

Technical Bulletin

Jamun- A Fruit For Future



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FOREWORD

The Jamun (*Syzygium cuminii* Skeels) is one of the important indigenous under utilized fruits, widely distributed throughout tropic and sub-tropics as stray plantation or avenue. The fruit is good source of iron, sugars, minerals, protein, carbohydrate etc. and can be processed into various types of beverages. Fruits are used as an effective medicine against diabetes. In the recent years, jamun fruits is becoming popular among the people due to its rich medicinal values particularly for its antidiabetic properties. Leaf extract reduces the radiation induced DNA damage in the cultured human peripheral blood lymphocytes. A wide range of variability occurs with regard to fruit size and quality owing to its sexual propagation, which needs to be conserved and exploited. India is emerging as major stakeholder in global horticulture scenario accounting for 10 per cent of world production of fruits. This has been made possible due to the concerted efforts of scientists and progressive farming community.

There is a considerable awareness about the nutritional security and food safety. More emphasis is given on to underutilized fruits due to their high nutritive and medicinal value in addition to being resistant/tolerant to many biotic/abiotic stresses. The demand of this crop is gradually increasing owing to its tremendous potential for commercial exploitation aimed at improving the economic status of the poor and marginal farmers.

Hence there is an urgent need of collection, documentation, conservation and utilization of jamun for their sustained production and popularization. This bulletin deals with the package of practices for jamun cultivation. It is hoped that, it will be helpful to the growers, traders, students, scientists and teachers in playing their role for the jamun production in India.

March, 2007
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(Dr. T.A. MORE)
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Introduction

The *Jamun*, *Syzygium cuminii* Skeels is a nutritious fruit with a variety of uses. It is one of the most hardy fruit crops and can easily be grown in neglected and marshy areas where other fruits plants cannot be grown successfully. The fruit is good source of iron, sugars, minerals, protein and carbohydrate etc. Fully ripened fruits are eaten as fresh fruit and can be processed into beverages like jelly, jam, squash, wine, vinegar and pickles. A little quantity of *jamun* fruit's syrup is much useful for curing the diarrhoea. Small *jamun* fruits, which are not suitable for table use, can be used in the beverage industry as they contained a high amount of acidity, tannins and anthocyanins (Anonymous, 1986). *Jamun* seeds contain alkaloids like jambosin and glycoside, which reduce the diastatic conversion of starch in to sugars. Fruits are used as an effective medicine against diabetes, heart and liver trouble (Singh, 2001). The powder of seeds has high value being useful in the treatment of diabetes. Oral administration of an aqueous *jamun* seed extract for 6 weeks caused a significant decrease in lipids, thiobarbituric acid reactive substances and an increase in catalase and superoxide dismutase in the brain of diabetic rats (Prince *et al.*, 2003). Leaf extract of *jamun* reduces the radiation induced DNA damage in the cultured human peripheral blood lymphocytes. Therefore, the *jamun* fruits are having high value in terms of therapeutic and nutrition.

Origin and Distribution

The origin of *jamun* is India. It is also grown in other countries like Thailand, Philipines and Madagaskar. The *jamun* has been successfully introduced in to many other tropical countries like West Indies, California, Algeria and Israel. In India, the maximum number of *jamun* trees are scattered throughout the tropical and sub tropical regions. It also occurs in the lower range of Himalayas up to an elevation of 1300 meters and in the Kumaon hills up to 1600 meters. It is widely grown in the larger part of India from the Indo-Gangetic plains in the North to Tamilnadu in the South.

Soil and climate

The *jamun* is adapted to a wide range of soils. For high yield potential and good plant growth deep loam and well-drained soils are needed. Such soils have sufficient soil moisture retention capacity, which is very beneficial for optimum growth and good fruiting. It can flourish in poor soils with little or no cultivation. It tolerates sodic and saline soils particularly in ravines and degraded land. It can also be grown in waterlogged conditions. *Jamun* survived and grew better under lower salinity and shallower water table condition (Hebbara *et al.*; 2002). *Jamun* plants survived in alkali soils up to 10.5 pH (Singh *et al.*, 1997).

It is adapted to a wide range of ecological conditions, reflecting its wide geographical distribution in the sub and semi-arid tropics. It can be grown in semi-arid subtropical regions with an annual rainfall ranging from 350-500 mm (Vashishtha, 1991). The *jamun* requires dry weather at the time of flowering and fruit setting. In sub - tropical areas, early rain is considered to be beneficial for fruit ripening and proper development on size, colour and taste.

Taxonomy of the crop

It belongs to the important genus *Syzygium* and family Myrtaceae having chromosome number $2n = 40$. There are about 400 to 500 species of which a few are considered as edible fruits bearer (Chundawat, 1990). Some of the species are described bellow.

Syzygium jambos (Rose apple or Safed jamun):

The trees are medium sized, evergreen and ornamental. The leaves have very small petiole. The fruits are light yellow - white in colour. They are rose scented and calyx persistent. The seeds are polyembryonic and it is being grown in Assam, Bihar, Andhra Pradesh, Tamil Nadu, West Bengal, Coastal areas of Maharashtra and Gujarat.

Syzygium fruitecosum:

The trees are suitable for windbreak. Fruits are edible and small in size.

Syzygium javanica (Water apple):

This species is found in South India and West Bengal.

Syzygium densiflora:

It is suitable for use as a rootstock for *Syzygium cuminii* as shows resistance against termites.

Syzygium uniflora (Surinam cherry or Pitanga cherry).

It is also a small tree and bears small size fruits having bright red colour and aromatic flavour. The tree is grown in South India.

Syzygium zeylanica:

The tree is small and bears edible fruits and grown in Western Ghats of India.

Jamun is an evergreen tree, attaining medium to large size. The trunk is thick and greyish white in colour. Leaves are opposite, simple, mostly firm and glossy, elliptic, pinnately veined with lateral veins close together; flowers are in a few flowered panicles, hermaphrodite, light yellow in colour, borne in the axils of leaves on branchlet, calyx lobes 4, calyx tube not extending beyond summit of ovary, 4 petals, white, spreading, stamens many, ovary inferior, 2 celled (Bailey and Bailey, 1978).

Reproductive biology

New vegetative shoots in the *jamun* emerge in 2 distinct flushes from February to May and from August to October, the number of inflorescences per shoot are found maximum in February flush and least in those produced in October (Mishra and Bajpai, 1971). The maximum anthesis (18.71 to 43.08%) and dehiscence have been recorded between 10 am and 12 noon. The pollen fertility is higher in the beginning of the season. Honeybees, houseflies and wind do the pollination. The highest level of pollen germination in *jamun* may be obtained in 20 % sucrose solution (Singh, 1978). The maximum fruit set (32.6 to 36.0%) can be obtained when pollination is done one day after anthesis and thereafter, a sharp decline could be observed in fruit set. Fruit is berry, purplish red, ovoid, edible and polyembryonic.

Reproductive biology of *jamun* under semi arid ecosystem of western India

Month of February is the peak period for panicle emergence. Peak period of flowering and fruit set is observed in the month of March. Highest panicle length (16.24cm) and fruit set per panicle (25.00) have been recorded in GJ 19. Time taken for complete development of flower bud ranges from 20-26. Peak period of anthesis is observed between 8 AM- 1 PM. Anther dehiscence commences after opening of flowers i.e. at 7AM and continued till 4 PM. Peak period of dehiscence may be observed between 9 AM –2 PM. Pollen viability ranges from 90.20-98.50 %. Pollen germination and pollen length range from 24.00-37.50 % and 29.00-48.90 micron respectively.

Status of genetic diversity

A little work has been done to exploit the genetic resources of *jamun*. Now, the crop is facing severe genetic erosion of several species as a result of activities related to urbanization and intensive agriculture.

A number of seedling strains having a lot of variation in respect of fruit shape and size, pulp colour, TSS, acidity and earliness particularly in Uttar Pradesh, Gujarat and Maharashtra provide a good scope for selection of better varieties. The survey in Pune and Ahmednagar districts of Maharashtra revealed wide variation in fruit weight (3.5 to 16.5 g), pulp content (54.29-85.71 percent), TSS (4.5-17 percent) and acidity (0.16 – 0.55 percent) from where promising types No.15, 4,14 and 13 were identified (Keskar *et.al.*1989a). Ashraf (1987) reported that fruit shape in *jamun* varied from round to oblong and apex of fruits from flat to pointed. He also observed great variability in physico-chemical characteristic of fruits offering possibility of selecting a variety suitable for fresh market and processing. Small seed size, high pulp content with better chemical properties are considered ideal characteristics. Singh *et al;* (1999) evaluated eight genotypes of *jamun* under Faizabad conditions and reported that oblong types had more fruit weight and relatively less seed weight. Among the locally

available genotypes of jamun in West Bengal, Selection No.1 (oval shaped large fruit) and Selection No.2 (Cylindrical shaped medium sized fruit) proved to be better on the basis of yield and fruit quality attributes (Kundu *et al*, 2001). A survey was undertaken in the Karnataka state to investigate the nature and extent of variability present in *jamun* seedling progenies for morphological characters of tree. It was observed that there were high degree of variability regarding plant girth, leaf area, petiole length and leaf length to petiole length ratio (Prabhuraj *et al*; 2002). A survey was carried out in North Goa to identify the elite genotypes of *jamun* and individual fruit weight ranged from 3.42 to 13.67 g, length from 3.31 to 5.26 cm, girth from 5.21 to 9.82 cm, pulp percentage from 58.57 to 84.55, TSS from 12.00 to 26.80%, titratable acidity from 0.59 to 1.63 %, total sugars from 6.87 to 25.31 % and sugar: acid ratio from 15.39 to 27.92 (Devi *et al*; 2002). Patel *et al*, 2005 made a survey of Uttar Pradesh and Jharkhand and identified the elite genotypes among its population. The genotypes RNC-26 and RNC-11 were found to be promising and had higher pulp and fruit weight.

Singh and Singh, 2005 also made a survey in Gujarat to identify the elite genotypes among its population. Flowering, fruiting and physico-chemical attributes of ripened fruits from seventeen selected genotypes were studied. The study revealed that there was a wide variation among the genotypes. Earliest

flowering (Mid February) took place in GJ-24, and latest (Last March) in GJ-23, GJ-30, GJ-31, GJ-32 and GJ-33. Maximum panicle length (15.24 cm) and number of fruits per panicle (26.00) were found in GJ-19. Collection numbers GJ-19, GJ-21, GJ-22 and GJ-25 have been found earliest (First Week May) in ripening period, while GJ-17, GJ-28



Flowering in Jamun

and GJ-32 ripened at the last (Last June). Maximum yield per plant was recorded in GJ-19 (175.00 kg) followed by GJ-23 (170.00 kg), GJ-22 (160.00 kg)

and GJ-18 (150.00 kg). Individual fruit weight ranged from 10.10 to 22.50 g, length from 1.99 to 3.24 cm and pulp percentage from 73.66 to 85.68. There was a wide variation in chemical characters also. Total soluble solids varied from 10.30 to 12.34 %, total sugar 8.58 to 9.13% and vitamin C 32.12 to 46.37 mg/100g. On the basis of overall performance GJ-18, GJ-19, GJ-23, GJ-24 and GJ-25 were found to be promising among the genotypes studied based on its yield and physico - chemical characters.

Varietal wealth

Common cultivar grown under North Indian condition is "Ra-Jamun". It produces big sized (length 2.5-3.5 cm) and diameter (1.5 – 2.0 cm), oblong fruit, deep purple colour at fully ripe stage, Juicy and sweet in taste. Fruit ripens in June-July possesses small stone. Another late maturing variety bears a small sized (length 1.5-2.0 and diameter 1-1.5 cm), slightly round fruit, deep purple or blackish in colour at full ripe stage. The stone present in these cultivars is comparatively large in size. Fruits ripen in the month of August. The *jamun* is a fruit, which offers a good scope for selection of better varieties out of the innumerable seedling strains that are existence in this country.

Plant Propagation

(a) Propagation by seeds

The most common method of propagating this fruit tree is seed. *Jamun* seeds have no dormancy period, hence fresh seeds can be sown (within 10-15 days) 4 – 5 cm deep at a distance of 25 cm x 15 cm. The seeds germinate 10-15 days after sowing. The seedlings become ready for transplanting in spring or next monsoon. If the seeds are sown too deep, emergence of seedling is delayed and



Jamun Rootstocks

there may be poor rooting due to lack of aeration. Seeds may also be sown in polythene bags as it facilitates in easy handling of rootstocks and grafted plants. There is occurrence of Polyembryony in jamun up to 20-50 per cent; hence

nucellar seedlings may be used to produce true to type plants (Singh and Thakur, 1977). The seeds of *jamun* take 24 to 61 days for total germination under Bihar conditions (Singh and Thakur, 1977). Sasthri *et al.*, 2001 recorded that large sized seeds had higher germination (99-98 %) than small sized seeds (89-79 %).

(b)Vegetative propagation

Budding



Patch Budding

In India, shield, patch and Forkert methods of budding are generally employed. Patch budding has been found successful when performed in the month of June under Gujarat conditions (Chovatia and Singh, 2000). Singh and Singh, 2006 reported that patch budding was successful in the month of March under semi-arid environment of western India.

Soft wood grafting

Soft wood grafting method was proved to be better for *in situ* grafting under rain fed conditions. Madalageri *et al.*, (1991) reported that soft wood grafting was found successful method for multiplication of *jamun* under Karnataka conditions. Chovatia and Singh (2000) recorded 41.67 percent success through soft wood grafting during the month of June under Gujarat conditions. Soft wood grafting was found successful in the month of July- August under semi arid environment of western India (Singh and Singh, 2006).



Soft Wood Grafting

Use of polycontainers

Raising of rootstock in nursery beds and lifting budded plants with earth ball in highly sandy soils is practically not feasible. Transportation of plants from long distance may also cause high mortality, particularly under semi arid

and arid environment. To reduce the time for raising rootstock and to avoid damage during handling and transportation, polyethylene tubes and polyethylene bags may be used on commercial scale. Generally polyethylene bags (25cm x 15cm) are used for raising the rootstocks. Small holes are made in the bottom and sides of polyethylene bags for drainage and aeration and filled with porous rooting medium or pot mixture for raising rootstocks. Generally 1-2 seeds are sown in each polythene bags and then placed in trench bed, so that it can be irrigated easily. Some times coiling of root is become problem, hence root pruner is also used for trimming of roots.

Orchard establishment

Once the climate and soil requirements of *jamun* have been taken in to consideration, the next step is to layout the orchard. The land may be prepared by usual ploughing, harrowing and leveling. There should be a gentle slope to facilitate proper irrigation and prompt drainage to avoid the harmful effects of water stagnation during rainy season. *Jamun* may be grown under various cropping systems i.e. as an orchard crop in a pure land, as an agro forestry species in mixed cropping systems or as a hedgerow tree. After marking the places for the plants, pits of 90 x 90 x 90 cm are usually dug out during summer months. Digging of pits is very essential for heavy type of soil or soils with shallow hard pan. While digging, it is necessary to keep the topsoil and subsoil separately in two heaps near each pit for about 2-4 weeks. This helps in exposing harmful soil organisms to weathering agencies, providing better aeration in the future rooting zone and making provision for the nutritional requirements for the healthy development of the plants. Well-decomposed organic matter is mixed with soil and filled in pits. Planting is done during the rainy season after settling the soil in the pits. While planting, one should be careful that the earth ball does not break and graft union remains well above the ground level. The planting should preferably be done during cloudy weather and in the evening. The plants should be irrigated immediately after planting. In the initial 2-3 years, it is advisable to protect plants against low temperature injury by covering plants with some short



Experimental Plot



Farmer's Plot



Growth Pattern of Jamun Genotypes
(a) G.J. 1 & (b) G.J. 2



Fruits of genotype G.J. 2

of cover, leaving the eastern side open for entrance of light. Grafted saplings of *jamun* may be planted at the distance of 8 x 8 m to achieve optimum yield. It is frequently planted along land borders, canal banks, on field boundaries, in village groves or in home gardens as individual tree.

Irrigation management

Irrigation is not normally practiced in *jamun* cultivation, but it promotes better growth during establishment and the early stages of growth, especially during the dry seasons. In the early age, plants require 8-10 irrigations in a year, while bearing trees require 4-5 irrigations during the time of fruit development and ripening. In dry areas, the use of water harvesting techniques during the rainy season should be considered as it encourages subsequent growth and fruiting.

As soil moisture is one of the limiting factors for successful cultivation of *jamun*, use of mulch is very beneficial. It reduces the loss of moisture from the soil, enhances the rate of penetration of rainwater or irrigation in the soil and controls the growth of weed, thus eliminating the competition between weeds and the fruit trees. Mulching can be done with black polythene or any organic materials. In general, mulching with paddy straw reduces the weed population and conserves the moisture in the soil. However, it needs to be standardized under various agro - climatic conditions of the country.

Nutrient management

The exact doses and type of manures and fertilizers for *jamun* is yet to be worked out. Generally *jamun* trees are not manured however, an annual dose of about 20 kg of FYM during the pre-bearing period and 50-80 kg per tree to bearing trees is considered beneficial (Bose, *et al*; 2000). Apart from manure, 125 g N, 50 g P₂ O₅ and 50 g K₂O per plant per year may be applied. This dose should be increased every year in the same proportion up to 8th years, after which the fixed dose should be applied each year in two splits during June and September. It may vary according to the soil conditions.

Canopy management

Canopy management of the crop deals with the development and maintenance of their structure in relation to the size and shape for the maximum productivity and quality. The basic concept in canopy management of a perennial tree is to make the best use of the land and the climatic factors for an increased productivity in a three-dimensional approach. Tree vigour, light, temperature and humidity play a vital role in the production and quality of the fruits. The crux of the canopy management lies in the fact, as to how best we manipulate the tree vigour and use the available sunlight and temperature to increase the productivity and quality and minimize the adverse effects of weather parameters. Some of the basic principles in canopy management are (1) maximum utilization of the light (2) avoidance of the build up of microclimate congenial for the disease and pest (3) convenience in carrying out the cultural operations (4) maximizing the productivity and quality. Basically the training is a potential tool to manage the canopy architecture of the plant. Young plants should be allowed 3-5 well spaced branches to develop in to the main scaffold structure of the tree. Framework of branches is allowed to develop above 60-100 cm from the ground level. Pruning is a tool to regulate tree size and shape to achieve a desired architecture of the canopy and also to reduce the foliage density by removing the un productive branches of the tree. Regular pruning in *jamun* plant is not required, however dry, weak and diseased branches should be removed.

Weed management

Productivity of Indian orchards can be increased only when all the aspects of production technology including weed management are given due consideration. Weeds injure crops very slowly in a subtle way. Most weeds complete their life cycle in a shorter time compared to the fruit trees and compete for light, water and mineral nutrients and reduce yields. In the orchard, hoeing, hand weeding and ploughing the land 2-3 times a year is done to suppress weed growth. Intercropping and mulching may also be followed to control weeds.

Maturity indices

Optimum stage of maturity has been worked out based on physical and chemical composition of the fruit. In *jamun*, Shukla (1979) recorded three distinct phases of fruit growth viz, during the first phase, the rate of growth was slow (15-52 days after fruit set), in the second phase (52-58 days after fruit set), the rate of development was quite rapid and the third and last phase (58-60 days after fruit set) comprised slower growth with little increase in fruit weight, moisture content, total and reducing sugars. Shukla and Prasad (1980) studied the respiration rate in developing fruits of *jamun* at frequent intervals from 15 to 61 days after fruit set. Initially respiration rate (15-30 days) declined, rose again at 56 days (climacteric peak) and again declined until harvest maturity at 60 days after fruit set. Geetha *et al*; 1992 reported that *jamun* fruit followed a sigmoidal curve with the first phase (7-14 days after fruit set), the second phase (14-35 days after fruit set) and the last phase (35-42 days after fruit set). They also confirmed that fruit length, fruit weight, fruit volume and moisture content increased during maturation of *jamun* fruit. The total soluble solids, total and reducing sugars showed a continuous increase as the fruits developed with a marked increase during ripening. A similar trend was also exhibited by the moisture content and acidity. There was a gradual decrease in tannins whereas pectin rose and then fell during the growth period. TSS: acid ratio and anthocyanin content followed an increasing trend with advancing maturity and markedly increased during ripening (Garande *et al*; 1998). Singh *et al*, 2006 observed that the fruit growth was faster initially and slowed down while reaching towards maturity stage and followed sigmoid growth pattern in all the genotypes of *jamun*. The specific gravity showed increasing trend (more than one) in all the genotypes during development. Total soluble solids, total sugar and vitamin C increased as the fruits reached towards the maturity. Titratable acidity showed declining trend while reaching towards ripening stage. Deep purple colour on fruit surface was observed in all the genotypes during ripening.

Harvesting and yield

The seedling *Jamun* plants starts bearing after 8-10 years of planting while grafted ones after 4-5 years. The fruit ripens in the month of June –July. The main characteristic of ripe fruit at full size is deep purple or black color. The *jamun* fruit should be picked immediately when it ripens, because it cannot be retained on the tree at the ripe stage. The ripe fruits are picked by hand and in all cases care should be taken to avoid all possible damage to fruits. Bamboo pegs are used for harvesting of the fruits. The fruits of *jamun* is generally harvested daily and send to market on the same day. The average yield of fruit from a full-grown seedling *jamun* tree is about 80-100 kg and from a grafted one 60-70 kg per year.



Harvesting Method



Jamun Fruits for Sale

Post harvest handling

Sorting

On arrival in the packing area, the *jamun* should be sorted to cull out the undersized, damaged and bruised fruits to avoid further spoilage loss.

Grading and packaging

Considerable variation exists in the quality of harvested fruit due to genetical, environmental and agronomic factors and therefore requires grading to get suitable returns from the market. Systematic grading coupled with the scientific packaging and storage reduces the post harvest losses and marketing costs substantially, which enables the producer to fetch a competitive price. *Jamun* should be graded on the weight basis to fetch better price in the market.

Packaging is a vital component of post harvest management to assemble the produce in convenient units and to protect it from deterioration during handling and marketing. Adequate packaging protects the fruits from physiological, pathological and physical deterioration in the marketing channels and retains their attractiveness. Jamun fruits are highly perishable and are normally packed in bamboo baskets for transport to local market. Physiological loss in weight, shriveling, discolouration and rotting were minimum when packed in bamboo baskets using leaves as liner. Fruits prepacked in leaf cups covered with perforated polythene shows less loss in weight and shriveling and better maintenance of appearance as compared with the conventional prepackaging only in green leaf cups (Singh and Pathak, 1988). Depending upon the distance to be covered, *jamun* fruits are transported as head loads, trucks and train. Among different types of containers shallow plastic crates are better during transportation of the fruits from field to market to prevent bruising losses. Gunny bag should not be used as they do not protect the fruits from mechanical damage. Care should be taken not to over fill or under fill the boxes to avoid damage during transport. It is advisable to transport in the cooler part of the day to avoid heat damage. Small size (2-3 kg capacity) corrugated fiberboard boxes may be used for transportation to distant markets.

Storage

The *jamun* fruit is highly perishable and can be kept in good condition for about 2-3 days under ordinary condition. Shukla (1979) observed that pre cooled fruits packed in perforated polythene bags could be stored well up to 3 weeks at low temperature 8 - 10°C and 85 - 90% relative humidity. Ethanol-treated fruits stored in polyethylene bags at 10°C were completely deastringent after 9 days of storage (Mohammed and Wickham, 1999).

Plant protection

Insect pest management

Leaf eating caterpillar (*Corea subtilis*):

Caterpillars attack the leaves and tree becomes defoliated. To control this pest, spray Rogar 30 EC 0.1 per cent or Malathian 0.1 per cent.

White fly (*Dialeurodes eugenia*)

It damages the tree in all over India. Affected fruits get wormy appearance on the surface. It can be controlled by maintaining sanitary situation in the orchard, which consist of picking up the affected fruits and burying them deep in the soil and area under the tree should be dug, so that the maggots in the affected fruits and the pupae hibernating in the soil may be destroyed.

Bark eating caterpillars (*Indarbela tetraonis* and *Indarbela quadrinotata*)

The larva feeds on the live bark tissues, shelters under the covering of silken webbing during night. Latter makes a tunnel in to the branch and stem and remain in the hole during day time. As a result, the tree looses vitality and yield declines. It can be controlled by maintaining sanitary situation in the orchard and petrol should be injected in the hole and be plugged. Foliar sprays with Dimethoate (0.05%) or Monocrotophos followed by endosulfan (0.07%) at tri weekly interval control the pest effectively.

Jamun leaf miner (*Acrocercops syngamma* and *Acrocercops phaeospora*):

This pest causes damage during reproductive phase i.e from April – September. The newly hatched caterpillar mines a narrow thread like silvery gallery on the leaf along the midrib upwards or latterly. The larval mine latter on is transformed in to a tubular blister- like swelling on the dorsal surface of the leaf. The pest can be controlled by clipping and burning of affected leaves followed by spraying of dimethoate30 EC (1.2 ml/ liter water).

Jamun leaf roller (*Polychorosis cellifera*):

The larvae web the leaves by folding the tip downwards on both the margins parallel to the mid-rib and feed inside. In case of severe attack 1/4th of the lamina is eaten up. The pest undergoes 3-4 generations between March - April and September – October in North India and second generation is most harmful. Regular clipping and burning of affected leaves can keep the population under control. In case of severe attack, spraying with chlorpyriphos 20 EC (2ml/l) or endosulfan 35 EC (2ml/l) is recommended.

Leaf Webbers (*Argyroploce aprobola* and *Argyroploce mormopa*)

The newly hatched larvae in large numbers web together the tender leaves at shoot tips and feed within. Regular clipping and burning of affected leaves can keep the population under control. In case of severe attack, spraying with chlorpyrifos 20 EC (2ml/l) or endosulfan 35 EC (2ml/l) is recommended.

Birds also damage the *jamun* fruits. For keeping them away, beating of drum or flinging stones is found useful.

Disease management**Anthraxnose**

The fungus incites leaf spot and fruit rot. Affected leaves show small-scattered spots, light brown or reddish brown in colour. Affected fruits show small, water soaked, circular and depressed lesions. Fruits rot and shrivel. This disease can be controlled by spraying of Dithane Z-78 @ 0.2 %.

References

- Anonymous (1986). Research Highlight, 1985, ICAR, New Delhi, P.27.
- Ashraf, S.M. (1987). Studies on post harvest technology of jamun fruits. Ph. D. thesis, Department of Horticulture, NDUAT, Kumarganj, Faizabad.
- Bailey, L.H. and Baily, E.J. (1978). Hortus Third- A concise dictionary of plants cultivated in the United States and Canada. MacMillan Publishing Co., Newyork, PP. 457-58.
- Bose, T.K., mitra, S. K. and Sanyal, D. (2000). Fruits: Tropical and Subtropical Vol. II, Pub. Naya Udyog, 206, Bidhan Sarani, Calcutta, India. PP. 643-56.
- Chovatia, R.S. and Singh, S. P. (2000). Effect of time on budding and grafting success in jamun (*Syzygium cuminii* Skeels). *Indian Journal of Horticulture*. 57 : 255-258.
- Chundawat, B.S. (1990). Arid Fruit Culture, Pub. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, PP. 165-171.
- Devi, S.P., Thangam, M., Desai, A.R. and Adsule, P.G. (2002). Studies on variability in physico- chemical characters of different *jamun* (*Syzygium cuminii* Skeels) accessions from Goa. *Indian Journal of Horticulture*. 59 : 153-156.

- Garande, V.K., Joshi, G.D. and Wasker, D.P. (1998). Studies of changes in chemical composition during growth and development of jamun fruit. *Orissa Journal of Horticulture*. 26 : 76-78.
- Geetha, C.K., Babylata, A.K., Methew, K. L. and George, S.T. (1992). Fruit development in jamun (*Syzygium cuminii* Skeels). *South Indian Horticulture*. 40 : 350-351.
- Hebbara, M., Manjunatha, M.V., Patil, S. G. and Patil D.R. (2002). Performance of fruit species in saline- water logged soils. *Karnataka Journal of Agricultural Sciences*. 15 : 94-98.
- Keskar, B.G., Karale, A. R., Dhawale, B. C. and Chaudhary, K. G. (1989a). Improvement of Jamun (*Syzygium cuminii* Skeels) by selection. *Maharashtra Journal of Horticulture*. 4:117-20.
- Kundu, S., Ghosh, D.K. and Maiti, S. C. (2001). Evaluation of some local types of jamun (*Syzygium cuminii* Skeels) of West Bengal. *Environment and ecology*. 19 : 872 – 874..
- Madalageri, M. B., Patil, V. S. and Nalawadi, U. G. (1991). Propagation of jamun (*Syzygium Cuminii* Skeels) by soft wood wedge grafting. *My Forest*. 27 : 176-178.
- Mishra, R.S. and Bajpai, P.N. (1971). Vegetative growth studies in the jamun. *Indian Journal of Horticulture*. 28 : 273-277.
- Mohammed, M. and Wickham, L. (1999). Effect of modified atmosphere packaging and ethanal on the destringency process in Jamun (*Syzygium cuminii* Skeels) fruit. *Journal of Applied Horticulture*. 1 :105-107.
- Patel, V.B., Pandey, S.N., Singh, S.K. and Das Bikash (2005). Variability in jamun(*Syzygium cuminii* Skeels) accessions from Uttar Pradesh and Jharkhand. *Indian Journal of Horticulture*. 62 : 244-247.
- Prabhuraj, H.S., Swamy, G.S.K., Athani, S.I., Patil, B.R., Hulamani, N.C. and Patil, P. B. (2002). Variability in morphological characteristics of Jamun (*Syzygium Cuminii* Skeels) trees. *My Forest*. 38 : 187-189.
- Prince, P.S.M., Kamalakkanan, N. and Menon, V.P. (2003). *Syzygium cuminii* Skeels seed extracts reduce tissue damage in diabetic rat brain. *Journal of Anthropology*. 84 :205-209.
- Sasthri, G., Srimathi, P. and Malarkadi, K.(2001). Effect of seed size on seed quality in jamun (*Syzygium cuminii* Skeels). *Madras Agricultural Journal*. 88 : 524-526.
- Shukla, J. P. (1979). Ph.D. Thesis, Department of Horticulture, CSA University of Agriculture and Technology, Kanpur.

- Shukla, J. P. and Prasad, A. (1980). Changing pattern of jamun fruit during growth and development III. Changes in respiratory activity. *Progressive Horticulture*. 12 : 71-73.
- Singh, G., Dagar, J. C. and Singh, N. T. (1997). Growing fruit trees in highly alkaline soils- a case study. *Land Degradation and Development*. 8: 257-268.
- Singh, H.L. (1978). Studies o pollen germination in jamun (*Syzygium cuminii* Skeels). *Plant Science*. 10:151-152.
- Singh, I.S. (2001). Minor fruits and their uses. *Indian Journal of Horticulture*. 58 : 178-182.
- Singh, I.S. and Pathak, R.K. (1988). Packing of Jamun, Aonla and Bael fruits. A Souvenir on packing of fruits and vegetables in India. Agri- Horticultural Society Publication Hyderabad. P. 108-11.
- Singh, I.S., Srivastava, A.K. and Singh, V. (1999). Improvement of some under utilized fruits through selection. *Journal of Applied Horticulture*. 1:34 - 37.
- Singh, R.K. and Thakur, S. (1977). Seed germination and seedling growth of jamun (*Syzygium cuminii* Skeels) types. *Proceedings of Bihar Academy of Agricultural Sciences*. 25 :139-142.
- Singh, Sanjay and Singh, AK (2005). Genetic variability in jamun (*Syzygium cuminii* Skeels) in Gujarat. *Progressive Horticulture*, 37:44-48.
- Singh, Sanjay and Singh, AK (2006). Standardization of method and time of propagation in Jamun (*Syzygium cuminii*) under semi- arid environment of western India. *Indian Journal of Agricultural Sciences*, 76:242-45.
- Singh, Sanjay, Singh, AK, Joshi H. K., Bagle, B.G. and Dhandar, D.G. (2006). Developmental pattern and standardization of maturity indices in jamun(*Syzygium cuminii* Skeels) under semi arid ecosystem of western India. National symposium on production, utilization and export of under utilized fruits with commercial potentialities, 22-24th November, 2006 at BCKV, Kalyani, West Bengal, pp114.
- Vashishtha, B. B. (1991). Lecture delivered in Summer Institute on Fruit Production and Utilization in Wastelands; NDUAT, Faizabad, June, 24 to July,12,1991.

