

Cultivar Bhagwa: Revolutionizing Pomegranate Scenario in India



All Indian Coordinated Research Project on Arid Zone Fruits
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Summary

Indian Council of Agricultural Research (ICAR) established All India Coordinated Research Project on Arid Zone Fruits (AICRP on AZF) during 1976 which was subsequently attached with ICAR-Central Institute for Arid Horticulture, Bikaner (Rajasthan) in 1993 to develop region specific varieties and technologies on arid zone fruits. At present, there are 18 centres of AICRP on AZF located in different parts of arid and semi-arid regions of the country. One of the coordinating centres located at Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri (Maharashtra) was involved for dedicated research on arid fruits like pomegranate, custard apple, tamarind, ber, and aonla. The intensive research efforts under ICAR-AICRP on AZF at MPKV, Rahuri has resulted in release of a wonderful pomegranate cultivar namely 'Bhagwa' during 2003-04, which is soft seeded with attractive saffron colour rind and dark red aril colour. The average yield is 30-40 kg fruits/ plant and 12.20 t/ha under normal planting density (500 plants/ha). However, under high density planting (1000 plants/ha) and with drip fertigation as well as adoption of good horticultural practices, farmers are harvesting fruits upto 25-30 tonnes/ha with net return of ₹ 3.66 lakhs/ha. The cultivar Bhagwa became highly popular among farmers of Maharashtra over earlier developed varieties like, Ganesh, Mridula, Phule Arakta, Ruby and Jalore Seedless and contributing about 92% of the total production of pomegranate in Maharashtra. Now, it is spreading in other pomegranate growing states too.

The cultivar Bhagwa brought revolution in pomegranate cultivation in India. The share of cultivar Bhagwa alone is 86.10% and 88.40% in total pomegranate area and production, respectively. Out of total area under pomegranate (2.16 lakh hectares), Bhagwa alone occupies 1.86 lakh hectare and contributes 22.29 lakh tonnes of total pomegranate production (25.21 lakh tonnes) in India (2016-17). Out of total export of pomegranate (49760 tonnes/year), about 39808 tonnes/year alone comes from cultivar Bhagwa, which fetched ₹ 597.12 crore/ annum of foreign exchange to the country. After release of cultivar Bhagwa during 2003-04, there is an increase of 121.43% in area, 279.09% in production, 70.55% in productivity and 381.42% in export quantity of pomegranate (2016-17) in India. Thus, as an estimate, cultivar Bhagwa alone is contributing ₹ 8220.12 crore/ annum to the national economy (₹ 7623 crore from domestic market + ₹ 597.12 crore from export to International market).

Introduction

Though, pomegranate (*Punica granatum* L.) is an exotic fruit which is native to Iran but naturalized so much in India that today the best quality fruits are produced in this country. It is widely cultivated throughout the Middle East and Caucasus region,



north and tropical Africa, the Indian subcontinent, Central Asia, the drier parts of southeast Asia, and parts of the Mediterranean Basin. In India, pomegranate cultivation has attained considerable importance because of their wide edaphoclimatic adaptability, high monetary returns, consumers awareness about its innumerable health benefits, as it is rich in vitamins, minerals, protein and polyphenols which have free-radical scavenging properties. Thereby, pomegranate has gained reputation as "Super Fruit". India ranks first in pomegranate area and production at global level but average productivity of Spain and USA (> 18 tonnes/ha) is more than India (11.70 tonnes/ha). Besides, other factors, the productivity of any crop largely depends on inherent production potential of a variety and good horticultural practices. Although, more than 50 pomegranate varieties/cultivars have been identified from different organizations so far, but real boost in cultivation of pomegranate was achieved with the release of new pomegranate cultivar in 2003-04 named as 'Bhagwa'. This was due to its unique fruit and aril colour, flavour and aroma and better keeping quality. All these features made it popular in domestic as well as in International market. After release of cultivar Bhagwa, the pomegranate cultivation in India has picked up steadily and area under pomegranate has increased from 0.97 lakh hectare (2003-04) to 2.16 lakh hectare (2016-17). Total production and export of pomegranate have also gone up. The impact made by cultivar Bhagwa in changing scenario of pomegranate cultivation in India is enumerated here under:

About Bhagwa

The cultivar Bhagwa was identified by ICAR-All India Coordinated Research Project on Arid Zone Fruits centre located at Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra) during 2003 and released for commercial cultivation in 2004 after presentation and detailed discussion during Biennial Group Workers Meeting of AICRP on AZF held at ND University of Agriculture and Technology, Faizabad (UP). The cultivar is also known by various names among growers viz., Shendri, Asthagandh, Kesar, Jai Maharashtra, Red Diana, Mastani in Maharashtra and extensively grown in Solapur, Nasik, Sangli, Satara, Ahmednagar, Pune and Dhule districts. The plant of Bhagwa cultivar is spreading type, evergreen bush with dark green foliage and spiny branches. The leaves are opposite, ovate and lanceolate. The flowers are dark saffron colour borne terminally or auxiliary in single or cluster. There are three sex forms of flowers viz., male, hermaphrodite and intermediate. It flowers in all the three flowering seasons/*bahars* (*Ambe*, *Mrig* and *Hastha*).



The fruits are very attractive having smooth glossy dark saffron thick rind with dark red colour, bold arils and soft seeds and hence fetches very good price in the market. The fruits of Bhagwa is in high demand both in domestic and export market. It is suitable for long distance market as it has thick rind and better keeping quality (15-20 days at ambient conditions). It is a late maturing cultivar, which takes 180-190 days for maturity. Fruits are medium to large in size (average weight 405.97 g). The average yield under drip is 30-40 kg fruits/ plant. Under high density orcharding and good horticultural practices, farmers are harvesting fruits to the tune of 25-30 tonnes/ha. Arils are sweet in taste with dark red colour having 15.38% T.S.S. and 0.37% acidity. Because of the attractive fruit and aril colour and excellent quality, it fetches better market price which is 2-3 times higher than that of Ganesh. There is a high demand of Bhagwa for export markets particularly in European countries. The cultivar is less susceptible to fruit cracking and fruit spot (PDI-4.68), relatively free from blackening of aril and tolerant to thrips and mites. The detail description of cultivar Bhagwa and its physio-chemical characteristics of fruits are given in Annexure-I and Annexure-II (Source: QRT Report of AICRP on AZF: 1999-2004).

Why Bhagwa?

- Very attractive, saffron coloured with glossy fruit surface is eye catching; thereby becoming consumers' first choice.
- Large fruit size ($405.97 \text{ g} \pm 70.40$); soft seeds, bold and dark red arils, which are sweet in taste, thus suitable for both domestic and export markets.
- Matures in 180-190 days with average yield of 30-35 kg fruit/tree.
- Excellent fruit quality with high antioxidant value and suitable for both table and processing purposes.
- Better keeping quality than other varieties (15-20 days under ambient conditions).
- Because of thick rind, it is suitable for transport to distant markets.
- Less susceptible to fruit spots and thrips as compared to other varieties, which reduces the number of pesticides sprays.
- It fetches better market prices, which is 2-3 times higher than that of earlier popular variety Ganesh.
- Heavy demand for export markets, particularly in United Kingdom, Holland, other European and Gulf countries etc.



Status of cultivar Bhagwa

Pomegranate (*Punica granatum* L.) is grown in tropical and subtropical regions of the country. The total area under cultivation of pomegranate in India is 2.16 lakhs ha with total production of about 25.21 lakh metric tonnes (2016-17). Maharashtra is the leading producer in the country having around 1.75 lakh ha area with a production of 18.50 lakh metric tonnes followed by Karnataka, Telangana, Gujarat, Andhra Pradesh and Rajasthan. In India, pomegranate is commercially cultivated in Solapur, Sangli, Nasik, Ahmadnagar, Pune, Dhule, Aurangabad, Satara, Osmanabad and Latur districts of Maharashtra; Bijapur, Belgaum and Bagalkot districts of Karnataka; Anantapur in Andhra Pradesh, Banaskantha, Bhavnagar and Ahmedabad in Gujarat; Sirohi, Jalore, Jodhpur, Barmer and Sikar districts of Rajasthan.

There is substantial increase in area of pomegranate cultivation in India from 1.1 lakh ha in 2011-12 to 2.16 in 2016-17 and total production also increased from 7.7 lakh tonnes in 2011-12 to 25.21 lakh tonnes in 2016-17 (NHB, 2016-17). The state of Maharashtra alone contributes 66.21% of total pomegranate production followed by Karnataka (20%), Gujarat (9%) and Andhra Pradesh and Telangana (5%). The details of area, production and productivity of pomegranate are given in Annexure III & IV.

The total area under pomegranate cultivation in India is 1.94 lakh hectares of which cultivar Bhagwa alone occupies 1.67 lakh hectares (2014-15). Similarly, it contributes 18.52 lakh tonnes out of total production of 20.94 lakh tonnes. The productivity of pomegranate has tremendously increased from 6.86 t/ha (2003-04) to 11.70 t/ha (2016-17). The estimates of area and production of cv. Bhagwa is given in Table 1. The popularity of this variety in 2016-17 can be adjudged through unprecedented increase in area (123%), production (280%), productivity (70%) and export (380%) under pomegranate in comparison to 2007-08 when the orchards of Bhagwa cultivar came into full bloom.

Table 1. Estimates of area and production of cultivar Bhagwa in India (2014-15)

| States | Area ('000 ha) | | Production ('000 tonnes) | |
|----------------------------|----------------|--------|--------------------------|---------|
| | Total area | Bhagwa | Total production | Bhagwa |
| Maharashtra | 142.20 | 127.98 | 1625.90 | 1495.83 |
| Karnataka | 19.00 | 14.25 | 204.60 | 153.45 |
| Andhra Pradesh + Telangana | 15.80 | 11.06 | 110.90 | 78.0 |
| Gujarat | 9.40 | 8.46 | 99.30 | 84.40 |
| Rajasthan | 1.30 | 0.91 | 6.10 | 4.27 |
| Others | 6.50 | 4.55 | 48.00 | 36.0 |
| Total | 194.20 | 167.21 | 2094.80 | 1851.95 |

The fruits of pomegranate are almost available in the market round the year. With the adoption of bahar treatment, its harvest can be tailored according to demand in the market, however, on the basis of standard bahars, major production comes in the market as given below:

| Sr. No. | Bahar | Flowering time | Period of harvest |
|---------|--------------|------------------|-------------------|
| 1 | <i>Mrig</i> | June-August | November -March |
| 2 | <i>Hasta</i> | October-November | February-May |
| 3 | <i>Ambe</i> | January-February | June-August |

Harvesting season of pomegranate is depicted in fig. 1. By adopting proper bahar treatments, pomegranate in Maharashtra and Gujarat states is available round the year.

| State | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Maharashtra | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Karnataka | | ■ | ■ | | | | | | | | | |
| AP+TL | | | | ■ | ■ | | | | | | | |
| Gujarat | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

Fig. Fruit harvesting season of pomegranate in different states.

Export of pomegranate

There is a tremendous potential for exports of pomegranate from India. It is pertinent to mention that India is not only largest producer of pomegranates in the world but also produces the finest edible quality which are available almost throughout the year. The major destinations of pomegranate exports are UK, Holland, European, Gulf and SAARC countries. The year wise quantity of export and export earning of foreign exchange is given in table 2. The total export of pomegranate has increased from 6303 tonnes (2002-03) to 49760 tonnes (2016-17), which is about 8 times in a period of 15 year. The total export of pomegranate is almost continuously increasing with exception during 2010-11. The country wise export and their value are given in table 3.



Out of the total export of pomegranate, about 39808 tonnes alone comes from cultivar Bhagwa, which gives about ₹ 597.12 crore foreign exchange to the country. There was a quantum jump in pomegranate export after release of Bhagwa cultivar (2003-04), which came in to full bearing after 2007-08. Besides Bhagwa, other cultivars like Ganesh, Phule Arakta, Ruby, Mridula, *etc.* are also exported to a limited extent. After release of cultivar Bhagwa during 2003-04, there is an increase of 121.43% in area, 279.09% in production, 70.55% in productivity and 381.42% in export quantity of pomegranate (2016-17) in India (Fig. 2).

Table 2: Export of pomegranate and export value during 2002-03 to 2016-17.

| Year | Quantity (Tonnes) | Value (in ₹ lakh) |
|---------|-------------------|-------------------|
| 2002-03 | 6303 | 1430 |
| 2003-04 | 10336 | 2109 |
| 2004-05 | 12035 | 2590 |
| 2005-06 | 19652 | 5670 |
| 2006-07 | 21670 | 7960 |
| 2007-08 | 35175 | 9119 |
| 2008-09 | 34811 | 11461 |
| 2009-10 | 33415 | 11942 |
| 2010-11 | 18212 | 7095 |
| 2011-12 | 30159 | 14727 |
| 2012-13 | 26030 | 23450 |
| 2013-14 | 31330 | 29850 |
| 2014-15 | 20997 | 32361 |
| 2015-16 | 31072 | 41600 |
| 2016-17 | 49760 | 49042 |

(Source: <http://nhb.gov.in> and <http://agriexchange.apeda.gov.in>)

Table 3: Country wise export of pomegranate from India

| Country | 2008-09 | | 2011-12 | | 2014-15 | | 2015-16 | | 2016-17 | |
|--------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|
| | Quantity (tonnes) | Value (₹ lakh) | Quantity (tonnes) | Value (₹ lakh) | Quantity (tonnes) | Value (₹ lakh) | Quantity (tonnes) | Value (₹ lakh) | Quantity (tonnes) | Value (₹ lakh) |
| UAE | 17350 | 5170 | 15900 | 6416 | 11277 | 19760 | 17320 | 25380 | 20953 | 25275 |
| Bangladesh | 4784 | 468 | 4593 | 2384 | 521 | 283 | 2650 | 572 | 12058 | 3303 |
| Netherland | 2568 | 1985 | 733 | 1028 | 586 | 1503 | 1032 | 2130 | 1316 | 2917 |
| Saudi Arabia | 1790 | 628 | 2197 | 870 | 1563 | 2059 | 2558 | 3176 | 2664 | 3040 |
| Nepal | 1448 | 157 | 1438 | 247 | 2108 | 877 | 1483 | 426 | 4878 | 1501 |
| UK | 973 | 1051 | 891 | 975 | 303 | 1408 | 180 | 872 | 345 | 1819 |
| Kuwait | 506 | 222 | 490 | 236 | 914 | 1024 | 871 | 1074 | 1187 | 1508 |
| Oman | 416 | 152 | 392 | 199 | 341 | 530 | 313 | 495 | 452 | 645 |
| Thailand | 280 | 196 | 298 | 311 | 327 | 649 | 582 | 1109 | 687 | 1384 |
| Others | 3254 | 1914 | 3230 | 2062 | 3057 | 4268 | 4083 | 6366 | 5217 | 7650 |
| Total | 33369 | 11943 | 30162 | 14728 | 20997 | 32361 | 31072 | 41600 | 49757 | 49042 |

During 2002-2015, the annual average wholesale prices of pomegranate fluctuate in International market, around € 2.0-3.75/ kg (₹ 150-285/kg). During the months of January to March, it increases roughly by € 0.3/kg during January, € 0.75/kg during February and by more than € 1.5/kg during March.

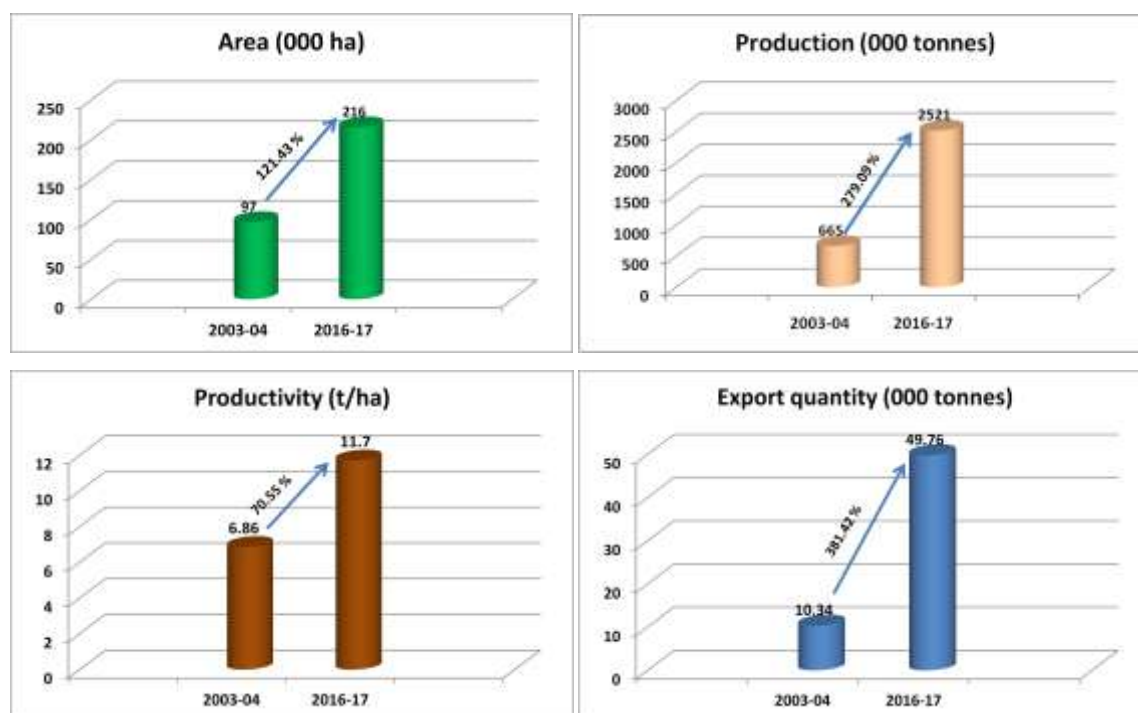


Fig 2. Per cent increase in area, production, productivity and export of pomegranate from 2003-04 to 2016-17 (2003-04 is considered as the base year when cultivar Bhagwa was released).

Description of grades

Details of grade designation and sizing of pomegranate as per AGMARK standard are as under:

| Grade | Grade Requirements | Grade tolerance |
|-------------|--|--|
| Extra class | Fruits must be of superior quality, furnish shape and colour of typical variety. Fruit must be free of defects | 5% by number of class I |
| Class I | Fruits of good quality, must have characteristics of variety. Slight defects, which does not affect the appearance, quality and presentation can be kept | 10% by number of class II |
| Class II | Fruits not included in higher class but satisfying the minimum requirements. | 10% by number or weight not satisfying the requirement of this grade |

The fruits of cultivar Bhagwa, in general comes under A and B size grades, which fetches premium price in International market. The size code specifications for pomegranate is given below.

| Size code | Weight in g (minimum) | Diameter in mm (minimum) |
|-----------|-----------------------|--------------------------|
| A | 400 | 90 |
| B | 350 | 80 |
| C | 300 | 70 |
| D | 250 | 60 |
| E | 200 | 50 |

Export potential

- India is the largest producer of pomegranate in the world.
- India produce the finest varieties of pomegranate having soft seeds, less acidic with attractive colour of arils and fruit rind.
- With adoption of different *bahars*, India can supply fruits throughout the year.
- Maximum cultivation of pomegranate are close to the western port of Mumbai for exporting to Gulf and European countries.
- Agri-Export Zone has been established in Maharashtra state.
- Establishment of Pomegranate Cooperative Society.
- Bhagwa cultivar has high acceptance in European and other International markets.

Measures for enhancing competitiveness for export

Following measures if adopted are likely to enhance competitiveness of Indian pomegranate in foreign market:

- Competition of India with regards to export is with countries like Spain and Iran which are nearer to European countries, hence efforts needed to reduce the production cost by increasing productivity.
- Pack house facilities need to be established in pomegranate growing areas.
- Pomegranate supplies from Spain and Iran to European countries taper from January onwards, therefore, India needs to concentrate during February to July months with the help of *Hasta* and *Ambe bahar*.
- Efforts need to be made to popularize pomegranate in Canada, USA, Australia, Korea and Japan.

Rapid area expansion of Bhagwa through tissue culture

The conventional methods of pomegranate propagation are by cuttings and layerings, which are not only less efficient but have their own limitations to produce clean and disease free planting materials. The plants propagated by these methods are under high risk of transmitting pests and diseases across the pomegranate growing states, if already affected. In order to ensure quality planting materials, which are true-to-type, free from pests and diseases (particularly bacterial blight and wilt) and as per standard as well as to cater the need of rapid area expansion under pomegranate; *in vitro* protocol for cultivar Bhagwa has also been standardized. The technology offers an advantage of producing large scale quality planting materials over conventional methods. The private firm like Jain Irrigation System Ltd., Jalgaon, Maharashtra has started commercial micro-propagation of pomegranate plants of cultivar Bhagwa from the year 2008, which resulted into rapid expansion of area under Bhagwa cultivar mainly in Maharashtra. Now, the tissue culture plants of Bhagwa are preferred in all pomegranate growing states like Karnataka, Andhra Pradesh, Telanagana, Gujarat, Rajasthan, Madhya Pradesh, Tamil Nadu, *etc.* Only Jain Irrigation System Ltd., Jalgaon a single agency is supplying more than 70 lakhs plants every year (2016-17) to the growers. The data depicted in fig. 3 indicate that the demand for tissue culture plants are almost increasing continuously. The organizations like ICAR-NRC on Pomegranate, Solapur (Maharashtra) is also supplying quality planting materials of pomegranate.

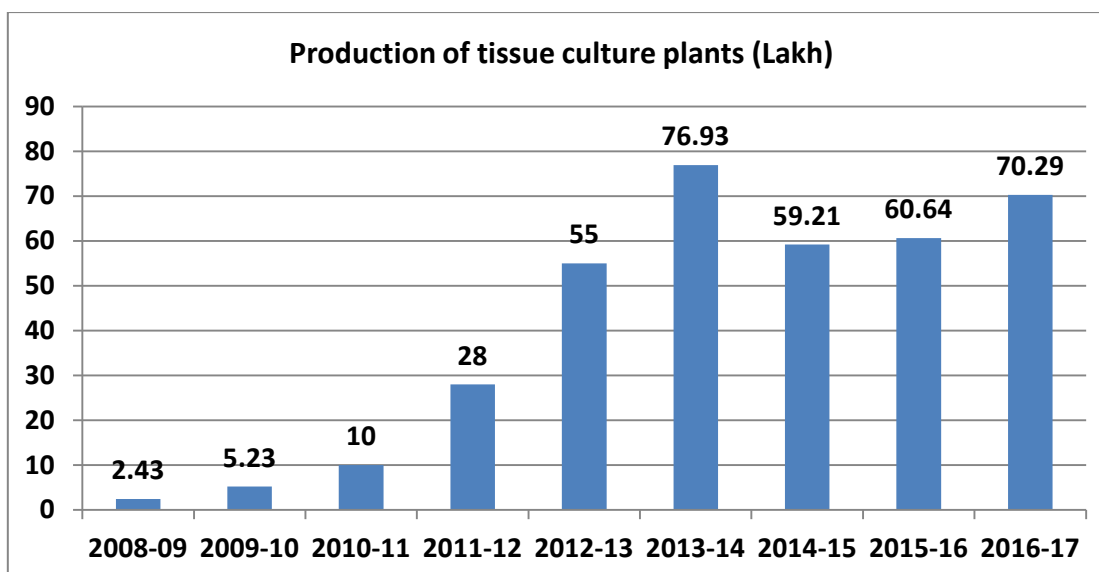


Fig. 3 Pomegranate tissue culture planting materials produced by Jain Irrigation System Ltd., Jalgaon

Bhagwa in arid and semi arid regions

- As per NHB database (2014-15), the area under pomegranate in Rajasthan is only 1300 ha but as on date it is more than 14,000 ha and most of the new plantations are of cultivar Bhagwa only.
- Almost all upcoming block plantations of pomegranate in Rajasthan and Gujarat are developed by tissue culture only indicating better prospect in arid and semiarid regions.
- Fruit cracking in cultivar Bhagwa is not reported from Maharashtra and other pomegranate growing states but in hot arid region of Rajasthan, some extent of fruit cracking has been noticed.
- In hot arid region, moderate reduction in fruit size and weight of Bhagwa have also been encountered.
- The problem of nematode is also observed in old plantations of pomegranate in arid region.

Economic analysis

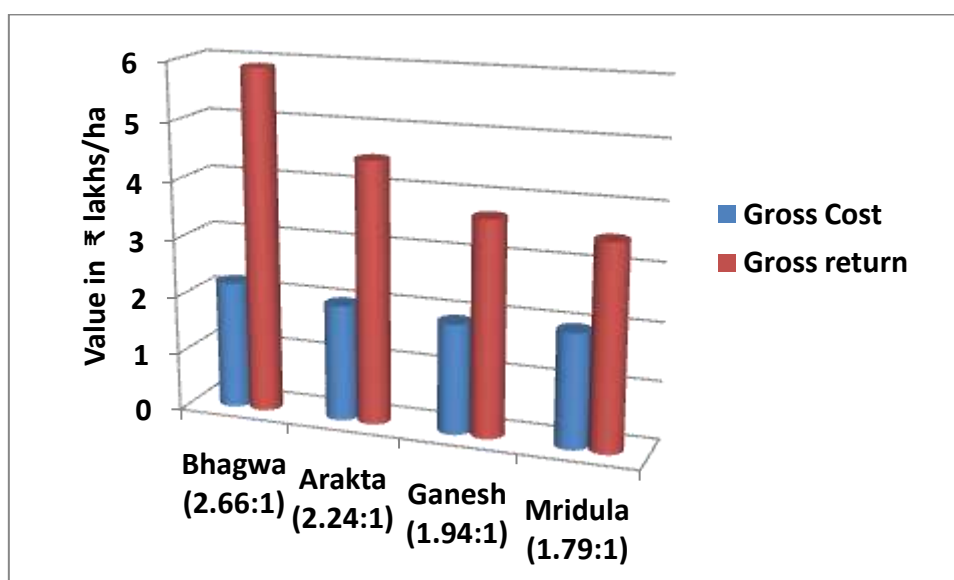
Pomegranate is considered as one of the most remunerative horticultural crops of India. At present, more than 1.2 lakhs farm families are earning their livelihood from pomegranate besides, large number of personnel are involved in processing, packaging and trade of pomegranate. The cost of cultivation depends upon the prevailing rates of inputs and output as well as management system of orchards. Though, Bhagwa is a heavy

yielder, the main limitation is longest maturity period, thereby the cost of cultivation is little higher than Ganesh, Mridula and Arakta. In spite of that under high density planting and drip irrigation, the highest net income of ₹ 3.66 lakhs/ha was realized from Bhagwa cultivation. The study conducted by MPKV, Rahuri revealed that the income of pomegranate growers has increased from ₹ 0.50 lakhs/ha/annum (1990) to ₹ 6.60 lakhs/ha/annum (2016) in the last 25 years. The details of cultivar wise income analysis is given in table 4. The benefit cost ratio was also highest with this cultivar in comparison to other popular pomegranate cultivars as depicted in fig 4.

Table 4. Income realization from cultivation of different pomegranate cultivars.

| S. No. | Year wise area (ha) | | Cultivars | Area (ha) | Yield (tonnes/ha) | Rate ₹/kg | Income ₹/ha |
|--------|---------------------|----------|--------------|-----------|-------------------|-----------|-------------|
| 1 | 1990 | 20,000 | Muskat | 1000 | 5.00 | 10.00 | 50,000 |
| | | | Ganesh | 19000 | 6.00 | 20.00 | 1,20,000 |
| 2 | 2000 | 56,000 | Ganesh | 10000 | 8.00 | 15.00 | 2,00,000 |
| | | | Mridula | 72000 | 10.00 | 25.00 | 2,50,000 |
| 3 | 2010 | 71,000 | Mridula | 8000 | 10.00 | 35.00 | 3,50,000 |
| | | | Phule Arakta | 6000 | 10.00 | 30.00 | 3,00,000 |
| | | | Bhagwa | 90000 | 12.00 | 50.00 | 6,00,000 |
| 4 | 2016 | 1,12,000 | Mridula | 5000 | 11.00 | 40.00 | 5,00,000 |
| | | | Arakta | 100 | 10.00 | 40.00 | 5,00,000 |
| | | | Bhagwa | 86000 | 13.25 | 50.00 | 6,60,000 |

(Source: QRT Report of AICRP on AZF, MPKV, Rahuri Centre: 2011-2017)



(Source: Shodhganga.inflibnet.ac.in/bitstream/10603/140689- Pomegranate cultivation in Maharashtra)

Fig 4. Benefit:Cost Ratio of different pomegranate cultivars

Good Horticultural Practices for Pomegranate cultivar Bhagwa

Pomegranate grows well under tropical, sub-tropical, semi-arid and arid conditions of India. It can be grown upto an altitude of 500m above mean sea level. The plant requires hot and dry climate during fruit development and ripening. It can tolerate moderate frost but severe frost and prolonged winter chilling temperature is detrimental for its growth. Though, pomegranate is a hardy plant but for realizing optimum yield, good horticultural practices (GHP) are essentially required as mentioned below:

| Sr. No. | Particular | Description |
|---------|---------------------------|--|
| 1. | Soil | Well drained, sandy loam to deep loamy or alluvial soils |
| 2 | Microsite | 60x60x60 cm pit size filled with FYM, pond silt and top soil in 1:1:1 |
| 3 | Spacing | Normal density: 5.0 x 5.0 m, (400 plants/ha) Medium density: 4.5 x 3.0 m (740 plants/ha) High density: 2.5 x 4.0 m (1000 plants/ha) |
| 4. | Time of planting | July-August and February-March |
| 5. | Variety | Bhagwa |
| 6. | Planting materials | Tissue culture plants |
| 7. | Canopy management | Single or multi stem (2-3) system of training and regular removal of ground suckers, water source, cross branches, dead and diseased twigs and light pruning old spurs should be done to encourage new growth. |
| 8. | Irrigation management | Drip system based on daily pan evaporation |
| 9. | Nutrient management | Recommended doses of N, P and K is 600-700g, 200-250g P ₂ O ₅ , 200-250g K ₂ O /tree/year. Application FYM @ 10 kg with annual increment up to the age of 5 years. The time of application is December/January for <i>ambe bahar</i> , May/June for <i>mrig bahar</i> and October/November for <i>hastha bahar</i> . Nitrogen fertilizer is applied in two split doses starting at the time of first irrigation after <i>bahar</i> treatment. |
| 10. | Regulation of flowering | Depending on rainfall pattern, flowering can be induced during June-July (<i>Mrig bahar</i>), September-October (<i>Hastha bahar</i>) and January-February (<i>Ambe bahar</i>). Areas having assured irrigation during April-May, flowering during January may be taken and where monsoon start early and withdraws by September, induction of flowering in October is possible. Maintenance of optimum crop load (100-125 fruits/plant) is also essential for quality produce. |
| 11. | Plant protection measures | For protection of crop against diseases and pests adopt preventive measures has essential as given below: Soil drenching of 0.1%, Carbendazim solution @ 5lit/tree followed by 25g <i>Trichoderma</i> . Apply 40g Phorate 10G in the soil near collar region to control nematode. For control of stem borer insect, Fenvalerate @ 5ml/lit to be applied with the help of injection in the holes of the stems and plugged with mud. Application of Mancozeb (2g/litre) during rainy season. |

| | | |
|-----|------------|--|
| | | <p>The management schedule recommended by MPKV, Rahuri for bacterial blight disease (oily spot) is given below.</p> <p>Spraying of Bromopol (2-bromo-2-Nitro Propen-1,3, Diol) (500ppm) @ 5gm/10 liters of water after total harvest of earlier <i>bahar</i> fruits.</p> <p>Resting period of 3 months is must. During resting period the infected leaves or plant should be sprayed at 10 days interval. If no infection is observed then spray at 30 days interval.</p> <p>Defoliation with Ethrel @ 20 ml/10 liters of water.</p> <p>Pruning of infected twigs, collection and burning of infected twigs, fallen leaves and fruits.</p> <p>Spraying of defoliated plant with Bromopol (500 ppm) @ 5gm + Captan (0.5%) @ 50gm/10 liters of water on trunks.</p> <p>Pasting of trunk with neem oil followed by application of Bromopol (500ppm) @ 5g + Captan (0.5%) @ 50g/ 10 lit. of water on trunk.</p> <p>Dusting of bleaching powder @ 60 kg/ha on the soil surface and plant basin.</p> <p>Spraying of 250 ppm Bromopol @ 2.5 gm/10lit. On new growth followed by Bordeaux mixture 1% @ 100gm Copper Sulphate + 100gm lime / 10 lit and Captan 0.25% @ 25gm/10lits of water at 10 days interval.</p> <p>Boardeaux mixture 0.5% + chelated zinc 0.25 to 0.4 g/lit.</p> <p>Note 1: The above spray sequence should be continued at an interval of 10 days during rains, high humidity and cloudiness. If these conditions do not prevail then spray should be given at an interval of 20 days if no infestation is observed then spray at 30 days interval. Use sticker @ 0.1% during rainy season.</p> <p>Note 2 : Spraying should be stopped 30 days before harvest if the weather is dry, whereas in rainy season it should be stopped 20 days before harvest.</p> |
| 12. | Harvesting | <p>The fruits become ready for picking 180-190 days after fruit set. At maturity, fruits turn saffron red in colour and calyx at the distal end of the fruit gets closed.</p> |

Way Forward

- Eco-friendly options may be explored to reduce dependency on chemicals for management of bacterial blight.
- To address problems like nematode management and fruit cracking in hot arid region.
- Intensification of research works on exploitation of nutraceutical properties, value addition and utilization of by-products.
- Proper enforcement of quarantine procedures in order to check further spread of diseases and pest through planting materials new areas.
- Harnessing advantage of lean period of fruit availability (December-March) in International market.
- Skilled development regarding protocol for export standard including maximum residue limit (MRL) and organic cultivation.

Annexure-I

Description of cultivar Bhagwa

| Sr. No. | Particular | Characters/value |
|---------|---------------------------------|---|
| 1. | Tree form | Well composed |
| 2. | Tree volume (m ³) | 14.93 |
| 3. | Growth habit | Evergreen, spreading |
| 4. | Foliage colour | Dark green |
| 5. | Arrangement of leaves | Opposite |
| 6. | Leaf shape | Ovate, lanceolate |
| 7. | Flower colour | Dark saffron |
| 8. | Season of flowering | Throughout the year |
| 9. | Age at first flowering | 1 st year |
| 10. | Bearing nature | Within the canopy |
| 11. | Bearing habit | Solitary with occasional clusters of 2-3 fruits |
| 12. | Days from fruit set to maturity | 180-190 |
| 13. | Fruit cracking | Not found |
| 14. | Yield (kg/tree) | 30.38 ± 1.83 |

Annexure-II

Physico-chemical characteristics of fruits of Bhagwa cultivar of pomegranate

| Sr. No. | Particular | Characters/value |
|---------|-------------------------------|--------------------------|
| 1. | Average weight of fruit (g) | 405.97 ± 70.40 |
| 2. | Fruit surface | Very smooth, very glossy |
| 3. | Fruit shape | Round |
| 4. | Fruit colour | Dark saffron |
| 5. | Taste | Sweet |
| 6. | Colour of aril | Dark red |
| 7. | Internal breakdown | Not found |
| 8. | Seed mellowness | Acceptable |
| 9. | Total soluble solids (%) | 15.38 ± 0.58 |
| 10. | Acidity (%) | 0.37 ± 0.05 |
| 11. | Peel thickness (cm) | 0.40 ± 0.02 |
| 12. | Seed hardness (cm) | 1.36 ± 0.19 |
| 13. | Spectronic absorbance (O.D.) | 0.516 ± 0.01 |
| 14. | Organoleptic evaluation score | |
| | i) Colour | 8.35 ± 0.65 |
| | ii) Flavour | 7.67 ± 0.93 |
| | iii) Texture | 8.01 ± 0.70 |
| | iv) Overall | 8.01 ± 0.76 |

Annexure III

Area, Production and Productivity of Pomegranate in India

| Year | Area (lakh ha.) | Production (lakh tonnes) | Productivity (tonnes/ha) |
|----------|-----------------|--------------------------|--------------------------|
| 2003-04* | 0.97 | 06.65 | 06.86 |
| 2008-09 | 1.09 | 08.07 | 07.39 |
| 2009-10 | 1.25 | 08.20 | 06.60 |
| 2010-11 | 1.07 | 07.43 | 06.90 |
| 2011-12 | 1.12 | 07.72 | 06.89 |
| 2012-13 | 1.13 | 07.45 | 06.59 |
| 2013-14 | 1.30 | 13.45 | 10.35 |
| 2014-15 | 1.91 | 20.95 | 10.96 |
| 2015-16 | 1.93 | 21.98 | 11.40 |
| 2016-17 | 2.16 | 25.21 | 11.70 |

* Base year when cv. Bhagwa was released

Annexure IV

State wise area, production and productivity of pomegranate in India

| States | 2008-09 | | | 2014-15 | | | Production Share (%) |
|-------------|-----------------|--------------------------|---------------------|-----------------|--------------------------|---------------------|----------------------|
| | Area (000, ha.) | Production (000, tonnes) | Productivity (t/ha) | Area (000, ha.) | Production (000, tonnes) | Productivity (t/ha) | |
| Maharashtra | 82.00 | 550.00 | 6.71 | 142.2 | 1625.90 | 11.45 | 66.21 |
| Karnataka | 14.30 | 138.10 | 9.66 | 19.00 | 204.60 | 12.95 | 20.00 |
| AP+TL | 06.50 | 64.70 | 9.95 | 15.80 | 110.90 | 7.02 | 5.00 |
| Gujarat | 04.00 | 39.30 | 9.83 | 09.40 | 99.30 | 10.56 | 9.00 |
| Rajasthan | - | - | - | 01.30 | 6.10 | 4.70 | - |
| Others | 6.40 | 15.10 | 2.35 | 6.50 | 48.00 | 7.38 | - |
| Total | 109.20 | 807.20 | 7.39 | 194.20 | 2094.80 | 10.80 | - |

Computational Criteria

Besides using published database of NHB, APEDA, QRT Report of AICRP on AZF; consultations and interactions were made with AICRP on AZF centre MPKV, Rahuri; Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani; Pomegranate Growers Associations of Maharashtra and Rajasthan, Progressive Pomegranate Growers etc. while computing data base for Bhagwa cultivar. The computational criteria used for making various estimates are given below;

- In Maharashtra and Gujarat, the estimated share of Bhagwa cultivar is about 90% out of total area under pomegranate, while in Rajasthan, it is about 75% and in Karnataka, Andhra Pradesh and Telangana it is only 70%.
- Whereas, production share of Bhagwa in Maharashtra is as high as 92% followed by 85% in Gujarat, 75% in Karnataka and only 70% in Andhra Pradesh, Telangana and Rajasthan.
- While estimating total production under Bhagwa, 6-8% post harvest losses have also been taken into consideration.
- Among total export quantity of pomegranate, the share of Bhagwa alone is 80%.
- For computing per kg cost of fruits, different size grades and prevailing market rates in major cities were taken into consideration and hence, an average of ₹35.0/kg was considered.
- For International trade, an average of ₹ 750.0/box of 5 kg was considered. In general, for European countries mainly U. K. and Netherland @ € 8.75/box (3.5 kg) and gulf countries mainly UAE, Bahrain and Qatar @ US \$ 11.5/box (5 kg) and other SAARC countries @ ₹ 250.0/box (5 kg).



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