include variety, methods of culture, harvest, field curing, temperature and humidity control, storage, and sprout inhibition. Onion bulbs under storage in chawls lose weight due to respiration upto 25-30%; loss due to rotting of bulbs may be 10-15% during July-Sept because of high humidity. Loss upto 15% also occur due to sprouting particularly in Oct-Nov due to low temperature. In all, the loss may be 45-60%. This loss can be minimised by selection of suitable varieties with long shelf life, date of planting (mid Nov.) balanced nutrition (nitrogen as ammonium sulphate and potash 80 kg/acre) efficient irrigation management, proper harvesting (Mar-Apr) curing and grading and improved storage chawls/cold storage etc. In cold stores with temperature 0-2^{0}C and RH 60%, onion can be stored nearly for 10-12 months. The rabi onions store well than the kharif onions.

MANAGEMENT OF DISEASES AND PESTS

Several diseases are of major economic importance. The incidence and severity vary from year to year.

Soil borne diseases

Damping off commonly caused by *Pythium sp.* under conditions of poor soil drainage, excessive rain. Roots of infected onion seedlings initially exhibit a greyish, water soaked appearance. Infected seedlings turn yellow, quickly collapse and die. Soil drenching with fungicides, Bordeaux mixture 0.5%, Dithane M-45 at 0.25% are recommended. Onions should not be grown continuously in the same seed beds

and fields. Crop rotation will be beneficial in reducing root diseases. Soil solarization for at least 1-1/2 months with intense solar radiation eliminates most of the soil-borne pathogens.

Foliar Diseases

Purple blotch caused by *Alternaria porri*.

Oval-shaped tan or deep brown water soaked lesions develop on the leaf blades. As lesions enlarge, they zonate and turn purple. After a few large lesions form in a leaf, they coalace and girdle the leaf; in advanced stages the leaves dry and die. Similar lesions may form on flower stalks of seed onions. As a result seeds do not develop or are shriveled.

Control

No resistant or tolerant cultivars available, V12 is comparatively tolerant to diseases. Cultural practices include adoption long-rotations and reduced plant density. Regular sprays of Dithane M-45 reduce disease severity. Purple blotch is difficult to control as bulbs approach maturity.

Leaf blight and stalk rot caused by *Stemphylium vesicarium*

The individual lesions are small, light brown and water-soaked. These soon develop into elongated spindle shaped diffusate spots often reaching the leaftips. Spots coalasce into extended patches, blighting the leaves. Similar symptoms may also occur on the inflorescence stalks.

Control

The same cultural and fungicide practices recommended for the purple blotch.

Twister, also known as anthracnose Caused by *Glomeralla cingulate.* Curling, twisting and chlorosis of leaves are the common symptoms, the neck may be elongated, roots stunted, bulbs are slender, do not develop into optimum size. Control can be achieved by sprays of Dithane / copper formulations. The crop residue should be destroyed to reduce the initial inoculum.

Diseases of bulbs

Black mold caused by *Aspergillus niger*, sporadically occurs in the field, common after the harvest of bulbs under storage. Appearance of black spore masses between the outer dry scales of the bulb, tend to form along the veins in black streaks. Disease development is favoured by high temperature and humidity. Thorough curing, good ventilation and cool temperature below 15^0C in storage minimises the loss due to mold.

Soft Rot Caused by *Erwinia carotvara.*

Soft rot is common during storage or transit. However, it develops in the field too, after heavy rains before harvest. The pathogen is wide-spread in soil and irrigation water. The affected fleshy scale tissues are water-soaked, pale yellow to light brown and become soft. As the rot progress, the whole interior of the bulb may break-down, and a watery, foul-smelling viscous liquid ooze from the neck if squeezed.

Control

Onion tops should be matured before harvest. Only well-dried onions should be stored preferably at 0.2^0C and less than 65% RH with good ventilation.

Insects

Onion thrips, *Thrips tabaci*

The most common and serious pest in onion production. During dry, warm weather, thrips feed on leaf surfaces and leaves become white. Preventive measures include destruction of weeds as they play alternate hosts. Dodder (*Cuscuta sp.*) a plant parasite causes menace in onion plantation. As soon as the infestation is noticed, the parasite should be removed and burnt.

SEED PRODUCTION

Onion is a biennial plant. Bulbs / plants are produced by sowing the seed and the harvested bulbs after vernalization (winter chilling) planted in the cool season to produce seeds. Seed crop is undertaken for the local varieties. While efforts are being made to produce seeds of introduced open pollinated variety in cooler regions as the temperature is the most influential factor affecting onion production.

Vernalization is required to initiate flower stalk development. Dry, warm weather from flowering to seed set is necessary (March-April).

The harvested bulbs are planted in the seed production field during late November-early December at 30 cm x 30 cm, on one meter wide, raised beds. The bulb to seed method requires the same cultural practices as a commercial bulb crop. Medium size mother bulbs 5-6 cm in diameter used for planting. Twins, splits, bolted bulbs, thick-necked etc. are avoided. Honey-bees are the agents of cross pollination. The seed-crop harvested when about 5% of the fruits are open and showing black seed. The plants dried and threshed, then milled to remove debris and impurities. Drying of seeds done below 35^0C and sealed in moisture-proof containers.

Yield

Usually 450 kg seed yield per acre under good management.

PRODUCTION COSTS

Costs of growing onions have increased considerably over the past few years. Efforts are made to improve efficiency of cost production and increase the yield per acre. The most marked difference between local and V12 varieties is in seed cost, the latter being imported till now. Costs for culture are about the same for both the crops. The market price of onions is greatly influenced by supply.

Input costs for bulb-onion production (one ha) Rabi V12

Particulars	Rs.
Seed / Seedlings*	8,796
Land preparation	2,149
Fertilizer (Liquid), Vermicompost etc.	12,041
Pesticides / Weedicides & spraying (3+1)	5,669
Labour - transplanting Weeding & harvesting	11,930
Irrigation water	4,718
Interest on drip system	2,816
Landrent	5,000
Total	53,119
Returns	1,18,500

** The seed/seeding cost for the local varieties will be Rs. 4515.*

The main objective is to highlight the results of Research and Development efforts taken by the Jain Group in improvement, in production and quality of onions and to encourage the farmers to adapt the latest technology in improvement of onion cultivation. The Group has distributed about 5120 kg seeds including 1800 kg of V12 to farmers in Jalgaon district and nearby areas at subsidised rates on buy-back arrangement. Efforts are underway to produce V12 onion seeds within the country for the rabi season of 2000-2001. A team of agronomists / horticulturists help farmers in transfer of technology developed by the Research workers. The results discussed here will help the farmer increase his knowledge of onion production and thereby increase production efficiency and yields, providing the consumer and processing industry with high quality product.

Processing

Jain irrigation has commissioned onion dehydration plant about three years back, a 100% export oriented unit, with an annual capacity of 2500 t of dehydrated product. White onion varieties such as Jalgaon white, Safal and improved varieties with high solids more than 18% total soluble solids are processed into dehydrated products such as onion powder, granules,flakes chops etc and exported to European, South East Asian countries and USA.

Inner view of State-of-the-art Onion Dehydration Plant at Jain Food Park, Jalgaon.

CASE STUDY OF ONION CROP GROWN UNDER DRIP IRRIGATION SYSTEM IN MAHARASHTRA STATE

[I] Primary Information

01.	Name of farmer & address	:	Shri Balwant Bapurao Patil (B.Sc., Agri.) At Post Tal: Kalwan, Dist- Nasik.
02.	Profession	:	Teacher
03.	Source of Irrigation	:	Open Well

[II] Crop Details (Under Drip Irrigation)

01.	Season & date of planting	:	October 96
02.	Transplantation	:	1st week of Deember.
03.	Area under cultivation	:	3 acres
04.	Variety	:	Nasik Red
06.	Plant Population	:	3,30,000/acre
07.	Details of drip irrigation	:	Lateral 12mm at every 4' Spacing between two successive dripper-2' (Turbokey 4 LPH)
08.	System supplied	:	Jain Irrigation Systems Ltd., Jalgaon
09.	Soil type	:	Medium, clayey

Prepared Raised beds with the help of tractor of size 3 feet width and height of 9 to 10 inch. Kept 1/2 to 1 feet furrow between two raisebeds.

10.	Fertilizer used, doses & time	:	60:50:78 (NPK) given through Jain Water Soluble Solid fertilizers like 19:19:19, 13:40:13, 13:0:46 Applied 5 kg Magnesium Sulphate per acre through soil application after 40days of transplantation.
11.	Other chemical used	:	Lihoseen spray
12.	Irrigation schedule (daily)	:	15,000 to 16,000 lpd, After 10th March irrigation is stopped.
13.	Yield obtained (Qt./Acre)	:	24 tons/acre

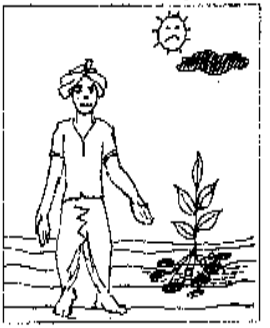
Conclusion of farmer

By using Jain Micro Irrigation System, I could get best quality of onion with considerable saving in water, fertilizers and labour cost. It is also possible to use Jain Micro Irrigation System for other vegetable crops as the spacing of vegetable crop is same. In traditional method, I got 12-13 tons/acre yield, while by using Jain Micro Irrigation system, it is approximately doubled i.e 24 tons/acre.

DRAWBACKS IN CONVENTIONAL IRRIGATION METHOD

For plant growth Soil, Water, Air, Nutrients and Sunlight are basic input needs. In the conventional irrigation method, normally the plant is irrigated at the interval of 8-15 days & the water distribution uniformity is limited up to 33% only. This means the irrigation efficiency is reduced & plant does not get the total applied quantity of water. Only 35% to 40% of the total quantity of water is utilised by the plant in reality.

If irrigation is at the interval of eight days, the exact status of moisture level in the soil will be as shown below.

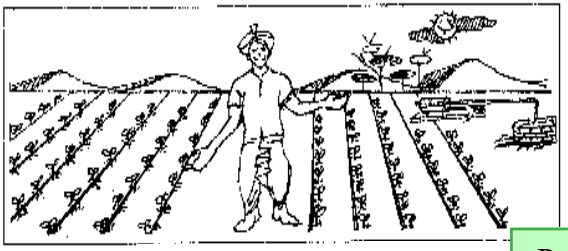
First Three Days After Irrigation	Middle Three Days	Last Two Days
		
During first three days of irrigation soil pores are saturated with water. In this condition, total air in the soil is replaced by water & field capacity level is not maintained in the soil. Though sufficient nutrients are available in the soil, the excess water condition suffocates the roots of the plant & water absorption by roots is totally ceased. As the plant is under suffocation the growth is hampered.	During next three days, due to evaporation & percolation losses, the excess soil moisture is reduced & soil comes to field capacity level wherein air, moisture & nutrients are available at optimum level. Plant growth takes place only during this phase.	In last two days, the moisture level in the soil goes below the root zone hence, plant is under stress condition in this period. Even though air and nutrients are sufficiently available in the root zone they can not be taken easily by plant as the plant is under stress and hence growth restricted.

Conclusion: It is very clear from the above phenomenon that for the plant growth, optimum moisture level available is only for about three days out of 8 days' cycle. Rest of the time plant is either under stress or suffocation condition, hence growth is restricted thereby yield is reduced.

JAIN MICRO IRRIGATION SYSTEM

Jain Micro Irrigation System by its very definition is the application of small and precisely predetermined amount of water near the root zone of plant at frequent intervals through emitting devices via a network of PVC/HDPE mains, submains, filteration unit, control valves and LLDPE laterals.

By this advanced method of irrigation, 90-95% irrigation efficiency and uniformity of application is achieved. And the optimum balance of nutrients, air & water is maintained in the soil resulting in continuous & better plant growth and high yields.



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Abundant yield of high quality.

ARE YOU LOOKING FOR A SCIENTIFIC, EFFICIENT AND ECONOMICALLY VIABLE MICRO IRRIGATION SYSTEM ?
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WE CONSIDER THE FOLLOWING ESSENTIAL PARAMETERS WHEN WE DESIGN A DRIP IRRIGATION SYSTEM FOR YOU THAT ENSURES SATISFACTORY SERVICE YEAR AFTER YEAR. ALL THE COMPONENTS OF THE TOTAL SYSTEM ARE MANUFACTURED BY JAINS THEMSELVES UNDER STRICT QUALITY CONTROL. THAT IS WHAT MAKES THE JAIN IRRIGATION SYSTEMS THE BEST MICRO IRRIGATION SYSTEMS THAT YOU ARE LOOKING FOR.

Engineering Survey

Technical survey of the land & collection of certain data are pre-requisites for designing a micro irrigation system. Therefore a survey of the land is conducted and necessary data like information of farmer, details of crop & their spacings, water-source, existing pump details, water-availability, field dimensions, undulations, agroclimatic information, etc. are collected. Samples of soil & water are also collected for testing in our laboratory.

Agroclimatic Data

Agroclimatic data like total rainfall, temperature, sunshine hours, relative humidity, evapotranspiration, wind velocity, wind direction etc. are collected & fed to the computer; to decide the stagewise and agewise irrigation schedule for better crop growth.

Design

After studying the interrelationship between crop, water, soil and Agro-climatic data, a suitable hydraulic and economical system is designed on computer by keeping in view the existing pump capacity, existing pipe line and peak water requirement of crop.

Soil and Water Analysis

The soil sample so collected is tested in our laboratory to know the pH factor, salinity, water holding capacity, soil infiltration rate, depth of soil, soil texture, fertility, etc.

The water is tested to know its quality, pH factor, electrical conductivity, hardness or softness, total dissolved solids, suspended particles, etc.

Such tests on soil and water are conducted to design a suitable system tailormade to suit the site conditions and also to establish needs for frequency of chemical treatment to ensure proper working of the micro irrigation system. It also helps to decide fertigation schedule.

Crop

Crop details like variety, row & plant spacings, age, canopy development, root system, cultivation-methods, etc. are collected to decide the proper irrigation schedule.

Conclusion

Jain Micro Irrigation System is the only scientific method of irrigation which considers all above parameters and designs the most suitable & economically viable system for better harvest.

Proven Benefits

- Increase in yield to the extent of 20% to 100%.
- Saves water from 30% to 80%.
- Cost of chemicals, fertilizers, labour & plant protection can be reduced by 30 - 40%.

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JALGAON

MAKING A DROP OF WATER GROW A LONG WAY

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- MDPE Pipes & Fittings.
- HDPE Pipes & Compression Fittings.
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