

Daisy: A high-yielding and early maturing mandarin for Thar desert

Daisy is an interspecific hybrid cultivar of mandarin and is known for its high yield, attractive dark orange fruit peel colour, and tasty juice. Its plant growth is medium in size with a drooping canopy and leaves (thick, larger, and slightly folding nature). These distinctive morphological characteristics make it well suited for high-density planting and water-deficit conditions. It produces medium-large sized, juicy, sweet, less-seeded fruits exhibiting dark orange, thin and glossy peel along with unique flavour. The better yield, attractive, sweet and juicy fruits mature in lean period (a gap between sweet orange and kinnow mandarin supply in market). It gives early quality marketable harvest in November month in the arid region may increase farm income, and farmers can adapt an alternative source in place of Kinnow mandarin, which is suffering from a market glut with a lower fruit price in current scenario.

INDIAN citriculture is unique for its different taste, colour, flavour, size, and year-round fresh fruit availability in the market as it has rich diversity. Nutritionally, citrus fruits are enriched with high content of vitamin C (ascorbic acid), carotenoids, alkaloids, flavonoids, essential oils, dietary fibre, and nutrients, particularly potassium and calcium. These compounds possess anti-ascorbic, anti-cancer, anti-lipoperoxidant, anti-microbial, hydroxyl radical scavenging, and cosmetic properties. Among the citrus fruits, the mandarins are dominating over the sweet orange, lime, lemon, grapefruit, and other citrus species in India due to their diverse and stable agro-climatic adaptability as well as commercial importance, such as Kinnow, Nagpur Santra, Khasi and Coorg mandarins.

India contributes 11.41% of world citrus production, with an annual production of 15.73 MT and annual growth rate of 1.42% and 1.83% in area and production, respectively. Citrus productivity remains unchanged due to poor orchard management and

climatic factors (heat waves during flowering and fruit setting). Additionally, growers are also facing unprofitable prices due to market glut, particularly Kinnow's, because its ripening index is highly positive responsive to cool temperature and fruit mature at the same time in arid region. Thus, ICAR-CIAH has taken initiative to start work

on germplasm augmentation cum improvement. For this, new cultivars of mandarins like Fremont, Daisy, Michal, Murcott, Nagpur seedless, Fairchild, Pear Tengel, PAU Kinnow -1 etc. and their interspecific hybrids were collected and established during 2015. Among them, Daisy mandarin has been found the most promising cultivar based on fruit yield, colour, juice, and storage qualities as revealed from one decade of research on citrus crop under arid environment.

Daisy mandarin's striking characteristics

It is an interspecific hybrid of Fortune Clementine and Fremont mandarin developed by Dowlin Young at US Department of Agriculture,



Attractive deep saffron orange peel colour and less seeded fruits

California, USA in 1995. It is medium in plant growth habit, dome and compact canopy with thornless branches. Leaves are thick, larger (LAI- 23-26 cm²), unifoliolate with an unwinged petiole, and curving in nature as compared to other mandarins like Kinnow and Nagpur Santra, which indicates a water stress tolerance mechanism. It is highly tended to precocious in bearing habit and able to produce commercial production after five to six years plantation. Blossom period is from mid February to mid March and takes 250-275 days for fruit ripening. It bears fruits on both the inner and outer sides of the canopy and is highly attractive due to its deep saffron/orange peel colour. Fruits are medium to large in size (diameter-7-8.5 cm and weight-190-246 g), oblate in shape with a thin peel thickness (2.05-3.16 mm). Fruit has 11-13 easily separable segments and easy peeling along with albedo, which is tightly attached to flavedo. Daisy mandarin is less seedy with 6–12 seeds per fruit. Fruits are juicy (41-47%) and sweet in nature. Its juice has a high TSS (11.58-13.44°Brix), ascorbic acid (81.28-87.68 mg/100 ml fresh juice), ripening index (44.8:1 to 57.9:1), and pH (3.58-4.01) with low acidity (0.2-0.3%). Juice has a unique flavour and highly acceptable among consumers due to its high ripening index. It is highly productive, with an average fruit yield more than 110-140 kg per plant from 7 years old plants under arid environment. In addition, excellent fruit keeping quality was also observed up to 10-15 days at room temperature (13-15°C) during the winter months.

Production technology

Soil and climate

It is highly suitable for cultivation in sandy or sandy loam soil with well drainage facilities and no hard pan at least 1-1.5 m deep in the soil profile to escape phytophthora infestation. Citrus is highly sensitive to high pH (>7.5) and EC (1.0 ds/m); hence, it should be planted only where canal, rain or good quality tube-well water facilities are available. It survives a wide range of ecological conditions, from arid and semi-arid to tropical regions, but extremely high temperatures (>48°C) cause fruit sun-burning and scald when humidity is less than 30% during the May - June months.

Layout and planting

The field should be leveled first, pit marked at 5×5m/4×4m distance, or according to rootstocks, and dug out to 1×1×1m size during the first week of May. The dug pits should be kept open for one month during the hot summer for the killing of spores and eggs of fungi and pests. Further, fill the pit with well-decomposed FYM @10 kg and neem/tumba cake @ 500-1000g per pit, and apply 3-4 times trichoderma and multi consortium of beneficial microbes at weekly interval through drenching or drip irrigation before planting.

Rootstocks selection

Daisy mandarin was evaluated on six rootstocks, namely Sour orange, Troyer citrange, Karna Khatta,

Daisy: A high-yielding...



Fruiting load on 7 years old plant

Pectinifera, and Volkamericana in comparison to the existing commercial Rough lemon rootstocks. Out of these, Pectinifera rootstock was found best for high density (54 m and 44 m), fruit quality with longer shelf-life, and tolerance to canker and sunscald.

Plant propagation

It can be multiplied through chip bud-grafting during March and July-August. Therefore, Rough lemon and Pectinifera rootstocks should be 8–10 months and 1.5 years old, respectively, with 20–25 cm height and 6-8 mm diameter seedlings. In this bud-grafting, remove the bark along with a slight wood of the scion and stock, then pasting the bud and tie the grafting area completely with transparent polythene. Wrapped polythene should be kept for 20 days for proper healing. Thereafter, the wrapped polythene is removed, and the rootstock seedling should be heading back above 4-5 cm from the grafting operation after successful healing and sprouting of the scion.

Planting

Under arid climate, the best time for planting is August to mid-September when moderate humidity is present. Otherwise, newly planted saplings may die due to high heat waves. The bud union portion should be kept 15-20 cm above the ground level. Therefore, pit filling material should be once moisturized before planting, and it will also help in the proper standing of the grafted plant in sandy or sandy loam soil.

Irrigation management

Daisy mandarin requires frequent irrigation water for the proper growth and development of plants. Hence, it should be applied through drip irrigation (two drippers per plant and dripper capacity 8 liters per hour) @ one hour weekly, twice a week during the winter and summer seasons, respectively, and as when as requirement by plants during the rainy season until two years old plantation. When the orchard age is increased simultaneously, the water requirement also increases to 50–60 liters per day for a fully grown and fruiting plant during the summer.



Maturity stage of fruit and freshly harvested Daisy mandarin

Nutrient management

Manure and fertilizers should be applied twice a year, as a basal dose (mid-December to mid-January) and a split dose (mid-July to August). Entire sheep manure @ 40–45 kg, phosphorus @ 500 g and micronutrients (Fe, Zn, Bo, Cu, Mn and Mo) @ 100-150g per tree should be applied as basal doses after training and pruning during January in full-grown trees. Nitrogen, phosphorus and potassium fertilizers should be applied at the rates of N-800 g, P-500 g, and K-500 g per tree, respectively, in two split parts as before flowering (February) and during fruit growth period (July-August). In addition, micronutrients should be applied after fruit setting and fruit growth period or whenever any micronutrients deficiency symptom is observed on plant.

Training and pruning

Training is an essential operation for developing desired canopy shape, and it is better to train trees in bushy dome shapes during July–August and December–January in the initial 3-4 years. Further, light pruning is only suggested for water sprouts, root suckers, dead or infected branches, and undesired hanging or crotched shoots because excessive pruning may lead to orchard decline. Copper-based fungicides (COC/Blue copper/Bordeaux mixture) @ 10% for pasting and 1% for spraying must be required after pruning to avoid any fungal infestations.

Flowering and fruit setting

Flowering starts from the third week of February and continue till mid-March. Fruiting should be retained on a third-year-old plantation because three-year-old plants are able to produce 25–40 kg fruit. It is suggested to the farmers to avoid irrigation during initial flowering and fruit setting period, and thereafter, irrigation water should be given in minimum quantity just for maintaining moisture in the initial 15 days after fruit setting, and later on, keep a frequent irrigation schedule as per plant requirements based on age and season.

Harvesting and yield

Fruits are ready to harvest when they develop deep saffron orange peel colour in November (250–275 days after fruit set). Individual fruit should be harvested along with one leaf, washed, and graded for better pricing in

the market. The plant produces 110–140 kg of fruit per plant from the 7th year old plantation.

Plant protection

Sunscald – It was observed when the outer and southern parts of the canopy exposed fruits to direct heat in the months of September and October. Therefore, it can be easily managed by proper training and pruning, regular irrigation, and the spraying of micronutrients @ 3-4 ml per liter.

Granulation – It is a physiological disorder that deteriorates fruit organoleptic quality. It is characterized by an enlarged hard, dry juice sac, off-flavours, and greyish fruit peel colour, leading to loss of edible and marketable value. It occurs due to water shortage, excess nitrogen, and unseasonable warm or persistent cold weather during fruit maturity and over-maturity. Orchardists keep proper and efficient irrigation and nutrients management, early fruit harvesting at proper maturity, and spraying of ZnSO_4 + CuSO_4 @ 0.5%.

Fruit sucking moth – Adult moth pierced by strong barbed proboscis into fruits and suck juice during late evening-night hours during the August. Infested fruits turn to yellow and drop premature after 5-8 days of infestation, and bacterial and fungal infestation has started at the site of attack (pin-hole). Therefore, light traps should be used as indicator tool, smoking and firing wood at 7.00-9.00 PM to attract insect as cultural management. Collect and disposed fallen fruit, and spray with Imidacloprid 17.8% SL @ 0.5 ml or Dimethoate 30% EC @1.0 ml per liter to avoid crop loss during evening time.

Lemon butterfly – Larvae are damaging stage and causes severe loss during nursery stage or in young orchard. Larvae appear like birds dropping in early instars and turns green in colour when start feeding on leaves. Larvae eat edge to mid rid of leaves, and mid-rib is only left during severity, because of which leaf looks defoliated and stunted. It can be managed by use of systemic insecticides like Imidacloprid 17.8% SL, Chlorantraniliprole 18.5% SL and Dimethoate 30% EC etc at their recommended dose when plants sprout new flush during February-March, July-August and October month.

Black fly – Both nymph and adult suck sap from tender twigs and leaves during March-April, July–October, when plants sprout new vegetative flushes. Leaves become curled, yellow, and shed at the severity. In addition, black flies give blackish appearance and grow sooty mould due to honeydew, and it is severely reduced the photosynthesis apparatus and fruit yield by premature dropping. Therefore, keep proper drainage and weeding, timely removing of water sprouts or root suckers, avoid excess pruning, optimum use of nitrogen fertilizers, and keep away from host crops like cotton, pomegranate, and guava. It can also be controlled chemically by spraying Fosmit 50 EC @ 2.0 ml or Imidacloprid 17.8% SL @ 0.7 ml or Triazophos 40 EC @ 1.25 ml per liter water during March-April, July-August and September-October; Ridomil Gold SL @ 2 g or Fosetyl Al 80% WP @ 2.0 g per liter especially for sooty mould control.

Bacterial canker – It is a bacterial disease and significantly reduces the fruit market value due to the ugly skin appearance of affected fruits and may lead to fruit cracking. It is typically characterized as an initial tiny, circular, water-soaked yellowish ring surrounding spots. It is gradually enlarged and gives rough, corky, and brownish appearances on leaves, twigs, thorns, and fruits. These necrotic lesions coalesce in advance and lead to leaf and fruit drop, fruit cracking, and die-back. For canker management, farmers should procure disease-

free planting material, avoid high-density planting, keep weed-free orchard, remove infected twigs, shoots, and fruit and dispose off them, and cut end pasting with 10% Bordeaux paste. During March-April and July-August, two sprays of Bronopol @ 0.5 g or Tagmycin @ 0.5 + copper oxychloride 50 WP @ 3 g were applied per liter of water at weekly intervals. In addition, leaf minor infection must be examined because it is the vector of citrus canker, and black fly control measured should be implemented for leaf minor management.

SUMMARY

‘Daisy’ mandarin is a promising interspecific cultivar for enhancing farmer’s income in Thar desert. It is highly suitable for high-density planting, high yielding, less seeded and high juice quality fruits. Fruit maturity is two months advanced in comparison to ‘Kinnow’ mandarin which extend fresh fruit availability in market. Its glossy and deep saffron orange peel-coloured fruits, appealing shape, distinct flavour, and a longer post-harvest shelf-life may fetch high price in the market during November and help in increasing farm income.

For further interaction, please write to:

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SUSTAINABLE DEVELOPMENT GOALS RELATED TO FRUITS AND VEGETABLES



SDGs 2 3

Health benefits of fruit and vegetables
Harness the goodness

Fruit and vegetables have multiple health benefits. They strengthen the immune system, combat malnutrition and help prevent non-communicable diseases.



SDGs 2 3

Diversified diet and a healthy lifestyle
Live by it, a diverse diet

Adequate amounts of fruit and vegetables should be consumed daily as part of a diversified and healthy diet.



SDGs 2 3

Food loss and waste
Respect food from farm to table

Fruit and vegetables are worth more than their price. Maintaining their quality and assuring their safety across the supply chain, from production to consumption, reduces losses and waste and increases their availability for consumption.



SDGs 2 3

Innovate, cultivate, reduce food loss and waste

Innovation, improved technologies and infrastructure are critical to increase the



SDGs 2 8 12 13 14 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Sustainable value chains
Foster sustainability

Sustainable and inclusive value chains can help increase production, and help to enhance the availability, safety, affordability and equitable access to fruit and vegetables to foster economic, social, and environmental sustainability.



SDGs 1 2 3 4 5 8 11 12 15

efficiency and productivity within fruit and vegetable supply chains to reduce loss and waste.



SDGs 1 2 3 4 5 8 11 12 15

Source: Fruit and vegetables – your dietary essentials, FAO background paper, FAO, Rome







