E-Book

"INNOVATIVE APPROACHES TO DEVELOP ENTREPRENEURSHIP IN GRAPES"

ICAR-NATIONAL RESEARCH CENTRE FOR GRAPES
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E-BOOK

ON

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Innovative Approaches to Develop Entrepreneurship in Grapes

Editors: *RG Somkuwar, Ajay Kumar Sharma, NA Deshmukh, Sujoy Saha and B Venkata Rao*

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Preface

Grapevine (*Vitis*) is the one of the major fruit crops in the world based on hectares cultivated and economic value. Presently, grapes are present in more than 70 countries covering all continents except Antarctica. According to an estimate a total area of 6.9 million ha was covered by grapevines and production was 77 million tons during 2019. Among table grape producing countries, India ranks second after china.

The demand of table grapes is growing globally, particularly in Asia-Pacific, the Middle East, and Russia. The total grape production in country was 3125 thousand tons from an area of 140 thousand ha during the year 2019-20. Grape growing in India is mainly concentrated in Maharashtra and Karnataka states and about 95% grapes are produced from this region only. Grape consumption pattern in the country is entirely different than EU and other countries where grapes are mainly processed in the form of the wines. In India, about 70% of total grape production is consumed as fresh, 28% are converted into raisins and remained share is processed in the forms of wines and juices.

Under hot and dry conditions of peninsular India higher production cost, prevailing abiotic and biotic stresses, product quality, increased post-harvest losses, etc. are responsible for lower returns to grape growers. Hence, making grape growing lucrative and sustainable to grape growing community as well as other stakeholders is a challenge. There is urgent need to propagate and support innovative ideas. There is need to impart the knowledge for developing skilled workforce in identified areas to support sustainability in grape growing and processing. This e-book provide information on entrepreneurship development in areas like nursery, approaches for input cost reduction, market intelligence, grape processing and value addition, establishment of FPCs/FPOs, etc. for opening new opportunities in area of grape production and processing. Same time, start-ups based on artificial intelligence, a tool for precision viticulture, decision support system, zero-waste processing are the important areas covered in this publication for benefit of the stakeholders.

R. G. Somkuwar
Director (Acting)

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Chapter-1

Smart viticulture practices to produce quality grapes

Dr. R. G. Somkuwar

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Introduction:

Indian viticulture is unique as it is being practiced in almost all climatic conditions from tropical to temperate. Grape is a high value export-oriented fruit crop which has gained significance in tropical climate due to location specific suitable modifications. In India, around 72-745% of grape is produced for fresh consumption and about 25% for raisin making and around 2% collectively for juice and wine production. If we look 25 years back into the grape production scenario of the country, the area under the grape cultivation was about 45000 ha with the production of 1100 thousand tones.

Presently grapes are grown in India over an area of 1.40 lakh ha with production of 31.25 lakh MT and productivity of 21.00 MT/ha (NHB, 2020). India ranks first in world for grape productivity and secured 7th position in the world for table grape export with the quantum of exported fresh grapes 2.22 lakh MT. India is a major producer of the fresh grapes (after China, Italy, USA, Spain, France and Turkey) producing around 6% of total world grapes. Over 50% of Indian grapes are exported to the European Union (EU). The EU continues to be the most preferred destination by Indian table grape exporters. Top importing countries for Indian grapes remain the Netherlands (51%), Russia (36.53%), United Kingdom (13%), Bangladesh (9%) and Germany (8%) as per agriexchange.apeda.gov.in.

Earlier, the vineyards were grown on the own roots of commercial varieties, as the soil and water used for grapevine cultivation had no problem associated with salinity. However, with the onset of situations like drought, salts in available water, etc. it forced the grape growers to use rootstock in grape cultivation as some of the rootstocks are known to tolerate water scarcity and soil salinity situations. Since the grapevine is a weak stem which requires support for its growth. During the initial stage of vineyard establishment, the use of proper trellises system with proper degree of angle as per the vigour of vine is the major requirement. Vineyard once established can remain productive for more than 15 years. To retain its economic value for longer period, it is necessary to establish a vineyard with an industrialist's vision.

Smart practices are listed below:

1. Use of rootstock:

Need for rootstocks:

Grapevines in India were exclusively grown on their own roots as most of the areas were considered free from soil borne problems. Till recently commercial exploration of rootstocks was not known in India. But with the reports of declining yield in the states of Maharashtra and Northern Karnataka due to problems associated with soil and water salinity, chlorides in the irrigation water, excess levels of sodium and free lime in the soil and drought, the interest on the rootstocks has grown based on the reports and references of rootstocks researches done in USA, Australia, USSR and Europe. Rootstocks have not only potential for combating the soil and water problems, but can also be a potential tool for manipulating vine growth and productivity. Even though horticultural practices like mulching, green manuring, leaching of salts and application of soil amendments have been employed by growers to overcome these adverse situations, the benefits realised by these practices are not fully satisfactory. Hence, the usage of rootstocks to sustain the productivity of grapes under adverse situation is gaining popularity.

Use of rootstocks under the situations:

Before deciding to employ the rootstocks to increase the productivity and quality of grapes, one should identify the problem. If the water is adequate, its quality is good with reference to EC, SAR and Cl^- content and the soil is also good with reference to ESP and free Calcium content, there is no need to employ rootstocks. Even, if we use rootstocks in situations where soil and water characteristics are ideal and adequate, it may lead to more vigorous growth and thus cost of cultivation for suppressing shoot vigour poses a problem to achieve desired level of productivity.

2. Canopy management of grafted vines:

Grapevines are a climber. It has indeterminate growth with weak steam. It needs support not only to support, the weight of its aerial parts and fruits but also maintain the canopy architecture. The canopy architecture of vines is shaped by the trellis and the system of training. The fabricated structure used for training the vines is called the trellis while the process of shaping the canopy is called training. The manner in which a grapevine is trained does not only influence the vine growth, productivity and quality but also brings about variation in microclimate. An ideal training system should fulfil the following requirements.

- ❖ It should be convenient for mechanization of cultural operations.

- Convenient to carry out manual operations efficiently.
- Give rise to adequate number of fruiting units (canes).
- Support heavy crop load of good quality per unit area of land.
- Should be simple and less expensive.
- Should allow good ventilation and light into the vine canopy.
- Avoid microclimate congenial for the growth and spread of diseases.

Many other training systems were tried in India, a few to mention are T, V and extended Y. Currently the gable system is becoming very popular. It has the good features of both bower and V systems of training. The salient features of this system are:

- The young shoots are exposed to sun and the buds get complete illumination for fruit bud formation.
- Shoots do not overlap and there is no mutual shading of leaves. As a result, all the leaves are functional photosynthetically. All canes mature well.
- It offers scope to develop adequate number of fruiting of canes as per the vine vigour.
- The flower clusters can be reached conveniently by an average tall person for various manual operations. Labour efficiency increases.
- Less disease problem as micro-climate is not built-up and the fungicidal sprays reaches all leaves.
- Fruits develop under diffused sun light. They are not exposed to direct sun. Hence little sun scorching of berries.

Ideal canopy:

Canopy refers to the size and shape of the aerial parts of the vine. The canopy components are stem, arms/cordons, canes shoot and leaves. The size, shape and orientation of these components determine the canopy architecture. The ideal canopy architecture can be brought about by the trellis we use, the system of training and also certain practices to increase the vigour retard the growth etc.

Tools in canopy management:

Canopy architecture is natural expression of genetic makeup of the tree. Genotypes vary in their canopy size and shape. However, the size and shape of the canopy can also be manipulated through the following means:

- ❖ Training
- ❖ Pruning
- ❖ Employing rootstocks
- ❖ Use of growth regulators
- ❖ Imposition of soil moisture stress
- ❖ Nutrition

3. Training of vines:

1. On bower trained and closely spaced vines, develop only two primary arms without secondary branches. Develop canes from the primary arms

Allow the primaries in North-South direction.

2. In vigorous vines trained to bower:

i. Develop two primaries in North-South direction

ii. Develop two pairs of secondary arms on each primary at 45 cm and 135 cm away from the main stem. The gap between two adjacent secondaries should be 90 cm.

3. In vigorous vines trained to extended Y trellis:

i. Induce primary branching on the main stem at 120 cm above the ground level.

ii. Develop four secondaries on two parallel wires stretched at least 60 cm apart at a height of 135 cm.

iii. Allow the primaries in East-West direction.

a. Spray CCC @ 500ppm on the shoots at 5 leaf stage.

b. Pinch the shoots to 7 leaves at 9 leaf stage of the shoots.

c. Spray CCC @ 500 ppm on the shoots at 5 leaf stage on the new shoot (7+ 5 leaves from the base of the shoot)

d. Impose soil moisture stress at 7+5 leaf stage.

e. Top the shoot to 15 leaves (7+8) when the shoots start maturing.

4. Importance of bud testing:

In peninsular India, grapes are pruned twice in a year. The vines are pruned in April for shoot formation and cane development which also leads to fruit bud formation and storage of food reserve in the cane. The pruning is again done in October for yield. Number of bunches are the indicator of yield in a particular vine which depends on the fruitfulness of the canes. Yield is a product of number of flower clusters over unit area and the mean weight of the cluster. Fruitfulness of the canes is decided during the same period after back pruning. Yield in grape is dependent on the cultural practices followed after back pruning (April to September).

Productivity refers to the inherent capacity of grapevine to produce maximum yield. The productivity of grape varies from variety to variety. There is a large gap between the productive potential of vine and the actual yield, hence; there is scope for reducing the gap between productive potential of vine and the actual yield by adopting various cultural practices. These include crop regulation, use of growth regulators, training and canopy management and disease and pest management, etc.

In other words, a fruiting cane is the unit of production. Even though yield per unit area is more in tropical and subtropical regions of India, the cluster / cane ratio is far less as compared to temperate regions of the world.

It has been reported that the farmers are facing the problems of unfruitfulness of the vineyards causing serious concern. There are number of reasons for the unfruitfulness but the major one is incorrect pruning level at the time of forward pruning. There are lots of thumb rules being followed by the growers while pruning based on the individual experience. But to determine the level of pruning in a vineyard scientifically by microscopic testing of buds is very much required. This will not only help to achieve the potential fruitfulness of the vine but also overall quality of the produce being enabled to carry out the cultural practices at the scheduled time. The measures to increase the productivity of vines by drawing out the total yield potential of the vine by the way bud testing has been discussed in detail in this bulletin.

Grape bud:

In grapevine, a bud develops at each node, just above the leaf i.e. the axil. It is a mixed bud because both leaves and flowers develop from the same bud. As generally, two growing points are formed in the axil since, they are enclosed in a common protective scale, they appear as one bud.

One of these develops and gives rise to lateral. However, in proximal bud positions no laterals are formed, two primary buds may be formed at the node. The other growing point meantime develops two accessory or secondary buds, one on each side, and the three remain enclosed in common scales so that they appear as one large bud, which is referred to an eye. The accessory buds seldom develop and the central bud constitutes the main unit. All these buds are called auxiliary buds. The compound bud remains dormant over the winter in temperate climate and resumes growth in the following season. These are called latent buds. If due to some reason, the central bud is killed, secondary buds can take its place. The buds located in the angle where the young shoot joins the previous year's wood are called basal buds.

In fact, every bud is potential flower bud; capable of differentiating into fruit bud however, it is practically not experienced.

Factors affecting fruitfulness of grapevine buds:

I. Environmental factors

A. Temperature

- Percent total fruitfulness
- Size (fresh weight) of primordial.
- Optimum temperature (30 - 35°C)
- Varieties differ in performance at low temperature
- Qualitative

B. Light

39,000 lux or one fourth of that of full sunlight

II. Inherent factors

A. Variety

III. Fruitfulness of primary buds in relation to cane character

i. Origin of the cane

ii. Position of the bud on the cane

iii. Morphological characters of the cane

IV. Management factors

i. Canopy management

ii. Water management

iii. Nutrient management

iv. Use of growth hormones

v. Disease and pest management

V. Horticultural techniques:

- **i.** Pruning, training
- **ii.** Pinching
- **iii.** Topping
- **iv.** Bending and girdling
- **v.** Shoot removing
- **vi.** Cane thinning

Much of the vine management is concerned with constraining vegetative vigour and maintaining a perennial structure that will sustain initiation and differentiation of fruitful buds for production viticulture. Key practices in canopy management for fruitfulness include trellis-training system, shoot positioning, shoot orientation and even shoot trimming. All aims at containing vegetative vigour in favour of reproductive developments rather than vegetative production. Knowledge of grapevine phenology and process responsible or setting yield potential is important. The potential can only be realized when there are sufficient structures to accept canopy photo assimilates (mainly options available to viticulturists in sustaining shoot fruitfulness of Thompson Seedless centre on trellis type and scion rootstock combinations with climatic factors (especially sunlight and temperature) as driving variables.

Fruit bud formation:

Key processes in Fruit Bud formation

1. Inflorescence initiation, differentiation.
2. Flower formation
3. Inflorescence of morphology development
4. Position and size of flowers.

Conclusively, flowering in grapevine involves three main steps:

1. Formation of anlagen or uncommitted primordial.
2. Differentiation of Analogue to form inflorescence primordial.
3. Differentiation of flowers.

Bud testing:

At this stage it is quite clear that fruit bud formation in grapevine is a complex process involving many biochemical changes in bud. The exact end results of the work done for this purpose

cannot be forecasted exactly in viticulture. To bring some kind of certainly in respect of no. and position of fruitful buds on a cane, bud testing for evaluating fruitful/unfruitful buds and their status and position on a cane is becoming more and more popular in modern days.

Objectives of bud testing:

1. To determine the pruning level.
2. To judge the yield potential of the vineyard.
3. To conclude pre-pruning scenario of fruitfulness.
4. To investigate the abnormalities in fruitfulness.
5. To suggest appropriate connective measures. What so ever.

Methods of bud testing:

1. Visual method.
2. Pre-pruning forced sprouting.
3. Microscopic method.

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Chapter-2

Opportunities in quality planting material production and supply system

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Horticulture sector is one of the important components for growth of agriculture in India. The total production of horticultural crops during 2017-18 is 305.4 million tonnes (mt), which is about 1.6% higher than previous year and 8% higher than previous five years average (Anon, 2017). Within horticulture, production of vegetables is estimated at 181 mt in 2017-18, about 1% higher than the year before, while that of fruits is estimated at 95 mt, 2% higher than the previous year. However, the challenge before us is to reach the production of horticultural crops to 500 mt by 2050 to meet the rising demand for these crops due to changing life style, enhanced purchase power, urbanization, food habits, awareness about medicinal plants etc. under conditions of deteriorating production environment. Though there is increase in per capita availability of fruits and vegetables, it is still below the recommended levels and hence, nutritional and health security can be achieved through enhanced productivity. The prime reason for low productivity are non-availability of quality planting materials, dwindling natural resources, poor farmers, non-adoption of modern research findings etc. The challenge is to enhance productivity by increasing the factor productivity of all the production inputs and at the same time sustaining it by adoption of good agricultural practices and precision farming principles.

Presently, more than 4409 nurseries are producing fruit plants in India of which 1575 are under government sector and 2834 are under private sector. These nurseries have annual target of producing only 1387 million fruit plants. This covers only 30-40% of the demand of planting material of fruit crops. Hence, there is a large scope to establish certified fruit nurseries to meet the annual demand keeping in view the area expanding under fruit crops.

Production of quality seeds and planting material:

As most of the horticultural crops especially fruit crops are propagated by vegetative means, they are produced in nurseries and sold to growers. Since, they have long gestation period, their full characteristics are shown after long period. It is therefore essential to ensure that planting material produced and supplied by the nurseries are of good quality, true to type of said variety. Since, no legislation to regulate production and sale of planting material by nursery, there is hardly any control on quality of plants supplied by nurseries. However, some states have enacted Nursery Registration

Act. In such states, though nurseries are being registered under the act, the quality aspect of such vegetative propagated planting materials is not ensured. Similarly, no mechanisms available for ensuring the quality of tissue cultured plants. Hence, there is need to develop a mechanism to assure the quality of planting material.

In spite of such difficulties, some success has been made due to constant support by research organization. Being true to type and uniform growth of nuclear seedlings in polyembryonic varieties of mango and citrus, development of true to type seedlings is assured. Rootstocks of several fruit crops like apple, mango, grapes, guava, sapota, peach, pear etc. have been identified and their method of propagation has been standardized. Softwood grafting of mango, sapota, custard apple, jack fruit, guava; veneer grafting of mango and cashew, shoot tip grafting of citrus, *in situ* grafting in grapes etc. have been standardized. Some of the new propagation techniques standardized were serpentine and bamboo method in black pepper; cleft grafting and patch budding in walnut etc. Micro-propagation protocols of apple, banana, pineapple, strawberry, papaya etc. are available in country. Green house production of quality planting material has been practiced in most of the nurseries.

In recent past many of the steps have been initiated to boost the growth of horticulture industry and one of the activities is strengthening the production of planting material.

1. Use of rootstocks and grafting:

Employing rootstocks in most of the horticultural crops is an alternative strategy to combat major abiotic stresses and some soil borne pests and diseases. It is an environmental friendly and economically feasible approach to overcome some of the constraints related to abiotic and biotic stresses. Major breakthrough in use of rootstocks in grapes has been achieved where use of Dogridge rootstock could overcome the problems associated with soil salinity and water scarcity in addition to its effect on increasing yield of most of the seedless grape varieties. In other crops also, rootstocks have shown good potential in either increasing yield, or altering the vigour of scion varieties or overcoming abiotic and stress tolerance. Many of the nurseries from state department of horticulture, ICAR institutes and state agricultural universities are involved in producing exclusively rootstocks or grafting commercially important varieties on such rootstocks and distributing to growers.

2. Maintenance of mother blocks:

The main problem faced by farmers when they acquire planting material from nursery is lack of genetic purity. This is mainly because improper maintenance of mother blocks in the nurseries. Hence, maintenance of mother block serves as a source of nucleus block for further multiplication

of foundation block. In perennial fruit crop nursery, there should be proper layout of the mother blocks as it serves as base material for longer period of time. The mother block should be established close to nursery and all the cultivation should be practiced to maintain the good health of the plants. To encourage the establishment of mother blocks of improved varieties and hybrids, National Horticulture Board is funding public and private sector nurseries, which in turn will facilitate rapid multiplication of a variety by collection scions from the mother block.

3. Standardization of vegetative propagation techniques in fruit crops:

a. Cuttings:

Though propagation by mean of cuttings is the easiest method for propagating different horticultural crops compared to grafting as complex of graft union can be avoided, the disadvantage of this method of propagation is some of the plants don't readily roots by cuttings. There is a large variability among different plant species in their ability to root. There are certain tropical and sub-tropical fruit species (e.g., grape, lime, lemon) which root easily on cuttings, whereas certain other plants (e.g., guava, litchi, mango, avocado, jackfruit) produce root only when some manipulative treatments are given; but in still others rooting is not possible even with the help of the treatments. Although, propagation of tropical and subtropical fruits through cutting is the least expensive method of vegetative propagation, its success is still limited. However, the root initiating hormones can induce early and uniform rooting.

b. Grafting / budding:

With the advent of rootstocks to combat adverse effects of soil salinity and water scarcity and also biotic stresses like nematodes, soil borne pathogens such as wilt, use of rootstock is gaining importance in most of the fruit crops. Accordingly, several methods have been standardized for multiplication of fruit crops. *In – situ* grafting is one of the recommended methods of establishing grape orchards which has been standardized and practiced by most of the growers. Similarly, some of the methods like bench grafting is also being standardized for multiplication of grape varieties where in grafting is performed using machines, which later will be kept in environmental controlled chambers for inducing callus from rootstocks and later will be put in rooting media where simultaneously rooting and graft union will take place.

c. Micro and macro propagation techniques:

It is one of the quick methods of multiplying plants in larger scale. But, very little success has been done in fruit crops due to lot of interfering substances which comes in the way of formation of callus/rooting/shooting etc. in fruit crops. However, satisfactory success has been done in many of the other horticultural crops both by public and private sectors. Some of the fruit crops which are multiplied by tissue culture in India are banana, strawberry, pomegranate both in private and public sector laboratories. In addition to tissue culture, some micro propagation techniques like shoo tip culture, green grafting etc. has also been standardized in some fruit crops like citrus, pomegranate, banana etc.

4. Use of alternate substrate for raising seedlings in nursery:

Planting media plays a major role in developing healthy seedlings. Any infection in the planting media may not only restrict the growth of seedlings, but also helps in spreading the soil borne pathogens like nematodes, soil borne diseases to other areas. In direction, use of alternate substrate like vermiculite, perlite, saw dust, cocopeat etc. is gaining importance of which cocopeat/coir pith is mainly used in nurseries to raise seedlings. Due to high content of tannins, phenols and higher C:N ratio it is very difficult to decompose coir pith These tannins and polyphenols retard a wide range of natural biological processes including decomposition and the germination of seeds sown on raw coir pith. In order to overcome these deficiencies leaching of the raw coir pith with good quality water has been recommended in order to remove the water extractable tannins and polyphenols, thereby making the material amenable for use as a plant growth substrate. This process of conversion using fresh water to reduce the levels of plant growth inhibiting compounds is widely followed commercially. A drawback with this method is that it consumes huge quantities of fresh water besides contributing to environmental degradation by way of disposal of waste water rich in tannins and polyphenols. Arka Fermented Cocopeat is a novel substrate for raising of vegetable seedlings has been developed by the solid-state fermentation of the raw coir pith with a tannase producing fungal consortium, in order to reduce the concentration of tannins and polyphenols that are naturally present in coir pith to levels that no longer retard seed germination and plant growth.

Private partner entrepreneurship development to increase production of varieties / hybrids released by government institutes:

Since, major constraint in existing accredited nurseries is their inability to meet the growing demand for quality planting material, some of the alternate arrangements like community based nurseries, training farmers registered with farmer producing organizations (FPOs) or self-help groups (SHGs) etc. in nursery practices and encouraging them to produce seedlings, licensing of the institute released varieties / hybrids with private nurserymen to multiply those varieties/hybrids in larger quantity has been initiated in country with very good success stories. Community based nursery in tribal areas in many of the states especially in fruit and forestry seedlings has given good success which not only increased the availability of planting material but also increased the income of tribal farmers.

Entrepreneurship development through nursery:

Nursery is one of the important enterprises which can create employment opportunities for the rural youth and women. Some of the areas under horticulture nursery includes production of seeds, seedlings, potted plants, landscaping in event management programs on rental basis, sale of plants to small and retail nurseries, start-up of plant libraries, etc.

Hence, nursery entrepreneur is a person who is very effective in commercial business who undertake

Nursery as an enterprise or business. Since it also generates wage-employment for others this is called as entrepreneurship and one who practice entrepreneurship is called an entrepreneur. But some of the qualities of good entrepreneur are:

- Ability to take risk by understanding the situation, gathering information, assessing available resources and setting goals
- Should perceive opportunities quickly and synthesis the available information and analyse the emerging patterns.
- Should have strong desire to hit new goals
- Should be innovative to change adversities into opportunities
- Seek opinion from expert to achieve foals rather than friends and pals

- Should take immediate feedback on performance and prefer prompt and accurate data irrespective of it is favourable or not
- Can influence others and motivate them to think and act in his way

The nursery enterprise helps in providing plants and planting material and related processes that indirectly help the national economy. The nursery enterprise also assists in gaining a more balanced financial development as the business flourishes both in urban and rural sector. It reduces the migration of labour from rural to urban areas in search of employment. It helps in empowering people by providing increased community participation. Most importantly the nursery enterprise contributes to national economy by providing employment opportunities for the skilled and unskilled workers.

Risk Analysis in nursery enterprise:

The nursery enterprise can be run successfully provided the raw material, labour, capital requirement, planning of expenditure and income, and knowledge of market are carefully taken into consideration. Various factors that can lead to losses in a nursery enterprise and factors which increase the profitability in nursery enterprise are mentioned as follows:

- Under-utilization of Capacity
- Untimely availability and Sale of Plants
- Production not as per demand
- Increasing competition
- Poor recovery of credit sales
- Increasing cost of labour and raw material
- Poor technical knowledge

Some important points to be considered for bringing nursery enterprise into a profitable venture are as follows:

1. Production of plants in a nursery is a commercial business activity and is to be seen from the point of view of economics of expenditure and returns.
2. There is need to balance the technical aspects and practical feasibility of production and sale of plants in a nursery.
3. The nursery enterprise may not start yielding profits from the first year onwards but may require minimum five to six years for planning and execution of operations and bringing the nursery business into profit.
4. Maintenance of records of expenditure and income need to be carried out regularly to ascertain the profitability or loss in the business. A critical analysis of such record may provide solution for overcoming the problem of poor returns.
5. Monitoring of daily activities in nursery activities can provide immediate answers to the problems faced during the production and sale in nursery.
6. There needs to be coordination amongst three important aspects of nursery enterprise which are production of plants, rearing of plants and sales of plants.
7. Increasing the sales through aggressive marketing, publicity and advertisement in newspaper, magazines and other mass media, participation in exhibitions can enhance the sales in nursery enterprise to a considerable extent.

Future strategies to improve production of quality planting material:

Strengthening/ establishment of nurseries/ micro-propagation laboratories and seed production activities are of prime important to meet the demand. Proper implementation of nursery and seed act and compulsory registration of commercial nurseries would go long way in production of quality plant/seed materials for the benefit of the farming community. Some of the strategies for future development of nursery industry and to ensure the availability of planting material to meet the growing demand are:

- Promotion for establishment of large and small nurseries under the purview of state and central sectors
- Provision of facilities for year-round supply of planting material by maintaining advanced structures
- Nursery act should be made in each state for perennial crops and should be strictly followed

- Quality Standards for each fruit plants should be developed
- It is better to establish nurseries in respective fruit growing belts to minimize transportation costs
- In similar way as seed crops, certification agencies should be established for perennial fruit crop nurseries

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Chapter-3

Agri business opportunities through FPOs, FPOs new edge farmer enterprises

Mr. Vijay Gophane
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Introduction:

A new type of Agro-industry is emerging through farmer-producer groups. The only option available to the individual farmer is to buy agricultural produce and sell it in the nearest market. However, if the farmers come together as a group, they can start a variety of joint farming and ancillary businesses to get services and facilities, including meeting their various needs. Today, land fragmentation is taking place rapidly and the number of small and marginal farmers is increasing and there are many difficulties in production and sales management. A single farmer cannot do everything from production to sales management properly. There are also limitations to the use of modern technology. As a result, there is scope for small, medium and smallholder farmers to come together in the present and in the future to start industries with the help of each other in agriculture and allied sectors.

Current issues of the individual farmers:

1) Small, minority and medium scale farmers face many problems. This mainly involves low income, low productivity and high production costs.

2) There are difficulties in getting timely expert advisory, information and guidance on cultivation and production.

3) Farmers have difficulty in getting modern farming technologies, equipment and farm implements.

4) Inadequate and untimely financing for agricultural production and farming operations.

5) There are difficulties in getting good quality inputs and inputs at the right price at the right time.

6) Lack of information and availability of revised and developed new varieties.

7) Decreased productivity due to deteriorating soil health caused to decrease farmer income.

8) Climate change is causing major obstacles to crop production due to unseasonal rains, hailstorms or droughts.

9) Post-harvest handling involves the use of technology for harvesting, loss of handling, packing, storage and non-availability of modern storage facility.

10) Good market place for sale of agricultural commodities, certain buyers and market sustainability.

11) Lack of value addition of agricultural commodities at local level and non-receipt of proper remuneration to farmers.

12) Difficulty in delivering quality raw materials to large buyers and processors likewise many more challenges facing by individual farmers.

Farmer producer companies / farmer groups:

a) Legal Aspects & Requirements:

i) Farmer group:

Group of Farmers come together and form legal entity where they can start Agri & allied business by taking required licenses. Farmers can form informal Group of 11 to 19 farmer which will be registered with ATMA (Agriculture Technology Management Agency) but does not have legal status. Thus, we recommend to form either Farmer Producer Company or Cooperative Society of the Farmers. Now a day's most of the Farmers have joined movement of Farmer Producer Company due to its simple legal framework and promotion by Government agencies.

ii) Farmer producer company:

An FPC is a hybrid between cooperative societies and private limited companies. The Farmer Producer Companies, registered under the Indian Companies Act, 2013, have democratic governance, each producer or member has equal voting rights irrespective of the number of shares held. Farmers can start services from Agri Production to Marketing from single platform.

iii) Cooperative society:

An agricultural cooperative, also known as a farmers' co-op, is a cooperative in which farmers pool their resources in certain areas of activity. Supply cooperatives supply their members with inputs for agricultural production, including seeds, fertilizers, fuel, and machinery services. Limitation is that farmers need to form cooperative society with each object and area limitations to the society.

b) Benefits of FPOs:

Some of the important benefits of organizing farmers into Groups

1) Cost of production can be reduced by procuring all necessary inputs in bulk at wholesale rates

2) Aggregation of produce and bulk transport reduces marketing cost, thus, enhancing net income of the producer.

3) Building the scale through produce aggregation enables to take advantage of economies of scale and attracts traders to collect produce at farm gate.

4) Access to modern technologies, facilitation of capacity building, extension and training on production technologies and ensuring traceability of agriculture produce.
5) Post-harvest losses can be minimized through value addition and efficient management of value chain.
6) Regular supply of produce and quality control is possible through proper planning and management.
7) Price fluctuation can be managed; if there are practices like contract farming, agreements, etc.
8) Easy in communication for dissemination of information about price, volume and other farming related advisories.
9) Access to financial resources against the stock, without collaterals.
10) Easy access of funds and other support services by the government / donors /service providers.
11) Improved bargaining power and social capital building.

Potential business opportunities:

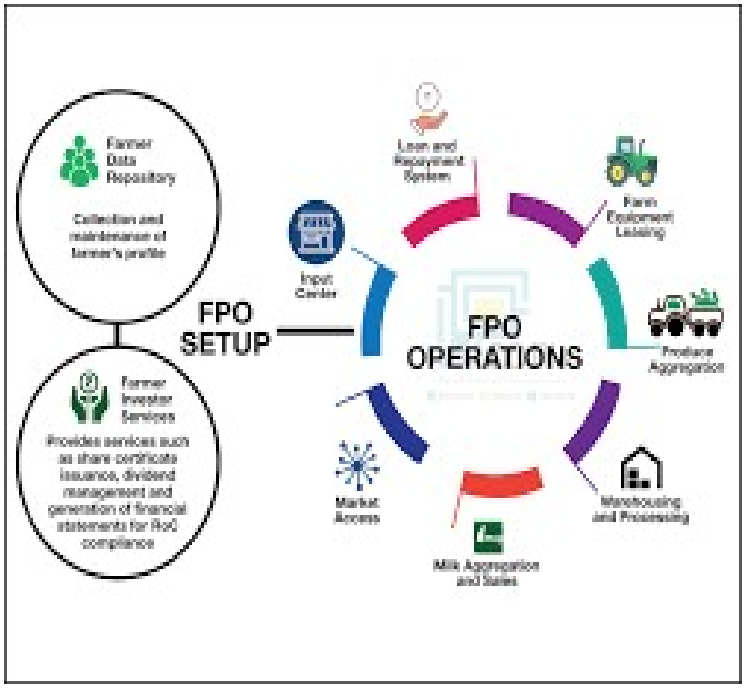

Fig. 1. FPO Set Up for Businesses

Fig. 2. Group requirements & potential businesses

Farmer start business activities through FPO platform:

FPCs offer a wide range of benefits compared to other formats of aggregation of the farmers. Its main activities consist of production, harvesting, processing, procurement, grading, pooling, handling, marketing, selling, and export of primary produce of the members or import of goods or services for their benefit.

1) Agri input supply:

Farmers can join the group and buy inputs for farming, including fertilizers, seeds, pesticides, drips, sprinklers, small implements, spraying implements and other inputs used to produce farm produce. This will save you money by buying inputs directly at wholesale prices and will reduce production costs. Moreover, it will be possible to get high quality inputs from small and marginal farmers.

2) Custom hiring:

Small and marginal farmers cannot afford to buy farm implements themselves, so they are renting out implements and modern technology. If the farmers come together through a group, they can set up a tool & implement, machinery bank for the group at their own expense and with government grants and make the tools / farm machinery available at a lower rate than the prevailing market rate. From planting to harvesting, threshing and packing of agricultural implements can be kept in the bank.

3) Collective production:

Farmers can come together and do collective farming and sell their produce in the right market. Group farming can be used by all farmers to get their quality produce and market to the right market or buyers can be invited to buy at farm gate.

4) Produce aggregation and procurement:

By setting up farmers' groups, their members can run their own commodity corporate company or government guaranteed price shopping centre. This will reduce the middlemen and help the farmers to get extra profit from direct sale of agricultural produce.

5) Primary processing, grading and sorting:

Through groups, farmers can come together and process their produce on their own farm gate or village. This will not only add value to the farm produce in the village but will also enable the buyers to get the best quality and bulk farm produce together which will enable them to pay a good price.

6) Seed production and processing:

Farmer can come together and start seed production for self-use and sell to other farmers. It will help to reduce the input cost and cost of cultivation. Seed production by group of farmers may ensure quality of the seed. Also, farmer may produce seed for the private companies.

7) Training and capacity building:

By joining the farmer group, they will be able to organize training for their members and make the technology, information and knowledge required for agriculture available to various organizations. Services and facilities will be provided to universities, research institutes, technology companies, tool companies and other stakeholders.

8) Secondary processing:

Farmer can jointly establish secondary processing unit based on the major crops in the territory. This value addition at village level may give very good market linkage and value to the farm produce. To establish such secondary processing unit's farmer, need capital and that capital may raise from the group of farmers.

9) Contract farming:

This group of farmers has always attracted corporates to contract farming. Corporate companies that have a strong position in the market and who need the same variety, better quality, for a larger domestic market or for export can do contract farming. This allows farmers to set up groups and cultivate contracts for different crops according to market needs.

10) Export of produce:

India exports a wide variety of agricultural products to the world market. This will enable the farmers to set up groups and sell the best quality produce directly to the exporter or in the country where the product is needed as per the demand of the market.

11) Direct marketing:

Farmers can do the direct marketing of the Agri Produce outside the state. As we know that India is huge market for Agri produce, farmer can sell their produce in the various states of the India. Due to variety in culture, food habits, occasions and seasons in India which create huge opportunity to produce and sell Agri produce in specific state. In some states specialized commodity markets are available to sell produce in such market directly in bulk quantity with good profit margin.

12) Retailing of produce:

India is experiencing rapid population growth due to which industrialization and urbanization are accelerating. This is also creating a big market in the city, where farmers can sell farm produce directly in urban areas, in society, at home, weekly market, on the side of the highway. They can also make extra profit by selling farm produce in retail form by setting up direct commodity sales outlets of the group.

13) Storage of agri. produce:

Storage of farm produce is also an opportunity to start a business through a group. To this end, by constructing warehouses from the group with the help of government scheme, the farmers will be able to store their produce for a period of time and sell it when the prices go up and this will be of great benefit to the farmers.

14) Farmer services:

Farmer Group can provide various incubation facilities, capacity building and need base various services to member.

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Chapter-4

Decision support system-based management practices in grapes

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Amongst fruit crops, grape is one of the most remunerative crop, but also capital intensive. The viticulture practices in India are quite different from other countries where grapes are grown in Temperate and Mediterranean climate under single pruning and single cropping system. However, in major grape growing regions of India, the grape growing practices involve double pruning (foundation and fruit pruning) and single cropping. Every year recurring cost of managing a vineyard range from Rs. 3 to 5 lakhs depending upon the purpose for which it is grown. Seasonal changes in climatic conditions are impacting grape productivity either in terms of reduced fruitfulness due to high temperature, unseasonal rainfalls or reduced rainfall, drought, cyclones, hailstorm incidence, low temperature or frost events. Thus, crop is adversely affected due to weather aberrations that have become quite frequent over no. of years. Sometimes the losses could be as high as cent per cent.

The impact of stresses varies at different growth stages and accordingly the response of the grape grower varies. For e.g. Moisture stress during veraison stage will lead to reduced bunch weight and quality of grapes. Depending upon expected yield and quality loss percentage, a farmer can decide in advance to buy/ transport water from elsewhere to take care of this problem as the cost involved will be compensated by the yield increase.

To arrive at decisions for field operations, farmers generally rely on their own experiential knowledge and if any specific issues are there which is beyond their knowledge, then they have to contact experts. The experts currently were able to interact with the stake holders in the following modes:

1. Physical meeting
2. One to one interaction over mobile/telephone/ video
3. SMS/ WhatsApp
4. Through radio

However, the reach is limited especially from item no. 1 to 3. In case of radio/ SMS service, wider reach but specific advice is lacking. As such many times, solutions will be different for different farmers, but the reach will be limited. Hence, there is a need to develop of Decision support

system that will improve the farmer's ability to take crucial management decisions keeping the economics and long-term prospects of the standing crop. It will provide recommendations to a grower based on his/her crop data, farm data, and prevailing weather conditions that will support or assist grower's decision-making capacity.

Structure of DSS: DSS will have a multitier architecture as shown in fig.1.

- **Presentation Tier:**

Presentation tier will have User interface components (Forms, controls, media and messages) designed for web browser and mobile devices. This is the layer that provides an interface for the end user into DSS application. That is, it works with the results/output of the Business Tier to handle the transformation into something usable and readable by the end user.

- **Business Logic Tier:**

This is basically where the brain of DSS application resides; it contains business rules, data manipulation, Web services, business work flow, business entities etc. Rules engine will be part of this tier which processes the query send by user using knowledge components like Farmer profile, crop profile, rule definitions, standard range tables, advisory, images etc.

- **Data Access Tier:**

Data Access layer is entirely responsible for all interaction with the database. This means it opens and closes all database connections. It is merely a reusable interface to the database. It uses relational database / multidimensional database.

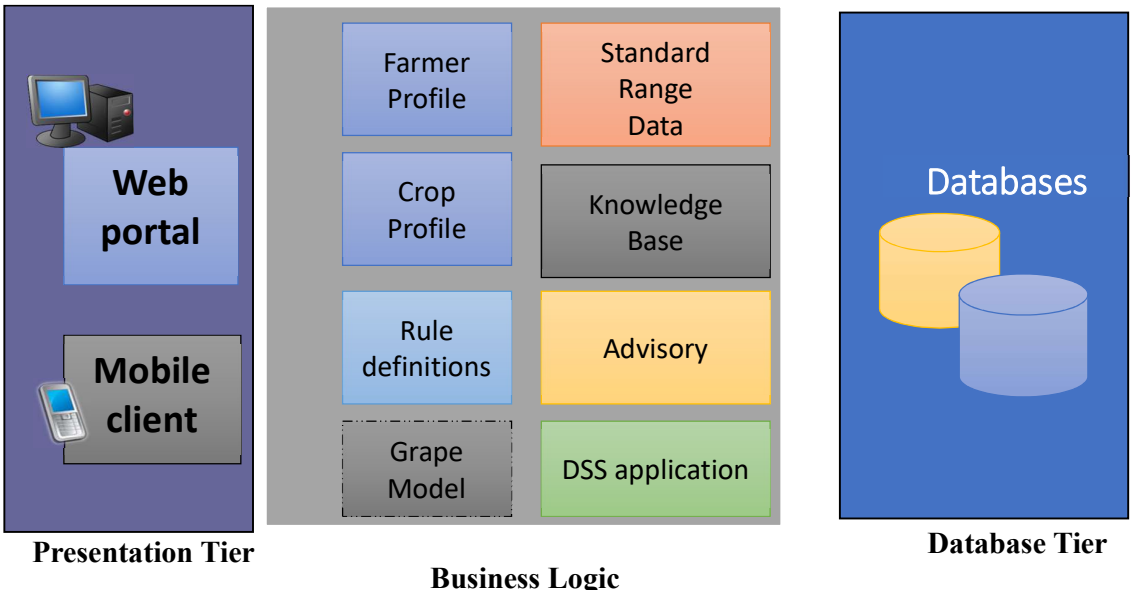


Fig. 1. DSS architecture

Rules Engine – Core of DSS:

Rules engine is the core engine of DSS and will form a part of Business logic tier. It is a collection of business rules, algorithms which are written on the basis of experiential knowledge about problems, symptoms and causal factors which are supported by standard value ranges, dynamically changing parameters, static parameters. Query received from farmer is provided as input to this rules engine which retrieves static data of the farmer, compares and filters these data parameters with standard or optimum value ranges. Through a complex, iterative filtering process among various available rules and scenarios, Rules engine will arrive at one or two probable solutions for the query asked by a farmer. Output of rules engine is advice for the query.

Arriving at a nearly accurate probable solution is a complex task and requires huge amount of data processing and check for numerous permutations and combinations. To achieve faster execution and accurate advice, multidimensional database and queries should be used. Further, online analytical processing, or OLAP, a broader category of business intelligence, which also encompasses relational reporting and data mining should be used. For example, the irrigation water requirement based upon vineyard spacing, location and time of the year is stored in multidimensional data structure. This enables the Grapes DSS to quickly respond to farmers queries (fig.2). Similarly, there can be many other scenarios covered in Rules Engine.

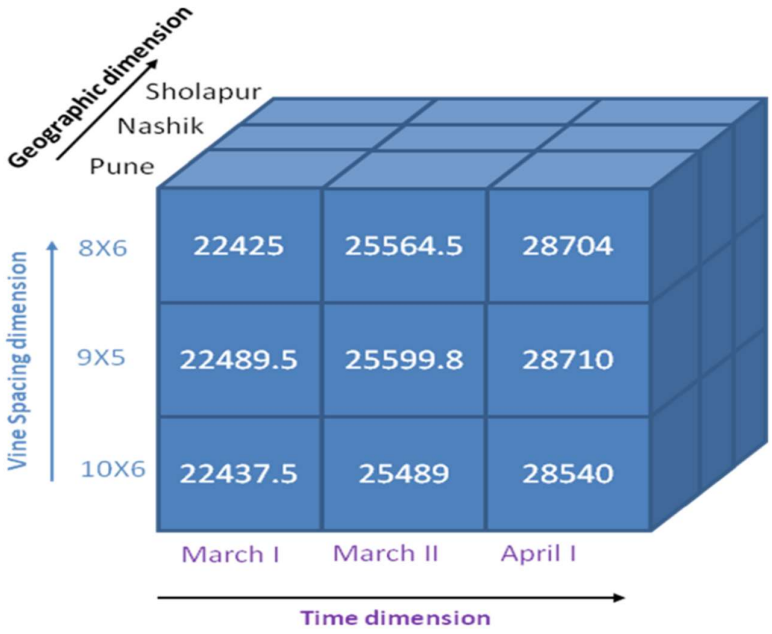


Fig.2. Multidimensional data structure for rules engine

The input requirement analysis for Grape DSS is given in table 1 and can vary based upon the purpose for which the DSS is developed. This become essential for developing the Rules engine.

Table 1. Input requirement analysis and targeted Outputs for Integrated Grape DSS

Inputs		
Initial Farmer field inputs GPS coordinates of farm and address Plot details – Age of vineyard, Rootstock, Variety, Spacing, Dripper per vine and dripper discharge rate Irrigation system – Drip, Subsurface, PRD, any other (combination of mulching + anti transparent)	**Soil** Soil type – Heavy, medium, light, Soil depth, Soil texture Soil EC, Soil Calcium carbonate content, Soil sodicity	**Soil test report as per standard parameters** **Irrigation water test report as per standard parameters** **Petiole test report as per standard parameters** At fruit bud differentiation stage At full bloom stage

Regular Farmer field inputs	**Irrigation water**	**Weather inputs – Actual (Previous 15 days) and Forecasted (7 days)**
Pruning dates (Fruit, Foundation) Pesticide spray history Irrigation water application (previous two days) Nutrient application history (stage wise) Level of disease and pest incidence	EC Sodium Boron Carbonates and bi carbonates Nitrate content and other nutrients	Pan evaporation Rain Temperature (min and max) Relative Humidity (min and max) Solar Radiation Wind speed Wind direction Leaf wetness

Outputs:

- Irrigation water requirement on a daily basis (Quantity and time of irrigation in min.)
- Forecasted irrigation water requirement for a season
- Stage wise nutrient requirement based upon soil and petiole test
- Fertilizer calculator
- Pest risk and advisory for today and next six days for six pests thrips, mealybug, mites, leafhoppers, flea beetle and caterpillars
- Disease risk and advisory for today and next six days for downy and powdery milde

Decision Support System for Grapes: Sample Graphical User Interfaces for Web based DSS

1. DSS User Interfaces:

Home Screen

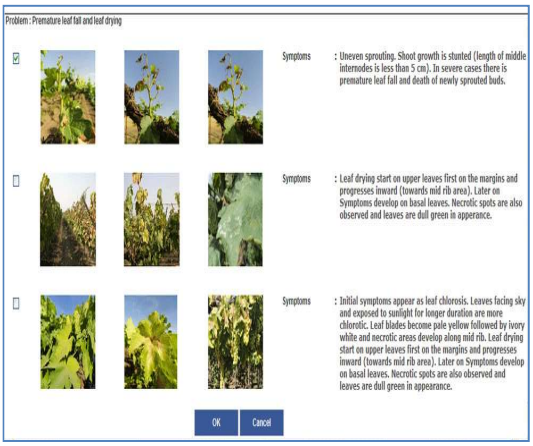
Create Account

Farmer Home

Create Profile > Farmer Registration (incl. plot details)

Crop Registration

Ask Query



Select symptom

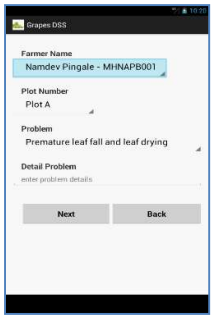
Answer Query –Advice Page

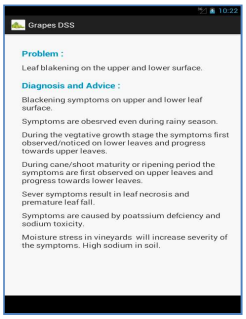
Fig. 3. Web applications

Mobile DSS:

1. **Download Mobile Application:**

2. Mobile Application Screens:





Plot Details and Problem feed screen **Diagnosis and Advice Screen**

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Chapter-5

Indian wine industry: SWOT analysis

Dr. Neeraj Agarwal

Resvera Wines Pvt. Ltd. Nashik (MS)

Introduction:

Grape is highly remunerative crop to farmers as per acre returns are the highest from this crop. Grapes export is also good in demand from last more than 50 years from western India and very remunerative to growers. However, many times in the past it has been experienced that due to poor climatic conditions & unseasonal rains and hail during production phase this crop suffers a lot in absence of any processing demand. Though raisins are processed but they need very high brix, so harvested late and then dried, however impact of bad weather comes in the middle of grape maturity and with lower brix level there is no option with the farmers but to lose the whole crop. In view of this, idea came to introduce wine making thinking that only 2-3 % of total grapes produced are used for processing and 95% are consumed as fresh in India and that processing is only for raisin making. Whereas, in rest of the world 95% grapes are used for processing and mainly for wine making.

India ranks number 5 in top liquor consuming countries however, wine consumption was very limited, thus attempts were made to produce and popularize grape wine. Initially first winery Chateau Indage started commercial production of wine in 1980's in Pune followed by another winery Grover Vineyards established in Bangalore in 1990's and then Sula Vineyards started commercial operations in Nashik in 1998 when serious efforts of marketing grape wines were initiated by linking wine with tourism, which resulted in good success to create wine market, awareness among consumers in India to become 1500 crores domestic wine industry now and to bring the Nashik region on world wine map and known as Wine Capital of India. All these efforts resulted in big boost to Indian wine Industry thus 45 wineries in Nashik, 75 wineries in Maharashtra, 15 wineries in Karnataka and many other wine productions units were established in HP, Mizoram, MP, AP, TN and other places.

The wine industry has played a major role in developing a sustainable environment in the rural areas by its green operations, generating employment in these areas and promoting the Agro & wine tourism in Maharashtra. There are many grape producers and wine entrepreneurs who have set up allied activities such as resorts, restaurant, Amphitheatre, wine shops etc. at their vineyards /wineries and which enable tourists to stay, taste and gain wine knowledge. Post the advent of the wine industry in Maharashtra, the quality of life of the people has taken a turn for the better. They

now have regular jobs at the vineyards or at the wineries and also take home regular salaries with which to support their families, thus helped to boost rural economy which is the need of the hour. This development is on similar lines globally where richest rural areas are those where wine industry is flourishing.

Now new initiation has started in HP, other hilly states and Maharashtra to make fruits wine, which is in line similar to other wine countries where fruit wines are introduced and people are accepting with a product which is something different. Global trend is that fruit wines production Is now 8% of total wine production in the world. Now Wine Lovers in Maharashtra will soon have a wider range of options, with the state government announcing excise duty exemptions for fruit-based and mead (honey) wines.

Growth of Indian wine Industry:

The modern-day wine production was pioneered by Champagne Indage Ltd. which produced Marquis de Pompadour and exported Omar Khayyam Brut using Method Traditionally with French collaboration in the 1980's and later 'Riviera' and 'Chantilly' still wines that enjoyed popularity because of its monopoly. The credit for introducing varietals however, goes to Grover and Sula in the mid-late 1990's and is considered a benchmark for modern day winemaking. The wine culture took off in 2001 as the State of Maharashtra announced a model excise policy, waiving excise duty for sales within the State and offering other incentives, and the Indian government allowing free import of wines in 2002 with high import duties of around 260%. There are about 90 wineries today, over 80% being in Maharashtra and the balance mostly in Karnataka. Of late, the fruit wine industry has started developing in parts where different fruits grow aplenty and wastage is humungous.

During the period of 1980's to the early 2000's the cheaper fortified wine market continued to grow, especially in the South and Southwest of India. Today, there is a total consumption of about 3.5 million cases with over 1 million cases of the 'cheap fortified' wines and about 450,000 cases of imported wines annually. There has been an average growth of around 10-12% during the last 20 years with a sharp drop during the global meltdown during 2008-2010 and in 2020-21 due to Covid-19, especially since wine tourism was reduced practically too nil and no online sales allowed. Women, especially middle class, and the youth have been driving the growth of wine culture. Increased tourism to foreign countries has also contributed to people adopting wine culture. Another factor is the health benefits of red wine propagated by the medical fraternity. About 60% of the wine consumed is red with 35% being white; the balance is Rose and sparkling wine which is slowly increasing in consumption.

Known as the Napa Valley of India, Nashik is the center of production since it has been growing table grapes for over 50 years; India is ranked as the 8th biggest producer of grapes in the world, though the vast majority is table grapes. Minuscule portions are produced in other states- Kashmir is out of reach today due to political and religious reasons but the foothills of Uttaranchal and Himachal Pradesh have a

Very good potential. Being nearer the equator India can have two crops of grapes for wine but due to the monsoons, winemakers prune their vines to keep only one crop for wine grapes, making January-April as the harvest season. Indian wines are gradually getting to be discovered out of India but only about 5% is exported because the prices are not internationally competitive. Due to continued premiumization, higher priced and higher quality wines are being added to the producer portfolios with upper end of the spectrum selling for up to Rs. 4500 ($65) a bottle.

However, wines have been accepted well for their flavor profile by the expats. There has been undeniably a marked improvement in quality in the last 10 years. This has also resulted in an increase in wine tourism with the leading producer Sula Vineyards making a million cases a year, receiving over 350,000 wine tourists a year. Other producers are gradually emulating its success, the financial constraints notwithstanding. Constitutional bottleneck unfortunately, the growth of the industry is not as fast as expected. There were perhaps less than 50,000 people drinking wine in 2001-today there are estimated to be around 4- 5 million. Indian producers try to be in tune with the wine trends and technology in the world. Sula introduced screw-caps around 15 years ago and a majority of producers followed suit. It introduced red sparkling wines and recently 'wine in the can'. It is a leader in sustainability, energy saving and using the latest technology. Grover is innovating by using optical sorters, egg- shaped fermenters and amphorae. It has even bought a winery in Burgundy. Fratelli has introduced Italian grapes and their winemaking style. KRSMA is a boutique winery that has made top quality wines despite acute water shortage and is exporting to the US. They are all selling their wines to Michelin Starred restaurants in Europe and the USA and are very popular in the Indian restaurants in Japan.

It is common knowledge that India and world-class wine are not spoken in the same breath, but if the recent promotional events held all over the country are anything to go by, then all that is about to change. At present times, finding a foothold in an arena that has been eternally dominated by European players has been quite an uphill task for Indian winemakers. However, the recent growth numbers – the wine market is currently growing at a rate of 10-15 per cent – have given them some cause to celebrate. A larger market translates to more demand, which in turn means that Indian wines can, now, share a shelf with their French and Italian counterparts. Moreover, Indians wines

are considerably cheaper than their Western counterparts; thus, enabling it to achieve a particular target audience of its own.

SWOT:

Indian wine industry saw a rapid growth in past 20 years from almost zero to now a market of 1500 crores, from 5 ml per capita consumption per annum to now 20 ml per capita consumption in last 15 years is commendable. However, there are various for growth and well as Indian wine industry has many

Challenges to face. The strengths and weakness of Indian wine industry can be summarized as follows;

Strengths:

1. Indian wine consumption is increasing at a rate of 10-15% per annum since last 20 years.
2. Good climate for grape growing compares too many other European countries so have potential to male one of the best quality wines in the world.
3. Urban population is increasing so wine demand is increasing
4. Youths are carving alternatives to hard liquor and developing more refined taste.
5. Wine is becoming more acceptable to woman and youths.
6. With more education now, Indians are understanding the wine and food pairing and is a product of enjoyment and health and not to abuse.
7. Medical fraternity is recommending red wines better for health.

Weakness:

1. Due to lack of cold chain it is difficult to store wines in proper condition to keep its good quality to remain intact.
2. Limited demand due to lack of wine knowledge and mostly Indian population (98%) prefer to drink hard liquor.
3. Higher price of wines is also hindering factor.
4. Reaching to consumer is limiting factor due to various regulation by every state & without consumer tasting it is difficult to convince the consumer to buy wines.

Opportunities:

1. Medical fraternity is recommending red wines are good for health.
2. Acceptance among woman and youths is increasing hence taboo associated with hard liquor is going away with wines.
3. Mostly domestic wines are cheaper compared to imported wines, hence better option for domestic consumers.
4. Indian wines are now exported to more than 30 countries in the world hence, Indian consumer is now confident about the quality of Indian wines.
5. Maharashtra government and other states are also considering to allow the sale of wines only through super markets would definitely support to the industry in big way.
6. Wine culture is developing mainly in metros with the more Indian population and specifically IT technocrats are travelling globally.

Threats:

1. Heavy investment required for developing cold chain for Indian hot conditions which is not an issue in European markets, otherwise Indian consumer will never get the right quality wines.
2. The Indian constitution discourages alcohol consumption and Indian Prohibition act is the key limiting factor for wines marketing as no wine promotion is allowed and each state have different laws for regulation with hefty fees.
3. There is move from European Union to reduce import duties of wines in India and if it is accepted by Indian government, it will affect the Indian industry drastically.
4. Indians still prefer other hard liquors over wine

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Chapter-6

Processing and value addition in grapes: Business opportunities

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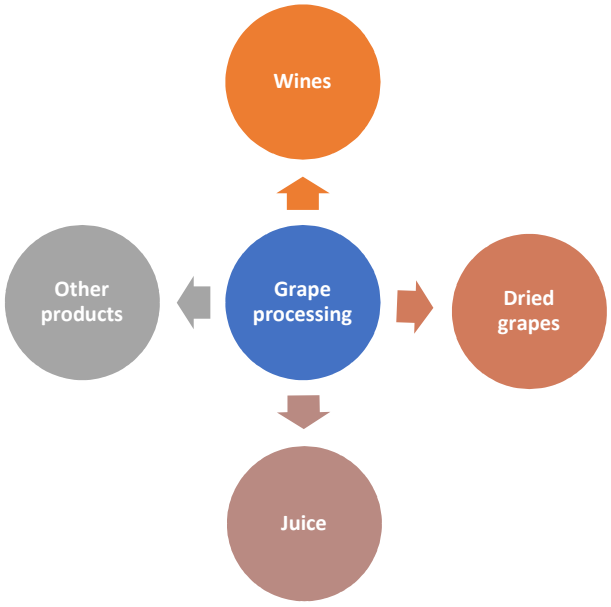
Grapes have become important fruit crop in India. However, grape growing is mainly concentrated in temperate conditions of different countries, especially Spain, Italy, France, Germany etc. Worldwide grapes are mainly produced for winemaking, but consuming pattern of grapes is changing and shift from wine grapes to table grapes is in last two decades. Adaptive behaviour of grapevines made grape growing on wider horizon of soil types under broad climatic conditions from temperate to tropical. In India, grapes are being grown from temperate to tropical conditions on wider type of soil conditions. But, grape production is mainly concentrated in tropical conditions of Maharashtra and Karnataka. As per an estimate 140 thousand ha area was under grapes and production was 3.12 million tons during 2020. As Maharashtra and Karnataka states share about 95% of total grape production of the country.

Grapes is the known for earn of foreign exchange by exporting to more than 60 countries. EU countries are major destination of Indian grapes. Hence, this sector is creating employment opportunities for farmers, farm labours, exporters, traders and others who are associated with it. Following the criteria of GAP can further help the stakeholders to attain international standard and thus to explore more opportunity for export and eventually to upgrade their economic status. Due to tropical conditions, the grape berries face higher temperature during maturity, ripening and harvesting. Supply chain in domestic market is very poor and has direct impact on bunch quality including shelf life. Many times, due to high temperature, berry shattering and rachis browning and shrivelling starts in the supply chain only and before reaching at destination, berries lose their shelf life. Not only high temperature, improper handling of bunches during harvesting and transportation, lacking of grading, improper packaging materials etc. lead to heavy post-harvest losses and deterioration in quality.



Grape processing

Worldwide about 48% of total grapes are fermented and wines are being prepared and about 36% grapes are dried for raisin making. But in India about 68% of total produce is consumed as fresh grapes and 30% are used for raisin making while only 1-2% are converted into wines. Very negligible quantity is used for juice purpose.

Wine industry:

Italy is major wine producers followed by France, Spain, USA, etc. Among the major exporting countries, the bottled export share was very high in terms of volume in 2020 in Portugal (81%), Germany (73%), France (71%), and Italy (59%). Bottled wines constituted 70% of the total value of wines exported in 2020 throughout the world. Portugal (92%), Argentina (89%), Chile (81%), and Australia (77%) held the largest export shares in terms of value in 2020.

In India wines production is mainly concentrated in Maharashtra state followed by Karnataka. Nashik is known as wine capital of country. Maximum wine production come from Nashik district only. India is producing about 18 million liters of wines and domination wine grape varieties are Cabernet Sauvignon, Shiraz, Merlot, Malbec, Zinfandel (red wines) and Sauvignon Blanc, Chenin Blanc, Chardonnay, Riesling, (white wines) etc. A GI named as Nashik Valley Wines is also provided. Indian wine industry is facing many problems like higher input cost, quality issues, taxation problems, excise, social taboo and Govt issues as wines are considered alcoholic drinks, not drinks for health.

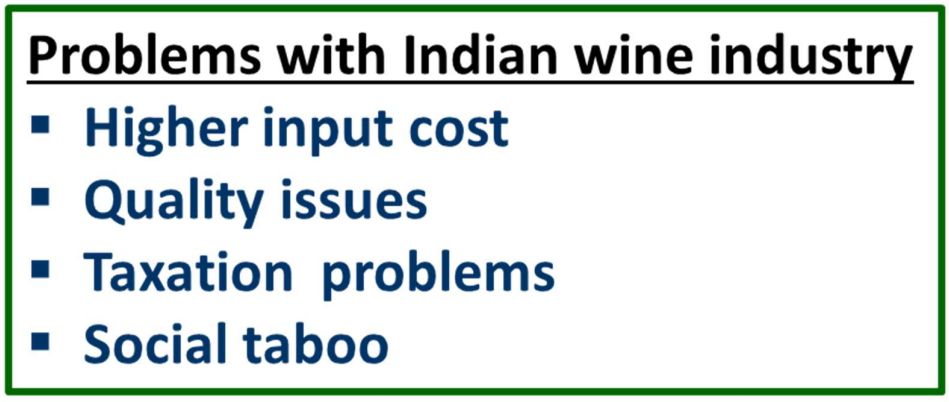
Indian wine industry: A scenario

- Maharashtra (Nashik, Pune, Sangli etc.) and Karnataka (Vijayapura, Bagalkot, Bangalore etc.)
- Wine production: 18 million L
- Maharashtra and Karnataka states have wine policy to support wine industry
- GI for Nashik Valley Wine
- Red wines: Cabernet Sauvignon, Shiraz, Merlot, Malbec, Zinfandel
- White wines: Sauvignon Blanc, Chenin Blanc, Chardonnay, Riesling
- Consumption: 9 ml/capita/year

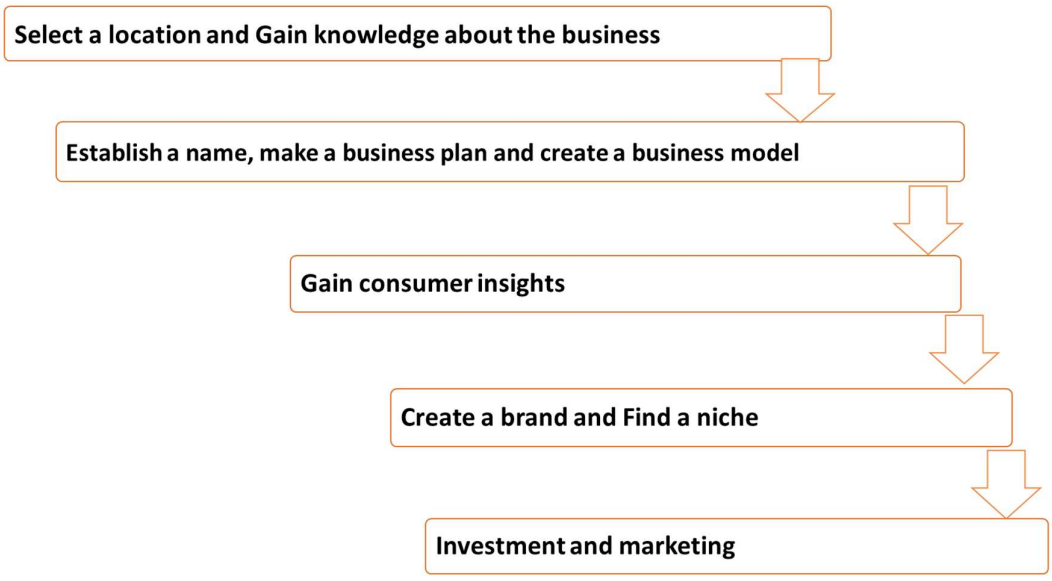
During the winemaking process the sugar contained in the must (the fresh grape juice) is transformed into alcohol along with the output of carbonic gases that escape into the environment. The grape skins give the colour to the wine. White wine can be made with red grapes if the marc is removed before the colour passes into the liquid. Fermentation and maturation can be completed in steel or oak containers. The fermentation period lasts from a few days, for lighter wines and up to 30 days for stronger wines, which depends upon temperature at which fermentation is being done. The longer the contact of the juice with the skins is maintained, the stronger the colour and tannin content of the wine. This can give the wine a fuller body and potentially a longer life span in the form of age reachable. Too much tannin can, however, ruin a wine. At this point the wine is separated from the skins and begins the aging process in barrels and later bottles. White wine differs from red not only in terms of colour. Traditionally they are fermented without maceration, have a lower tannin content, a lighter body, a higher acidity and a shorter aging time compared to red wines. A white wine usually has less alcohol but a greater fruit and floral characteristic. Several fermentation conditions such as fermentation temperature, skin contact time, and skins to must ratio (berry size) influence the extraction of anthocyanins and other phenolic compounds.

Broadly wines are categorized as, demi-sec, semi-sweet and sweet based on sugar content in finished wines. *Dry:* when the wine contains a maximum of either 4 g/L sugar or 9 g/L when the level

of total acidity (expressed in grams of tartaric acid per litre) is no more than 2 g/L less than the sugar content. *Demi-sec:* when the sugar content of the wine is more than that specified dry, up to a maximum of either 12 g/L or 18 g/L when the content in total acidity is fixed according to the dry wine *Semi-sweet*, when the sugar content of the wine is more than that specified in the demi sec, up to a maximum of 45 g/L. *Sweet*, when the wine has a minimum sugar content of 45 g/L.



How to start a wine business



Opportunities in wine industry:

Indian wine industry is facing several problems like higher productions cost, wine quality, low demand, taxation issues, etc. However, a growth of 10-12% has been registered in this sector. By the support of Govt. agencies and awareness of consumers, this industry can perform very well. With problems, India has good opportunities also.

1. Higher demand of alcoholic drinks within domestic market
2. Higher yield potential under tropical conditions
3. Adoption of DSS for maintain vineyards at lower inputs
4. Utilization of locally available microbes without compromise on wine quality
5. Utilization of locally available machineries
6. Wealth from waste
7. Wine-tourism

Entrepreneurship opportunities in wine industry:

Wine industry has lot of business opportunities. Many sectors have own importance and business can be started by understanding the sector as well as considering backward and forward linkages. Some important areas for entrepreneurship development are mentioned bellow:

I. Supply of clean plant material
II. Supply of quality Grapes
III. Winemaking
IV. Manufacturing of machineries
V. Machinery supply
VI. Supply of microbes (yeast, bacteria, etc.)
VII. Supply of fining materials
VIII. Packaging material
IX. Wine tasting
X. Laboratory to support wine industry
XI. Online marketing and retailing

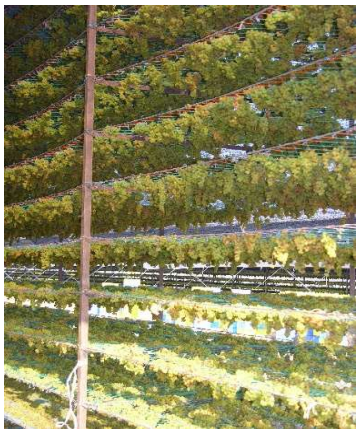
XII. Import of wines

XIII. Support to allied industries

Raisin industry:

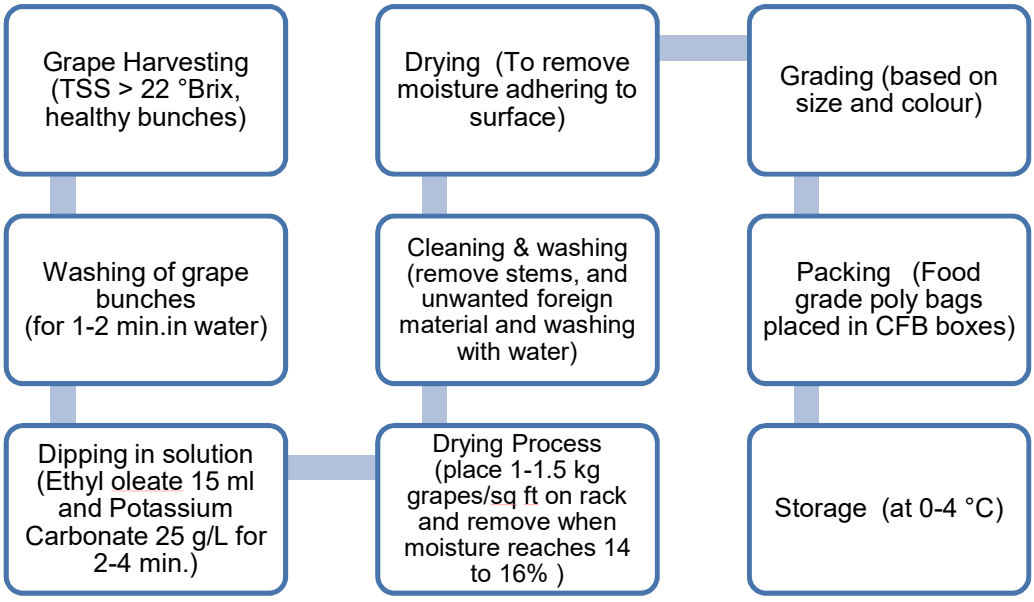
Grape drying is a major available method of grape processing. It can process grapes into raisins for longer shelf-life and further utilization in various forms. As per an estimate about two lakh tons raisins are produced from areas of Maharashtra (Sangli, Solapur and Nashik) and Karnataka (Vijayapura and Bagalkot). Presently India is producing about 3.2 lakh tons raisins. Different drying technologies for grape drying are being used worldwide such as natural open sun drying, shade drying, solar drying, hot air drying, microwave drying, vacuum pulsed drying etc. Commercial grape production in India is mainly confined in tropical belts of Maharashtra and Karnataka and about 95% grape is produced from this area. Under these conditions, grapes are harvested during high temperature and low humidity conditions. In India, Australian method of raisin making is well adopted where grape bunches are treated with solution of ethyl oleate and potassium carbonate before drying in racks inside sheds.

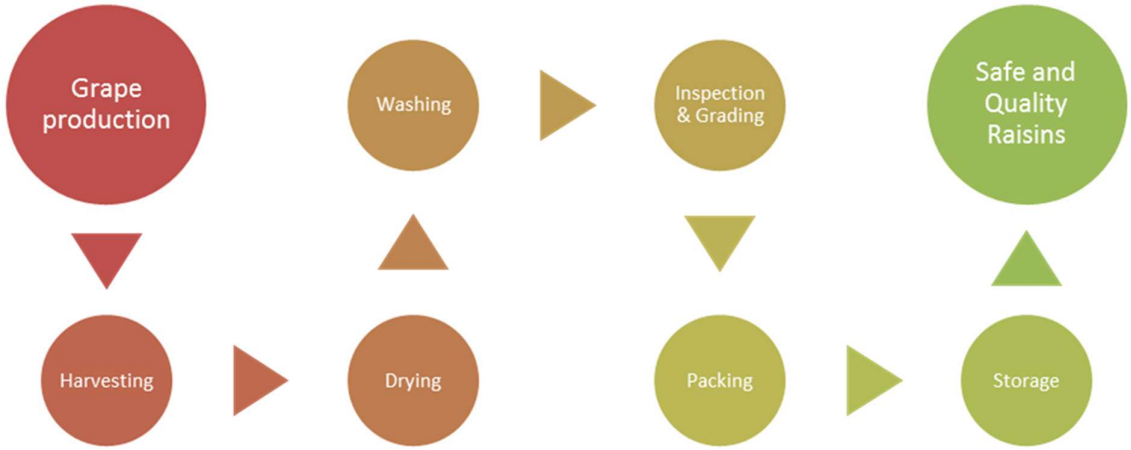
The efficiency and quality of the post-drying operations are significantly influenced by biomechanical and physical properties of the dried grapes. The post-drying operations may vary depending on the drying method. The operating conditions may affect the physical and hygienic characteristics of the dried product. The cleaning involves individualizing the dried fruit, removal of stems and foreign materials, and removal of off-grade raisins. Water is used to eliminate foreign materials such as dust and soil, through multiple washing.



Raisin quality: Varietal effect

Raisin making flowchart:





Check points for quality raisin production

GI: New opportunities in raisin trading

SANGLI RAISINS

सांगली बेदाणा

SANGLI RAISIN

Opportunities in raisin industry:

Indian raisin industry has lot of opportunities. There is need to establish marketing, utilization in food industry, traceability system in raisin production and supply chain, encourage raisins in mid-day meal. These conditions will create demand and it will require more raisin production to cater domestic demand. Important opportunities are mentioned as under:

1. Higher yield potential and suitable climatic conditions
2. High domestic demand
3. Production of naturally dried (without using chemicals during grape drying) raisins
4. Utilization in dairy, bakery and confectionary industry will one lot of opportunities
5. Utilization in preparation of other valuable products like Raisin juice, wine, paste and pekmez
6. Ethanol
7. Establish brand value
8. Utilization of GI for marketing purpose
9. Better return from export market: need to address quality

Entrepreneurship opportunities in raisin industry:

This sector has unlimited opportunities for starting of business. Major areas are mentioned bellow.

I. Dipping oil production
II. Supply of dipping oil and potassium carbonate
III. Creation of Infrastructure like raisin shed, pack house, cold storage, etc.
IV. Market intelligence and supply chain management
V. Traceability system
VI. Development of brand value
VII. CFC for cleaning, washing, grading and packing
VIII. Supply of packaging materials
IX. Wholesale and retail marketing

Juice:

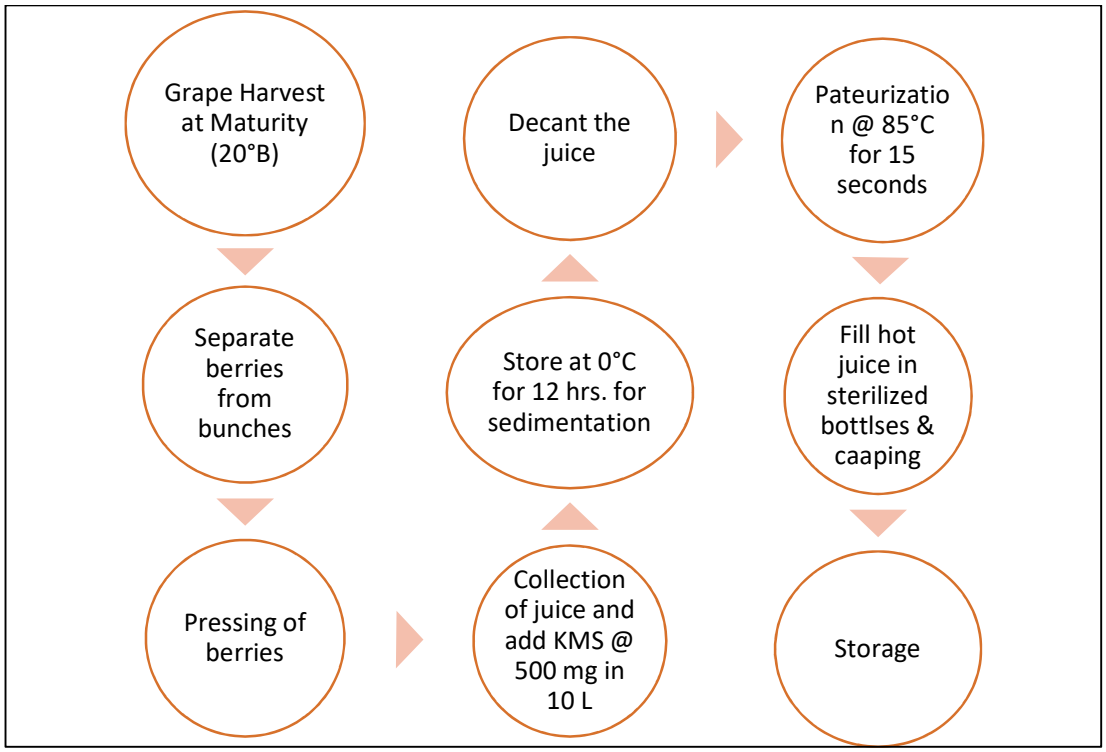
The quality of grape juice depends to a great extent on the sugar level, acid content and flavour constituents. The specific composition of the juice from any cultivar varies from year to year and changes continually during ripening. The composition of a specific cultivar will also vary from one area of growth to another and from one vine-yard to another since composition is affected by soil, climatic conditions, and vineyard management practices. In general, colour of grape juice is the result of anthocyanin pigments located in or near the skin. Different cultivars have different types and amounts of these pigments.

Varietal variation in grape juices

Manjari Medika Juice:

1. **High recovery (> 70%)**
2. **Dark Red colour juice**
3. **Higher content of anthocyanins (5-6 g/kg grapes)**
4. **Also, fairly good content of resveratrol**
5. **Suitable for zero waste processing**

Juice preparation flow chart:



Opportunities:

- Available brands in market are not have true juices
- Grape juice varieties have yield potential with higher juice recovery
- Highlight nutraceutical values of grape juices for establishing these juices as drink for health
- Manjari Medika juice: Grape variety juice has very high antioxidant properties
- Zero waste processing of Manjari Medika grapes can be promoted
- Make competitive with other drinks by adding package values, storability and value addition by carbonation

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Chapter-7

Artificial Intelligence: Smart way to manage vineyards

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The problem solving revolved around three steps, perceive, analyse and act. Artificial intelligence (AI) can work on all three aspects of problem solving and thus opened new possibilities in grape production and vineyard management. Artificial intelligence (AI) strives to make machines to become capable of performing tasks which typically require human intelligence. The advancements in AI have led to paradigm shifts in almost every sector. AI in Indian viticulture has immense potential.

Few of the major challenges in Indian viticulture are

- drudgery in farm work,
- lack of skilled labour,
- time consuming and inefficient manual operations,
- timing of operations,
- appropriate technical and financial decision making,
- marketing,
- lack of knowledge of peak time of farm input demand,
- predictions on demand of farm produce, market discovery, acreage planted, price prediction, crop choices,
- inefficiency in irrigation, nutrition, and pesticide applications,
- Lack of accurate and long-term farm specific weather forecasting, etc.

AI can provide efficient solutions to many of these challenges. Currently, sufficient progress has been made in the areas of machine learning, wireless sensor networking, automated navigation systems, smartphone, and digital connectivity. These advances can provide artificial intelligence-based solutions to the farmers on their fingertips. AI can prove to be the most disruptive technology in agriculture. It can learn, understand, and interact with different environments to maximize agricultural productivity. Microsoft is working with 175 farmers in Andhra Pradesh to provide agricultural, land and fertilized advisory services. This initiative has already resulted in increasing 30 per cent higher average yield per hectare recently. In this lecture, I tried to compile few of the areas where AI can be utilized to smartly manage vineyards.

Automated monitoring and advisory:

AI powered wireless network of sensors, drones and autonomous navigation robots mounted with image capturing devices can help in automated monitoring of farms, geo tagging of plants with specific problems and generating automated advisory for timely decisions. Thus, achieving the goals of precision farming in true sense. Trained machine learning models for plant stress conditions can help in geo tagging of affected individual plants for precision viticulture. The diseases and pests can be identified at the beginning before their spread to whole farm which will help in timely action and reduction in cost of cultivation. The automated monitoring and advisory can be implemented at both micro and macro scales.

- ✓ Automated Monitoring
  - ❖ Micro monitoring
    - ➢ Capturing signals for plant health from each plant
    - ➢ Mapping entire field/orchard for plant health
    - ➢ Analysing plant health based on machine learning models
    - ➢ Labour efficiency
  - ❖ Macro monitoring
    - ➢ Area under cultivation
    - ➢ Distribution of varieties
    - ➢ Date of planting/pruning/sowing
    - ➢ Biotic and abiotic stress conditions
- ✓ Automated advisory
  - ✓ Micro advisory
    - ➢ plant specific advisory
    - ➢ canopy management
    - ➢ pest and disease management
    - ➢ irrigation and nutrient management
  - ✓ Macro advisory
    - ➢ Pruning/sowing/planting dates
    - ➢ market intelligence
    - ➢ spread of disease or pest

Automation of farm operations:

The advantages of automation are primarily reflected as saving in time required to accomplish it, savings in labour, energy, input resources, improvement over control and quality of the work, etc. The automation advantages more visible in operations frequently done and require higher skill. The adoption of automation is seen more in high value crops that offer higher profits. Grapes is one such high-value crop that requires special skill and care for cultivation in tropical India. The important areas of automation of farm operations are spraying, pruning, thinning, loose bark removal, weeding, etc.

Timely availability of skilled labour is becoming a major challenge in viticulture. AI enabled bots can help overcoming the labour challenge. These bots can be developed to automatically navigate inside the farm, identify and kill weeds, do pruning at precise site on the plant, apply growth regulators on specific plant part, scare birds away, tying and training plants, harvest, grade, and pack final produce. It can reduce drudgery involved in the farming. These bots can also provide round the clock watch and labour to the farm making non-availability of labour on time a thing of past.

Extension education:

AI can also help in disseminating information and knowledge complementing Krishi Vigyan Kendras (KVKs). AI enabled tools such as chatbots, decision support systems, automated call centres capable of processing natural language, etc. can be developed which will bridge the extension gap.

Supply chain improvements:

Grapes is an important export commodity for India generating foreign exchange. The supply chain of grapes export can be improved with traceability, monitoring storage conditions, cargo tracking, price realization from producer to retailer, increased transparency, trust and confidence in the trading, etc.

Market intelligence:

Machine learning models can be trained for identification of areas under sowing and/or pruning for different crops at different time intervals. It can help in predicting the time of arrival of produce in the market and price predictions can also be made. It can help policy makers or food processing industries to plan ahead regarding their future course of action. More accuracy

can be added by identifying stress conditions during crop growth period. It can also help in predicting input demands which can help in farm input industries to plan their production.

Therefore, the realm AI has opened up new possibilities of applications for all pre-production, production and post-production sectors involved in grape production and vineyard management. However, AI is not the panacea for all the ills in agriculture. AI has its own limitations in solving real world problems in viticulture. AI is only the simulation of human thinking to some extent. It is learning and classification of objects and tasks based on the given data. A robust and vast data is the pre-requisite to train machine learning models for accurate results. The affordability of new technology with the small holding farmers may be a challenge but it can be solved through custom hiring basis. Technological advancements in the field of AI are mature enough, it's only time that we take a leap of faith and adopt it.

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Chapter-8

Pesticide residue management in grapes and associated business opportunities

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Introduction:

Usage of agrochemicals (pesticides) are integral part of commercial viticulture in India. Different agrochemicals are used for the control of insect pests, various diseases and management of weeds and as plant growth regulators etc. at various stages of commercial viticulture. One of the non-targeted effect of these agrochemicals usage in grape is the issues associated with the residues of these chemicals in final harvested produces, especially with respect to international trade. Hence, it is important to manage the residues of these pesticides at or below the prescribed regulatory limit (Maximum Residue Limit (MRL)) in order to facilitate smooth trade at domestic and international level. Various strategies need to be adopted by growers to manage these residues at or below the prescribed MRL levels which are briefly discussed in this article.

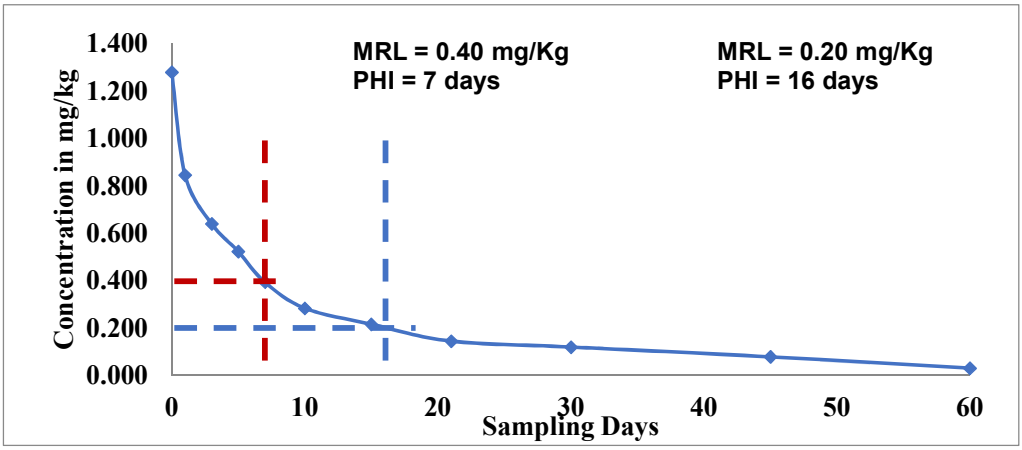
Pesticide Residues and Maximum Residue Limit (MRL):

Before going to the residue management strategies, one should be very clear about the term pesticide residues and Maximum Residue Limit (MRL) of a pesticide. In simple term, pesticide residues are substance or mixture of substances in food resulting from usage of a pesticide, which could be the remains of the parent compound or its degradation or conversion product that are considered to be of toxicological significance.

The MRL of a pesticide is the maximum concentration of residue legally tolerated in a food product when a pesticide is used according to label directions. It is important to note here that the MRL is a legal limit set for international trade and it is related to label direction, and it is not a safety limit. Hence, for a pesticide, the MRL value will be different for different countries and changes with the label direction (Good Agriculture Practice (GAP)) or crop. So, it is important to follow the Good Agriculture Practice (GAP) to ensure the residues in the harvested produce are below the prescribed MRL.

Pre-Harvest Interval (PHI)/ Waiting Period: A tool for field level pesticide residue management:

When a pesticide is applied in the field, the initial residue (on the day of application present on crop) will degrade by various factors such as microbial degradation, chemical degradation (hydrolysis, oxidation, reduction etc.) and by physical means (photolysis etc.) and ultimately the residue will come down to zero. Once a pesticide is applied on a crop, after a certain day of waiting period the residue of the particular pesticide will come down below its MRL level in the harvested produce. This waiting period is termed as PHI. Hence, PHI is the wait time between a pesticide application and when a crop can be harvested. So, for effective residue management at field level, it is very important to follow the waiting period prescribed for the particular pesticide with respect to target MRL. It is also important to note here that once the MRL of a pesticide is changed, the PHI prescribed for that pesticide also will change. If the MRL of a pesticide is reduced, then the PHI/ waiting period will increase and vice versa. The schematic graph presented below clearly depict the relationship of MRL and the PHI. The PHI is considered as the most effective tool for the management of pesticide residues below the target MRLs in the harvested produce.



Annexure 5 (Label direction for pesticide usage in grape):

Annexure 5 of the Residue Monitoring Plan (RMP) of APEDA, Ministry of Commerce, GoI is the list of pesticide formulation registered with Central Insecticide Board and Registration Committee (CIB & RC) having official label claim for use in grape. This list of Annexure 5 is updated every year by IACR-NRC for Grapes, Pune before the onset of every grape season. This list is considered as the GAP or Label Direction for the use of pesticide formulation in grape. The list contains the information pertaining to targeted pest or diseases, application dose, European Union (EU)-MRL and PHI of the pesticide. Hence, usage of any pesticide beyond this list is considered as

an illegal usage and will be considered as a violation of GAP. Usage of such chemical will hamper the price realization of your produce in export. Since the RMP is formulated for the control of pesticide residues in export pf grape to Europe in particular, all the PHI value recommended are with respect to EU-MRL. Hence, it is important to note here that, if any grower or exporter is targeting a particular market other than EU where the MRL of a particular pesticide is less than the EU-MRL, the PHI recommended in Annexure 5 will not be sufficient to produce MRL complied grape production for that market. If the targeted market MRL is more than the EU-MRL, the EU-MRL based PHI in Annexure 5 can be easily followed without any hurdles. The Annexure 5 for the grape season 2021-22 can be accessed from the ICAR-NRCG website in the following link; https://nrcgrapes.icar.gov.in/ for %20 farmers/ Annexure%205 _RMP Grapes _ 2021-22_15 _09_2021%20Final.pdf.

Annexure 9 (List of monitoring chemicals in grape):

Different economies have regulated more than 600 pesticides in grape for export compliance. Hence, it is expected the MRL compliance to all these pesticides. However, practically it is almost impossible to give compliance after testing all these regulated pesticides in any commodity. Hence, ICAR-NRCG, Pune has recommended a list of pesticides (Annexure 9) to be tested in all export consignments considering the registered list of pesticides in India, banned pesticides in India, label claim pesticides for use in grape and feedback from the stakeholders. Annexure 9 of the Residue Monitoring Plan (RMP) of APEDA is the list of pesticides mandatorily monitored in every consignment of grape exported to EU. ICAR-NRCG, Pune updates this list every year and the latest Annexure 9 for the grape season 2021-22 can be accessed from the ICAR-NRCG website in the following link; https://nrcgrapes.icar.gov.in/for%20farmers/Annexure%209%2003.02.2022.pdf . It is important to note that this year's Annexure 9 has a total of 268 chemicals. Now the list contains all the pesticides registered with CIB & RC across the crops. Hence the growers may also take a watch on the usage of pesticides in fields adjacent to your vineyards. Just a wind drift from adjacent field near the time of harvest may cause detection of these pesticides in your grape and may become a reason for failure.

Current market requirement: Mere MRL complied grape production is not sufficient:

MRL complied grape production is very much essential to avoid failure and to get clearance for export to EU. But the important question arise here is only the mere MRL complied grape production is sufficient? The feedback from the exporters clearly indicates that for a better price realization for your produce, mere MRL compliance is not sufficient. If your product could meet the

stringent requirement of some private standards of prime super markets in Europe, you can fetch more than 20-30 % higher price realization for your produce. The major extra requirement in these private standards are; a). The number of detection should be minimal (generally less than or equal to 5) even though your produce is pass; b) The residues detected should be less than 1/3rd of MRL; c) The total residue concentration should be minimal (generally less than 1 mg/Kg; d) There should not be any detection beyond the GAP. In order to meet this stringent private standard, mere adoption of Annexure 5 PHI will not be sufficient. For the production of such produce, the Annexure 5 chemicals should be used considering the following strategies described below.

Strategies for selection of Annexure 5 chemicals for field applications:

For the use of any pesticide formulation in grape, first and foremost important things is that the chemical should be present in Annexure 5 and the PHI mentioned should be followed. This will ensure the residues in harvested produce below the EU-MRL. However, when you follow Annexure 5, many more time

More than two pesticide will be available and you should go for a choice among the recommended pesticide. Under such situation, in order to meet the above stringent market requirement, the following strategies may be adopted so that the residues in the final produce should be as low as possible.

Strategy-1:

At a given point of pest or disease infestation, select the pesticide with minimal MRL (0.01 mg/Kg) and follow the PHI accordingly. If you follow this strategy, the pesticide used will not be coming in the analysis report and will not be counted in the detection list. For example, pest or disease infestation appeared 70 days before harvest, the available pesticide in Annexure 5 is as follows;

Pesticide	MRL (mg/kg)	PHI
Pesticide-A	0.5	65 days
Pesticide-B	0.05	65 days
Pesticide-C	0.01	65 days

Under such situation, the ideal choice will be the Pesticide C. Use of pesticide A or B will give MRL compliance, however the reside could be present below the EU-MRL level and will be counted in number of detections.

Strategy-2:

At a given point of pest or disease infestation, select the pesticide with lower MRL and follow the PHI accordingly. If you follow this strategy, the pesticide used, even if it is detected, will be below the EU-MRL and the level will be minimal ensuring lowest contribution to the total residue content (< 1 mg/kg). For example, pest or disease infestation appeared 50 days before harvest, the available pesticide in Annexure 5 is as follows;

Pesticide	MRL (mg/kg)	PHI
Pesticide-A	0.50	45 days
Pesticide-B	0.40	45 days
Pesticide-C	0.05	45 days

Under such situation, the ideal choice will be the Pesticide C. Use of pesticide A or B will give MRL compliance, however, the reside contribution to the total residue will be comparatively higher.

Startegy-3:

At a given point of disease infestation, use the class of pesticide which are analysed as a common derivatization product (Eg. dithiocarbamate pesticides as CS_2). Usage of such formulations (mancozeb, propineb, metiram) following the PHI, even though the residue presents in the analysis report, it will be appearing as a common residue of CS_2 and will be counted as one detection. Further, if you go for the application of their combination products, the selection may be made based on their partner pesticides following the Strategy 1 and 2.

Startegy-4:

Avoid use of high-risk fungicides (resistance developed against target pests, Eg: QoI fungicides and PA fungicides (Foot note provided in Annexure 5)) which will result in multiple sprays in over dose. Usage of such formulations may lead to residues above MRL level in the final produce.

Startegy-5:

Use alternate chemicals who's MRLs are not prescribed by the regulatory body. For examples; Sulphur, Chitosan, Silver complex of H_2O_2, Chlorine dioxide, Ozonized water etc. may be used whenever possible. As MRL are not prescribed for these chemicals, their residue will not be tested for the regulatory compliances.

Startegy-6:

Usage of biological formulation or bio-pesticides without confirming its chemical purity with respect to Annexure 9 chemicals should be avoided, especially near to the harvest. You can use the biologicals after verifying their purity so that there will not be any contamination or sample failure due unintended pesticides.

Experience from the past grape seasons:

Failure or detection pattern of the past grape season always will give a direction for usage of different formulations in the current season. For the past three grape season, among Annexure 5 chemicals, major reasons for failures are due to forchlorfenuron (CPPU), abamectin, buprofezin, chlormequat (CCC), fipronil, lamda cyhalothrin, flusilazole, hexaconazole, carbendazim, methomyl etc. Usage of this chemicals should be strictly followed as per the directions in Annexure 5. Among the Annexure 9 chemicals, the major failures are due to 4-bromo-2-chlorophenol (metabolite of profenophos), chlorpyrifos, acephate, captan, profenophos, thiophanate-methyl, thiodicarb, thiamethoxam, cypermethrin, hexythiazox, acetamiprid etc. So, usage of any such chemicals which are not recommended in grape should be strictly avoided.

Business opportunities in residue management:

Issues associated with pesticide residue management at field level and pesticide residue testing offers new business opportunities. The major business opportunity can be classified in to Service oriented opportunity, Production oriented opportunity and Laboratory/Testing oriented opportunity.

A. Service oriented business opportunity:

Service oriented business opportunity entirely depends on disseminating knowledge to the stake holders through various consultancy service or firms. This could be on the following grounds;

- **Service provider for scientific usage of agrochemicals:**

The growers may not be aware about the scientific strategy for the usage of pesticides as per the GAP recommendation. Hence, the service provider which has all the scientific knowledge about GAP recommendation, label claim pesticides available, the PHI/ MRLs of each pesticide and the target market MRLs. This type of service will ensure judicious use of agrochemicals in grape and production of target market specific MRL complied grape having better price realization to growers.

- **Service provider to act as connecting link between growers and exporters:**

In order to get better price realization of the produce, the growers need to align the activities as per the requirement and need to be connected to exporter. The technical requirement for registration of the farm, GAP requirement etc. may not be aware to the growers. This can be well coordinated by an external service provider through a contract farming agreement with growers' group and connect this group with reputed exporter by convincing them about the quality of produce and GAP implementation.

- **Establish a consulting firm for establishing food testing lab:**

For product testing for MRL compliance establishment of food testing lab is very much essential. Lots of things such as infrastructure requirement, regulatory requirement, laboratory layout as per regulation, the target commodities, accreditation requirement, specifications of infrastructure, requirement of analytical method etc. need to be considered in establishing a food testing lab. This may not be known by an investor; hence, he should require an expert support for coordination and implementation of all these activities. This give a better business opportunity to start a constancy firm for establishing a food testing lab.

B. Production/product-oriented business opportunity:

- **Establishment of agrochemical firm:**

Agrochemical are inevitable in commercial viticulture. Establishment of agrochemical firm as an Alternative to chemical pesticides such as firm based on bio-pesticides, form based on alternative chemical as mentioned above could be an alternate business opportunity. Further, this also give an opportunity to act as dealer for these pesticides, bio-pesticides or alternative chemical.

- **Development of a decision support system (Mobile APP) for pesticide application based on GAP:**

Development of a decision support system through a mobile app for usage of agrochemicals in grape as per GAP recommendation will be a good entrepreneur opportunity. This will help the grows to select the most suitable pesticides for spraying at given point of time in their finger tip. It is essential to consider all the strategies explained above in developing the decision support system.

C. Laboratory/Testing oriented business opportunity:

- **Establishment of a food testing laboratory:**

Food testing is an inevitable activity to check for the MRL compliance. Hence, establishment of an advanced food testing lab will be a great business opportunity and to become an entrepreneur. It

is important to note here that before establishing the laboratory one should be very clear about the budget requirement, infrastructure requirement, potential customer, targeted products, locational advantage and disadvantages, manpower requirement, accreditation requirement, regulatory requirement etc.

- **Establish a R & D Lab as a supporting system for food testing laboratory:**

Any food testing laboratory face lots of problems in their day to day activities. Hence, establishment of R&D laboratory as a supporting system to solve the problems associated with a food testing laboratory could be business opportunity. Some of the relevant activity could be accreditation support, method validation and development support, repair and maintenance of advance equipment, spare parts support for equipment, accessories of advanced equipment, auditing support etc.

Conclusion:

Commercial viticulture without the usage of synthetic pesticides is almost impossible. One of the important drawbacks of pesticide usage is the presence of residues in the final produce and it becomes a hurdle in international trade. To avoid the residue problems, the adoption of GAP of label directions for pesticide usage should be strictly followed as per Annexure 5 especially with respect PHI. In order to get better price realization, only MRL complied grape production is not sufficient and the current market requirement is beyond MRL compliance. In order to meet these stringent requirements, the strategies mentioned in this article may strictly be followed so that the pesticide residues will not be a trade issue in grape. These strategies may be easily followed in any viticulture either for export or domestic purpose and growers can Ensure a better price realization for their produce.

Issues associated with pesticide residues in grape also opens various business opportunities. These opportunities could be of service provider oriented such as consultant for safe use of agrochemical, GAP implementation, contract farming, laboratory accreditation and establishment etc.; production or product oriented such as establishment of agrochemical firm, development of mobile App etc and testing oriented business opportunity such as establishment of food testing laboratory and supporting R&D laboratory.

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Chapter-9

Market intelligence- An important player in business development:

Aiming to enhance grape farmers income

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India is the fifth largest economy in the world as measured in terms of nominal GDP and is continuing to grow rapidly at a growth rate surpassed globally only by China. Agriculture is the backbone of Indian economy contributing about 16 % of GDP (and 12.6% of exports of India. It derives its importance from the fact that it has vital demand and supply links with the manufacturing and services sector. India in the past has seen substantial gains in Agriculture sector through green revolution, blue revolution, white revolution, yellow revolution, and golden revolution. These initiatives have made India among the world's leading producer of cereals, fruits and vegetables, spices, milk, sugar, seafood products, etc. and increasing its share in global exports of agriculture products from 1.1 per cent in 2000 to 2.2 per cent in 2019.

There is a recently released by report WTC which suggest with certain affirmative initiatives India's export ranking can jump to 5th position from current 8th position. India's annual agri exports is likely to have touched USD 50 billion in 2021-22. The other major agri commodity exporters in the world are EU (USD 181 billion), the US (USD 172 billion), Brazil (USD 93 billion), China (USD 83 billion), Canada (USD 69 billion), Indonesia (USD 46 billion) and Thailand (USD 44 billion) according to the 2019 WTO data.

There is a concern highlighted by the various reports that in spite of being the second largest producer of fruits and vegetables, Largest Producer of Papaya, lemons and lime India's share in global exports is under 1.8 per cent. The recent reforms announced by the government in the farm sector by allowing farmers to sell produce outside the regulated APMC markets, the Essential Commodities Act, among others will play an important role in boosting exports. It will also address concern on the low share of export of agricultural commodities as compared to their total production. It is pertinent to focus on Agri exports to boost farmer's income and in this direction the recently unveiled Agri Export Policy has given the roadmap. Agri processing and agricultural exports are a key area for focus.

According to Foreign Trade Policy, (2015-2020) target is to double India's exports of goods and services to approximately USD 900 billion. The government aims to increase the

India's share in world export to 5% from current 2 % and share of agriculture export to US$ 60 billion from present US $ 30 Billion by 2022 and reach US$ 100 Billion in the next few years thereafter. Exports are a national priority for every nation – be it a developed, developing, or an underdeveloped economy. Foreign Trade Policy of India has always focused on substantially increasing the country's share of global merchandise trade. The Government of India's initiative towards boosting trade with the rest of the world by adopting policies and procedures that would help to increase and facilitate both exports and imports with the other countries of the world have yielded fruitful results in the last decade

The Agri Export Policy highlights that renewed and vigorous efforts towards bringing efficiency in supply chain, infrastructure development, diversifying export markets, a higher value-addition for promoting agricultural export, Compliance of International standards and cultivation and production of exportable produce will make India a key player in Global Agri value chain apart from boosting farmers income. Doubling Farmer's Income by 2022 has been the focus of the government, which aims at doubling the agricultural exports and integrate Indian farmers and agricultural products to the global value chain. Thus, it becomes imperative to create an ecosystem to promote high valued and value-added agricultural exports.

Considering Market Intelligence is defined as "gathering marketing information from all accessible points i.e., marketing research, market developments, internal and external environment, verifying and validating the reliability and consistency of information sources and employing it for decision making" (Kelley, 1965).

Marketing intelligence landscape (Muller, 2006)

Dimension	Description
Product Intelligence	Research & Development, Product modification & innovation
Competitor Intelligence	Competitor market share, Competitor product share, Competitor area of operations, Competitor Capabilities
Customer Intelligence	Customer present needs & future requirements, Customer Satisfaction and Loyalty parameter's

Market Intelligence	Key Market trends, Demand & Supply mechanism, Driving Forces, Market developments, Risk Variables, Market size, Market Analysis
Competitive Intelligence	Success Factors, Core Competence, Competitive Advantage

This training program equipped participants with a comprehensive knowledge and skills on role of Market Intelligence: An important player in business development. The workshop gave insight into the structure of Main methods & structure of Market Intelligence, Functions of Market Intelligence, International trade operations, regulatory guidelines, documentary formalities, Export Incentives, shipping documents, packaging, security in international trade, transaction cost, freight forwarding, logistics and role of the other intermediaries; thus giving a comprehensive insight into the fast changing global environment Training objectives & Scope were

1. Product Classification (Description) for accessing accurate data
2. Which global markets offer opportunities for exporters of grapes?
3. Which trends offer opportunities on the International market for grapes?
4. Which requirements should grapes comply with to be allowed on the US/EU Markets?
5. What competition will I be facing on the US/EU/MENA grapes market?
6. What are the end-market prices for grapes on the global market?
7. How to choose the best market for your exports?
8. Understanding basics of International Trade Operations
9. To gain know how on International Trade transaction process flow by exploring Trade documents and Procedures, regulations pertaining to export and import of goods.
10. Gain Fundamental awareness on an export – import transaction in terms of process, regulations, and procedures to trade successfully
11. Exposure to Government schemes and subsidies for exporters
12. Export Promotion Schemes viz EPCG, DBK, etc with reference to Agri Sector
13. Step-by-Step Process of Starting an Agri Export Business
14. Transaction Cost Management in International Agri Trade
15. Sources of Market Intelligence

Marketing Intelligence works by accumulating "information about customer needs, preferences attitudes, and behaviours, plus potential changes in the business environment that may affect buyers" (Cornish, 1997). Participants considering above were given insight on how to export their product to potential markets, locating buyers, understanding of compliances and standards of the importing countries. Thus, it is pertinent for a grape grower to understand the rapid changes in the global marketing environment that create many challenges to their organizations and cooperatives. Market Intelligence access assists to deepen understanding about trends in global trade for grapes, trade policy issues, SPS, creating databases etc. making them more resilient to dynamic global trading environment.

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Chapter-10

Start-up environment to boost entrepreneurship in Agriculture sector

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Introduction:

The Entrepreneurship is known as capacity and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit. The most obvious example of entrepreneurship is the starting of new businesses. If entrepreneurial spirit is characterized as Science and technology based, innovation, IP protected, networking, communication and risk-taking, is a start-up.

Department for Promotion of Industry and Internal Trade, Government of India, which is the nodal agency for steering Start-up India programme defined Start-up as

An entity shall be considered as a Start-up:

I. Upto a period of ten years from the date of incorporation/ registration, if it is incorporated as a private limited company (as defined in the Companies Act, 2013) or registered as a partnership firm (registered under section 59 of the Partnership Act, 1932) or a limited liability partnership (under the Limited Liability Partnership Act, 2008) in India.

II. Turnover of the entity for any of the financial years since incorporation/ registration has not exceeded one hundred crore rupees.

III. Entity is working towards innovation, development or improvement of products or processes or services, or if it is a scalable business model with a high potential of employment generation or wealth creation.

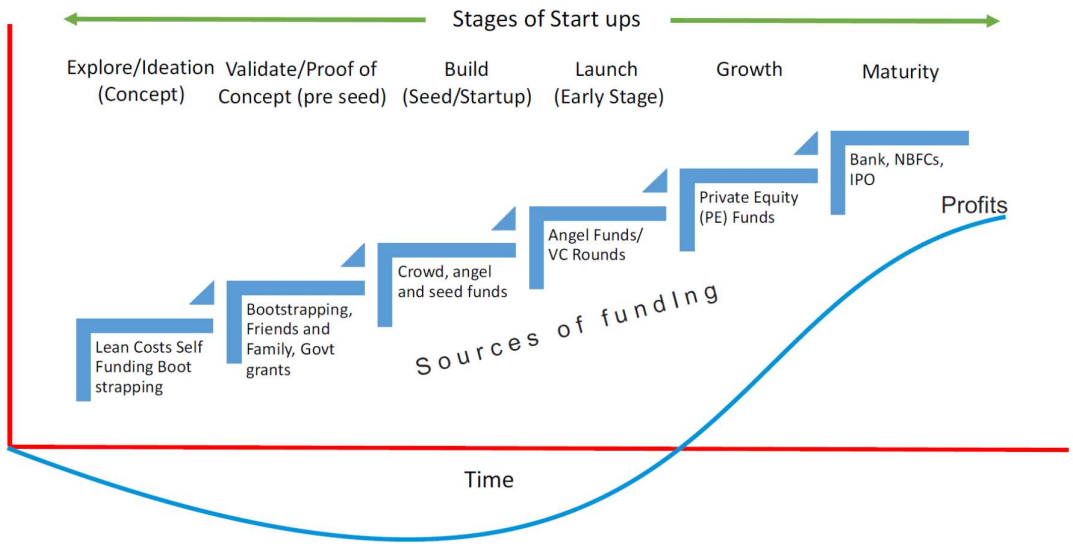
Provided that an entity formed by splitting up or reconstruction of an existing business shall not be considered a 'Start-up'. Essentials for success of any Start-up

For any good start-up to succeed, five components are important. It should come with an innovative an **Idea** to solve any identified problem which society is facing and which can be monetized. Start-up, should have a **Team** which can actually complement each other to achieve the goal of the start-up. A good **Business model** that would scale up the start up in

very short term is another component. This should be backed by proper **Funding**. **Timing** of the Innovation to go to market is most important aspect in achieving the success.

Start-up development phases:

As shown below, different stages of growth of any typical start-ups and the possible funding sources, which incubators help to bring on to the table for the discussion? Business incubators thus provide a high degree of management support to the start-ups besides helping them with technological inputs. This would cut the time and cost for a business to establish at a faster rate.



(Source: Srinivas et.al (2019), fostering entrepreneurship in agriculture through incubation centres in National Agricultural Research and Education System. Policy paper 5; ICAR NAARM)

Challenges in agriculture and opportunities for agri Start-up:

Presently, many hurdles are coming in the path of start-ups. On the basis of stage of start-ups, the challenges are summarized as under.

Pre-production stage:

- Lack of
    - Market advisory
    - Weather advisory
    - Product planning advisory
    - Soil Analysis and nutrition advisory
    - Production advisory
    - Input supply chain
    - Farm equipment for pre-production activities
    - Financial services

Challenges in agriculture and opportunities for agri start-ups:

Production:

 Weather advisory

 Biotic stress advisory and material

 Abiotic stress advisory and material

 Package of practice (PoP) advisory

 Financial services

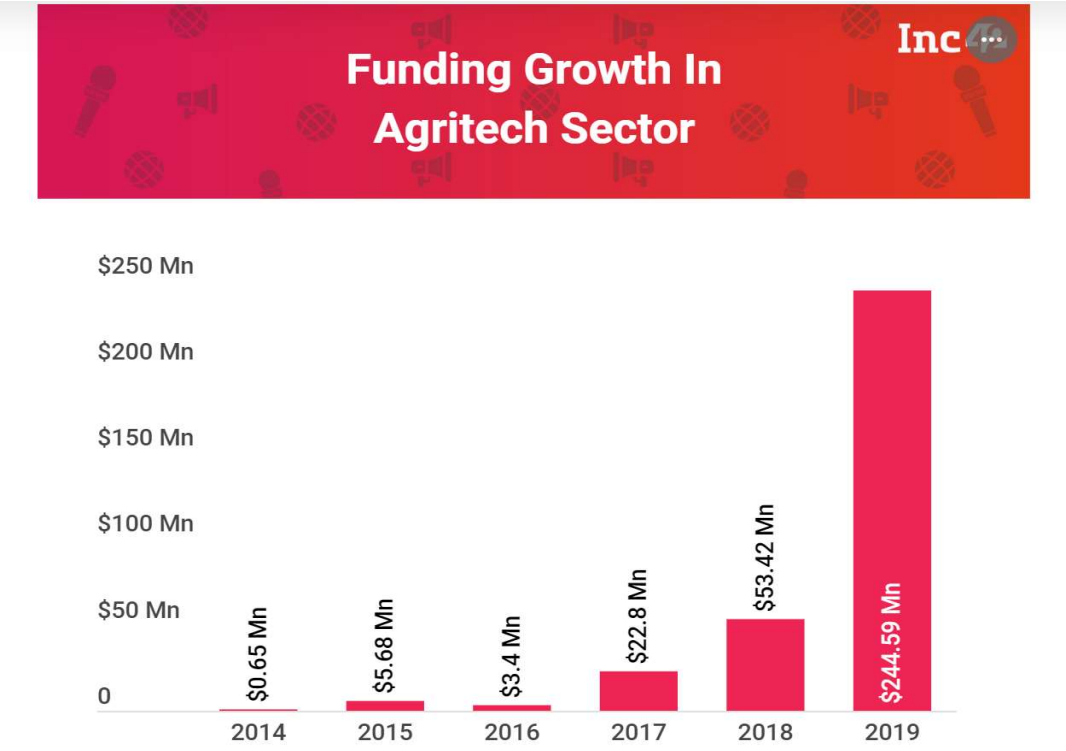
Challenges in agriculture and opportunities for agri-start-ups:

Post production:

- Market advisory
- Post-harvest practices including grading and packaging
- Storage od produce
- Prospects of Value addition

Funding increase over years:

There has been substantial growth of Agri-tech start up in India. Many companies like Agro star, Intello lab, AgNext etc. in 2019 it was 244.59 million US Dollars.

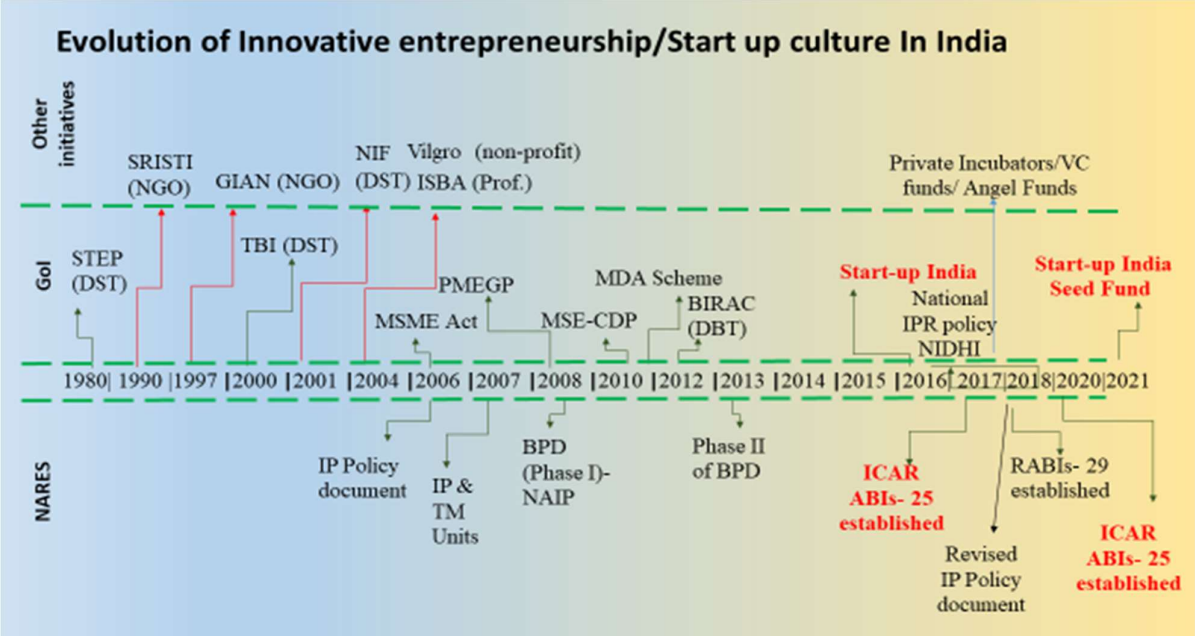


Technology Business Incubator (TBI): A new Era EDP:

Technology Business Incubators (TBI) are recognised as technology-led and knowledge-driven entities to help in speedy commercialisation of innovations and research outputs through passionate entrepreneurs or start-ups. The TBIs not only help in growth of technology based new enterprises but also improve their survival rate from 30 % to 5 70 % (NSTEDB, 2016). The primary role of any incubator is to help nascent innovative technology or business idea(s)- by providing resources, access to industry mentors, interactions with other entrepreneurs and most importantly much needed capital at early stage. These include exploring and matchmaking with suitable funding agencies such as High Net worth Individual(s), angel investors, venture capitalists (VCs) or equity investors, depending upon the stage of the start-ups and business scalability**.**

Evolution of Innovative entrepreneurship/Start up culture In India:

National Science and Technology Entrepreneurship Development Board (NSTEDB) of Department of Science and Technology, Government of India has been promoting knowledge and technology intensive enterprises through Science and Technology Entrepreneur Parks (STEPs) programme since 1982. Currently 18 are in place and agriculture forms a part of the mandated areas. Since 2000, NSTEDB initiated Technology Business Incubators (TBI) programme for nurturing technology and knowledge-based start-ups. There are more than 100 TBIs established under NSTEDB in India (NSTEDB, 2016b). Interestingly, only four or five TBIs have been granted with primary focus in agriculture sector; of these two are established in ICAR and one in SAU). Another 20 TBIs in other sector shave nurtured technologies with plausible applications in agricultural and food sector (NSTEDB 2016a). An infrastructure support provided by the TBI in agri-business and agri-biotechnology includes wet labs, testing facilities, support equipment areas, discussion rooms, and conference rooms.



Start-up India action plan:

In order to imbibe all these objectives under one umbrella policy framework for the entire nation, while addressing all the aspects of the startup ecosystem, a Startup India Action Plan1 was announced on 16 January 2016. It comprised of 19 action items spanning across three key areas of 'simplification and handholding', 'funding support and incentives', and 'industry-academia partnerships and incubation'. Under the provisions of this plan, start-ups were entitled to a number of benefits such as tax incentives including capital gains tax exemption, Governments' assistance in funding, prioritization of start-ups in public procurement, etc. The benefits above included a provision for start-ups to avail assistance of a self-certification compliance system with respect to labour and environmental laws and exemption from any inspections of their place of business. The action plan also envisaged a common platform for stakeholders to interact, facilitation for funding support, and partnership with academia and private sector entities. Some other key benefits that the Action Plan included were entitlement to an 80% rebate in patent registration fees as well as a 50% rebate in trademark filing. Start-ups could also benefit from faster exit norms and free of cost assistance provided by patent and trademark facilitators in filing for Intellectual Property Rights (IPRs).

Agri Start-ups:

- **More than 6000 registered agri start-ups**
  - ✓ They are working independently or through Incubators/accelerators
  - ✓ They have raised investments from VC/Angels
  - ✓ Southern states followed by western states are on top of number of agri start ups
  - ✓ Least in North east states
- **Number of Incubators**
  - ✓ 50 under ICAR
  - ✓ 29 funded RABI rafter
  - ✓ 4 funded by NABARD
  - ✓ 7 by NSTEDB

Agri-Business Incubation Centres at ICAR (April-2016 onwards)

❖ Agri-business Incubation:

This initiative addresses the much-needed requirements of business incubation for converting agriculture technologies into an attractive commercial proposition. Accordingly, 25 ABI centres have been supported/ established in various institutes; and issued a sanction for 25 new ABIs (in Oct-2019), at different ICAR institutes. Thus, the total strength of ABIs in ICAR is 50.

These ABIs undertook different activities to facilitate the business environment in the ICAR institutes, which include, Agri-entrepreneurs/Incubators admitted for incubation (977); Entrepreneur Development Programme (EDPs) organized (316); and Entrepreneur/ Start-ups Initiated their business (715).

Table 1. Distribution of IACR ABI Centres in different states

S. No.	State	ABI Centres
1	Andhra Pradesh	1
2	Assam	1
3	Bihar	1
4	Goa	1
5	Haryana	1
6	Meghalaya	1
7	West Bengal	1
8	Gujarat	2
9	Jharkhand	2
10	Karnataka	2
11	New Delhi	2
12	Orissa	2
13	Madhya Pradesh	3
14	Punjab	3
15	Rajasthan	3
16	Tamil Nadu	3
17	Kerala	4
18	Maharashtra	5
19	Telangana	5
20	Uttar Pradesh	7

Subject Areas of ABIs:

1. Animal Science: 7
2. Crop Science: 13
3. Agril. Engineering: 5
4. Agril. Education: 2
5. Horticulture: 12
6. Fisheries: 4
7. Natural Resource Management: 7

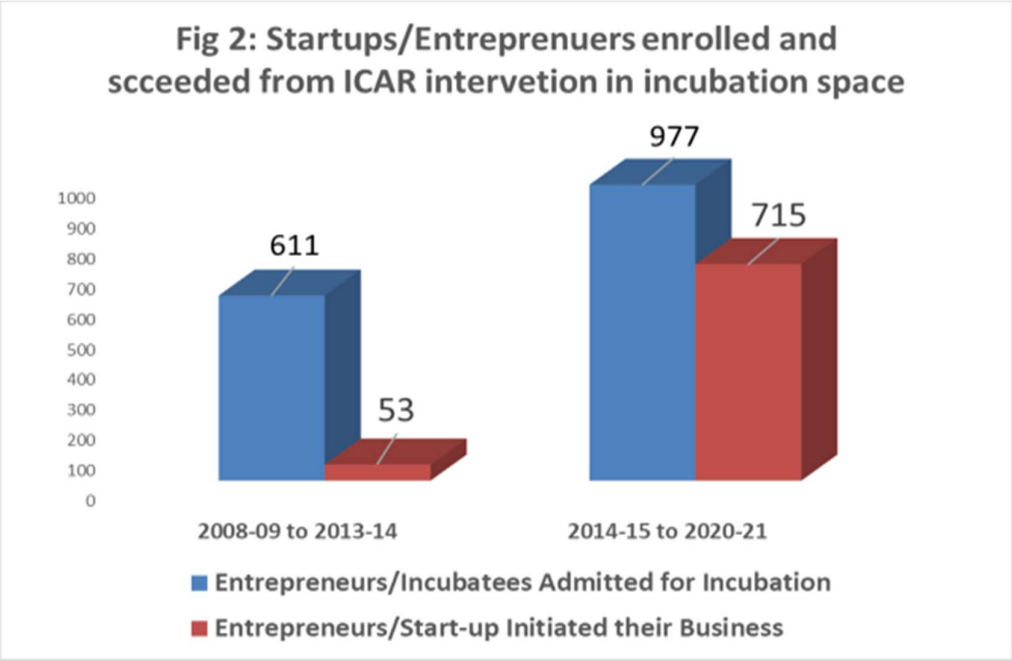


Fig 2: Startups/Entreprenuers enrolled and scceeded from ICAR intervetion in incubation space
1000
900
800
700
600
500
400
300
200
100
0
611
53
977
715
2008-09 to 2013-14
2014-15 to 2020-21
Entrepreneurs/Incubatees Admitted for Incubation
Entrepreneurs/Start-up Initiated their Business

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Chapter-11

Vine health management: strategies to reduce input cost

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Commercial grape varieties belonging to *Vitis vinifera* are highly susceptible to three important disease viz. downy mildew, powdery mildew and anthracnose. However, during recent times rust infection is becoming serious in certain areas, especially in the nurseries. Similarly, in hotter areas, where warm and humid conditions prevail bacterial infection is also seen. Both rust and bacterial spot diseases cause premature leaf drop. Grapevine leaf roll associate virus-3 too has been observed in some vines. The incidence and severity of most of the grape diseases depend on young growing tissues and weather conditions. Generally, from April to first week of June the climate is hot, and hence there is less chance of disease development, but during south-west monsoon season chances of infection of powdery mildew, downy mildew and anthracnose are increased. The warm, humid and intermittently wet or cloudy weather in this region is highly conducive for disease attack. Frequent preventative and curative applications of pesticides in vineyards is needed. Due to plant protection measures, 30% of the recurring cost of grape cultivation is prevalent. The high pesticide use (30-40 fungicides applications/year) leads to detection of their residues at harvest. Considering the significance of food safety in grapes, strengthening of the bio-intensive strategies for disease management plays prime role in production of pesticide residue free grapes. It is to be noted that only bio-control methods are not effective, but only few fungicide applications necessary at high risk period during critical growth stages. Lesser application of fungicides for disease management is the key to reduce input cost.

1. Downy mildew:

Downy Mildew (c.o. *Plasmopara viticola*) is the most destructive disease of grape and causes colossal losses under favourable conditions. White downy growth is seen on the leaves, cluster, flowers, rachis, pedicle, young berries or young shoots. On the upper leaf surface yellow circular spots with an oily appearance in white grape varieties and red spots in coloured grape varieties are observed while the white downy growth later can be seen on the lower leaf surface on the underside of these spots (Fig 1A and B). Young clusters turn necrotic and young infected berries appear greyish (Fig. 1C).

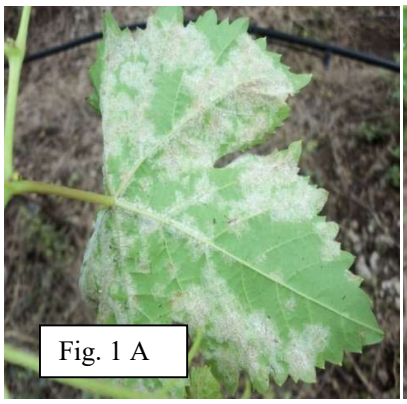

Fig. 1 A

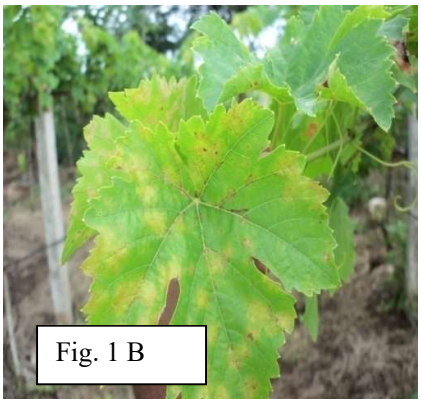

Fig. 1 B

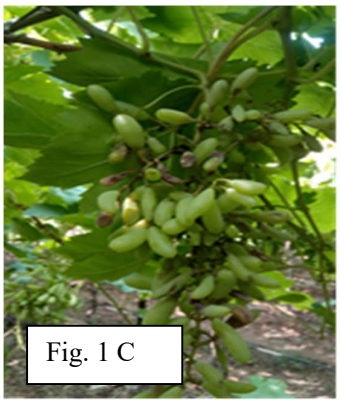

Fig. 1 C

A temperature of 17 to 28ºC with a rainfall/irrigation of 10 mm and relative humidity more than 40% favours infection. Wetness of leaf or soil further predisposes the plants to the disease. If running water flows in the vines for 2-3 days, then there is a high probability of disease incidence. A moist, dark condition following a period of light favours maximum sporulation.

Downy mildew infections are first observed after the start of the monsoon rain and when the maximum temperature is below 30ºC. Several cultural practices like removal and burning of infected leaves as well as removal of excess new shoot growth during monsoon may help in reducing primary infection. Proper tying of shoots to the trellis and avoidance of excess doses of nitrogen also reduces the primary inoculum.

Systemic fungicides for the control of downy mildew are not encouraged after foundation pruning. Low risk systemic fungicides are used during 25 days after fruit pruning and after high risk fungicides are used. In one fruiting season maximum 5 sprays of low risk systemic fungicides and 2 to 3 sprays of high-risk fungicides are recommended. Prophylactic use of Mancozeb 75WP is recommended as it inhibits the formation of secondary haustoria and growth of mycelium. A tank mix of potassium salt of phosphorus acid @4g/L and Mancozeb75WP @ 2g/L gives a good control of the disease. The current list of fungicides, their nature, recommended doses, pre harvest interval (PHI) and the European Union Maximum Residues Limit (MRL) are given in Table 5. The regularly updated list can be accessed at https://nrcgrapes.icar.gov.in/Warning system through weather based advisory enable effective control of downy mildew with reduced numbers of sprays.

Table 1: List of recommended fungicides for the control of downy mildew by ICAR-NRCG

S. No.	Chemicals	Nature chemical	Dose	EUMRL (mg/kg)	PHI (days)
Low risk fungicides: Non-systemic					
1	Mancozeb 75WP	NS	1.5-2g/L	5.0	66
2	Propineb 70WP	NS	3g/L	1.0	75
3	Copper Oxychloride 50WP	NS	2.5g/L	50.0	42
4	Copper hydroxide 53.8 DF	NS	1.5 g/L	50.0	12
5	Copper Sulphate 47.15% + Mancozeb 30%WDG	NS	5000 g/ha	50.0 + 5.0	66
6	Dimethomorph 50 WP	S	0.50 to 0.75 g	3.0	34
Low risk fungicides:					
7	Cymoxanil+Mancozeb 8+64WP	S+NS	2.0g/L	0.2+5.0	66
8	Dimethomorph 50WP+Mancozeb75WP	S+NS	0.5to 0.75g/L+2.0g/	3.0+5.0	66
9	Iprovalicarb+ Propineb 5.5+61.25WP	S+NS	2.25g/L	2.0+1.0	75
10	Mandipropamid 23.4%	NS	0.8ml/L	2.0	5
11	Fosetyl Al 80WP	S	1.4-2g/l	100.0	30
12	Potassium salt of Phosphorus acid	S	4g/L	-	-
13	Ametoctradin 27 + Dimethomorph 20.27 SC	NS + S	0.8-1.0 mL/L	6.0+3.0	34
14	Fluopicolide 4.44**%** + Fosetyl-Al 66.67% WG	S	2.25-2.5g/l	2.0+100	40
High risk fungicides					
15	Metalaxyl+Mancozeb 8+64WP	S+NS	2.5g/L	2.0+5.0	66
16	MetalaxylM+Mancozeb(mefenoxam)4+64WP	S+NS	2.5g/L	2.0+5.0	66
17	Benalaxyl-M 4% + Mancozeb 65% WP	S+NS	2750 g/ha	0.3 + 5.0	66
18	Fenamidone 4.44% + fosetyl-Al 66.66% WDG	S	2000-2500 g/l	0.6 + 100	90
19	Metiram 44% + Dimethomorph 9% WG	S+NS	2500 g/ha	5.0 + 3.0	66
20	Kresoxim methyl 18% + Mancozeb 54% WP (72 % WP)	S+NS	1500 g /ha	1.0 + 5.0	66
21	Fenamidone+Mancozeb10+50 WG	S+NS	2.5 to 3g/L	0.5+0.5	66

22	Azoxystrobin23SC**	S	494ml/ha	2.0	7
23	Azoxystrobin 8.3% + Mancozeb 66.7% WG *	S + NS	1500 g/ha	3.0 + 5.0	66
24	Famoxadone16.6%+Cymoxanil 22.1%SC	S+NS	500ml/ha	2.0+2.0	27
25	Kresoxim methyl 44.3SC	S	600-700ml/ha	1.0	30
26	Pyraclostrobin5%+Metriram55 % 60WG	S+NS	1.5-1.75kg/ha	1+5	15
27	Dimethomorph 12% +Pyraclostrobin 6.7% WG*	S + S	1500mL/ha	3.0 + 1.0	55
28	Azoxystrobin 11 % + Tebuconazole 18.3% w/w **	S + S	750 mL/ha	3.0 + 0.5	60
29	Cyazofamid 34.5% SC	NS	200 mL/ha	2.0	50

S=Systemic; NS= non-systemic

2. Powdery Mildew:

Powdery Mildew (c.o. *Erysiphe necator*) is a serious problem during the vegetative growth phase especially when cloudy and humid conditions prevail. Thick canopy creates favourable conditions for disease development. Optimum temperature for growth is 20-27˚C but no fungal growth occurs below 6˚C or above 32˚C. Relative humidity more than 60% favour and less than 30% does not favour the disease respectively.

The first powdery mildew lesions are frequently found on the undersides of leaves. As the disease progresses, lesions become apparent on the upper sides of leaves as well (Fig 2 A). Grey to whitish powder is usually seen on rachis and severe infections of the rachis can result in clusters being dropped. Berries turn into an ash grey colour and quickly become covered in spores giving them a floury appearance (Fig. 2B). Affected berries dry out and may drop off.

Fig.2A

Fig.2B

Cleistothecia of the fungi is not found in India due to the absence of mating types. Excessive use of nitrogen fertilizer should be avoided and by removing non- photo synthetically active and Non-bearing shoots will help to open up the canopy and improve the efficacy of spray application. *Bacillus subtilis* @2g/L and *Ampelomyces quisqualis*@ 4-5g/L gives a good control of the disease and should be applied during the rainy season when humidity is high for their profuse multiplication. Though a number of fungicides have been evaluated against powdery mildew, at present only the following are registered for use in grapes in India. The regularly updated list can be accessed at https://nrcgrapes.icar.gov.in/.

Table 2: List of recommended fungicides for the control of powdery mildew by ICAR-NRCG

S. No.	Chemicals	Nature chemical	Dose	EU MRL (mg/kg)	PHI (days)
Low risk fungicides					
1	Sulfur 40SC,55.16SC, 80WP,80WDG,85WP	NS	3.0ml,3.0ml,2.50g,1 2.50g, 1.50-2.0g/L	50	15
2	Meptyldinocap 48EC	NS	308.6-342.8 mL/ha	0.05	50*
Medium risk fungicides					
3	Hexaconazole 5SC	S	1.0ml/L	0.1	38
4	Difenoconazole 25EC	S	0.50ml/L	0.5	45
5	Tetraconazole 3.8EW	S	0.75-1ml/L	0.5	30
6	Myclobutanil 10WP	S	0.40g/L	1.0	30
7	Metrafenone 50% SC	S	0.25mL/L	7.0	22
High risk fungicides					
8	Azoxystrobin 23SC	S	494ml/ha	2.0	7
9	Kresoxim methyl 44.3SC	S	600-700ml/ha	1.0	30
10	Pyraclostrobin 5% + Metiram 55% 60WG	S+NS	1.5-1.75g/l	1+5.0	15
11	Fluopyram 200+Tebuconazole 200SC	S+S	0.563mL/L	1.5+0.5	60
12	Meptyldinocap 35.7% EC	NS	308.6-342.8 mL/ha	1.0	50
13	Fluxapyroxad 75 g/L + Difenoconazole 50g/L SC	S+S	800 mL/ha	3.0 + 3.0	45
14	Tebuconazole 50% + Trifloxystrobin 25% WG	S+S	0.175g/L	0.5+3.0	34
15	Fluxapyroxad 25% + Pyraclostrobin 25% SC	S+S	0.2mL/L	3.0+1.0	60

16	Boscalid 25.2% + Pyraclostrobin12.8% w/w WG	S+S	0.5-0.6mL/L	5.0+1.0	55

S=systemic; NS= non-systemic;

3. Anthracnose:

Anthracnose (c.o**.** *Colletotrichum gloeosporioides*) occurs during warm, wet and cloudy weather and can cause complete kill of new growth, reduce the vigour, fruit falling, yield and quality. The disease occurs mainly during monsoon corresponding to vegetative growth season.

Small, yellowish spots on the leaves are seen, which turn into circular, grey lesions (Fig. 3A). Numerous lesions are formed on the leaf and the dead tissue drop out the spots causing hole in the centre, which is a typical symptom of anthracnose called as **"Shot Hole**" (Fig. 3 B). The lesions may show cracking at the late infection stage and if the infection is at the base of the stem, the stem may crack and break.

Fig.3A

Fig.3B

To control the disease all shoots canes with anthracnose lesions should be removed at the time of pruning. Through a number of fungicides have been evaluated against anthracnose, at present only the following are registered for use in grapes in India. The regularly updated list can be accessed at https://nrcgrapes.icar.gov.in/.

Table 3. Fungicides presently registered for management of anthracnose by ICAR-NRCG

S. No.	Chemicals	Nature of chemical	Dose	EU MRL (mg/kg)	PHI (days)
1	Propineb70WP	NS	3.0g/L	1.0	40
2	COC 50WP	NS	2.5g/L	50.0	42
3	Carbendazim 50WP	S	1.0g/L	0.30	50
4	Thiophenate methyl 70 WP	S	1.0g/L	0.1	50
5	Fluopyram 200+Tebuconazole 200SC	S+S	0.563mL/L	1.5+0.5	60
6	Kresoxim methyl 18% + Mancozeb 54% WP (72 % WP)	S + NS	1500 g /ha	1.0 + 5.0	66
7	Azoxystrobin 8.3% + Mancozeb 66.7% WG	S+NS	1.5g/L	3.0+5.0	66
8	Copper Sulphate 47.15% + Mancozeb 30%WDG	NS+NS	5.0g/L	50.0+5.0	66
9	Carbendazim 12% + Mancozeb 63% WP	S+NS	3.0g/L	3.0+5.0	66
10	Kasugamycin 5% + Copper Oxychloride 45%WP	S + NS	750 g/ha	0.01 + 50.0	70

S=systemic; NS= non-systemic;

N.B: Water volume used in the spray is 1000L/Ha

4. Rust:

Rust (c.o**.** *Phakospora euvitis*) can cause severe defoliation during July-August and January-February, which usually coincides with veraision and thus hampers the berry ripening and development. After the introduction and adoption of Dogridge as a rootstock for table grapes, rust was observed on Dogridge rootstock plants and from the infected Dogridge plants it was seen getting transmitted to the scion plants. Thus, in recent years rust is also being observed during September-October *i.e.* at the end of monsoon period on Thompson Seedless and its clones in Maharashtra.

Characteristic sign of the disease are numerous yellow-orange coloured pustules present on the lower surface of the mature leaves. Sometimes these pustules are also present on the petioles, young shoots and rachis as well. Occasionally the upper surface of the leaf corresponding to the uredial pustules shows brown necrotic spots. In severe infections the entire leaf area may be covered by these fruiting bodies and the leaves fall off.

Copper based fungicides e.g. Bordeaux mixture, copper hydroxide or copper oxy-chloride or chlorothalonil provide effective control of the disease. Curative applications with triazole fungicides also showed good control of the disease.

5. Bacterial Blight:

Bacterial Blight (c.o. *Xanthomonas citri* pv. *viticola*) occurs on all the aerial parts of the vine during wet and warm weather. Minute water-soaked lesions are seen on the lower surface, which enlarge and become angular and cankerous. Stunting, cracking and irregular growth of shoots is seen in advanced stage of infection. Recent studies depict that spray of mancozeb 75WP @2-2.5g/L gives a good control of the disease. Kasugamycin 5% + Copper Oxychloride 45%WP @750g/ha is also registered against the pathogen.

Conclusion:

Disease management in grapes is predominantly dependent upon weather conditions and hence weather-based advisories generated by ICAR-NRCG should be followed for effective control.

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Chapter-12

Zero Waste processing in grapes: An option for entrepreneurship

Dr. Ajay Kumar Sharma and Dr. Ahammed Shabeer TP

IACR-National Research Centre for Grapes, Pune

Grape is one of the largest growing fruit crops around the word. Sustainability is particularly relevant to the field of grape growing and processing. Protecting the health of the vineyard's soil and surrounding environment can be seen as intrinsic to enhancing *terroir*. Other benefits of growing grapes under sustainable practices include building consumer interest, encouraging natural lower application of agro-chemicals, decrease input cost, profitability enhancement and adoption of eco-friendly approaches in vineyard management system. Sustainability, as a philosophy, integrates economics, ecology, and community into the farming operations. The practices to support the economic sustainability of a business include developing a comprehensive business plan and researching new marketing strategies. Social equity in employment practices, as well as consideration of farm neighbours, mutually supports the longevity of both the business and local economy. Grape growing under tropical conditions of different countries is facing sustainability issues, not only in production system, it is being reflected in availability of quality grapes to consumers.

Present situation:

India is known for table grape production and processed in the form of raisins, wines and juice. Except raisin making, wine and juice industry is not becoming popular or can say profitable. India is not considered as a winemaking country as this culture is only about 30-40 years old, while other countries have thousands of years old legacy. Moreover, vines are always in active mode under tropical conditions of country whereas grapevines grown under temperate conditions face low temperate and become dormant for a long duration of 4-6 months. It means there is no need of any activity in vineyards while under Indian conditions, vines are always in active phase so management practices are needed for 365 days. In nutshell, the input cost under tropical conditions is more than double in comparison to vineyards under temperate regions. Same time prevailing abiotic and biotic stresses make the situation more crucial and expenses of vineyard management are always higher. Dependency on imported machinery, microbes, packaging materials, etc. makes the winemaking as costly affair. The present taxation situation in different states of country is problematic and affecting free flow of wines from production to consumers. Ultimately, our wines comparatively costlier in the international market and always targeted as wines from tropical regions, which means not considered as premium wines. Juice industry is not accepting the grape juice as growing sector and facing

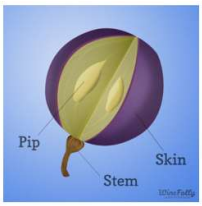
challenges as pure juice is expensive than the available juices from different fruits having logos of various known companies. However, pure grape juice contained nutraceutical compounds and can be presented in market as health drink.

Generated wastes:

Either for wine or juice preparation, grapes processing generates huge quantities of residues. At the primary production level, vine shoots (or vine pruning or trimmings) derive from in-field interventions for both the productions, even though different cultivation systems may lead to different amounts of shoots. At the processing level, also the destemming step is carried out for both juice and wine line which generate second residue: the grape stalks, often referred to as stems. At this point, the grape juice is extracted through pressing and the residue grape marc (often referred to as grape pomace) is obtained. In the case of grape juice and white wines (with a few exceptions), grape marc is immediately discarded. In the case of red wines (and for some white wines), grape marc is not promptly removed but left with juice (from this point called must in the wine-making process) for a certain fraction of the fermentation period, in order to enhance the extraction of grape constituents (mainly phenolic compounds and pigments). After this maceration step, grape marc can be taken away from the must, pressed and discarded. After completion of fermentation, the lees are removed (generally by decanting) and the following steps (the whole or only some, depending on the wine type) are carried out: second fermentation (for sparkling wines), ageing (in stainless tank or wooden barrels), clarification, filtration, cold stabilization (detartrating) and bottling. Additional residues are generated from the filtration and stabilization steps, which are carried out also in the grape juice manufacturing.

Wine and juice industry based wastes

- Pomace
- Lees
- Stalk



Waste	Red Wine	White wine
Stalk	3.5-5.5%	
Marc	22	25
Yeast lees	0.7	0.5
Juice lees		10.0
Fine wine lees	12.0	2.5
CO2	8	7

Possible uses

- Alcohol
- Bio fuel
- Food industry
- Natural colours and dyes
- Cosmetic industry
- Nutraceuticals
- Cattle feed

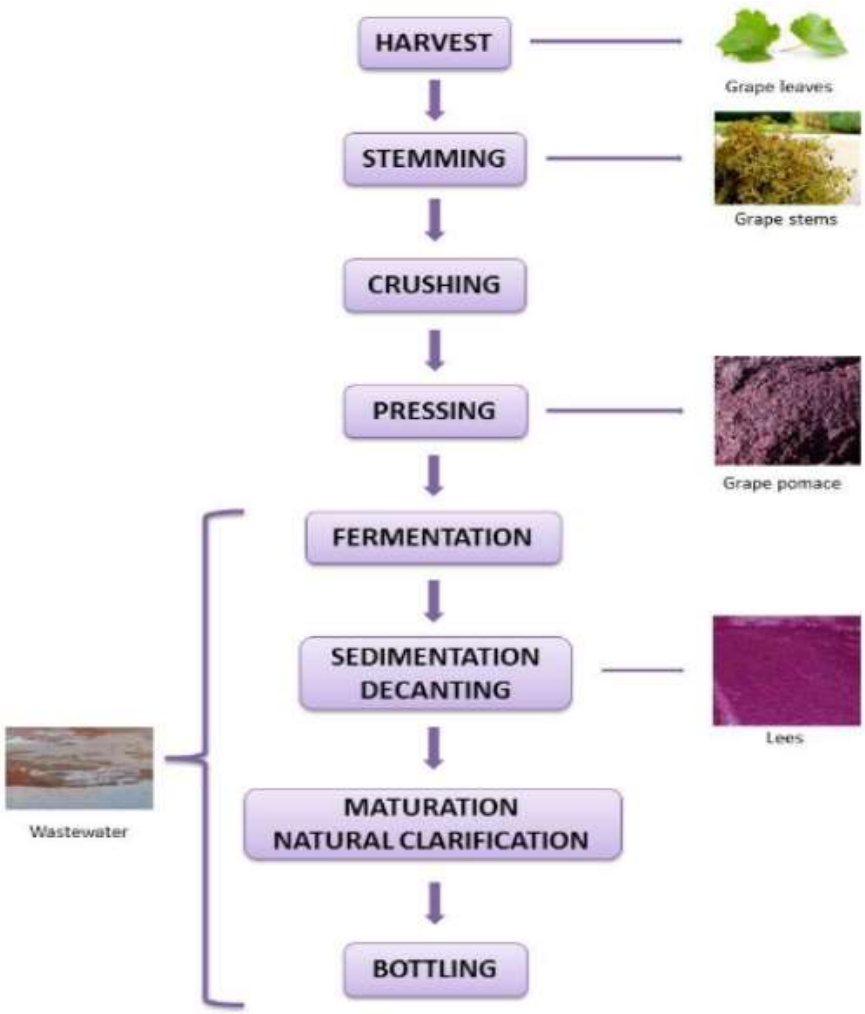


Fig 1. Fermentation process and generated wastes

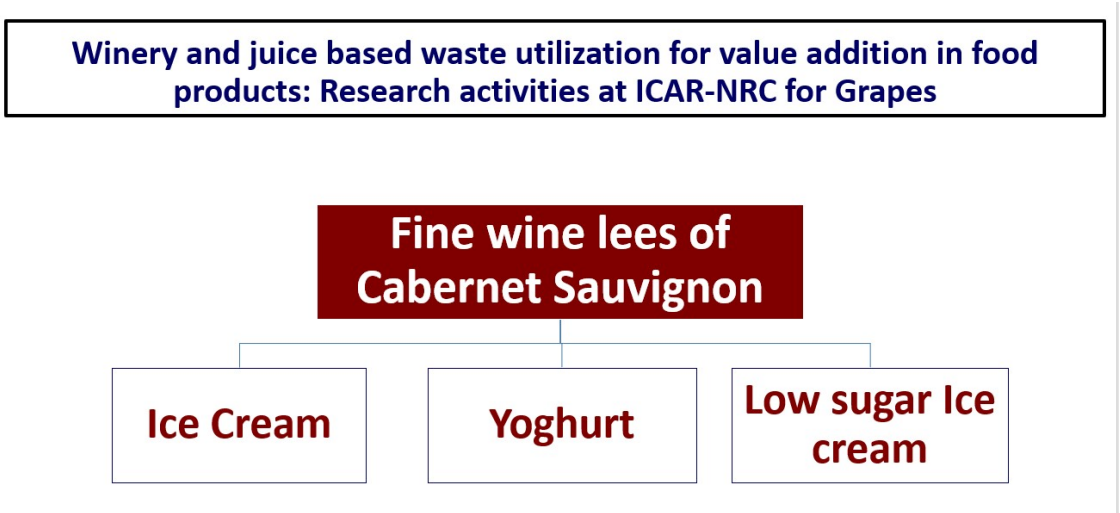
(Source: https://www.researchgate.net/publication/338552423_Sustainability_of_Wine_Production)

Grape marc is the material that is discarded after the juice or wine is extracted through pressing. This material consists of grape skins/pulp, seeds and either juice or wine depending on whether pressing occurred before or after fermentation. The characteristics of the marc vary depending on the variety of grapes, the climate, the production techniques used and the final product (white or red wine). Grape marc can account for 22% of the fruit processed at small wineries. Stalks are a significant waste for both red and white wines accounting for up to 5.5% of the crush. After wine and juice are recovered from yeast lees, from both red and white ferments, there are still 0.5-0.7 tones dry lees per 100 tones fruit. The main by-products of vineyard are the grape stalks. Grape stalks have a high degree of fibers (lignin and cellulose) and a high percentage of nutritive mineral elements, especially nitrogen and potassium. Grape stalks can be used for producing compost (a high-quality fertilizer and soil amendment) by mixing them with winery sludge digested aerobically and centrifuged. The residues generated by

juice and wine industry are composed of water, proteins, lipids, carbohydrates, vitamins, minerals, and compounds with important biological properties such as fiber, vitamin C, and phenolic compounds (tannins, phenolic acids, anthocyanins, and resveratrol), depending on the type of waste, the cultivar, growing conditions, adopted processing procedures, etc. Broadly, wine lees contain natural color and flavor, natural antioxidants and antibacterial properties, so it can bring itself rheological changes, enhance color and flavor as well as having health benefits.

Zero waste concept:

Under zero waste concept, idea is utilizing the wastes generated by the industry for different purposes. The development of innovative procedures to recycle, reuse, and recover residues generated by wine and grape juice industry, is consistent with the growing demand for green materials and renewable sources of nutrients and bioactive compounds for the feed/food, pharmaceutical and cosmetic sectors, thus leading to reduced dependence of the current manufacturing activity from the starting raw materials a reduced dependence of the current. Being abundant in bioactive components, these can be extracted from generated wastes that can be further utilized for the development of functional foods. In case of wine and grape juice industry, zero waste concept is utilizing the generated wastes from stalks to wine less in different food materials, cosmetic products, high valued wines, feed, functional foods, grape seed oil, production of plastic, energy, pure ethanol, etc. For this purpose, many innovative research activities are being conducted and new ideas are coming to make grape growing and processing more sustainable. Ultimate goal of zero waste concept is achieve the SDGs and supporting the new kind of industries by giving innovative products to community.



Manjari Medika:

Grape Variety Manjari Medika variety is evolved after crossing between Pusa Navrang X Flame Seedless. The work on this variety was initiated by ICAR-National Research Centre for Grapes during 2007. The variety is belonging to teinturier category of grape varieties. The juice content in berries is found between 68-74% with average recovery of 71%. This variety is found suitable for juice making. TSS content in juice is recorded 19 to 22 °Brix with acidity of 0.5-0.6 per cent. Due to its teinturier nature, juice of this variety is very dark in colour and contains anthocyanins. One kg grapes contain 4-6 mg anthocyanins which shows richness of anthocyanins in berries of Manjari Medika. It requires 130 days from pruning and belongs to mid maturity period. Manjari Medika variety is released during 2018 by ICAR-National Research Centre for Grapes, Pune (India).

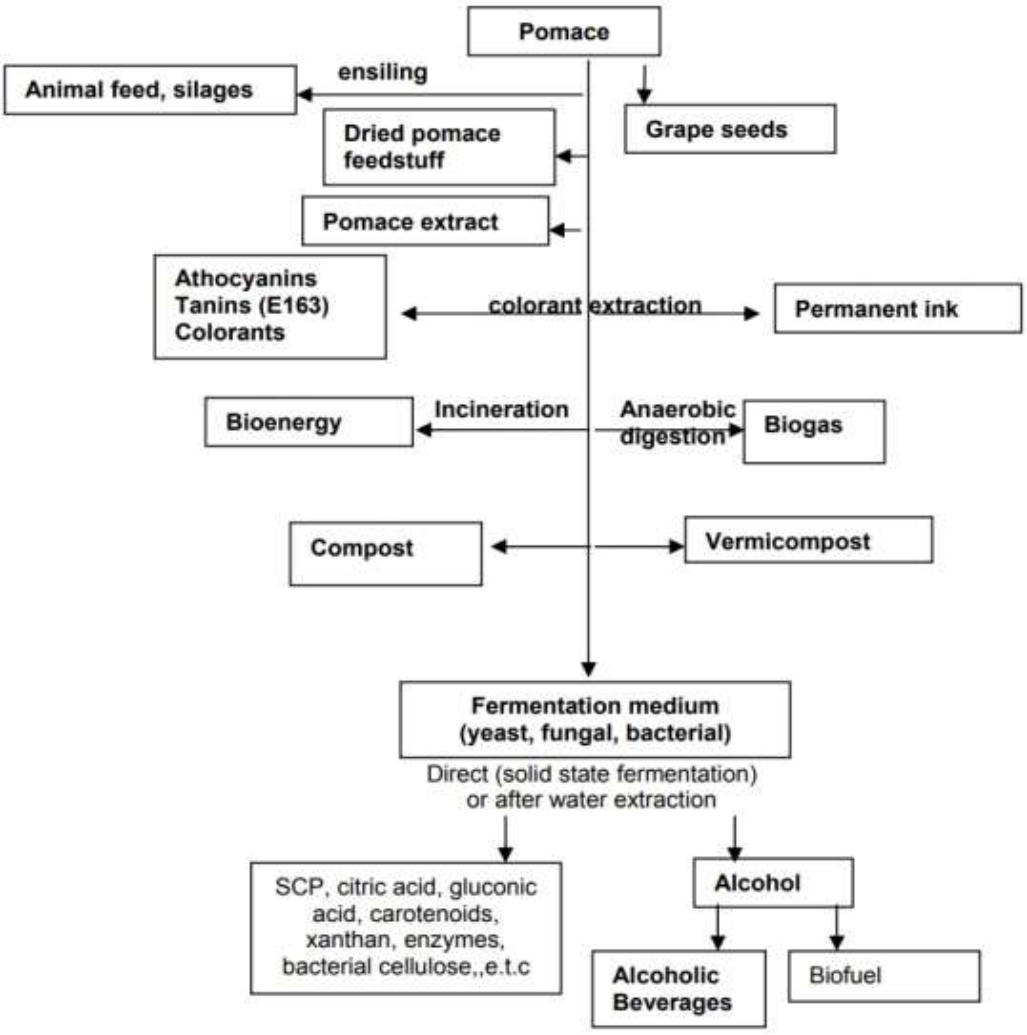


Fig. 2. Products derived from wine and juice industries and possible utilization products

(Source:https://www.researchgate.net/publication/237699859_Integrated_Enology_Utilization_of_winery_by-products_into_high_added_value)

High value dairy products by addition of processed fine wine lees of Cabernet Sauvignon

Suitability of Manjari Medika for Zero Waste Processing:

The conservation of all resources by means of responsible production, consumption, reuse, and recovery of all products, packaging, and materials, without burning them, and without discharges to land, water, or air that threaten the environment or human health is known as Zero Waste Concept. Presently, this is need of time to make available quality grape juice packed with health benefits by utilizing wastes generated during the processing by adopting sustainable approaches. This Zero Waste concept-based technologies have been developed for juicing, utilization of pomace in making high quality bakery products (cookies, breads and muffins) and remaining seeds for extraction of high-quality grape seed oil or grape seed extract for further utilization. The Manjari Medika berries can be utilized to extract anthocyanins for utilizing as preventive approach against different human diseases. The technologies developed at ICAR-NRC for Grapes, Pune are ready to serve purpose of zero waste processing of Manjari Medika grapes. The concept of suitability of zero waste processing of Manjari Medika grapes is presented in Fig. 3 and able to open unlimited opportunities in the area of waste to wealth.

Anthocyanin extraction from Manjari Medika grapes

- **Manjari Medika Contained anthocyanins 4-6 g/Kg**
- **Technology has been optimized for extraction of pure anthocyanins**
- **Purification is based on affinity chromatography.**
- **Purified anthocyanin extract further freeze dried and lyophilized for powdery from.**
- **Uses as dietary supplement as general antioxidant after suitable formulations, as a natural dye/ food colorant or an active ingredient of cosmetic products.**

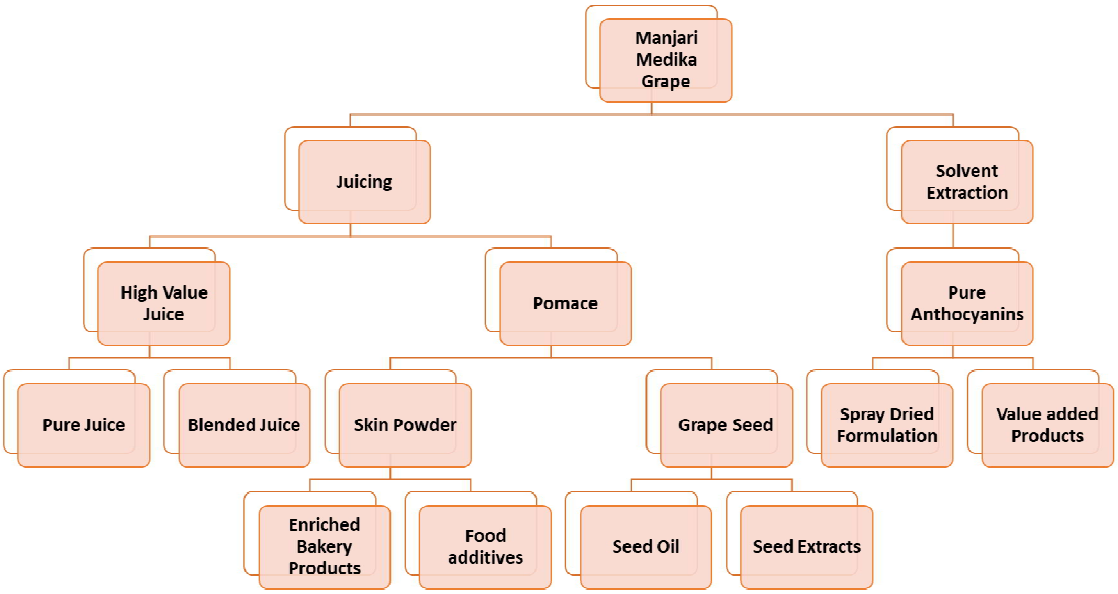
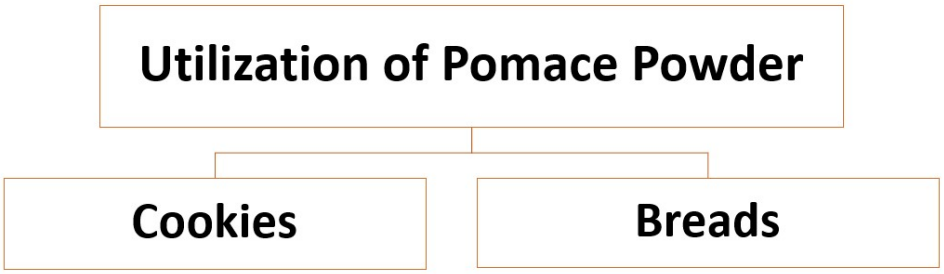


Fig. 3. Zero waste processing of Manjari Medika grapes



- Evaluated pomace powder from different type of grapes were Fine wheat flour by replaced by different levels of pomace powder
- Baking conditions for making of cookies and breads were standardized
- Higher nutraceutical values, fiber content, sensory score with attractive colour were recorded in prepared products

Levels of pomace powder of Manjari Medika grapes: Added value in breads

Manjari Medika based technologies for entrepreneurship development

Opportunities:

ICAR-NRC Grapes has developed various technologies to support zero waste processing of Manjari Medika grapes and extend help for entrepreneurship development in this area. The developed technologies related to utilization of different type wastes generated by wineries or grape juice industry like wine lees, pomace, seeds, etc. are ready for sell and Agri-Business Incubation Centre at this research centre is ready to support the upcoming business ideas.

Suggested readings:

1. Sharma, Ajay Kumar, Shabeer, Ahammed TP and Banerjee, Kaushik 2019. Manjari Medika grape juice variety: Suitable for Zero Waste Concept of Processing. Pp 7 https://nrcgrapes.icar.gov.in/technical%20bulletins/e-techbul-1-manjari-medika.pdf
2. Sharma, Ajay Kumar and Shabeer, Ahammed TP. 2019. Zero waste processing technologies for high value products from Manjari Medika: A grape variety of ICAR-NRCG. https://nrcgrapes.icar.gov.in/Technical%20or%20Extension%20folders/'Zero%20Waste'%20processing%20technology%20for%20high%20value%20products%20from%20Manjari%20Medika-a%20grape%20variety%20of%20ICAR-NRCG.pdf

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Chapter-13

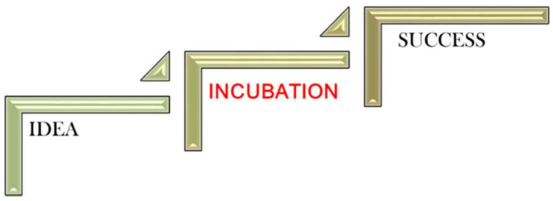
Agri-Business Incubation Centre of ICAR - NRC for Grapes: Scope and Activities

Dr. Ajay Kumar Sharma and Mr. Rohit Palghadmal

IACR-National Research Centre for Grapes, Pune (MH)

Agri-Business Incubation (ABI) Centre at ICAR - National Research Centre for Grapes (NRC for Grapes) was sanctioned in the year 2019 by ICAR Incubation Fund (Component II) under XII Plan scheme of IP&TM unit, ICAR i.e. National Agricultural Innovation Fund(NAIF).

Through this ABI Centre, ICAR – NRC for Grapes would extend support to prospective entrepreneurs by providing technical assistance, consultancy, infrastructure facility, guidance and training for sustainable business establishment.



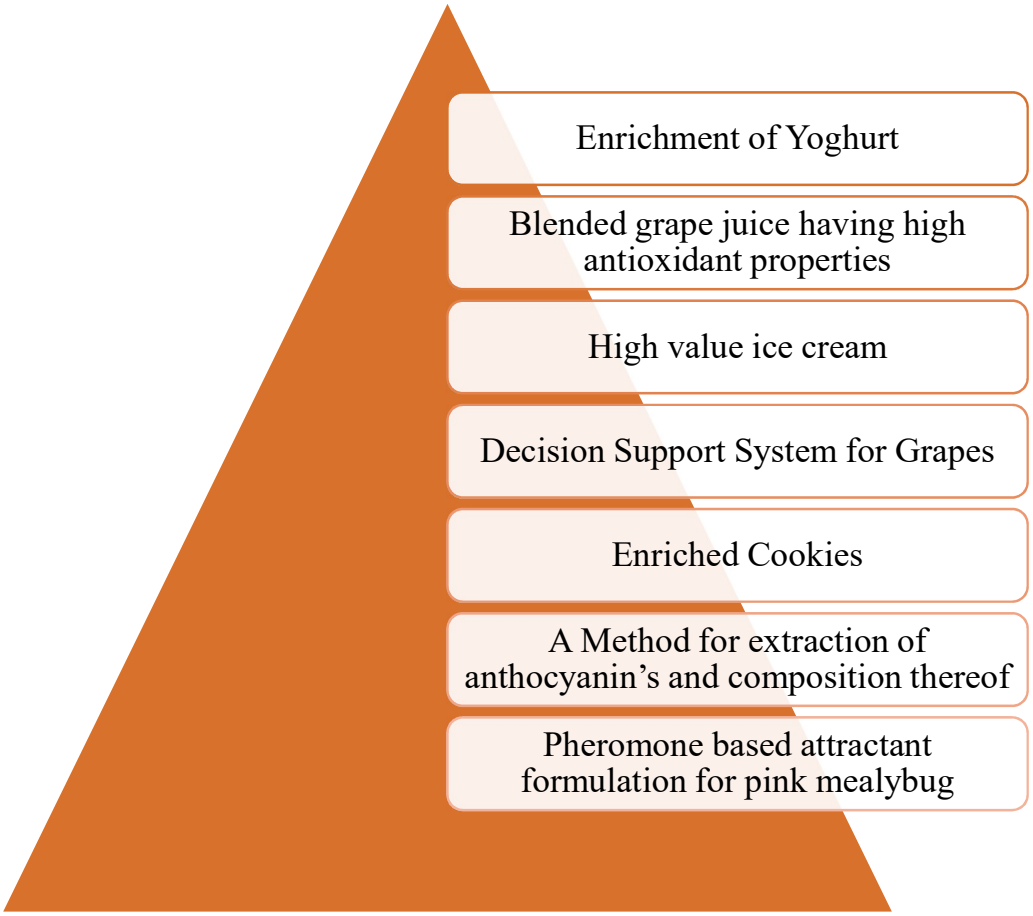
OBJECTIVES:

1. To provide incubation facility and technical assistance for Agri-business development.
2. To scale up the technologies in collaboration with stakeholders.
3. To impart training and capacity building to prospective entrepreneurs in agribusiness ecosystem.
4. To promote innovation, entrepreneurship and business creation in agriculture and allied sector by skill development, capacity building and technology scale up.
5. To promote an integrated approach for technology acquisition, R&D, commercial technology transfer and knowledge dissemination.
6. To facilitate evolution of an Agri-Start-Up ecosystem by support for cost effective, value added services including technical, legal, financial, intellectual property and regulatory compliance related services to Agripreneurs

Following services will be offered by ICAR – NRC for Grapes to the on-site incubate clients upon registration:

1. Office space & Lab space
2. Capacity building and training
3. Scientific Services
4. Business facilitation
5. Industrial connects for business development support

Technologies at ICAR- NRCG, Pune:



We call applications from person with innovation in the following areas with ideation and prototype:

- Grapes Processing
  - ✓ Wine making
  - ✓ Juice making
  - ✓ Raisins
  - ✓ Cookies
- Agri-Food Processing
- Nursery Management
- Farm Mechanization
- Decision Support Services for Grapes
- Supply chain Management
- Internet of Things (IoT) & Information and Communication
- Technology (ICT) in Agriculture
- Laboratory establishment
- Supply chain

Activities under Agri Business Incubation Centre, ICAR-NRCG, Pune

1. Memorandum of Agreements (MoA's) with companies:

ABI Centre of ICAR-NRC for Grapes received some proposals. These proposals were reviewed, evaluated and after thorough discussion in the advisory committee meetings of ABI, two proposals were found suitable to provide support. M/s. Sitai Agro Processing, a Nashik based company was identified for support to produce juice from Manjari Medika grapes and promote the juice as nutraceutical product, as juice of this variety contains higher antioxidant activities.

Another Sangli based company M/s. VVP International is involved in quality raisin production. This company will be supported in brand establishment of the product and market linkages. On October 18, 2021, the representatives of both companies signed MoA's with ABI Centre for ICAR-NRC Grapes, Pune. Mr. Vivek Ugale of M/s. Sitai Agro Processing and Mr.

Yogesh Padman of M/s VVP International signed the MoA's with Dr. R. G. Somkuwar, Director of NRCG.

On November 11, 2021 ABI Centre organized MoA ceremony 2.0. Our incubatee Dr. V. K. Tiwari signed two MoA's with Dr. R. G. Somkuwar, Director of NRCG. On this occasion Mr. Mahesh Londhe also signed MoA for the proposal "Production of millet-based cookies, Laddu's and millet nutri bar from Manjari Medika grape variety on small scale".

Mr. Yogesh Padman (M/s VVP International, Sangli) and Dr. R. G. Somkuwar signed MoA

Mr. Vivek Ugale of M/S. Sitai Agro Processing and Dr. R. G. Somkuwar signed MoA

Dr. V. K. Tiwari of M/s. Palus Foods Pvt. Ltd and Dr. R. G. Somkuwar signed MoA

Mr. Mahesh Londhe of M/s AgroZee Organics Pvt. Ltd. and Dr. R. G. Somkuwar signed MoA

2.Training programs:

Training Programme entitled 'Entrepreneurship Development in Manjari Medika grapes' was organized by Agri-Business Incubation Centre of ICAR-National Research Centre for Grapes, Pune, on 16th February, 2021.


मांजरी मेडिका अंगूरों में उद्यमिता विकास

3. Farmers visit

a. Visit of women farmers

A group of 120 women farmers from Kalvan, Dindori, Surgana and Devla tehsil of Nashik visited NRC for grape, Pune on 16th Dec 2021, we sensitized them on activities of ABI Centre. Also updated them on technological support in starting agri-based business and create self-help group. Explained opportunities in grape processing for better returns.

b. Visit of women farmers

45 women farmers from Niphad tehsil of Nashik district visited NRC for grape, Pune on 30 Dec 2021, we sensitized them on ABI activities in business development and available transferable technologies. Also Interacted on benefits of SHG/FPC for starting own Agri based business.

c. Visit of farmers (Distt. Sangli).

65 farmers from kadegaon, Khanapur, Atpadi, Tasgaon and Palus tehsil of Sangli visited ICAR-NRCG on 31 Dec, 2022. Farmers were sensitized on activities of ABI Centre. Also updated on available transferable technologies. Requested to join ABI Centre for starting agri based business.

4 Awareness programs:

Demonstration on raisin making technology at Jalna, Maharashtra

Incubatees at ICAR- National Research Centre for Grapes, Pune

S. No.	Name of entity/start up	Project title of Start-up/EDP	Details of the Incubatee
1	M/s Sitai Agro Processing, (Distt. -Nashik)	Production of healthy juice from Manjari Medika grape variety on small scale	Mr. Vivek Madhav Ugale A/P Khedgaon, Tal – Dindori, Dist – Nashik
2	M/s VVP international Pvt Ltd. (Distt. – Sangli)	Production, brand development and marketing of quality raisins."	Mr. Yogesh Shri Padman A/P Halbhag, Tal – Walwa, Dist – Sangali
3	AgroZee Organics Pvt Ltd., (Distt. - Pune)	Utilization of Manjari Medika pomace (grape powder) in millet-based cookies and laddus and millet nutribar.	Mr. Mahesh Chhagan Londhe, A/P Uruli- Kanchan (Pandurang Niwas, Gadakari Vasti), Tal-Haveli, Dist-Pune
4	Palus Food Pvt. Ltd., (Distt. – Sangli)	Solar dehydration of fresh grapes. (Naturally dried residue free Raisin production)	Dr. Vishwas Kisan Tiwari A/P- Sandgewadi, Tal- Palus, District-Sangli
5	Palus Food Pvt. Ltd., (Distt. – Sangli)	Production of residue free juice from Manjari Medika grape variety	Dr. Vishwas Kisan Tiwari A/P- Sandgewadi, Tal- Palus, District-Sangli
6	Jalna District Farmer Producers Company Ltd. (Distt. - Jalna)	Establishment of Farmer Producers Organization and its management	Mr. Bhimraj Ramchandra Kharat and Co. At- Nandapur, Post- Navha, Tal, Dist-Jalna (Maharashtra)
7	Sudarshan Enterprises, Indapur (Distt. - Pune)	Utilization of rejected grape berries from export consignment for raisin and grape juice production	Mr. Rajendra Waghmode *A/p: - Shetphal Haveli Tal: - Indapur Dist: - Pune Pin: -413103*
8	Grape Growers Association Indapur Farmers Producer Company, Indapur (Distt. - Pune)	Establishment of Farmer Producers Organization and its management	Mr. Rajendra Waghmode and Co. *A/p: - Shetphal Haveli Tal: - Indapur Dist: - Pune Pin: -413103*

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