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1. AGRICULTURE

Genomic Selection and CRISPR-CAS Technology: A Tool for Precise Genome Editing

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Abstract

The enhancement of vegetable crops has been greatly impacted by recent developments in molecular breeding, with CRISPR genome editing and genomic selection emerging as extremely successful contemporary techniques. Breeders may choose better genotypes for complex characteristics including productivity, quality features, and resistance to biotic and abiotic challenges by using genome-wide marker information to determine the genetic potential of plants early on. Compared to conventional breeding methods, our approach shortens the breeding cycle and improves selection accuracy (Kumar *et al.,* 2024). On the other hand, target genes can be precisely and site-specifically modified with CRISPR-Cas technology without causing undesirable genetic alterations. Desired characteristics including increased nutritional value, disease resistance, stress tolerance, and longer shelf life can be more effectively attained by targeted gene editing. Global food and nutritional security, climatic resilience, and sustainable agriculture are all supported by the quick creation of superior vegetable cultivars made possible by the combined use of CRISPR and genomic selection (Khatodia *et al.,* 2016).

Keywords: Genomic selection, CRISPR-Cas9, molecular Breeding, disease resistance, abiotic stress tolerance, nutritional quality, precision breeding, climate-resilient varieties.

Examples of Vegetable Varieties / Lines Developed Using Genomic Selection and CRISPR-Cas Technologies (Weiss and Gruda, 2025)

Tomato (Solanum lycopersicum)

- CRISPR-edited lines targeting SlRIN, SlNOR, and SlALC genes Trait improved: Delayed fruit ripening and extended shelf life Status: Advanced research / pre-commercial lines Use of GS: Identification of elite high-yield backgrounds before editing.
- High-lycopene tomato lines (SlSGR1 edited) Trait improved: Increased lycopene content Technology: CRISPR-Cas9 Application: Nutritional quality improvement.

Chili / Capsicum (Capsicum annuum)

- Virus-tolerant edited lines (EIF4E gene edited) Trait improved: Resistance to potyviruses Technology: CRISPR-Cas GS role: Selection of high-yielding parental lines before editing
- Improved pungency and fruit quality lines Status: Research-stage breeding lines

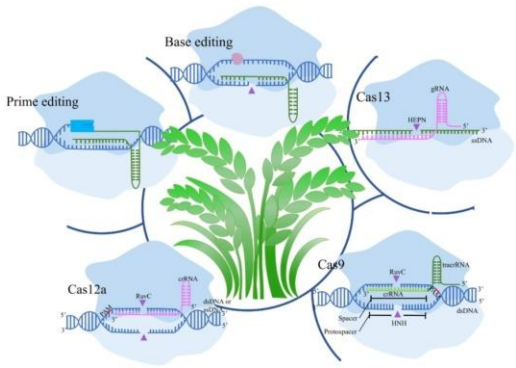

Fig. Advanced CRISPR-Based Genome Editing Tools in Plants: Cas9, Cas12a, Cas13, Base and Prime Editing

Brinjal / Eggplant (Solanum melongena)

- **Bacterial wilt–tolerant edited lines** *Genes targeted:* Disease-resistance related genes *Technology:* CRISPR-Cas9 *GS application:* Early selection of superior yield and adaptability traits

- **Reduced browning brinjal lines (PPO gene edited)** *Trait improved:* Better post-harvest quality

Cucumber (Cucumis sativus)

- **Non-bitter cucumber lines (**CsBADH **gene edited)** *Trait improved:* Reduced bitterness *Technology:* CRISPR-Cas9 *GS role:* Identification of elite fruit-quality genotypes
- **Improved flowering and yield stability lines** *Status:* Experimental breeding lines

Lettuce (Lactuca sativa)

- **Downy mildew–resistant edited lettuce lines** *Technology:* CRISPR-Cas *GS use:* Selection of fast-growing, high-biomass backgrounds
- **Delayed bolting lettuce lines***Trait improved:* Extended harvesting period

Carrot (Daucus carota)

- **High β-carotene carrot lines** *Technology:* Genomic selection for nutritional traits *CRISPR use:* Targeted improvement of carotenoid pathway genes *Status:* Advanced research lines

Spinach (Spinacia oleracea)

- **Oxalate-reduced spinach lines** *Technology:* CRISPR-Cas *GS role:* Selection for yield and leaf quality *Benefit:* Improved nutritional safety

Limitations of Conventional Breeding in Vegetable Crops (Kondrateva et al., 2021)

- Time-consuming process
- Low efficiency for complex qualities
- Environmental Impact on selection
- Limited precision
- Difficulty in early-stage selection
- Limited genetic base
- Difficulties in breeding for biotic and abiotic stress resistance

Conclusion

Despite the difficulties, molecular breeding techniques like CRISPR-Cas and genomic selection have enormous potential to transform the development of vegetable crops, guaranteeing increased nutritional value, resilience to climate change, and sustainable production.

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2. AGRICULTURE

Organic Dairy Farming in India

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Introduction

In organic dairy farming, the dairy animals are raised on organic feed, which consists of pastures grown without the use of fertilisers or pesticides, and they have access to pasture with limited use of antibiotics and hormones (Oruganti, 2011). The dairy products that are made from milk sourced from organic dairy farms are referred as organic. Although organic vegetables, fruits, grains and some livestock

have long been mainstays of the organic movement, the organic dairy farming is relatively a newcomer (Pierce and Tilth, 2014). The success of organic dairy can largely be attributed to several critical events, including an increased consumer awareness regarding crops of farm products treated with an array of synthetic pesticides being fed to livestock; concerns about mad cow and lumpy disease; and the increased use of synthetic medications including hormones, antibiotics, and steroids have encouraged many consumers to seek organic dairy products. These customers now depend on certified organic dairy as a reliable source of pure dairy products (Hamadani and Khan, 2015). Organic dairy farming is a production system that consists a set of goal-based regulations which allows farmers to individually manage their own particular situations along with maintaining organic integrity. Organic dairy products are frequently viewed as "Gateway Products", in which consumers makes their first foray of purchasing organic dairy products and eventually increasing their allegiance to organic products as they become increasingly food savvy (Oruganti, 2011).

Benefits of Organic Milk

Organic milk contains the beneficial omega-3 fatty acid which is an essential fatty acid and it is required for healthy growth (Lairon and Huber, 2014). Its deficiency leads to various health problems that have seemed to increase in recent years. Regular intake of omega 3 fatty acids protects from various diseases and helps to reduce the incidence of heart disease, inflammation (in skin diseases like eczema), cancer, and arthritis (Annon, 2014). Greater amount of conjugated linoleic acid (CLA) is also present in the organic milk (Mercola, 2014). CLA increases the body's metabolic rate, immunity and muscle growth. It also reduces abdominal fat, cholesterol and allergic reactions (Annon, 2014). Organic pastures are used for the grazing of organic cows. As a result, their milk is free from harmful chemicals such as pesticides residues, hormones and fertilizers residues (Singh *et al*., 2011). Furthermore, as the cows are not fed with antibiotic residues, genetically modified feed, urea, or reproductive hormones to boost milk production, this nutrient-rich organic milk is also free of these substances. Organic milk has about 2-3 times higher concentration of antioxidants like zeaxanthin and lutein as compared to non-organic milk (Mercola, 2014). Lutein is extremely important for eye health and is effective in preventing numerous eye diseases such as macular degeneration and cataracts. Zeaxanthin is also important for good eye health and protects the eye from UV damage and the impact of free radicals. It is very helpful in preventing cataracts, diabetic retinopathy, glaucoma and macular degeneration. The milk produced by organic cows has about 50% higher vitamin E and 75% higher beta-carotene as they graze on fresh grass and clover. Hence, as compared to conventional milk, the organic milk has a higher concentration of vitamin A and vitamin E (Nielsen and Nielsen, 2004)

Recommendations for Organic Milk Production

The following are the recommendations for organic milk production (Alexander, 2010):

- **Conversion to Organic from Conventional Farming**: The process of switching from conventional to organic farming involves either converting the entire farm in a single block or phasing the conversion over a number of years. Converting the land to organic status takes at least two years. Once the land achieves complete organic status, organic milk can be produced. In order to obtain organic certification, the herd must have started nine months and feeding six months before the planned organic milk production date.
- **Feeding**: From the beginning of conversion, all feedstuffs used on the farm must be produced and certified in accordance with organic standards. All the required feed should be produced on the farm itself and maximum utilization of grazing should be done. Up to 30% of the feed may come from in-conversion sources, with the remaining coming from the farm or affiliated organic farms. Both the purchased blends and the remaining portion of the ration must be entirely

organic. Mineral supplementation is allowed if organic husbandry procedures are unable to meet the trace element requirement. Certain synthetic vitamins can be used, but only with the approval of control body. Since fodders based on clover are the primary source of nitrogen, they are essential to the development of organic dairy farms. If molasses is used, it must be organic.

- **Soil Fertility**: Appropriate rotations, alternating silage and grazing ground whenever feasible, and the cautious application of recovered manures and slurry can all help to preserve soil fertility. Synthetic fertilizers should be strictly restricted for use in organic agriculture while use of natural sources of nutrients is permitted.
- **Livestock Manures**: Organic manure should also be transported from neighbouring farms. There should be no more than 250 KGN/ha/yr applied to any one region. Additionally, poultry litter from certified organic farms may be utilised.
- **Housing**: A comfortable, dry bedded lying area must be provided to cows. Well bedded loose housing is preferred. Dairy cows should be provided a minimum space of 6 sq. m. per animal. Space requirements for young stock should range from 1 to 1.75 sq. m. per 100 Kg live weight.
- **Animal Health**: All cohorts and offspring of cases of bovine spongiform encephalopathy must be eliminated from the herd prior to conversion. Homoeopathic treatments and preventive care are usually recommended. Antibiotics and veterinary medications should not be used as preventative measures, but they can be used to lessen suffering in the case of disease or trauma if the withdrawal period is at least twice as long as specified. Good management measures, such as teat dipping and culling cows with high cell counts, can help control mastitis. Careful grazing management techniques can reduce infection exposure and help control parasites. In situations where a recognised disease risk exists, vaccination is allowed under derogation. With the exception of immunisation, parasite treatment, and any mandatory eradication programs, animals lose their organic classification if they undergo more than three courses of treatment in a single year. After losing their organic designation, livestock must undergo another conversion period in order to regain it.
- **Sources of Stock**: Cattle that have been purchased must not come from herds that have experienced bovine spongiform encephalopathy during the last six years. The current livestock on a farm may be kept, but they will never be able to be sold as organic. However, after the necessary conversion periods, the milk from these cows and their offspring may be sold as organic. It is possible to replace up to 10% of the breeding herd annually with conventional herds. Organic milk should make up at least 51% of the total ration when feeding calves that are 12 weeks old. Bulls can be rented or bought from conventional farms as long as they are handled according to organic standards when they arrive at the organic farm. Artificial insemination is also permitted.
- **Selling of Organic Milk**: Selling milk through an officially registered processing facility is required in order to obtain premium prices for organic milk. Dairies and milking parlours may employ approved sterilant.

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3. AGRICULTURE

Diseases of Beans and Management

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Introduction

Bean cultivation plays a vital role in supporting the livelihood of small and medium-scale farmers across India. However, maintaining healthy bean crops is a challenging task due to various agronomic and environmental factors. Farmers often struggle with issues such as poor soil fertility, irregular rainfall, pest infestations, and limited access to quality seeds and fertilizers. Among the major concerns, crop diseases significantly impact bean production by reducing yield and quality. Common diseases such as bean rust, anthracnose, and bacterial blight spread rapidly under favorable conditions, weakening plants and leading to economic losses. Without timely diagnosis and effective management practices, these diseases pose a continuous threat to sustainable bean farming.bean is an important food legume comprising both dry and snap beans widely grown in the temperate, tropical and sub-tropical areas of the world (Pamela et al., 2014; Awori et al., 2018). beans were first brought from America to other continents about 500 years ago

Since then, they have become an economically and geographically significant plant , especially in underdeveloped nations where they are a key source of dietary protein (Angioi et al. 2010). the common bean is a grain legume that is particularly intriguing for human health and sustainable food production due to its capacity for symbiotic atmospheric nitrogen fixation (Foyer et al. 2016).The crop is rich in protein and micronutrients, such as calcium, folate iron, zinc, magnesium, phosphorus, potassium and vitamin B (Mederos, 2006; Beebe et al., 2014; Petry et al., 2015).

Anthracnose

Symptoms

- In soil infected seeds generally undergo rot and show distinct pinkish fungal spores on seed coat.
- On seedlings, the cotyledons show small to large, brown to black, sunken spots.
- On growing plants the leaves show small, angular and brown lesions mostly adjacent to veins.

- On pods the spots appear as black sunken cankers with light or grey centered area.
- The center portions of these spots show pinkish mass of spores especially in wet weather.
- Mature seeds from diseased pods may or may not be stained.
- If stained, the color is various shades of brown.
- On stems of adult plants, the spots are eye shaped and longitudinal along the stem.

Causal Organism

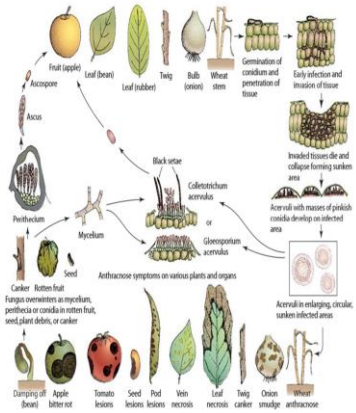
- Colletotrichum lindemuthianum.
- Perfect stage – Glomerella cingulata f.sp. phaseoli
- Mycelium is septate, branched and hyaline becoming dark with age
- Acervuli develop beneath the cuticle.
- Conidia are borne on short conidiophores.
- Setae are brown and hyaline.
- The fungus also produce perithecia.

Disease Cycle

- The fungus overwinters in infected seeds and in plant debris.
- Conidia or dormant mycelium in infected seeds germinate, become active and infect the young seedlings.
- Secondary spread is through wind, water, rain splashes and insects.

Favourable Condition

- 90 % relative humidity.
- High Rainfall.



Management

- Grow disease free seeds.
- Field sanitation.
- Soil should be well drained and good spacing.
- Seed treatment followed by 2-3 sprays of mancozeb (0.25%) after 45, 60 and 75 days of sowing.
- Biological control through seed bacterization and through inoculation with avirulent strains of the pathogen (Sticker et al.,1997; Ban Loon et al., 1998).

- Captan,zinab or mancozeb at the rate 2kg/ha are usually recommended.
- Leaves treated with calcium or sodium silicate show significantly reduced anthracnose lesions without showing any accumulation of silicon barrier level (Moraes et al., 2006)

Bacterial Blight

Symptoms

- The symptoms appear first on the lower sides of the leaves as small, water-soaked spots.
- The spots enlarge, coalesce, and form large areas that later become necrotic.
- Bacteria may also enter the vascular tissues of the leaf and spread into the stem.
- In common blight and in bacterial brown spot, the infected area, which is surrounded by a narrow zone of bright yellow tissue, turns brown and becomes rapidly necrotic.
- Several small spots coalesce and produce large dead areas of various shapes.
- In halo blight, a much wider halo-like zone of yellowish tissue 10 millimeters or more in width forms outside the water-soaked area, giving the leaves a yellowish appearance.
- All diseases produce identical symptoms on the stems, pods, and seeds, but when a bacterial exudate is produced on them, it is yellow in common blight (Xanthomonas) and light cream or silver colored in halo blight and in bacterial brown spot (Pseudomonas).
- On the stem, water-soaked, sometimes sunken lesions form that gradually enlarges longitudinally and turns brown, often splitting at the surface and emitting a bacterial exudate.
- Such lesions are most common in the vicinity of the first node, where they girdle the stem, usually at about the time the pods are half mature.
- The weighted plant often breaks at the lesion.
- On the pods, water-soaked spots also develop that enlarge and turn reddish with age.
- Often the vascular systems of the pod become infected, resulting in infection of the seed through its connection with the pod.
- Seeds may rot or may show various degrees of shriveling and discoloration depending on the
- timing and degree of infection.
- Similar symptoms are caused on pea and soybean by two different species of Pseudomonas.

Causal Organism:

- Three blights of bean are caused by bacteria
- Common blight, caused by *Xanthomonas campestris* pv. *phaseoli.*
- Halo blight caused by *Pseudomonas syringae* pv. *phaseolicola.*
- and Bacterial brown spot caused by *P. syringae* pv. *syringae.*
- All three diseases occur wherever beans are grown and cause similar symptoms.
- In the field, the three diseases affect the leaves, pods, stems, and seeds in a similar way and are usually impossible to distinguish from one another on the basis of symptoms.
- Common blight seems to be more prevalent in relatively warm weather, whereas the other two blights are more prevalent in relatively cool weather.

Development of Disease:

- In all three bacterial blights, bacteria overwinter in infected seed and infected bean stems.
- From the seed, bacteria infect the cotyledons, and from these they spread to the leaves or enter the vascular system and cause systemic infection, producing stem and leaf lesions.
- Internally, bacteria move between cells; however, the latter collapse, are invaded and then digested, and cavities form.
- When in the xylem, bacteria multiply rapidly and move up or down in the vessels and out into the parenchyma.
- They may ooze out through splits in the tissue and may reenter stems or leaves through stomata
- or wounds.

Management:

- Use of disease-free seed.
- Three year crop rotation.
- Sprays with *streptocycline or tetracycline.*
- Avoid overhead irrigation.

RUST

Symptoms

- The disease attacks all aerial parts of the plant
- The disease is usually found when the plants are about 6 weeks old.
- Rust can be readily recognized as orange coloured pustules (uredinia)
- that appear on the lower leaflet surface and rupture to expose masses reddish brown urediniospores.
- Pustules appear first on the lower surface and in highly susceptible cultivars the original pustules maybe surrounded by colonies of secondary pustules.
- Pustules may also appear on the upper surface of the leaflet.
- The pustules are usually circular and range from 0.5 to 1.4 mm in diameter.

Pathogen

- Uromyces phaseoli typica Arth.
- The pathogen produces both uredial and telial stages.

- Uredial stages are produced in abundant The production of telia is limited.
- Teliospores are dark brown with two cells.
- Pycnial and aecial stages have not been recorded.
- There is no information available about the role of alternate host.

Disease Cycle

- The pathogen survives as uredospores on volunteer groundnut plants or in infected plant debris in soil.
- The spread is mainly through wind borne inoculum of uredospores.
- The uredospores also spread as contamination of seeds and pods.
- Rains plash and implements also help in dissemination.

Favourabl Conditions

- Low temperature, 20-25°C.
- High relative humidity above 85 per cent.

Managment

- Field sanitation
- Removal and burning of crop debris.
- Long crop rotation.
- Use resistance variety.
- Suitable plant spacing and removal of weed to lower the humidity in the crop.
- *Cladosporium tenuissimum* and *verticillium lrcanii* as biocontrol agent of bean rust.
- If disease occurs early and weather is favourable the crop can be spray with *mancozeb, maneb, zineb or daconil* at the rate of 2 kg/ha,2.4 grams per liter (g/L).

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4. SOIL SCIENCE

Production of Urea-Free Coir-Pith Compost

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Introduction

Coir pith is a by-product generated from coir industries. It consists of short fibres and mesocarp pith that remain after extracting long fibres from retted or fresh coconut husks. The fibre-to-pith ratio in the coconut mesocarp is about 30:70 (w/w basis). In India, husks from nearly 40–60% of coconuts are utilized for coir fibre production. On average, 0.5 to 1 million tonnes of coir pith waste is generated annually in the country, which needs to be utilized effectively.

Coir pith has high porosity and a remarkable water-holding capacity of up to 500%, making it a unique soil amendment. Along with these beneficial physical properties, it also contains a high concentration of potash, enhancing its agricultural value. However, its high polyphenolic content makes raw coir pith toxic to the roots of many crops. Therefore, composting is considered the most suitable option for its beneficial use in agriculture, as the process reduces the concentration of toxic phenolics and makes plant nutrients more readily available.

Composting of Coir-Pith

Composting coir pith is a challenge because it has a very high C:N ratio and lignin content ranging from 30 to 54%, which makes microbial decomposition difficult. To make it more amenable to microbial breakdown, the C:N ratio is reduced by adding urea, followed by the inoculation of lignocellulose-degrading mushroom fungi such as Pleurotus sajor-caju.

The compost produced through this technology becomes a good source of organic manure, improving soil physical properties, enriching the soil with valuable plant nutrients, and serving as a plant growth medium for both horticultural and field crops. However, the effectiveness of this technology depends on the regular availability of mushroom fungal culture, which often becomes a limiting factor for farmers.

Urea-free Composting of Coir-Pith

In this technology, organic materials with high nitrogen content and a low C:N ratio (such as animal manures) are mixed with organic materials with low nitrogen content and a high C:N ratio (such as coir pith). This balancing of high C:N and low C:N materials facilitates improved microbial decomposition of the substrates. The method is a low-cost, simple, and rapid composting technology that utilizes locally available resources, making it easily adoptable by both farmers and cottage-industry level entrepreneurs.

Required Five Main Inputs

Coir-pith , Poultry manure, Lime (Calcium oxide), Rock phosphate and Water

Steps for Coir-Pith Composting

1. Site Selection
   a. Choose a shaded area protected from direct sunlight and rainfall.
   b. Alternatively, create shade using greenhouse nets draped on wooden poles.
2. Preparation of Mixture
   a. Mix 90 kg coir pith + 10 kg poultry manure + 0.5 kg lime + 0.5 kg rock phosphate thoroughly.
   b. For larger heaps, mix 450 kg coir pith + 50 kg poultry manure + 2.5 kg lime + 2.5 kg rock phosphate and spread in a 4 × 2 × 1 m (L × B × H) area.
3. Heap Formation
   a. Spread the mixture evenly in a pit or heap of 2 × 1 × 0.5 m dimensions (for small heap) or as per larger

heap size.

4. Moisture Management
   a. Sprinkle water regularly using a watering can to maintain uniform moisture throughout the heap.
   b. Avoid over-wetting or drying of the heap.
5. Covering
   a. Cover the heap with gunny bags, greenhouse nets, or dry grasses to conserve moisture and protect from external exposure.
6. Turning the Heap
   a. Turn the heap thoroughly once every 15 days.
   b. Turning helps aeration and speeds up decomposition.
   c. Progress is indicated by colour change from reddish-brown (raw) to dark brown.
7. Completion of Composting
   a. Within 45–60 days, the coir pith turns dark brown to black, indicating full composting.
8. Final Processing
   a. Shade dry the composted material.
   b. Pack and store the composted materials for future agricultural use.

Physico-Chemical and Microbial Properties of Urea-Free Coir Pith Compost

The coir-pith compost produced through this technology is a highly porous, dark-coloured, odour-free product with a pH ranging from 6.1 to 6.4 and a water-holding capacity of up to 500%. The final compost has a C:N ratio of 21–22 and an organic carbon content of 28–30%.

Nutrient Composition:

- Nitrogen (N): 1.3–1.4%
- Phosphorus (P): 0.9–1.2%
- Potassium (K): 1.3–1.6%

In addition, it is a good source of micronutrients such as iron (Fe), copper (Cu), zinc (Zn), and molybdenum (Mo). From a microbiological perspective, the urea-free coir-pith compost is enriched with beneficial microorganisms, including free-living nitrogen-fixing bacteria and phosphate-solubilizing bacteria. It also harbours significantly high populations of actinomycetes, which are known for their antibiotic production and play an important role in suppressing soil-borne pathogens.

Advantages of Using Coir-Pith Compost

- The urea-free coir-pith composting technology serves as an ideal input for organic cultivation of both field and horticultural crops.
- Application of coir-pith compost improves soil physical properties and significantly enhances its water-holding capacity.
- It enriches soil organic matter and carbon content, making it particularly beneficial for soils with poor fertility.
- The compost supports better root development, thereby enhancing overall crop growth and yield.
- It provides an excellent medium for raising pot-tray seedlings, ensuring healthy and vigorous plant establishment.

Reference:

https://cpcri.gov.in

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5. HORTICULTURE

Managing Physiological Disorders in Arid Fruits for Better Return

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In western Rajasthan due to the unfavourable climatic condition as well as inappropriate cultural practices leads to the higher chances of physiological disorders that adversely affect the cultivation of many arid fruits in this area. Physiological disorders are the non parasitic abnormalities in fruit which are not associated with disease or insect pest. They are mainly caused by limitation or excess of different factors such as temperature, moisture, soil mineral and nutrient concentration etc. Presently due to changing climatic scenario problems like frost, temperature fluctuation, low moisture availability, very low precipitation associated with high evaporation rate, nutrient imbalance creating unfavourable condition for the cultivation of many arid crops. This article gives a view on the physiological disorders and their management associated with pomegranate, ber, aonla and date palm for getting satisfactory ruminative price from arid fruits under hot western Rajasthan region.

1. Pomegranate

Fruit Cracking

It is the most serious physiological disorder in pomegranate in arid region which accounts 30-75% losses and hinders its cultivation in large area. In immature fruits it is mainly due to the deficiency of boron but fully developed pomegranates crack due to moisture imbalances, as they are very sensitive to variation in soil moisture, relative humidity, rate of transpiration, rind pliability and extreme fluctuation between day and night temperatures. It has been observed that during drought period hardened the peel which loses their ability to divide and enlarge. If after a dry spell, water supply is greatly increased, the meristematic tissues quickly resume growth but not the peel so, resulted cracked fruit. If harvesting is delayed and there is attack of insect-pest it also leads to the cracking of fruits.

Different management practices reported for controlling fruit cracking has been adopted like maintaining soil moisture and cultivation of tolerant verities. The varieties selected as crack resistant had the highest WUE, whereas, the lowest in susceptible. The plant should be irrigated regularly during entire development stages of plant. Plant nutrients and transpiration rates also have significant effects of on fruit splitting. Reduction in fruit cracking in plants on the spray of borax is found significant. Kaoline can be used as antitranspirant to reduce the transpiration and ultimately the cracking problem. Physiological characters such as calcium content and pectin value have significant effects on the mechanical properties of cell membrane. Spray of calcium hydroxide on leaves and the fruits reduces the incidence of cracking. Spray of zinc also suppress the cracking as it has beneficial effects on controlling water absorption and nutrient uptake as well as enhancing the biosynthesis of the natural hormone namely IAA reducing fruit cracking per cent.

Sun Scald

In hot arid region during the afternoon hours particularly in the month of May to July when sun rays are very intense and fruit surface facing sun turns yellow, brown or black dark tan patch on the sun exposed side of the fruit due to scorching while the underneath skin is normal. This disorder is serious in ambe bahar crop. To avoid this disorder one should maintain a canopy structure in such a way by which no fruit get exposed directly towards the sunlight. Larger fruits are more susceptible for sun scald then the small fruits.

Shading with 35% shade net is helpful in reducing sunburn. Spraying of kaoline during the hot months is useful for reducing sunscald. First spray of 5% kaoline and subsequent second and third spray with kaoline @2.5% at

15 days interval is significant. Bagging of fruits with white coloured butter paper bag also found effective in controlling the sunscald problem.

Aril Browning

Aril browning or internal breakdown of arils in pomegranate critically affect fruit quality in some commonly grown cultivars such as Ganesh and Bhagwa which leads to 50-60% loss. It is due to delayed harvest resultant aril browning and rotting. The pomegranate fruit should be harvested as soon as they mature between 140-150 days after flowering in Jallore Seedless and 170-180 days in Bhagwa. Aril breakdown or browning is characterized by soft, light creamy, brown, dark blackish or brown and slightly flattened arils which are deformed and posses an unpleasant odour when the fruits cut open. This disorder is accompanied by desiccation, wrinkling and development of internal spaces in arils. Experimental studies indicated that the juice and seed content of affected fruits have reduced level of TSS, acidity, ascorbic acid reducing sugar, calcium, phosphorus and enzyme catalase and increased level of non reducing sugar, starch, tannins, nitrogen, potassium , boron and enzyme polyphenol oxidase compared to healthy fruits. Studies have shown that genetic background, pruning, growing season, fruit size, and harvested date variety. It can be managed by harvesting at proper maturity period.

2. Ber

Stylar-end Browning

This physiological disorder identified in ber cv Chhuhara, stylar-end of the fruit turns brown. This disorder appears during late harvesting period, when atmospheric temperature is higher. High temperature and high evaporation losses with higher illumination had resulted boron accumulation beyond the threshold level, which leads to the formation of browning of stylar-end of the fruits.

Fruit Drop

The fruit drop in ber mainly due to the abortion of embryo and secondly due to premature formation of absession layer in the stalk of ripe or nearly ripe fruits. Spray of NAA in mid October control the fruit drop significantly.

Fruit Cracking

This disorder characterized by the cracks developed after rain on the fruit surface and also deep down to the flesh of fruits. This may be due to the temperature fluctuation, low moisture availability, low relative humidity as well as nutrient deficiency at the time of fruit development and ripening stage.

Cracking in ber can be minimized by the spray of gibberellins @ 20 ppm, 2-4 D, NAA at the concentration of 20 ppm and boric acid @ 2g/l at the fruit development stage. Use of mulching for conservation of moisture throughout the development period of fruits also reduces the cracking problem in ber.

3. Aonla

Internal Necrosis

This is the main disorder in aonla which is mainly due to the deficiency of boron. Francis and NA-9 found susceptible for this disorder. However, NA-6, NA-7, NA-10, Kanchan and Chakiya found resistance for this malady and exhibit higher productivity.

A combined spray of zinc sulphate @ 0.4%, copper sulphate @ 0.4% and borax @ 0.4% during September-October found effective in controlling this disorder. Treatment of borax @ 0.5-0.6 % in the month of September-October also controls the necrosis problem in aonla.

Off-Season Flowering

It is another serious problem in aonla production. This causes approx. 30-40% of economical losses. The main cause of off season flowering is changing environmental conditions which leads to the alteration in tree physiology which leads to the absence of dormancy after fruit harvest. Plant produces a partial flowering with predominant male flowers which do not set fruit and exhaust the plant.

To control the off season flowering spray of 10% urea after fruit harvest is found effective. Restricting soil moisture build up near root zone can lead plant to enter into dormancy.

4. Date Palm

Black Nose

Black nose characterized by shrivelled and darkened tip of the fruit. Verities Deglet Nour and Hayani seem to be most susceptible for

this disorder. This disorder is mainly found in the areas with high humidity and rainfall, so it can be controlled by checking environmental humidity.

This problem can be managed by bagging the fruits with brown paper bags. Over thinning can also increase the incidence of black nose in fruits.

Crosscuts

This disorder consists of slightly deep notch or cut similar to knife on the fruit stalk and fronds. Cross cut leads to the sterile cavity leading to mechanical breakdown during the elongation of the stalk or fronds. This disorder mainly found in Khadrawy and Sayer. The only control for this disorder is to do not use such type of plants for propagation.

Barhee Disorder

This disorder consists of bending of crown in Barhee and Dayri date palm verities. Affected palm bend mostly to south and some time south-west direction.

To control this disorder iron bar is placed on to the opposite side of the bending and the fruit bunches are tied on this bar. It seems that after 2-3 year the bending is corrected.

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6. GENETICS & PLANT BREEDING

Poison nut (*Strychnosnux-vomica*): An underexploited medicinal crop of Western Ghats

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Introduction

Poison nut is native to India and South-east Asia, belongs to the family *Loganiaceae*. It is commonly known as Strychnine tree,Poison nut while natively known by Kuchila (Hindi), Kanjiram (Malayalam) and Kanjaram (Tamil). The name "poison nut" is derived because of their toxic nature of seeds. The tree is deciduous in nature and found in the semi-evergreen forests of India, Sri Lanka, Myanmar, Thailand, Indo-China and Malaysia region.In Indiait ismajorly found in the parts ofMaharashtra(Kolhapur, Raigad, Ratnagiri, Sindhudurg), Karnataka (Belgaum, Chikmagalur, Coorg, Mysore, NorthKanara, Shimoga, SouthKanara) and all districts of Tamil Nadu.Almost all part of this tree contains alkaloids "strychnine" having medicinal importance but seed is official in many pharmacopeia. Though it is commonly used as a natural remedy for many different symptoms and disorders, the seeds must be treated before they are consumed, to make them safe.

Botanical Classification

- Kingdom : Plantae
- Division :Magnoliophyta
- Class :Magnoliopsida
- Order :Gentianales
- Family :Loganiaceae
- Genus :Strychnos
- Species :Nux-vomica

Botanical Description

The tree trunk is tall, thick, straight and cylindrically covered with yellowish-grey to dark grey, smooth and thin barks. Fruit is a globose, indehiscent berry with a smooth and hard shell. The fruit is full of soft, white, fleshy and jelly-like pulp containing 1-3 seeds. Seeds are lens-shaped to orbicular or ellipsoid, covered with dense silky hairs radiating from the centre, and giving a characteristic shine to the seed.The tree is deciduous in nature; start to bloom in the month of March and fruits get mature in the month of November.

Medicinal Properties

- **Leaves:** Cures wounds or ulcers when applied as poultice.
- **Flowers:** Antibacterial and antioxidant
- **Fruits:** Alleviates urinary disorder, Constipation (ripe fruits), diseases due to impure blood and paralytic affliction of paws and feet.

- **Seeds** : Used in cholera; diabetes; emotional disorders, hysteria; epilepsy; intermittent fevers; gout, rheumatism, hydrophobia; impotence; insomnia; paralytic and neuralgic afflictions; prolapsed rectum;

Scientific validation of many ayurvedic therapeutic claims like analgesic and anti-inflammatory properties, anticancer and anti-tumor activity, antioxidant, anticonvulsant, antiamnesic, antiallergic, antialcoholic and immunomodulatory property increases the importance of this poison plant in modern medicines.

Detoxification of Seed

The seeds have to be treated properly before the usage, as they contains high amount of strychnine and brucine. Theheat treatment will reduce the alkaloid content along with increase in isostrychine, isobrucine, strychnine N-oxide and brucine N-oxide. The following methods can be used for detoxification:

Unani Medicine

- Frying the seeds in cow's ghee until it turns brownish red
- Soaking the seeds in cow's milk for seven days and then peeling the seeds

Ayurveda

- Soaking the seeds in cow's urinefor seven days
- Frying in cow's ghee until it turns brownish red
- Tying in a cotton cloth and placing it in a vessel of boiling cow's milk for three hours
- Parching in a sand bath (about 240°C) for three minutes
- *Chinese traditional medicine*
- Treating with vinegar
- Treating in licorice decoction
- Frying in oil bath (about 240°C) for three minutes.

Seeds of poison nut

Fuits of poison nut

Conclusion

Though the plant possesses poison in its seeds, it has many other advantages in medicines and is being underutilized. There is a vast scope for clinical trials, investigation in the field of medicinal and pharmaceutical sciences for holistic applications of this plant.

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7. HORTICULTURE

Geographical Indications of the Indian Plantation Sector

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Introduction

Geographical indications are part of the intellectual property law, and areawarded to products that have some unique characteristics owing to aparticular region.India has 365 products till now including agriculture crops and products. The plantation sector covers major part of the export of the country. The number of GI tags in this sector were 14 and the special attributes are described here.

Darjeeling Tea

The first plantation crop to get GI tag is the Darjeeling tea**.** It is grown at an elevation ranging from 600 to 2000 meters above sea level with an average of 309cm mark annual rainfall. The Darjeeling tea when brewed gives a colour of pale lemon to rich amber. The brew is said to have remarkable varying degrees of visual brightness, depth and body. The flavour emanating from the brew is a fragrance with a complex and pleasing taste and after taste with attributes of aroma, bouquet and point. The organoleptic characteristics of the Darjeeling tea brew are commonly referred to as mellow, smooth, round, delicate, mature, sweet, lively, dry and brisk.

Assam Orthodox Tea

Assam means 'one without equal' and that is really true about its teas. They say 'you haven't woken up fully if you haven't sipped Assam tea'. It is grown at an elevation ranging from 45 to 60 metres above sea level and an annual rainfall of 250 to 380cm. The strong tea, grown on the rolling plains by the Brahmaputra River that weaves her way through vales and hills, is famous for its smooth malty flavour. Assam Tea has a rich, deep-amber colour and is famous for its rich, full-bodied cup. It is known for its brisk, strong and malty character, making it a perfect tea to wake up to.

Kangra Tea

The Himachal's Kangra, the 'Valley of Gods', nothing less than the majestic Dhauladhar mountain range could have served as a backdrop. The climate (900 to 1400 MSL and annual Rainfall of 270 to 350cm), the characteristic terrain and soil conditions, and the coolness of the snow clad mountains play a role in crafting a delightfully distinct cup of quality tea. Particularly the first flush with an aroma and flavour that has an unmistakable tinge of fruitiness. Being one of India's smallest tea regions makes Kangra green and black tea all the more exclusive. While the black tea has a sweet lingering after taste, the green tea has a delicate woody aroma. A little milder than Darjeeling tea in terms of flavour, Kangra tea has more body and liquor

Wayanad Robusta Coffee

"Coffee based farming system is a notable feature of Wayanad**(**600-900MSL/1100mm rainfall). Coffee is grown both as pure crop and as mixed crop along with pepper. Wayanad produces almost around 90% of the state's Coffee produce **. -**Wayanad in northern Kerala is the largest Robusta producing region in India with medium-altitude, gently sloping hills with fertile laterite soil. Wayanad coffees are prepared from the washed Arabicas of Chikmagalur, Coorg, Biligiris, Bababudangiris, and Shevaroys. The coffee beans are broad, bluish-green in color, and have a clean, polished appearance. The CXR and S.274 Robusta varieties from Wayanad are famous for their soft to neutral essence, full-body, and intense aroma with hints of chocolate.

Chikmagalur Arabica Coffee and Bababudangiris Arabica Coffee both are grown in Chikmagalur district, Karnataka which is also known as the birthplace of coffee

in the country. “Higher elevation of 1000-1500msl and 1750-2200mm annual rainfall is predominantly Arabica growing track and known for its unique flavour and aroma. Selectively handpicked and processes by natural fermentation, the cup exhibits full body, acidity, mild flavour and striking aroma with a note of chocolate.S-795 is the most prominent coffee grown at Baba Budangiri which is natural descendant of two of the oldest African cultivars of coffee –*Coffea arabica* and *Coffea liberica*.. This coffee is also called high grown coffee which slowly ripens in the mild climate and thereby the bean acquires a special taste and aroma.

Coorg Arabica Coffee

It is grown specifically in the region of Kodagu district in Karnataka an elevation of 750-1100msl and 1000-2500mm annual rainfall. The varieties such as S-795, Sln6, Sln9 and Cauvery are grown here. Coffee cultivation is an integral part of the lives of the people of Kodagu district and forms the backbone of the economy of the district till today. The district has a unique biotic and abiotic conditions which provides uniqueness to the Coffee grown in it. The terrain provided for coffee by the broader landscape provides it a unique aroma and flavour notes to the coffee when roasted.

Sirsi Supari

The latest entrant in the list of agricultural produce, with a GI (geographical indication) tag, ‘Uttara Kannada district of the Karnataka is known for the Areca Nut plantation.Sirsi town which is known asthe biggest Areca Nut market in the country. Sirsi Supari’ is unique in taste from arecanuts grown in other parts of the country due to the differences in the chemical composition of different arecanuts. Medium in size, somewhat flat and rounded in shape, somewhat ash coloured, and has a hard seed. The arecanut grown in these taluks have unique features like a round and flattened coin shape, particular texture, size, cross-sectional views, taste, etc. Its average dry weight is 7.5 g and average thickness is 16 mm. and total average flavonoids content in it is around 90 whereas in others it is around 80. The total carbohydrates content ranges between 23% to 26%, total arecoline is 0.11% to 0.13%, total tannin content is 14.5% to 17.5%. Sirsi Supari’ is suited for both white and red varieties; around 65 per cent of the production is white arecanut

Monsooned Malabar, and Manssoned Arabica Coffee

It is also known as Monsoon Malabar, is a process applied to coffee beans. The harvested coffee seeds are exposed to the monsoon rain and winds for a period of about three to four months, causing the beans to swell and lose the original acidity, resulting in a flavor profile with a practically neutral pH balance. The coffee is unique to the Malabar Coast of Karnataka, Kerala and the Nilgri mountains of Tamil Nadu and has protected status under India's Geographical Indications of Goods Act. The brew is heavy bodied, pungent, and considered to be dry with a musty, chocolatey aroma and notes of spice and nuts. Different varietals of the coffee bean may be processed in this way, hence monsoon Malabar arabica and monsoon Malabar robusta. The whole crops of cherry coffee are selected and sun-dried in expansive barbecues. The dried beans are cured and sorted into 'AA' and 'A' grades, after which they are stored in warehouses until the onset of monsoon. From June through September, the selected beans are exposed to moisture-laden monsoon winds in well-ventilated warehouses (12 to 16 weeks time). The monsooning process involves careful handling, repeated spreading, raking and turning around in regular intervals. The beans absorb moisture and get significantly larger, turning a pale golden colour. Further micro-sorting is done to separate fully monsooned beans.

Araku Valley Arabica Coffee, grown at an elevation of 900-1100 Mt MSL around Visakhapatnam district in Andhra Pradesh and Koraput district in Odisha.The coffee produce of Araku, by the tribals, follows an organic approach in which they emphasis management practices involving substantial use of organic manures, green manuring and organicpest management practices. It is famousfor its rich blend of good taste and invigorating aroma as well as purity is light to medium in strength, has a pleasant acidity with a citrus note of grape fruit and a mild jaggery-like sweetness.

Nilgiri Orthodox Tea

The beautiful Nilgiri Hills, sprawling through the states of Tamil Nadu, Karnataka and Kerala, are home to the pastoral Toda tribe and tea gardens that create the fragrant cup of tea**(**1000 to 2500mMSL and 150 to 230cm rainfall). Nilgiri tea has a slightly fruity, minty flavour, probably because trees like the Blue Gum and Eucalyptus dot the region and perhaps the spices produced in close proximity to the tea gardens lend the light brew its briskness. The balanced blend of flavour and body makes Nilgiri tea a 'blender's dream'. The Nilgiri Hills aka the 'Blue Mountains' come under the influence of both south-west and north-east monsoons; a reason why the tea leaves grown here are plucked around the year. A deliciously fragrant and exquisitely aromatic tea, with high tones of delicate floral notes and a golden yellow liquor. Crisply brisk and bright. Lingering notes of dusk flowers with an undercurrent of briskness. Creamy mouth feel. A truly flavored tea for a stressful day.

Eathomozhy Tall Coconut

A natural selection from the West coast Tall normally found in Kerala and Tamilnadu. The traditional knowledge and wisdom of the farmers cultivating this Coconut type helps for the high yield and its preservation. It is known for its sturdy stem, large crown, fairly big sized nuts, with good fiber in the thick shell, kernel and high copra and oil contents. The tree grows toa height of 30metre and lives for a period over 80 to 100 years, The crown with 36-40 leaves, bearing 13-15large inflorescences and bunches, and having nuts in various stages of development, provides a panoramic view. The nuts are roundor oblong and dark or light green in colour. They mature in 1'l-12 months. Thekernel in nuts measures 1 .25 - 1.50 cm in thickness.

Vengurla Cashew

In Vengurla, due to fantastic atmosphere, soil and climate for cashew crop, provides a unique taste to the cashew. The size of Kernel increases from varieties V1 to V7 and is longest in V7. Color: Creamish white. The Kernel weight of V1 variety is 1.39gm which increases to 2.9gm in variety V7. Taste: Sweet cashew apple has high Vitamin C content and is five times more than that of an orange Absence of wrinkles gives a catchy appearance. 86 percent juice content bioactive compounds *viz.* high-quality vegetable protein, fiber, minerals, tocopherols, phytosterols, andphenolic compounds.

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