A Handbook on Variety Description and Production Technology of

MANGO

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CONTENTS

PREFACE

Pakistan has been blessed with a wonderful blend of agro-climatic conditions suitable for growing all types of tropical, sub-tropical and temperate crops and fruit trees. The major fruit crops grown in different climatic zones in Pakistan include mango, citrus fruits, banana, date palm, apple, pear, apricot, almond, cherry, grapes and many others. The fruit trees whether tropical, sub-tropical or temperate are very important economic and crash crops for the farming community. At the same time the fruits are excellent source of all the essential components which help supplement and improve the quality of the human diet. In addition to the dietary nutritional value, many of the fruit species have multi-purpose uses, as they also produce non-food products such as fuel, timber, feed and fodder for livestock, medicinal components and many industrial products.

More so the cultivation of fruit crops involves high investment in various phases of production, harvesting, handling, processing, packaging, transportation and marketing thereby providing livelihood to millions of growers, traders, labor and fruit vendors. These activities bring about accelerated economic activity in the agriculture sector which helps alleviate poverty particularly in the rural sector.

Fruiticulture plays a very significant role in crop diversification of farming and agroforestry systems. Their inclusion in farming system reduces the risks against field crop failures. Generally it is said that the farmer's income from fruit orchards is much higher than that from traditional field crop production. However, in Pakistan the potential of tropical, sub-tropical and temperate fruits has not yet been fully realized.

There are a number of reasons for under-achieving of the genetic potentials of fruit trees; the outstanding ones are non-availability of healthy and true performing nursery trees and absence of regulatory and quality control measures. This requires establishing variety descriptions so as to identify them in the nurseries and the fields.

The purpose of this manual is to provide information on those characteristics which are basic and necessary to identify the fruit nursery trees in the nurseries and the fields so as to enable application of regulatory and quality control measures, and on those characteristics, which are necessary for raising orchards to maximize yields of best quality, uniform and healthy fruits.

The need was felt since long that the biologically diversified fruit wealth introduced in this part of the world recently or being cultivated since centuries must be described and documented properly. It is appreciated that the Federal

Seed Certification and Registration Department has accomplished this highly needed task by producing fruit a Handbook on mango which is the most important economic fruit crop of the country.

The Handbook is quite comprehensive as it covers descriptive information along with morphological and phenological characteristics of commercial varieties. It includes the information about the origin of the variety, maintaining centre and research organizations and leading horticultural characteristics. It is expected that with this basic information at hand, the production system will soon be streamlined to produce and provide sufficient quantities of quality fruit nursery trees to the farming community.

The manual will further help disseminate very useful information on technical, quality control and production aspects to teachers, students, extension workers, policy makers, fruit tree growers, traders and exporters.

INTRODUCTION

The mango commonly known as the *king of fruits* is the most popular and relished fruit particularly in the sub-continent Indo-Pakistan. Indisputably a well ripened mango when beautifully packed and well presented is irresistible so the famous Urdu poet Mirza Asad Ullah Khan Ghalib loved mangoes and desired the mangoes should be richly sweet flavored and in abundance.

The mangoes are grown on largest area in Pakistan second only to citrus fruits. It covers about 157,000 ha with a total production of 1754,000 tons making Pakistan the 4th largest mango producing country in the world. The three leading mango producing countries according to the FAO (FAOSTAT 2005) are India (10,800,000 tons); China (3,673,000 tons) and Thailand (1,800,000). Some other countries closely following Pakistan are Mexico (1,503,000 tons), Indonesia (1,478,000 tons) and Philippines (950,000 tons). However the mango grows well under a great variety of hot, humid and temperate climatic conditions in over 100 countries of the world.

The designation of mango covers a number of large groups of very versatile and exclusive varieties. There are very early to medium and very late maturing varieties; acid sour to richly flavored very sweet varieties; simple plain to highly refreshing aromatic varieties, dull colored to attractive bright colored varieties depicting light green to parrot green, light yellow to medium and deep yellow, speckled red to bright crimson. Within the broad outline of the fruit there exists a wide range of shapes like almost round to semi round, cylindrical to slightly flattish, medium oblong to oblong, medium long to long, along with a very short to medium and long neck, shallow to deep dimple, narrow to medium and broad shoulders, skin giving rough leathery to silky feel. Similarly the consumption modes and manners depicts vary wide range. Consumption starts from very early immature dropping to mature and ripened fruits.

On varietal level the list of mango varieties according to some reports is stated very long however the list of varieties in commerce production is not very long. The concentration of different varieties mainly occur in Punjab and Sindh but the number of mango varieties found in Sindh areas exhibits wider range as compared to Punjab.

The importance of mango as a profit-making cash crop for the farmers needs no emphasis. Thousands of orchard growers, fruit dealers, middle men and retail traders earn their livelihood through production, harvesting, transport, grading, curing, processing, retailing and finally consumption of this fruit. It is an important commercial and food crop grown in almost all provinces of Pakistan.

The total area under mango orchards in Pakistan is 157,000 hectares. Out of which 67% of the area falls in Punjab; 32% in Sindh; 0.8% in Balochistan and only 0.2% in NWFP. The major mango producing areas include Khanewal, Multan, Bahawalpur, Rahim Yar Khan, Dera Ismael Khan, Sukkur, Hyderabad and Mirpur Khas.

The king of fruits despite of its exceptional importance is prone to many disorders and serious troubles like alternate bearing, mango malformation, quick decline and die-back. Along with these troubles there are many serious diseases and insect pests attacking mangoes. The major reason for wide spread of the diseases is the non-availability of disease free healthy nursery trees from the fruit nurseries. It is very difficult to get true-to-type, disease free healthy nursery trees in the market.

The Project for Horticultural Promotion (PHP), and Department of Agricultural Research, NWFP has established a Germplasm unit (GPU) at Rakhazandani, D I Khan for tropical fruit crops including mango varieties. The GPU has been represented with genuine and true to type mango trees of almost all the commercial varieties produces in Pakistan. The principal objective of the establishment of the GPU is to provide true breeding nursery trees and propagating materials to the nurseries and mango growers.

To provide the basis for genuine and healthy propagation, breeding and evaluation the Federal Seed Certification Department in collaboration with the PHP and the research and extension organizations has developed morphological descriptions of all the mango varieties commercially grown in the country. The present publication **"A Handbook on Variety Description and Production of Mango"** focuses attention on this diversity of the mango in Pakistan, main areas of production including tree and fruit characteristics.

The efforts of the FSC&RD, the PHP, NWFP and the mango research workers are highly appreciated. It is expected that this publication will help provide guidelines and basis for maintenance of mother stocks and augmenting availability of true breeding nursery trees.

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SUMMARY

Variety	Origin	Leaf color	Flush color	Inflo color	Fruit size	Lent icels	Ripe fruit color	Flesh color
Almas	LS	LG	Pin	LP	M	M	PaY	LY
Alphonso	LS	G	Dpin	LG	M	M	GoY	GoY
Anmol	LS	G	Pin	LG	Mla	M	Y	Y
Anwar retaul	LS	G	Pin	LP	M	M	PaY	RY
Baganpali	LS	LG	Pin	DP	La	M	YGB	W
Baramasi	LS	G	Pin	LG	M	M	Y	Y
Budhia MS	LS	BG	Pin	BP	MLa	Hi	Y	Y
Burma surkha	LS	LG	Pin	P	M	M	YB	Y
Chaunsa kala (SSI)	LS	G	Lpin	LG	M	Hi	YG	LY
Chaunsa late (SSIII)	LS	DG	Lpin	LG	Mla	M	LY	W
Chaunsa rampuri	LS	LG	Lpin	LG	Mla	M	Y	W
Chaunsa SB	LS	DG	Lpin	LP	Mla	M	LY	PaY
Collector	Intr	DG	Lpin	P	Mla	M	BLG	LY
Dosehri	LS	MG	Lyg	LG	SM	M	Y	LY
Early gold	Intr	LG	Lpin	LP	Mla	M	GoB	LY
Fajri	LS	LG	Lyg	LP	Mla	M	LY	PaY
Gulabe khas	LS	G	Lpin	LP	M	Hi	YB	LY
Haden	Intr	MG	Mpin	P	Mla	M	RB	LY
Jagirdar	LS	G	Mpin	P	M	M	LY	Y
Keitt	Intr	LG	Lpin	R	MLa	M	YB	OY
Kensington	Intr	LG	Lpin	LP	Mla	M	GYB	OY
Langra	LS	LG	Lpin	P	M	M	GY	LY
Malda	LS	G	Lpin	LP	M	Hi	GY	LY
Malda late (SSII)	LS	G	Mpin	P	SM	M	GYY	LY
Maya	Intr	G	Lpin	R	MLa	M	GYB	PaY
Momi k	Intr	LG	Lpin	LP	MLa	M	LYB	PaY
Neelum	LS	LG	Lpin	R	M	M	YB	W
Pope	Intr	G	Lpin	P	MLa	M	YB	LY

Variety	Origin	Leaf color	Flush color	Inflo color	Fruit size	Lent icels	Ripe fruit color	Flesh color
Retaul late (R 12)	LS	DG	Lpin	LG	M	M	LY	RY
Salehbhai	LS	LG	Pin	P	M	M	PaYB	LY
Sanaglakhi	LS	LG	Pin	P	M	Less	LY	
Saroli	LS	LG	Dpin	P	MLa	M	LY	YO
Saroli early	LS	LG	Dpin	LG	M	Hi	LYG	MY
Saroli late	LS	DG	Dpin	LG	MLa	Hi	YG	MY
Sensation	Intr	G,	Lpin	R	M	M	YB	LY
Sindhri	LS	G	Mpin	LG	MLa	M	LY	PaY
Sobhedi t	LS	G	Mpin	LG	M	M	LY	PaY
Springfels	Intr	G	Mpin	P	M	M	LYB	LY
Swarnarika	LS	LG	Mpin	G	MLa	M	YGB	PaY
Taimuriya	LS	G	Mpin	P	M	M	LY	PaY
Tommy atkins	Intr	LG	Lpin	R	M	M	YB	LY
Totapri	LS	G	Mpin	P	MLa	M	LGY B	LY
Yakta	LS	lushG	Lpin	LP	MLa	M	GoY	Y
Zafran	LS	G	Mpin	R	M	M	LY	Y
Zardalu	LS	LG	Mpin	R	M	M	YGB	LY
Zill	Intr	LG	Mpin	P	M	M	YB	PaY

Note

B	Red blushed	Dpin	Dark pink
G	Green	Go	Golden
GoY	Golden yellow	Goy	Golden yellow
Iflo	Inflorescence	L	Light
Int	Introduction	LGB	Light green with red blush
LG	Light green	LS	Local selection
Lpin	Light pink	M	Medium
LY	Light yellow	Pin	Pink
MLa	Medium large	RY	Reddish yellow
R	Red	YO	yellowish orange
YG	Yellowish green		

MANGO VARIETIES

ALMAS

Origin and Adaptation: Almas a local selection, a chance seedling from Chaunsa plantation, midseason, medium grown mango.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall, medium vigorous, medium branched, semi spreading, tendency for alternate bearing low.

Leaf: Foliage medium dense, color light green, leaf shape elliptical, midrib curvature medium, twisting weak, undulation very weak, medium concave, length 20-25, width 12-15, petiole 2-3 cm, tip acute, base acuminate, fragrance medium, new flush pink.

Inflorescence: Medium to long, medium branched, compact, stalk light pink, flower off-white.

Mature Fruit: Bluish green, size medium, ovate, neck absent, stalk cavity absent, base flattened, right shoulder broader and higher than left, left shoulder groove medium, apex rounded, beak weak, sinus medium, fruit length 10-12, breadth 7-9, thickness 5-8 cm, weight 200-350g, skin smooth, bloom weak to medium, lenticels density weak, size medium, conspicuous, whitish.

Ripe Fruit: Skin pale yellow, medium thick, leathery, adherence medium, flesh light yellow, texture medium fine, medium firm, medium juicy, fibers rare, fine, flavor good, sweet, TSS 25-27%, acidity 0.15-0.2%.

Stone and Seed: Stone medium, oblong, medium ridged, fibers sparse, long on ventral edge, length 7-9, width 4-5, thickness 2-3 cm, seed size medium, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Almas: Tree medium tall, moderately vigorous, tendency for alternate bearing low, new flush pink, leaf folding medium, fruit medium big, smaller than Fajri, ovate to oblong, color bluish green at maturity, yellow at ripening, right shoulder broader and higher than left, sinus medium, skin medium thick, lenticels density weak, conspicuous, flesh light yellow, medium juicy, fibers rare, flavor rich, sweet, pleasant, aromatic.

ALPHONSO

Origin and Adaptation: Alphonso a local selection, a chance seedling, midseason, grown on small scale.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Tall growing, medium vigorous, medium branched, semi spreading, tendency for alternate bearing low, medium bearer.

Leaf: Foliage medium dense, medium green, leaf elliptical, midrib curvature weak, twisting weak, undulation medium, medium concave, length 18-22, width 4-5, petiole 4-5 cm, tip acute, base acuminate, upper surface smooth, fragrance strong, new flush dark pink.

Inflorescence: Short to medium long, less branched, color greenish white, flower greenish white.

Mature Fruit: Light green, size medium, ovate to cordate, neck absent, stalk cavity absent, base broad, obliquely flattened, apex rounded, right shoulder broader and higher than left, left shoulder groove weak, beak absent, sinus shallow, fruit length 8-11, breadth 5-7, thickness 5-7 cm, weight 200-350g, skin smooth, bloom weak, lenticels density medium, size small, less conspicuous, whitish.

Ripe Fruit: Color brownish yellow mixed with golden glow, skin medium thick, leathery, adherence medium, flesh golden yellow, texture medium fine, medium firm, medium juicy, fibers rare, fine, flavor good, acid sweet, TSS 21-23%, acidity 0.17-0.18%.

Stone and Seed: Medium, oblong, medium ridged, fibers long, sparse on ventral edge, length 6-9, width 3-4, thickness 2-3 cm, seed size medium, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Alphonso: Tree tall growing, medium branched, semi spreading, foliage medium green, 1-2 fruits per peduncle, size medium large, shape ovate to cordate, color light green at maturity, brownish yellow with golden glow at ripening, sinus shallow, beak absent, lenticels density medium, size small, less conspicuous, flesh color golden yellow, medium juicy, flavor good, acid sweet, more suited for processing industry.

ANMOL

Origin and Adaptation: Anmol a local selection, a chance seedling, late season, medium scale commercial mango.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium to tall growing, medium vigorous, medium branched, semi spreading, regular bearer.

Leaf: Foliage medium dense, medium green, leaf elliptical, midrib curvature medium, twisting weak, undulation medium, medium concave, length 32-35, width 5-8, petiole 2-3 cm, tip acute, base narrow, upper surface smooth, fragrance medium, new flush pink.

Inflorescence: Medium to long, medium branched, medium compact, stalk color light greenish white, flowers light green.

Mature Fruit: Light green, size medium to large, ovate to oval, neck absent, stalk bold, cavity absent, base flattened, apex rounded, right and left shoulders rounded, left shoulder elevated, groove absent, beak absent, sinus medium, fruit length 9-11, breadth 6-8, thickness 7-8 cm, weight 250-400g, skin slightly rough, bloom weak, lenticels density medium, size small, medium conspicuous, whitish.

Ripe Fruit: Yellow, skin medium thick, leathery, adherence medium, flesh yellow, texture medium fine, medium firm, low juicy, fibers rare, fine, flavor good, very sweet, TSS 26-28%, acidity 0.17-0.19%.

Stone and Seed: Medium small, oblong, medium ridged, fibers few, medium long, sparse on ventral edge, length 5-8, width 2-4, thickness 2-3 cm,, seed medium, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Anmol: Tree medium tall growing, late maturing, semi spreading mango, alternate bearing tendency absent, foliage medium green, fruit size medium large, shape ovate to oval, color light green at maturity, yellow at ripening, sinus medium, lenticels size small, density medium, medium conspicuous, bloom weak, flesh yellow, texture medium fine, juice low, flavor good, very sweet, stone ridged with few short fibers.

ANWAR RETAUL

Origin and Adaptation: Anwar Retaul a local selection, a chance seedling selected by a farmer Shaikh M. Aafaq in the village "Retaul", midseason, popular commercial variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall, vigorous, medium branched, semi erect to spreading, tendency for alternate bearing high.

Leaf: Foliage medium dense, medium green, leaf elliptical, midrib curvature weak, twisting weak, undulation weak, medium concave, length 20-30, width 4-7, petiole 3-6 cm, tip acute, base acuminate, fragrance weak, new flush light pink with midrib dark pink.

Inflorescence: Short to medium long, well branched, compact, stalk light pink, flower medium and light pink.

Mature Fruit: Good looking, green, size medium, ovate, neck absent, stalk cavity medium, base flattened, shoulders rounded right higher than left, beak and sinus weak to absent, apex rounded, fruit length 7-9, breadth 5-7, thickness 6-7 cm, weight 150-350g, skin smooth, bloom weak, lenticels medium dense, size medium, conspicuous, whitish.

Ripe Fruit: Skin pale yellow, medium thick, leathery, adherence medium, flesh reddish yellow, texture fine, medium firm, medium juicy, fibers rare, flavor strong and very pleasant with very sweet and wonderful taste, TSS 26-28%, acidity 0.17-0.18%.

Stone and Seed: Medium to small, medium thin, flattish, medium ridged, short and sparse fibers on ventral edge, length 4-6, width 2-3, thickness 2-3 cm, seed size medium large, mono-embryonic.

Yield: Good bearer.

Leading Characters: Anwar Retaul: Tree medium tall, spreading, less than Sindhri, alternate bearing high, new flush pink with dark pink midrib, fruit medium, ovate, color attractive yellow, lenticels conspicuous, flesh reddish yellow, medium juicy, fibers rare, flavor excellent, exceptionally favored for table purpose and Monsoon mango festivities.

BAGANPALI

Origin and Adaptation: Baganpali a local selection, a chance seedling, mid to late season, medium scale commercial variety of Sindh.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium large, medium vigorous, moderately branched, spreading, tendency for alternate bearing low.

Leaf: Foliage density high, light green, leaf elliptical, midrib curvature medium, twisting medium, undulation medium, medium concave, length 19-21, width 5-7, petiole 2.0 cm, tip acute, base narrow, upper surface smooth, fragrance medium, new flush pink.

Inflorescence: Medium long, medium branched, medium compact, dark pink, flowers light green.

Mature Fruit: Medium green, size large, obliquely oval, neck absent, stalk thin obliquely inserted, cavity slight, base, apex rounded, left shoulder broader, much elevated, right slopping, groove deep, strong, sinus medium, fruit length 12-15, breadth 7-9, thickness 7-9 cm, weight 350-600g, skin slightly rough, bloom medium, shining, lenticels density medium, size small, medium conspicuous, whitish.

Ripe Fruit: Yellowish light green with light crimson patches, skin medium thick, leathery, shining, adherence medium, flesh whitish, texture fine and firm, low juicy, fibers rare, fine, flavor good, very sweet, TSS 18-20%, acidity 0.2-0.4%.

Stone and Seed: Stone size medium, oblong, thin, medium ridged, fibers few, medium long, sparse on ventral edge, length 9-11, width 3-4, thickness 2-3 cm,, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Baganpali: Tree medium tall growing, spreading, alternate bearing tendency low, foliage color light green, fruit size large, obliquely oval, medium green at maturity, yellowish light green with light crimson patches at ripening, bloom shiny, lenticels density medium, size small, conspicuous, sinus medium, flesh whitish, texture fine, juice low, flavor good. Good germplasm for large fruit size.

BARAMASI

Origin and Adaptation: Baramasi a local selection, a chance seedling, all season variety of very low commercial importance.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall, medium vigorous, well branched, semi spreading, upright plant, medium to poor bearer, early season to very late.

Leaf: Foliage dense, medium green, leaf elliptical, midrib curvature medium, twisting weak, undulation medium, medium concave, length 30-33, width 8-10, petiole 3-4 cm, tip acute, base narrow, upper surface smooth, fragrance strong, new flush pink.

Inflorescence: Medium long, medium branched, light greenish white.

Mature Fruit: Light green, size medium, ovate to oval, neck absent, stalk bold, cavity absent, base flattened, apex rounded, right and left shoulders rounded, left shoulder elevated, groove absent, beak absent, sinus very weak, fruit length 9-11, breadth 5-7, thickness 6-7 cm, weight 200-350g, skin smooth, bloom weak, lenticels density medium, size small, medium conspicuous, whitish.

Ripe Fruit: Yellow, skin medium thick, leathery, adherence medium, flesh yellow, texture medium fine, firm, low juicy, fibers medium, flavor medium acid, less sweet, TSS 25-27%, acidity 0.2-0.3%.

Stone and Seed: Stone size medium, thick, oblong, medium ridged, fibers abundant, medium long, dense on ventral edge, length 5-8, width 2-4, thickness 2-4 cm,, seed medium, mono-embryonic.

Yield: Low bearer but can be improved through better management, improved agronomic and nutritional practices.

Leading Characters: Baramasi: As the name indicates it bears fruit all the year round but mostly 2 -3 times a year, tree medium tall, foliage dense, medium green, fruit medium, ovate to oval, light green but yellow at ripening, sinus very weak, lenticels density medium, conspicuous, flesh yellow, texture medium fine, low juicy, less sweet, flavor medium acid, fragrant, stone ridged, fibers medium, liked during off-season only.

BUDHIA MUNA SYED

Origin and Adaptation: Budhia Muna Syed a local selection by Syed Muna Shah, a chance seedling, midseason, small scale variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, moderately vigorous, well branched, semi spreading, upright tree.

Leaf: Foliage medium dense, bluish green, leaf elliptical, midrib curvature medium, twisting very weak, undulation medium, medium convex, length 18-22, width 5-7, petiole 2-3 cm, tip acute, base narrow, upper surface smooth, veins grooved, fragrance strong, new flush pink.

Inflorescence: Short to medium, medium branched, medium compact, color bluish pink, flower light pink.

Mature Fruit: Bluish dark green, size medium, ovate to oval, neck absent, stalk bold, cavity absent, base and apex rounded, right and left shoulders rounded, beak absent, sinus very weak, fruit length 11-14, breadth 7-10, thickness 6-7 cm, weight 200-350g, skin slightly rough, bloom strong, lenticels density medium, size bold, very conspicuous, whitish.

Ripe Fruit: Yellow, skin thick, leathery, adherence low, flesh yellow, texture medium fine, firm, medium juicy, fibers low, flavor very rich, delicious very sweet, TSS 25-27%, acidity 0.18-0.2%.

Stone and Seed: Stone size medium, thin, oblong, medium ridged, fibers few, medium long, sparse on ventral edge, length 6-9, width 2-5, thickness 2-3 cm,, seed medium, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Budhia Muna Syed: As the name suggests a local seedling selection. Tree medium tall, foliage medium dense, bluish green, new flush pink, fruit size medium, ovate to oval, color bluish dark green at maturity, yellow at ripening, sinus very weak, lenticels density medium, size bold and very conspicuous, skin thick, leathery, flesh yellow, texture medium fine, low juicy, sweet, flavor very rich, very sweet, stone medium, thin, ridged, fibers few.

BURMA SURKHA

Origin and Adaptation: Burma Surkha a local selection, a chance seedling, midseason variety of low commercial importance.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, medium vigorous, medium branched, semi spreading, upright tree.

Leaf: Foliage medium dense, light green, leaf elliptical, midrib curvature weak, twisting absent, undulation medium, medium concave, length 20-24, width 6-8, petiole 2-3 cm, tip acute, base narrow, upper surface smooth, veins grooved, fragrance medium, new flush pink.

Inflorescence: Medium long, well branched, medium compact, color pink, flower medium pink.

Mature Fruit: Light green with red blush on basal part, size medium, shape ovate to oval oblong, neck absent, stalk medium, base rounded, apex rounded, shoulders rounded, left shoulder elevated, beak absent, sinus weak, fruit length 9-12, breadth 5-8, thickness 6-7 cm, weight 200-350g, skin smooth, bloom weak, lenticels density medium, size small, less conspicuous, whitish.

Ripe Fruit: Yellow with red blush, skin medium thick, leathery, adherence medium, flesh yellow, texture medium fine, firm, medium juicy, fibers medium, flavor good, TSS 25-28%, acidity 0.18-0.2%.

Stone and Seed: Stone size medium, oblong, medium ridged, fibers abundance, medium long, sparse on ventral edge, length 6-9, width 2-4, thickness 2-4 cm,, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Burmasurkha: Tree medium tall growing, semi spreading, foliage light green, new flush pink, fruit medium, ovate to oval oblong, color light green with red blush at maturity, turning yellow with red blush at ripening, sinus weak, lenticels size small, density weak, less conspicuous, flesh yellow, texture medium fine, low juicy, flavor fair, sweet, stone size medium, medium ridged, fibers medium.

CHAUNSA KALA

Origin and Adaptation: Chaunsa Kala (SS I) a local selection, a chance seedling most probably of Chaunsa, very late popular promising variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium large, vigorous, medium branched, spreading, alternate bearing tendency high, fruit hold on capacity very good.

Leaf: Foliage medium dense, medium green, leaf elliptical, midrib curvature medium, twisting medium, undulation weak, strong concave, length 18-22, width 4-7, petiole 3-4 cm, tip acute, base medium broad, upper surface smooth, veins grooved, fragrance strong, new flush light pink.

Inflorescence: Medium long, well branched, medium compact, color greenish white, flower greenish.

Mature Fruit: Dark green, size medium, shape ovate to oval oblong, neck absent, stalk medium, base flattened, apex rounded, right and left shoulder rounded, left elevated, right slopping, beak weak, sinus weak, fruit length 12-15, breadth 5-8, thickness 7-9 cm, weight 250-350g, skin smooth, bloom medium, lenticels density medium, size medium bold, conspicuous, whitish.

Ripe Fruit: Yellowish green to lemon yellow, skin medium thick, leathery, adherence medium, flesh lemon yellow, texture medium fine, firm, medium juicy, fibers medium to high, flavor rich, distinctive sweet, TSS 20-24%, acidity 0.16-0.17%.

Stone and Seed: Stone size medium, oblong, medium ridged, fibers high, long, medium dense on ventral edge, length 8-10, width 3-5, thickness 2-4 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Chaunsa Kala (SS I): A chance seedling selection, resembles Chaunsa Samar Bahisht, maturity very late, color dark green at maturity, turning yellowish green to lemon yellow at ripening, foliage color medium green, fruit ovate to oval oblong, sinus weak, lenticels density medium, size medium bold, conspicuous, flesh lemon yellow, flavor rich, distinctive sweet, mild aromatic, fibers high, long.

CHAUNSA LATE

Origin and Adaptation: Chaunsa Late (SS III) a chance seedling selection from Chaunsa plantation, late season, large scale popular commercial variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, vigorous, medium branched, spreading, alternate bearing tendency low.

Leaf: Foliage medium dense, dark green, leaf elliptical, midrib curvature medium, twisting medium, undulation weak, medium concave, length 27-30, width 7-10, petiole 3-4 cm, tip acute, base roundish, upper surface smooth, veins grooved, fragrance weak, new flush light pink.

Inflorescence: Medium long, medium branched, medium compact, color light greenish white, flower light greenish.

Mature Fruit: Light green, size medium to large, ovate to oval oblong, neck absent, stalk medium, cavity absent, base flattened, apex rounded, right and left shoulders rounded, left shoulder elevated, right slopping, beak short, sinus weak, fruit length 10-14, breadth 5-8, thickness 5-7 cm, weight 400-550g, skin smooth, bloom medium, lenticels density medium, size medium, medium conspicuous, whitish.

Ripe Fruit: Color light yellow, skin medium thick, leathery, adherence medium, flesh whitish, texture fine, firm, medium juicy, fibers medium to high, flavor distinctive, rich, very sweet, TSS 16-18.0%, acidity 0.16-017%.

Stone and Seed: Medium, oblong, medium ridged, fibers medium, long, sparse on ventral edge, length 7-10, width 3-5, thickness 2-4 cm,, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Chaunsa Late (SS III): A chance seedling selection from Chaunsa plantation, tree medium large, spreading, foliage dark green, fruit medium to large, bigger than Chaunsa, ovate to oval oblong, light green at maturity, light yellow at ripening, sinus weak, lenticels medium dense, size medium, medium conspicuous, flesh yellow, medium juicy, sweet, flavor rich, aromatic, stone ridged, fibers medium.

CHAUNSA RAMPURI

Origin and Adaptation: Chaunsa Rampuri, also a local chance seedling selection by Nawab Kalbe Ali Khan, of Rampur, previously it was known as Samar Bahisht Rampuri, a midseason, large scale popular variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium large, vigorous, upright, semi spreading, regular bearer.

Leaf: Foliage medium dense, light green, leaf elliptical, midrib curvature medium, twisting weak, undulation medium, medium concave, length 27-30, width 8-10, petiole 1.5-2.0 cm, tip acute, base obtuse, upper surface smooth, veins grooved, fragrance strong, new flush light pink.

Inflorescence: Medium, well branched, compact, light greenish.

Mature Fruit: Light greenish yellow, size medium to large, ovate to obliquely oblong, neck absent, stalk medium, cavity absent, base obliquely rounded, apex rounded, right and left shoulders rounded, left shoulder elevated, beak rounded, sinus weak to absent, fruit length 10-12, breadth 6-8, thickness 6-7 cm, weight 300-400g, skin smooth, bloom weak, lenticels density medium, size medium, less conspicuous, whitish.

Ripe Fruit: Yellow with reddish tinge on one side, skin thin, leathery, wrinkled, flesh whitish, texture very fine, firm, medium juicy, fibers medium, flavor distinctive rich, TSS 18-20%, acidity 0.14-0.17%.

Stone and Seed: Stone size medium, oblong oval, medium ridged, fibers at germ point medium, long, sparse on ventral edge, length 7-8, width 3-4, thickness 2-3 cm,, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Chaunsa Rampuri: A chance seedling selection, tree medium large, upright, foliage light green, fruit resembles Chaunsa Samar Bahisht but slightly more roundish, ovate to obliquely oblong, light greenish yellow at maturity, yellow with reddish tinge at ripening, sinus weak to absent, lenticels medium dense, size medium, less conspicuous, flesh yellow, texture very fine, medium juicy, sweet, flavor rich, aromatic, stone ridged, fibers medium.

CHAUNSA SAMAR BAHISHT

Origin and Adaptation: Chaunsa Samar Bahisht a local selection; a chance seedling in Fajri plantation in village "Chaunsa or Chausa" by a farmer Mir Khan Bahadur Altaf Rasul; very popular late season mango.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Large growing, vigorous, well branched, spreading tree.

Leaf: Foliage medium dense, dark green, leaf elliptical, midrib curvature medium, twisting weak, undulation weak, slight concave, length 25-28, width 8-10, petiole 1.5-2 cm, tip acute, base broader, upper surface smooth, veins grooved, fragrance strong, new flush light pink.

Inflorescence: Long, medium branched, medium compact, color light pink, flower light pink.

Mature Fruit: Medium to light green, size medium to large, ovate to oval oblong, neck absent, stalk medium, base obliquely flattened, apex rounded, right and left shoulders rounded, left shoulder elevated, beak weak to medium, sinus weak, fruit length 11-14, breadth 6-8, thickness 6-7 cm, weight 300-400g, skin smooth, bloom medium, lenticels density medium, size medium, medium conspicuous, whitish.

Ripe Fruit: Light yellow, skin medium thick, leathery, adherence medium, flesh pale yellow, texture very fine, firm, medium juicy, fibers medium, flavor rich, distinctive, very sweet, TSS 18-20%, acidity 0.17-0.18%.

Stone and Seed: Stone size medium, oblong, medium ridged, fibers medium, medium long, sparse on ventral edge, length 8-10, width 5-7, thickness 2-4 cm,, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Chaunsa Samar Bahisht: A chance seedling selection, tree large, vigorous, spreading, foliage dark green, fruit size medium to large, shape ovate to oval oblong, color light green at maturity, yellow at ripening, sinus weak, lenticels medium, size medium, conspicuous, flesh pale yellow, texture very fine, medium juicy, sweet, flavor rich, distinctive, aromatic, stone ridged, fibers medium.

COLLECTOR

Origin and Adaptation: Collector an introduction**,** a chance seedling selection, late season, small scale commercial variety of mango belt.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, vigorous growing, medium branched, spreading, regular bearer.

Leaf: Foliage medium dense, dark green, leaf elliptical, midrib curvature medium, twisting weak, undulation medium, medium concave, length 18-20, width 5-7, petiole 2-3 cm, tip acute, base roundish, upper surface smooth, veins grooved, fragrance weak, new flush light pink.

Inflorescence: Long, medium branched, medium compact, color strong pink, flowers also pink.

Mature Fruit: Light green, size medium large to large, shape ovate to irregular oval, neck short, stalk medium, cavity absent, base flattened, apex rounded, shoulders rounded, equal, beak broadly pointed, sinus indistinct, fruit length 11-14, breadth 9-12, thickness 8-11 cm, weight 400-500g, skin medium rough, bumpy, bloom medium, lenticels density medium, size bold, conspicuous, whitish.

Ripe Fruit: Brownish with light greenish ting, skin medium thick, leathery, adherence medium, flesh light yellow, texture firm, less juicy, fibers medium, flavor fair, less sweet, TSS 13-15%, acidity 0.30-0.32%.

Stone and Seed: Medium, oblong, medium ridged, fibers medium, long, sparse on ventral edge, length 9-11, width 3-5, thickness 3-4 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Collector: An introduction, late season variety, tree medium tall, spreading, foliage color dark green, fruit size medium to large, ovate to irregular oval, color light green at maturity, brownish with light greenish tinge at ripening, neck short, sinus indistinct, lenticels medium dense, size bold, conspicuous, flesh light yellow, texture firm, less juicy, flavor fair, less sweet, stone ridged, fibers medium.

DOSEHRI

Origin and Adaptation: Dosehri a local selection, a chance seedling from Malihabad Township, early to midseason, large scale popular variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, moderately vigorous, spreading, regular bearer, very early to bear fruit.

Leaf: Foliage medium lax, droopy downward, medium green, leaf elliptical, midrib curvature medium, twisting weak, undulation weak, medium concave, length 18-22, width 4-7, petiole 3-4 cm, tip acute, base roundish, upper surface smooth, veins grooved, fragrance strong, new flush light yellowish green.

Inflorescence: Medium long, medium branched, medium compact, light green, flower light greenish.

Mature Fruit: Light green, size small to medium, oblong to oblong-oblique, neck absent, stalk bold, cavity absent, base flattened, apex rounded, left shoulder a bit elevated, beak absent, sinus absent to weak, fruit length 8-10, breadth 6-8, thickness 4-7 cm, weight 150-200g, skin smooth, bloom medium, lenticels density medium, size medium, medium conspicuous, whitish, store well.

Ripe Fruit: Yellow, skin thin, adherence medium, flesh lemon yellow, texture very fine, firm, medium juicy, fibers very low, flavor distinctive, rich, very sweet, TSS 21-22%, acidity 0.17-0.19%.

Stone and Seed: Stone small, oblong, medium ridged, fibers medium, long, sparse on ventral edge, length 5-8, width 2-4, thickness 2-4 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Dosehri: A chance seedling selection from Malihabad township, tree medium tall growing, spreading, fruit size medium to small, shape oblong to oblong-oblique, color light green at maturity, yellow at ripening, sinus very weak, lenticels density medium, size medium, conspicuous, flesh lemon yellow, texture very fine, fibers low, medium juicy, flavor rich, very sweet, stone thin, medium ridged, store well.

EARLY GOLD

Origin and Adaptation: Early Gold an introduction from Florida, a chance seedling, early season variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium large growing, moderately vigorous, upright, semi spreading, regular bearer.

Leaf: Foliage medium lax, light green, leaf elliptical, midrib curvature medium, twisting weak, undulation weak, medium concave, length 16-20, width 4-6, petiole 2-3 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance strong, new flush light pink.

Inflorescence: Medium long, medium branched, medium compact, light pink, flowers early in November.

Mature Fruit: Light green mixed with red blush, size medium to large, obliquely round, neck very short, stalk bold, cavity absent, base obliquely round, ridged beneath, apex rounded, left shoulder elevated, beak absent to weak, sinus medium, fruit length 10-12, breadth 6-8, thickness 6-7 cm, weight 225-400g, skin smooth, bloom medium, lenticels density medium, conspicuous, whitish, store well.

Ripe Fruit: Golden with red blush, skin medium thick, flesh lemon yellow, texture fine, soft, medium juicy, fibers scanty, flavor good, sweet, TSS 16-18%, acidity 0.18-0.20%.

Stone and Seed: Stone size medium large, oblong, medium ridged, fibers medium, long, sparse on ventral edge, length 7-9, width 4-5, thickness 2-3 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Early Gold: Introduction, a chance seedling selection from Florida, tree medium large, spreading, regular bearer, foliage light green, fruit medium to large, obliquely round, color light green at maturity, golden at ripening with red blush, sinus medium, lenticels conspicuous, flesh lemon yellow, texture soft, fibers scanty, medium juicy, flavor good, sweet, stone medium, medium ridged, store well.

FAJRI

Origin and Adaptation: Fajri (*Fajri Klan)*, a local selection, a chance seedling by Madam Fajri, from Behar, late season, popular variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, moderately vigorous, spreading, rounded, tendency for alternate bearing absent.

Leaf: Foliage medium lax, light green, leaf elliptical, midrib curvature medium, twisting weak, undulation slight, flat, length 18-20, width 4-6, petiole 3-4 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance medium, new flush light yellowish green.

Inflorescence: Medium long, medium branched, medium compact, light pink, flowers light pink.

Mature Fruit: Light green, size large, oblong to obliquely oval, neck absent, stalk bold, cavity absent, base and apex rounded, left shoulder elevated, beak medium, sinus weak, fruit length 12-15, breadth 7-10, thickness 7-9 cm, weight 350-700g, skin bumpy, bloom medium, lenticels medium dense, bold, conspicuous, whitish, store well.

Ripe Fruit: Light yellow, skin medium thick, adherence medium, flesh pale yellow, texture medium fine, soft, juice high, fibers scanty, long, fragrance weak, flavor medium, very sweet, TSS 16-18%, acidity 0.19-0.21%.

Stone and Seed: Stone size medium large, oblong, medium ridged, fibers low, long, sparse on ventral edge, length 8-10, width 3-5, thickness 3-4 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Fajri: A chance seedling selection from Behar, late maturing, more suitable for processing, tree medium tall, spreading, regular bearer, vigorous, fruit large, oblong to obliquely-oval, color light green at maturity, light yellow at ripening, sinus weak, lenticels medium dense, conspicuous, surface bumpy, flesh pale yellow, texture medium soft, juice high, very sweet, flavor medium, fragrance weak, stone thick, medium ridged, fibers low, store well.

GULABE KHAS

Origin and Adaptation: Gulabe Khas *(Gulab khas; Gulab Khasa)***,** a local selection, a chance seedling, midseason, small scale variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium large growing, moderately vigorous, semi spreading to spreading, rounded, regular bearer.

Leaf: Foliage medium lax, medium green, leaf elliptical, midrib curvature strong, twisting weak, undulation slight, length 20-25, width 4-6, petiole 3-4 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance strong, new flush light pink.

Inflorescence: Medium long, less branched, medium compact, light pink, flower dark pink.

Mature Fruit: Pale green with red blush, size medium, obliquely oval, neck absent, stalk bold, cavity absent to weak, base obliquely rounded, apex tapering round, left shoulder elevated, beak absent, sinus weak, fruit length 9-11, breadth 6-9, thickness 6-7 cm, weight 250-300g, skin smooth, bumpy, bloom strong, lenticels density medium, size bold, very conspicuous, whitish, store well.

Ripe Fruit: Bright yellow with beautiful red blush, skin thin, adherence medium, flesh light yellowish, texture fine, firm, juice high, fibers medium, fragrance medium, flavor good, TSS 16-17%, acidity 0.27-0.29%.

Stone and Seed: Stone medium large, oblong, medium ridged, fibers medium, long, medium on ventral edge, length 5-8, width 3-4, thickness 3-4 cm, seed medium, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Gulabe Khas: A chance seedling selection, midseason, tree medium tall, spreading, regular bearer, fruit size medium, obliquely-oval, color pale green with red blush on basal side at maturity, bright yellow with red blush very beautiful at ripening, sinus weak, lenticels medium, very conspicuous, skin smooth, flesh light yellow, texture firm, fibers medium, juice high, flavor rich, sweet, medium fragrant, stone thick, medium ridged, store well.

HADEN

Origin and Adaptation: Haden an introduction from Florida, a seedling selection of Mulgoba (from sub-continent selected by Cap. Haden 1910), midseason variety (early July), grown on small scale in Multan area.

Maintainer: MRI, Multan and ARI, Tarnab (GPU, DI Khan).

Tree: Medium short, less vigorous, well branched, medium spreading, tendency for alternate bearing low.

Leaf: Foliage medium dense, almost droopy, color medium green, leaf elliptical, curvature medium, twisting and undulation weak, medium concave, length 17-22, width 4-7, petiole 3-4 cm, tip acute, base acuminate, fragrance medium, new flush medium pink.

Inflorescence: Medium long, well branched, medium lax, stalk medium pink, flower light pink.

Mature Fruit: Sea green with reddish blush, size medium to large, ovate, neck slight, base rounded, right shoulder higher than left, beak weak to medium, sinus medium, apex rounded to broadly pointed, fruit length 9-12, breadth 8-10, thickness 8-9 cm, weight 300-400g, resembles Kensington, skin smooth, bloom strong, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Lemon yellow with orange red blush, skin medium thick, adherence medium, flesh lemon yellow, texture firm, fine, less juicy, fibers low, flavor mild, taste good, medium aromatic, TSS 17-18%, acidity 0.18-0.20%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers low, medium long and soft on ventral edge, length 6-9, width 4-6, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Haden: A small scale midseason variety, a seedling selection of Malgoba, tree medium short, semi spreading, foliage medium dense, medium green, fruit medium to large, ovate, sea green with reddish blush at maturity and lemon yellow with orange red blush at ripening, flesh lemon yellow, fibers low, flavor mild, sweet.

JAGIRDAR

Origin and Adaptation: Jagirdar a local selection, a chance seedling, very early maturing variety.

Maintainer: MRI, Multan and ARI, Tarnab (GPU, DI Khan).

Tree: Large in size, medium vigorous, well spreading, droopy medium branched, regular bearer.

Leaf: Foliage medium dense, medium green, leaf elliptical, midrib curvature medium, twisting absent to weak, undulation absent to weak, medium concave, length 19-20, width 7-8, petiole 3-4 cm, tip acute, base acuminate, fragrance strong, new flush medium pink.

Inflorescence: Medium long, well branched, compact, stalk pink, flower medium and light pink, flowering twice, November and February.

Mature Fruit: Light green, size medium, oblongish, neck absent, stalk cavity absent, base obliquely rounded, right shoulder higher than left, beak absent, pointed, sinus medium, apex rounded, fruit length 8-10, breadth 7-9, thickness 5-6 cm, weight 150-250g, skin smooth, bloom strong, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Lemon yellow, skin medium thin, adherence medium, flesh yellow, texture firm, fine, medium juicy, fibers medium, but more near skin, flavor fair, taste acid sweet, strong characteristic aroma, TSS 11-12%, acidity 0.29-0.31%.

Stone and Seed: Medium thick, oblong, medium ridged, fibers medium, medium long and soft on ventral edge, length 6-8, width 3-4, thickness 2-3, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Jagirdar: A very early variety of Sindh area, chance seedling, tree large, spreading, foliage medium dense, medium green, stalk cavity absent, fruit size medium, oblongish, neck absent, beak absent, color light green at maturity, lemon yellow at ripening, skin medium thin, smooth, lenticels medium dense, size small, less conspicuous, flesh yellow, fibers medium, flavor fair, suitable for pickles and *achar.*

KEITT

Origin and Adaptation: Keitt an introduction from Florida, most probably a seedling selection of Mulgoba, midseason, small scale variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium large, medium vigorous, semi spreading to spreading, regular bearer.

Leaf: Foliage medium lax, light green, leaf elliptical, midrib curvature strong, twisting weak, undulation slight, medium convex, length 18-22, width 4-7, petiole 2-3 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance medium, new flush light pink.

Inflorescence: Medium long, less branched, semi compact, color peach red, flower pink.

Mature Fruit: Medium green with reddish brown blush, size medium to large, obliquely oval to ovate, neck absent, cavity absent to weak, base obliquely rounded, apex tapering round, left shoulder elevated, beak weak to medium, sinus weak, fruit length 10-12, breadth 7-9, thickness 7-8 cm, weight 250-400g, skin smooth, slightly bumpy, bloom medium, lenticels medium, size small, conspicuous, yellowish, fruit store well.

Ripe Fruit: Orange yellow with reddish brown blush, skin medium thick, flesh orange yellow, texture fine, soft, juice high, fibers scanty, fragrance medium, flavor good, sweet, TSS 16-17%, acidity 0.26-0.28%.

Stone and Seed: Medium large, oblong, medium ridged, fibers medium, long, sparse on ventral edge, length 8-9, width 3-4, thickness 3-4 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Keitt: A chance seedling selection from Florida, large and predominant commercial mango of USA, fruit medium to large, obliquely-oval, pale green with reddish brown blush at maturity, bright yellow with reddish brown blush at ripening, sinus weak, lenticels medium, conspicuous, skin smooth, flesh light yellow, fibers scanty, flavor medium, sweet, fragrance medium, stone thick, medium ridged, store well.

KENSINGTON

Origin and Adaptation: Kensington an introduction from Australia, chance seedling selection, midseason, small scale commercial variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall, moderately vigorous, rounded, regular bearer.

Leaf: Foliage medium lax, light green, leaf elliptical, midrib curvature medium, twisting very weak, undulation slight, medium concave, length 25-30, width 6-8, petiole 2-3 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance strong, new flush light pink.

Inflorescence: Medium long, medium branched, semi compact, color light pink, flower light pink.

Mature Fruit: Light green with pink blush, size medium to large, obliquely oval, neck absent, cavity absent to weak, base obliquely rounded, grooved, apex tapering round, left shoulder elevated, medium deep furrowed, beak weak to medium, sinus weak, fruit length 9-12, breadth 7-9, thickness 7-8 cm, weight 300-400g, skin smooth, bumpy, bloom weak, lenticels density medium, size medium, conspicuous, whitish, store well.

Ripe Fruit: Greenish yellow with pink blush, skin medium thick, flesh orange yellow, texture firm, juice high, fibers scanty, fragrance medium, flavor good, sweet, TSS 18-19%, acidity 0.20-0.22%.

Stone and Seed: Medium large, oblong, medium ridged, fibers medium, long, sparse on ventral edge, length 7-9, width 3-5, thickness 3-4 cm, seed medium, poly-embryonic.

Yield: Good bearer.

Leading Characters: Kensington: Introduction from Australia, tree medium large, regular bearer, moderately vigorous, fruit medium to large, obliquely rounded, light green with pink blush at maturity, greenish yellow with pink blush at ripening, sinus weak, beak weak to medium, lenticels medium dense, size medium, conspicuous, skin smooth, flesh light yellowish, texture firm, fibers scanty, juice high, sweet, flavor good, stone medium thick, medium ridged, store well.

LANGRA

Origin and Adaptation: Langra a local selection from Hajipur or Banaras area, chance seedling, early to midseason, large scale popular commercial variety of the mango belt.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium large, moderately vigorous, spreading, rounded, tendency for alternate bearing high.

Leaf: Foliage medium dense, light green, leaf elliptical, midrib curvature medium, twisting absent to weak, medium concave, undulation medium, length 18-20, width 5-7, petiole 3-4 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance medium, new flush light pink.

Inflorescence: Medium to long, well branched, medium compact, medium pink, flower light pink.

Mature Fruit: Skin light green, size medium, ovate, neck absent, stalk medium to bold, cavity absent to weak, base obliquely round to flattened, apex round, left shoulder elevated, beak absent to weak, sinus weak to medium, fruit length 9-11, breadth 6-8, thickness 6-7 cm, weight 250-350g, skin medium smooth, bloom light to medium, lenticels density medium, size medium, conspicuous, whitish, store well.

Ripe Fruit: Light green turns yellow on over ripening, skin medium thin, flesh lemon yellow, texture firm, juice high, fibers scanty, fragrance medium, flavor good, very sweet, TSS 20-21%, acidity 0.18-0.19%.

Stone and Seed: Small, oblong, thin, medium ridged, fibers low, long, sparse on ventral edge, length 7-9, width 4-6, thickness 2-3 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Langra: A chance seedling from Hajipur or Banaras area, medium early maturing mango, tree medium large, spreading, rounded, fruit medium, ovate, light green at maturity and ripening, sinus weak to medium, lenticels medium, conspicuous, skin smooth, flesh lemon yellow, texture firm, fibers scanty, juice high, flavor good, sweet, mild aromatic, stone thin, medium ridged, store well.

MALDA

Origin and Adaptation: Malda a local selection, chance seedling, early season, medium scale commercial variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, moderately vigorous, semi spreading to spreading, rounded, regular bearer.

Leaf: Foliage medium dense, medium green, leaf elliptical, midrib curvature medium, twisting absent, strong concave, undulation high, length 16-18, width 3-5, petiole 4-5 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance medium, new flush light pink.

Inflorescence: Medium long, medium branched, medium compact, color light pink, flower light pink.

Mature Fruit: Medium green, size medium, shape broad oblongish, neck short, stalk medium bold, cavity absent, base round, apex tapering round, left shoulder elevated, beak short to medium, medium fleshy, sinus weak, fruit length 9-11, breadth 6-8, thickness 6-7 cm, weight 250-350g, skin smooth, bloom medium, lenticels density medium, size bold, very conspicuous, whitish, store well.

Ripe Fruit: Medium greenish, yellowish on one side, skin medium thin, flesh light yellowish, texture firm, juice high, fibers scanty, fragrance medium, flavor good, sweet, TSS 12-14%, acidity 0.30-0.32%.

Stone and Seed: Medium large, oblong, medium ridged, fibers medium, long, sparse on ventral edge, length 7-8, width 5-6, thickness 2-3 cm, seed medium, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Malda: A chance seedling selection, early maturing, tree medium tall, spreading, rounded, regular bearer, fruit size medium, broad oblongish, medium green at maturity, at ripening one side yellowish, sinus weak, lenticels medium dense, size bold very conspicuous, skin smooth, flesh light yellowish, texture firm, fibers scanty, juice high, sweet, flavor good, stone thick, medium ridged, store medium.

MALDA LATE

Origin and Adaptation: Malda Late (SS II) a local selection, a chance seedling, late season variety, grown on small scale.

Maintainer: MRI, Multan and ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall, medium vigorous, medium branched, branches semi erect, tendency for alternate bearing low.

Leaf: Foliage medium dense, color medium green, leaf elliptical, midrib curvature medium, twisting weak, undulation slight, concave, length 20.0-22.0, width 5.5-6.0, petiole 4.0-4.5 cm, tip acute, base roundish, fragrance medium, new flush medium pink.

Inflorescence: Medium long, well branched, compact, stalk medium pink, flower light pink.

Mature Fruit: Sea green, size small to medium, oblongish oval, neck weak, stalk cavity absent, base rounded, shoulders tapering rounded right slightly higher than left, beak very short, sinus slight to medium, apex rounded to broadly pointed, fruit length 5-8, breadth 4-6, thickness 4-5 cm, weight 160-200g, skin smooth, bloom medium to strong, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Greenish yellow, on one side yellow, skin medium thick, adherence medium, flesh lemon yellow, texture soft, fine, less juicy, fibers low, flavor medium, tasty, medium aromatic, TSS 20-22%, acidity 0.17-0.18%.

Stone and Seed: Stone size medium, oblong, medium ridged, fibers medium long and fine on ventral edge, length 3-5, width 2-4, thickness 2-3, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Malda Late: Local selection, a late season good bearer new promising variety, a chance seedling selection, tree medium tall, spreading, foliage medium dense, medium green, fruit size small to medium, oblongish oval, sea green at maturity and greenish yellow at ripening, bloom medium to strong, lenticels medium dense, size small, less conspicuous, flesh lemon yellow, fibers low, flavor medium, sweet.

MAYA

Origin and Adaptation: Maya an introduction from Philippine, midseason, very small scale variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, moderately vigorous, spreading, rounded, regular bearer.

Leaf: Foliage medium dense, medium green, leaf elliptical, curvature weak, twisting weak, concave, undulation weak, big broad leaf, length 22-25, width 6-8, petiole 3-4 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance medium, new flush light pink.

Inflorescence: Medium long, medium branched, medium compact, color peach red, flower dark pink.

Mature Fruit: Light green with light pink blush, size medium, broad oblongish round, neck short, stalk bold, cavity absent, base round, apex round, left shoulder elevated, beak weak, sinus weak, fruit length 9-12, breadth 8-10, thickness 8-9 cm, weight 300-450g, skin medium rough, bloom medium, lenticels dense, size small, less conspicuous, whitish, store medium.

Ripe Fruit: Greenish yellow with light pink blush, skin medium thick, flesh pale yellow, texture soft, juice high, fibers medium, fragrance medium, flavor good, sweet, TSS 16-17%, acidity 0.20-0.22%.

Stone and Seed: Medium large, oblong, medium ridged, fibers high, short, medium on ventral edge, length 7-8, width 5-6, thickness 2-3 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Maya: An introduction from Philippine, medium maturing mango, tree medium tall growing, spreading, shape rounded, regular bearer, fruit size medium, broad oblongish round, color light green with light pink blush at maturity, greenish yellow with light pink blush at ripening, sinus weak, lenticels dense, size small, less conspicuous, skin medium rough, flesh pale yellow, texture soft, fibers medium, juice high, flavor good, sweet, stone thick, medium ridged, store medium.

MOMI K

Origin and Adaptation: Momi K an introduction from Hawaii, midseason, very small scale variety.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium large growing, moderately vigorous, semi spreading to spreading, rounded, regular bearer.

Leaf: Foliage medium dense, light green, leaf elliptical, midrib curvature weak, twisting weak, concave, undulation weak, big broad leaf, length 20-24, width 5-8, petiole 2-3 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance medium, new flush light pink.

Inflorescence: Medium long, medium branched, medium compact, color light pink, flower light pink.

Mature Fruit: Light green with red blush, size medium to large, obliquely oblong, neck short, stalk bold, cavity absent, base round, apex round, lump medium, left shoulder elevated, medium grooved, beak weak, sinus absent to weak, fruit length 10-14, breadth 6-8, thickness 6-8 cm, weight 300-450g, skin medium rough, bloom medium, lenticels dense, size small, less conspicuous, whitish, store medium.

Ripe Fruit: Light yellow with reddish blush, skin medium thick, flesh pale yellow, texture firm, juice high, fibers scanty, fragrance medium, flavor good, sweet, TSS 18-19%, acidity 0.18-0.20%.

Stone and Seed: Medium large, oblong, medium ridged, fibers medium, short, sparse on ventral edge, length 7-10, width 4-6, thickness 2-3 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Momi K: Introduction from Hawaii, midseason maturity, tree medium tall, spreading, shape rounded, regular bearer, fruit size medium to large obliquely oblong, light green at maturity and light yellow with reddish blush at ripening, sinus absent to weak, lenticels dense, size small, less conspicuous, skin medium rough, bloom medium, flesh pale yellow, texture firm, fibers scanty, juice high, flavor good, sweet, stone thick, medium ridged, store well.

NEELUM

Origin and Adaptation: Neelum a local chance seedling selection, late season, medium scale mango.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium dwarf in height, moderately vigorous, spreading, regular bearer, a good rootstock germplasm for breeding dwarf varieties.

Leaf: Foliage medium dense, light green, leaf elliptical, midrib curvature weak, twisting absent, concave, undulation weak, big broad leaf, length 20-25, width 4-7, petiole 3-4 cm, tip acute, base broad, upper surface smooth, fragrance medium, new flush light pink.

Inflorescence: Medium long, medium branched, medium compact, color peach red, flower pink.

Mature Fruit: Sea green, size medium, ovate, neck absent, stalk bold, cavity absent, base round, apex round, left shoulder elevated, medium furrowed, beak prominent, sinus medium, acute to obtuse, fruit length 7-10, breadth 6-8, thickness 6-7 cm, weight 130-250g, skin medium smooth, bloom medium, lenticels dense, size small, less conspicuous, whitish, store medium.

Ripe Fruit: Yellow with reddish tinge, skin medium thick, flesh whitish, texture firm, juice low, fibers low, fragrance medium, flavor good, sweet, TSS 12-14%, acidity 0.19-0.21%.

Stone and Seed: Stone size medium, ovalish, medium ridged, fibers medium all over, long on ventral edge, length 5-7, width 3-5, thickness 1.5-2 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Neelum: A local selection, late maturing, tree medium dwarf, spreading, new flush light pink, regular bearer, fruit bearing single and from main stem in clusters, size medium, ovate, sea green at maturity, yellow with reddish tinge at ripening, beak prominent, sinus medium, lenticels dense, less conspicuous, skin medium smooth, flesh whitish, texture firm, fibers low, low juicy, flavor good, sweet, stone thick, medium ridged, store medium, a good dwarf germplasm.

POPE

Origin and Adaptation: Pope an introduction from Hawaii, midseason variety of low commercial importance.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall, moderately vigorous, spreading, regular bearer, very susceptible to mango hopper.

Leaf: Foliage medium dense, medium green, leaf size big broad, elliptical, droopy, midrib curvature weak, medium concave, undulation weak, length 20-28, width 5-9, petiole 3-4 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance medium, new flush light pink.

Inflorescence: Medium to long, medium branched, medium compact, color pink to light green, flowers pink.

Mature Fruit: Medium green, blushed pink, size medium to large, obliquely oblongish, neck very small, stalk bold, cavity absent, base round, deep ridged, apex round, tapering, left shoulder elevated, sinus absent, beak short, fruit length 10-13, breadth 6-9, thickness 6-7 cm, weight 250-400g, skin medium surface smooth, bloom medium, lenticels dense, size small, less conspicuous, whitish, store medium.

Ripe Fruit: Orange yellow with reddish blush, skin medium thick, flesh lemon yellow, texture soft, low juicy, fibers low, fragrance medium, flavor good, sweet, TSS 18-20%, acidity 0.17-0.19%.

Stone and Seed: Medium, oblong, medium ridged, fibers medium all over, long on ventral edge, length 8-10, width 4-6, thickness 2-3 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Pope: An introduction from Hawaii, tree medium tall growing, regular bearer, fruit size medium, obliquely oblongish, color medium green at maturity, orange yellow with reddish blush at ripening, bloom medium, beak short, sinus absent, lenticels dense, size small, less conspicuous, flesh lemon yellow, texture soft, fibers low, flavor medium, sweet, stone medium thick, medium ridged, store medium.

RETAUL LATE

Origin and Adaptation: Retaul Late (*Retaul 12)* a local selection, a chance seedling, most probably of Anwar Retaul, late season, popular variety.

Maintainer: MRI, Multan; and ARI, Tarnab (GPU, DI Khan).

Tree: Medium large, vigorous, medium branched, branches semi erects to spreading, tendency for alternate bearing low.

Leaf: Foliage medium dense, dark green, leaf elliptical, midrib curvature weak, twisting weak, undulation weak, medium concave, length 22-27, width 5-7, petiole 3-5 cm, tip acute, base acuminate, fragrance weak, new flush light pink with midrib dark pink.

Inflorescence: Short to medium, well branched, compact, stalk color light green, flower light green.

Mature Fruit: Light green, size medium somewhat larger than Anwar Retaul, ovate, neck absent, stalk cavity shallow, base flattened, shoulders rounded right higher than left, beak and sinus weak to absent, apex rounded, fruit length 8-10, breadth 6-8, thickness 6-7 cm, weight 150-350g, skin smooth, bloom weak, lenticels medium lax, size medium, conspicuous, whitish.

Ripe Fruit: Skin light yellow, medium thick, leathery, adherence medium, flesh reddish yellow, texture fine, medium firm, medium juicy, fibers abundant, flavor rich, very sweet, mild aromatic, TSS 16-17%, acidity 0.16-0.18%.

Stone and Seed: Stone size medium to small, medium thin, flattish, medium ridged, short and abundant fibers on ventral edge, dense at germ point, length 5-7, width 3-5, thickness 3-5 cm, seed medium large, mono-embryonic.

Yield: Good bearer.

Leading Characters: Retaul Late: A local selection, late season variety, tree medium large, spreading but less than Sindhri, tendency for alternate bearing low, foliage dark green, new flush light green, fruit medium, ovate, larger than Anwar Retaul, color attractive yellow, lenticels medium lax, size medium, conspicuous, stone thicker than Anwar Retaul, flesh yellow, fibers abundant, flavor excellent, sweet.

SALEHBHAI

Origin and Adaptation: Salehbhai a local selection, a chance seedling, midseason, medium grown variety.

Maintainer: MRI, Multan and ARI, Tarnab (GPU, DI Khan).

Tree: Medium large, vigorous, medium branched, semi spreading, resemble Zafran, tendency for alternate bearing low.

Leaf: Foliage medium dense, light green, leaf elliptical, midrib curvature medium, twisting medium, undulation, medium, concave, length 20-25, width 5-8, petiole 4-5 cm, tip acute, base broad, fragrance strong, new flush pink.

Inflorescence: Medium to long, well branched, compact, stalk medium pink, flower light pink.

Mature Fruit: Good looking, light green, size medium, ovate oblong, neck absent, stalk cavity medium shallow, base flattened, shoulders rounded right slightly higher than left, beak medium, downward, sinus medium to strong, apex rounded, fruit length 9-12, breadth 5-8, thickness 5-6 cm, weight 250-350g, skin smooth, bloom weak, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Skin color pale yellowish with light pink blush, medium thick, leathery, adherence medium, flesh color lemon yellow, texture fine, medium firm, medium juicy, fibers few, flavor good, very pleasant, sweet, aroma slight, TSS 17-18%, acidity 0.20-0.22%.

Stone and Seed: Stone size medium big, oblong, medium ridged, short and sparse fibers on ventral edge, length 6-8, width 4-6, thickness 3-5 cm, seed size medium large, mono-embryonic.

Yield: Good bearer.

Leading Characters: Salehbhaii: A local seedling selection, tree medium large growing, spreading, tendency for alternate bearing low, foliage medium dense, color light green, fruit size medium, ovate oblong, color light green when mature, yellowish with light pink tinge at maturity, lenticels medium dense, size small, less conspicuous, juice medium, fibers few, very tasty, flavor good, stone medium, seed medium large.

SANGLAKHI

Origin and Adaptation: Sanglakhi a local selection, a chance seedling selection, very late hardy variety of low importance; immature and mature fruit very hard and heavy hence the name Sanglakhi meaning resembling stone, regular bearer.

.**Maintainer:** MRI, Multan and ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall, vigorous, medium branched, semi erect and spreading, tendency for alternate bearing high, a good rootstock for high bearing.

Leaf: Foliage medium dense, light green, leaf elliptical, midrib curvature medium, twisting weak, undulation weak, medium concave, length 20-30, width 4-7, petiole 3-6 cm, tip acute, base acuminate, fragrance weak, new flush pink.

Inflorescence: Medium long, well branched, compact, stalk color medium pink, flower light pink.

Mature Fruit: Fruit hard, color sea green, size medium, ovatish round, neck absent, stalk cavity shallow, base flattened, shoulders round, right slightly higher than left, beak weak, rounded, sinus weak to absent, apex rounded, fruit length 8-10, breadth 7-9, thickness 7-8 cm, weight 250-350g, skin smooth, bloom weak, lenticels medium dense, size medium, less conspicuous, whitish.

Ripe Fruit: Lemon yellow, skin medium thick, leathery, adherence medium, flesh reddish yellow, texture firm, medium juicy, fibers abundant, fine, flavor fair, acid sweet, TSS 15-17%, acidity 0.22-0.24%.

Stone and Seed: Stone size medium long, thin, oval, medium ridged, fibers abundant on ventral edge, length 6-8, width 5-7, thickness 3-4, seed size medium, mono-embryonic.

Yield: Very good bearer.

Leading Characters: Sanglakhi: A local seedling selection, tree medium tall growing, very hard variety, regular heavy bearer, fruit size medium, feel hard and heavy, shape ovatish round, color sea green at maturity, attractive lemon yellow at ripening, lenticels medium dense, size medium, less conspicuous, flesh lemon yellow, fibers abundant, flavor fair, acid taste, highly suitable for pickles and *achar,* good germplasm for rough adaptability.

SAROLI

Origin and Adaptation: Saroli a local selection, most probably selection from Malda, a chance seedling, early season variety, slightly late than Malda, grown on small scale.

Maintainer: MRI, Multan and ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall, medium vigorous, medium branched, semi spreading, tendency for alternate bearing high.

Leaf: Foliage medium dense, light green, leaf elliptical, midrib curvature medium, twisting weak, undulation medium, medium concave, length 18-22, width 5-8, petiole 2-3 cm, tip acute, base acuminate, fragrance medium, new flush dark pink, droopy.

Inflorescence: Medium long, well branched, compact, stalk color medium pink, flower light pink.

Mature Fruit: Light green, size medium, ovalish oblong, neck absent, stalk cavity absent, base obliquely rounded, left shoulder elevated, beak short to medium, sinus absent to weak, apex broadly pointed, fruit length 10-12, breadth 6-8, thickness 6-7 cm, weight 200-350g, skin smooth, bloom medium, lenticels medium dense, size medium, medium conspicuous, whitish.

Ripe Fruit: Light yellow, skin medium thick, adherence medium, flesh yellowish orange, texture soft, fine, less juicy, fibers medium, flavor good, tasty, medium aromatic, TSS 15-16%, acidity 0.20-0.22%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers medium, medium long and soft on ventral edge, length 7-10, width 4-6, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Saroli: a small scale early season variety, most probably selection from Malda, tree medium tall, semi spreading, foliage medium dense, light green, fruit medium, ovalish oblong, lemon yellow at ripening, lenticels medium dense, size medium, medium conspicuous, flesh yellowish orange, fibers medium, flavor good, sweet, aromatic.

SAROLI EARLY

Origin and Adaptation: Saroli Early a local selection, selection most probably same as Saroli from Malda, a chance seedling, early season variety, produced on medium scale in Sindh.

Maintainer: HRI, Mirpurkhas; ARI, Tarnab (GPU, DI Khan).

Tree: Medium large growing, medium vigorous, medium branched, spreading, regular bearer.

Leaf: Foliage medium lax, light green, leaf elliptical, midrib curvature medium, twisting weak, undulation medium, concave, length 20-24, width 5-7, petiole 2-3 cm, tip acute, base acuminate, fragrance medium, new flush dark pink, droop.

Inflorescence: Long, well branched, compact, stalk color medium creamy, flower creamy.

Mature Fruit: Skin color light green, size medium, shape ovalish oblong, neck absent, stalk cavity absent, base roundish, left shoulder elevated, beak absent, sinus absent to weak, apex broadly pointed, fruit length 8-11, breadth 6-8, thickness 6-7 cm, weight 200-350g, skin smooth, lenticels medium, size medium, very conspicuous, whitish.

Ripe Fruit: Light yellow with greenish tinge, skin medium thick, adherence medium, flesh medium yellow, texture soft, fine, less juicy, fibers medium, flavor good, tasty, medium aromatic, TSS 15-16%, acidity 0.20-0.22%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers medium, medium long and soft on ventral edge, length 6-9, width 4-5, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Saroli Early: A local selection, small scale early season variety, selection same as Saroli (from Malda), tree medium tall, semi spreading, foliage medium lax, light green, fruit size medium, ovalish oblong, light green at maturity, light yellow with greenish tinge at ripening, lenticels size medium, density medium, very conspicuous, flesh medium yellow, fibers medium, flavor good, sweet, moderately aromatic.

SAROLI LATE

Origin and Adaptation: Saroli late (*Kala Saroli)* a local selection, most probably selection also from Malda, a chance seedling, late season variety, grown on small scale.

Maintainer: HRI, Mirpurkhas; ARI, Tarnab (GPU, DI Khan).

Tree: Medium large growing, medium vigorous, well branched, spreading, regular bearer.

Leaf: Foliage medium lax, dark green, leaf elliptical, midrib curvature medium, twisting weak, undulation medium, strong concave, length 20-24, width 5-7, petiole 2-3 cm, tip acute, base acuminate, fragrance medium, new flush dark pink, droopy.

Inflorescence: Long, well branched, compact, stalk color light green, flower light green.

Mature Fruit: Sea green, size medium, ovalish oblong, neck absent, stalk cavity absent, base obliquely rounded, left shoulder elevated, beak absent, sinus weak, apex broadly pointed, fruit length 10-13, breadth 6-8, thickness 5-6 cm, weight 250-400g, skin smooth, lenticels medium, size medium, very conspicuous, whitish, latex excessive on picking and of strong turpentine odor.

Ripe Fruit: Yellowish green, skin thick, adherence medium, flesh medium yellow, texture soft, fine, less juicy, fibers medium, flavor good, taste good, medium aromatic, TSS 14-15%, acidity 0.22-0.23%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers medium, medium long, soft on ventral edge, length 8-10, width 3-5, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Saroli late: Local selection, a small scale late season variety, most probably selection from Malda plantation, tree medium large growing, foliage color dark green, fruit size medium, shape ovalish oblong, color sea green at maturity, yellowish green at ripening, lenticels medium, very conspicuous, flesh medium yellow, fibers medium, flavor good, sweet, produce excessive latex on picking which gives strong turpentine odor.

SENSATION

Origin and Adaptation: Sensation an introduction from Florida, late season variety of medium importance.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall, moderately vigorous, spreading, round, regular bearer.

Leaf: Foliage medium dense, medium green, leaf elliptical, drooping, midrib curvature strong, twisting weak, medium concave, undulation weak, big broad leaf size, length 25-30, width 5-8, petiole 5-6 cm, tip acute, base broad, upper surface smooth, veins grooved, fragrance medium, new flush light pink.

Inflorescence: Medium long, medium branched, medium compact, color peach red, flower pink.

Mature Fruit: Skin color purple red, size medium, oval oblique, neck small, stalk medium, cavity absent, base round, apex oblique, tapering, beak short, sinus absent, fruit length 9-11, breadth 5-8, thickness 5-8 cm, weight 250-350g, surface slightly rough, bloom strong, lenticels dense, size small, less conspicuous, whitish, store medium.

Ripe Fruit: Yellow with dark reddish blush, skin medium thin, flesh pale yellow, texture firm, low juicy, fibers low, fragrance low, flavor good, sweet, TSS 18-20%, acidity 0,20-0.21%.

Stone and Seed: Stone size medium, oblong, medium ridged, fibers low, long on ventral edge, length 7-9, width 4-6, thickness 2-3 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Sensation: An introduction from Florida, late maturing mango, tree medium tall growing, spreading, round, regular bearer, fruit size medium, obliquely round, purple red at maturity, yellow with dark red blush at ripening, beak short, sinus absent, surface slightly rough, lenticels dense, size small, less conspicuous, bloom strong, flesh lemon yellow, texture firm, fibers low, low juicy, fragrance low, flavor good, medium sweet, stone medium thick, medium ridged, store well.

SINDHRI

Origin and Adaptation: Sindhri a local selection, a chance seedling, most popular midseason variety grown throughout the mango tract.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Large growing, medium vigorous, medium branched, round, tendency for alternate bearing low.

Leaf: Foliage medium dense, green, leaf elliptical, midrib curvature medium, twisting weak, undulation slight, medium concave, length 16-20, width 4-7, petiole 3-4 cm, tip acute, base roundish, fragrance medium, new flush medium pink.

Inflorescence: Medium long, well branched, compact, stalk color greenish white, flower light green.

Mature Fruit: Light green, size medium large, ovalish oblong, neck very short, stalk cavity absent, base obliquely rounded, shoulders leveled, rounded right slightly higher than left, beak almost absent, rounded, sinus weak to medium, apex rounded to broadly pointed, fruit length 15-17, breadth 7-9, thickness 7-8 cm, weight 330-450g, skin smooth, bloom medium, lenticels medium dense, size medium, medium conspicuous, whitish.

Ripe Fruit: Skin light yellow, medium thick, leathery, adherence medium, flesh pale yellow, texture firm, very fine, less juicy, fibers rare, fine, flavor rich, aromatic, very sweet tasty, TSS 15-17%, acidity 0.14-0.16%.

Stone and Seed: Stone size medium long, thin, oblong to elliptical, deeply ridged, short and sparse fibers on ventral edge, length 10-12, width 3-5, thickness 2-3, seed size medium thin, mono-embryonic.

Yield: Good bearer.

Leading Characters: Sindhri: A local selection, one of the most popular early midseason varieties grown in Sindh and Punjab, matures about a fortnight early in Sindh than Multan area. tree large, moderately vigorous, canopy round, fruit medium large, ovalish oblong, color beautiful and attractive, lemon yellow, lenticels medium dense, medium conspicuous, flesh pale yellow, fibers scanty, flavor excellent, sweet, medium aromatic.

SOBHEDI TING

Origin and Adaptation: Sobhedi Ting a local selection, a chance seedling selection, midseason variety, grown on small scale.

Maintainer: MRI, Multan; ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall, medium vigorous, medium branched, branches semi erect, tendency for alternate bearing medium.

Leaf: Foliage medium dense, color medium green, leaf shape elliptical, midrib curvature medium, twisting weak to very weak, undulation slight, strong concave, length 18-22, width 4-6, petiole 3-4 cm, tip acute, base roundish, fragrance medium, new flush medium pink.

Inflorescence: Medium short in growth, branching low, stalk color light green, flower light green.

Mature Fruit: Sea green, size medium, ovalish oblong, neck weak, stalk cavity absent, base obliquely rounded, shoulders tapering rounded, right slightly higher than left, beak weak, sinus medium, apex rounded to broadly pointed, fruit length 7-10, breadth 5-7, thickness 5-6 cm, weight 250-300g, skin smooth, bloom medium, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Lemon yellow, skin medium thick, adherence medium, flesh pale yellow, texture firm, fine, less juicy, fibers more, flavor medium, taste good, medium aromatic, TSS 15-16%, acidity 0.15-0.16%.

Stone and Seed: Stone size medium big and thick, oblong, medium ridged, fibers abundant long and rough on ventral edge, length 5-7, width 3-5, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Sobhedi Ting: a small scale medium season variety, a chance seedling selection. tree medium tall growing, moderately vigorous, fruit size medium, ovalish oblong, beak weak, sinus medium, color sea green at maturity, lemon yellow at ripening, lenticels medium dense, size small, less conspicuous, bloom medium, flesh pale yellow, texture firm, fibers abundant, flavor medium, sweet, medium aromatic.

SPRINGFELS

Origin and Adaptation: Springfels an introduction from Florida, a seedling selection of Haden, midseason variety, grown on small scale.

Maintainer: MRI, Multan; ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall growing, medium vigorous, medium branched, branches semi spreading, regular bearer.

Leaf: Foliage medium dense, color medium green, leaf shape elliptical, slightly concave, curvature medium, twisting weak, undulation weak, length 18-22, width 4-7, petiole 3-4 cm, tip acute, base acuminate, fragrance medium, new flush medium pink.

Inflorescence: Medium long, well branched, compact, stalk medium pink, flower light pink.

Mature Fruit: Light green with reddish blush, size medium large, ovalish oblong, neck slight, base rounded, right shoulder higher than left, beak short to medium, sinus medium, apex rounded to broadly pointed, fruit length 9-11, breadth 7-9, thickness 6-8 cm, weight 200-300g, skin smooth, bloom strong, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Lemon yellow, colorful with red blush, skin medium thick, adherence medium, flesh lemon yellow, texture firm, fine, less juicy, fibers scanty, flavor medium, tasty, medium aromatic, TSS 17-18%, acidity 0.19-0.20%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers low, medium long and soft on ventral edge, length 5-8, width 4-6, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Springfels: Introduction from Florida, small scale midseason variety, a seedling selection of Haden, tree medium tall, well branched, foliage medium dense, medium green, fruit size medium large, ovalish oblong, light green with reddish blush at maturity, lemon yellow with reddish blush at ripening, lenticels medium dense, less conspicuous, flesh lemon yellow, fibers scanty, flavor good, sweet.

SWARNARIKA

Origin and Adaptation: Swarnarika a local selection, a chance seedling, late season, medium scale commercial variety of Sindh.

Maintainer: HRI, Mirpurkhas; ARI, Tarnab (GPU, DI Khan).

Tree: Large growing, medium vigorous, well branched, round, spreading, tendency for alternate bearing low.

Leaf: Foliage density medium lax, light green, leaf elliptical, curvature medium, twisting medium, undulation medium, medium concave, length 20-24, width 5-6, petiole 2-2.5 cm, tip acute, base narrow, upper surface smooth, fragrance medium, new flush medium pink.

Inflorescence: Long, less branched, medium compact, color greenish white, flower light green.

Mature Fruit: Light green, size large, obliquely oval, neck very short, stalk thin obliquely inserted, cavity slight, base and apex rounded, left shoulder broader, much elevated, groove deep, right slopping, sinus medium, fruit length 12-15, breadth 7-9, thickness 7-8 cm, weight 350-500g, skin slightly rough, bloom medium, shining, lenticels density medium, size medium, medium conspicuous, whitish.

Ripe Fruit: Yellowish green with light crimson patches, skin medium thick, leathery, shining, adherence medium, flesh pale yellow, texture medium fine, medium firm, juice low, fibers rare, fine, flavor good, pleasantly aromatic, very sweet, TSS 19-20.0%, acidity 0.3-0.4 %.

Stone and Seed: Stone size medium, medium thin, oblong to elliptical, medium ridged, fibers few, medium long, sparse on ventral edge, length 9-12, width 3-5, thickness 1-2 cm,, seed medium, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Swarnarika: A less common late season variety of Sindh, tree large, spreading, alternate bearing low, foliage light green, fruit size large, larger than Baganpali, ovalish, light green at maturity, yellowish green at ripening, sinus medium, lenticels medium conspicuous, flesh pale yellow, juice low, fiber few, flavor good, good germplasm for fruit size.

TAIMURIYA

Origin and Adaptation: Taimuriya a local selection, a chance seedling from Dosehri plantation, late season variety, grown on small scale.

Maintainer: MRI, Multan; ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall growing, medium vigorous, medium branched, semi spreading, tendency for alternate bearing high.

Leaf: Foliage medium dense, medium green, leaf elliptical, curvature medium, twisting weak, undulation medium, medium concave, length 18-22, width 4-6, petiole 3-4 cm, tip acute, base acuminate, fragrance medium, new flush medium pink.

Inflorescence: Medium long, well branched, compact, stalk color medium pink, flower light pink.

Mature Fruit: Sea green with dark green longitudinal streaks, size medium, ovalish oblong, neck absent, stalk cavity absent, base obliquely rounded, right shoulder slightly higher than left, beak short to medium, sinus absent to weak, apex rounded to broadly pointed, fruit length 9-11, breadth 6-8, thickness 6-7 cm, weight 200-350g, skin smooth, bloom medium, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Lemon yellow, skin medium thick, adherence medium, flesh pale yellow, texture soft, fine, less juicy, fibers scanty, flavor medium, taste good, medium aromatic, TSS 14-15%, acidity 0.22-0.25%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers medium, medium long and soft on ventral edge, length 7-9, width 4-6, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Taimuriya: a small scale late season variety of Multan area, a chance seedling selection from Dosehri plantation, tree medium tall growing, semi spreading, foliage medium dense, medium green, fruit size medium, ovalish oblong, sea green with dark green streaks at maturity, lemon yellow at ripening, lenticels medium dense, small, less conspicuous, flesh pale yellow, fibers scanty, flavor medium, sweet.

TOMMY ATKINS

Origin and Adaptation: Tommy Atkins an introduction from Florida, a seedling of Haden, major export variety of USA, midseason small scale variety in Pakistan.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium tall growing, medium vigorous, round, regular bearer.

Leaf: Foliage dense, light green, leaf elliptical, droopy, midrib curvature weak, twisting absent, medium convex, undulation weak, big broad leaf, length 25-30, width 6-9, petiole 3-4 cm, tip acute, base acuminate, upper surface smooth, veins grooved, fragrance medium, new flush light pink.

Inflorescence: Medium long, medium branched, semi compact, color peach red, flower pinkish.

Mature Fruit: Dark green with red and heavy purple blush, size medium, oblong-oval, neck small, stalk medium, cavity absent, base round, apex rounded, beak absent, sinus absent, fruit length 9-11, breadth 6-9, thickness 7-8 cm, weight 300-350g, surface medium rough, bloom strong, lenticels medium dense, size medium, conspicuous, whitish.

Ripe Fruit: Orange yellow covered with red and heavy purple blush, skin thick, flesh lemon yellow, texture firm, medium juicy, fibers medium, fragrance medium, flavor fair, sweet, TSS 18-19%, acidity 0.18-0.20%.

Stone and Seed: Stone size medium, oblong, medium ridged, fibers medium all over, long on ventral edge, length 6-9, width 4-6, thickness 2-4 cm, seed medium, mono-embryonic.

Yield: Good bearer.

Leading Characters: Tommy Atkins: Introduction from Florida, midseason, medium tall, spreading, round, regular bearer, foliage dense, light green, fruit medium, ovate round, dark green with red and purple blush at maturity, orange yellow covered with red and purple blush at ripening, beak absent, sinus absent, lenticels dense, less conspicuous, skin medium thick, flesh lemon yellow, texture firm, fibers low, medium juicy, flavor fair, medium sweet, stone medium thick, medium ridged, store medium.

TOTAPRI

Origin and Adaptation: Totapri a local selection, a chance seedling selection, late season variety, grown on small scale.

Maintainer: MRI, Multan; HRI, Mirpurkhas; ARI, Tarnab (GPU, DIK).

Tree: Medium short in growth habit, medium vigorous, medium branched, spreading, regular bearer.

Leaf: Foliage medium dense, medium green, leaf elliptical, midrib curvature slight, twisting and undulation slight, concave, length 18-22, width 4-6, petiole 4-5 cm, tip acute, base roundish, fragrance medium, new flush medium pink.

Inflorescence: Long in size, well branched, compact, stalk color light pink to pink, flower color light pink.

Mature Fruit: Parrot green, size medium, oblongish, neck long, stalk cavity absent, base pointed neck, shoulders tapering rounded, right slightly higher than left, beak medium, sinus medium, apex rounded to broadly pointed, fruit length 12-14, breadth 5-8, thickness 7-8 cm, weight 300-400g, skin smooth, bloom weak, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Light green yellowish with light red blush on shoulders hence the name Totapri (Parrot like fairy), skin medium thick, adherence medium, flesh lemon yellow, texture firm, fine, less juicy, fibers medium, flavor medium, medium aromatic, TSS 15-16%, acidity 0.22-0.24%.

Stone and Seed: Stone size medium big, thick, oblong, medium ridged, fibers medium long and fine on ventral edge, length 8-10, width 3-5, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Totapri: Local selection, late season typical variety, medium bearer, a chance seedling selection, tree medium short in growth habit, spreading, foliage medium dense, color green, fruit size medium, shape oblongish, neck medium to long, color parrot green at maturity, light green yellowish at ripening with light red blush at shoulder, hence the name *Totapri*, flesh lemon yellow, fibers medium, flavor medium, sweet.

YAKTA

Origin and Adaptation: Yakta a local selection from Sindh area, a chance seedling most probably of Sindhri, early season new promising variety.

Maintainer: MRI, Multan; ARI, Tarnab (GPU, DI Khan).

Tree: Large, vigorous, well branched, spreading, regular bearer.

Leaf: Foliage medium to dense, lush green, leaf elliptical, curvature medium, twisting weak, undulation medium, concave, length 20-25, width 5-8, petiole 3-4 cm, tip acute, base acuminate, fragrance medium, new flush light pink with pinkish tinge at leaf base.

Inflorescence: Medium long, branching low, compact, stalk color light pink, flower light pink.

Mature Fruit: Light green, size medium to large, ovalish oblong, neck absent, stalk cavity absent, base rounded, right shoulder slightly elevated than left, beak absent, sinus medium, apex rounded to broadly pointed, fruit length 10-14, breadth 6-9, thickness 6-7 cm, weight 300-400g, skin smooth, medium thick, bloom medium, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Golden yellow distinctive, skin medium thick, adherence medium, flesh yellow, texture soft, fine, less juicy, fibers low, flavor fine rich, medium aromatic, TSS 19-20%, acidity 0.18-0.19%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers low, medium long and soft on ventral edge, length 7-10, width 3-5, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Yakta: Local selection, a chance seedling, from Sindh area, new promising early season variety of Multan area, tree resembles Sindhri, medium tall growing, spreading, foliage medium to dense, color lush green, fruit size medium to large, shape ovalish oblong, light green at maturity, distinctive golden yellow at ripening, neck absent, beak absent, skin smooth, medium thick, lenticels medium dense, size small, less conspicuous, flesh yellow, fibers low, flavor rich, sweet tasty, medium aromatic.

ZAFRAN

Origin and Adaptation: Zafran a Local selection, a chance seedling, early season variety, grown on medium scale, Zafran means Saffron, the name given due to resemblance to the color and fragrance of Saffron.

Maintainer: MRI, Multan; ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall growing, medium vigorous, medium branched, semi spreading, tendency for alternate bearing low.

Leaf: Foliage medium dense, medium green, leaf elliptical, midrib curvature medium, twisting absent to weak, undulation absent to weak, medium concave, leaf broad and bigger, length 28-32, width 6-10, petiole 7-8 cm, tip acute, base acuminate, fragrance strong, new flush medium pink.

Inflorescence: Very long, well branched, compact, stalk color peach red, flower light pink.

Mature Fruit: Light green with light pink blush, size medium, oblongish, neck absent, stalk cavity absent, base obliquely rounded, right shoulder higher than left, beak medium, pointed, sinus medium, apex rounded, fruit length 8-11, breadth 6-9, thickness 5-6 cm, weight 150-300g, skin smooth, bloom strong, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Lemon yellow, skin medium thin, adherence medium, flesh yellow, texture firm, fine, medium juicy, fibers low, but medium near skin, flavor high, taste good, strong characteristic aroma, TSS 15-16%, acidity 0.22-0.24%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers low, medium long and soft on ventral edge, length 6-8, width 3-5, thickness 2-3, seed size medium thick, mono-embryonic.

Yield: Medium bearer.

Leading Characters: Zafran: A medium scale midseason variety, a chance seedling, tree medium tall, semi spreading, foliage medium dense, medium green, fruit size medium, oblongish, color light green with light pink blush at maturity, lemon yellow with light pink blush at ripening, skin smooth, flesh yellow, fibers low, flavor fine rich, strong aromatic resembling saffron.

ZARDALU

Origin and Adaptation: Zardalu a Local selection, chance seedling, midseason variety, grown on small scale.

Maintainer: MRI, Multan; ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall growing, medium vigorous, branched, semi spreading, tendency for alternate bearing high.

Leaf: Foliage medium lax, light green, leaf elliptical, midrib straight, twisting weak, undulation absent, medium concave, size short, length 14-16, width 2-4 petiole 1-2 cm, tip acute, base acuminate, fragrance strong, new flush medium pink.

Inflorescence: Medium long, well branched, compact, stalk color peach red, flower light pink.

Mature Fruit: Light green with basal 1/4th area having crimson red flush, size medium, shape obliquely ovalish, neck medium to long, stalk cavity absent, base roundish, right shoulder higher than left, beak very weak, sinus weak to medium, apex rounded, fruit length 9-11, breadth 7-9, thickness 7-8 cm, weight 200-350g, skin smooth, bloom strong, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Yellowish green with crimson red blush on base, skin medium thick, adherence medium, flesh light yellow, texture soft, fine, medium juicy, fibers medium, flavor medium, taste good, medium aromatic, TSS 18-20%, acidity 0.22-0.24%.

Stone and Seed: Medium thick, oblong, medium ridged, fibers medium, medium, length 6-9, width 5-7, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Zardalu: A small scale late season variety, a chance seedling selection, tree medium tall growing, semi spreading, foliage medium lax, color light green, fruit size medium, shape obliquely oval, color light green with crimson red blush at maturity, yellowish green with crimson red blush at ripening, lenticels medium dense, size small, less conspicuous, flesh light yellow, fibers medium, stone medium thick, medium ridged, flavor medium, sweet.

ZILL

Origin and Adaptation: Zill an introduction from Florida, a chance seedling of Haden, midseason variety, grown on small scale.

Maintainer: MRI, Multan; ARI, Tarnab (GPU, DI Khan).

Tree: Medium tall, medium vigorous, well branched, branches spreading, regular bearer.

Leaf: Foliage medium dense, color light green, leaf shape elliptical, midrib curvature medium, twisting weak, undulation weak, medium concave, length 22-25, width 5-7, petiole 3-4 cm, tip acute, base acuminate, fragrance medium, new flush medium pink.

Inflorescence: Medium long, well branched, compact, stalk color dark pink, flower medium and light pink.

Mature Fruit: Light green with red blush, size medium, roundish, neck short, stalk cavity absent, base rounded, deep ridged, right shoulder elevated, beak medium, sinus medium, apex oblique, fruit length 8-11, breadth 7-9, thickness 7-8 cm, weight 300-350g, skin smooth, bloom strong, lenticels medium dense, size small, less conspicuous, whitish.

Ripe Fruit: Yellow with red blush, skin medium thick, adherence medium, flesh pale yellow to yellow, texture firm, fine, less juicy, fibers little, flavor medium, taste good, medium aromatic, TSS 18-19%, acidity 0.23-0.24%.

Stone and Seed: Stone size medium thick, oblong, medium ridged, fibers little, medium long and soft on ventral edge, length 6-9, width 4-6, thickness 3-4, seed size medium thick, mono-embryonic.

Yield: Good bearer.

Leading Characters: Zill: An introduction from Florida, a small scale late season variety, a chance seedling selection of Haden, tree medium tall, medium vigorous, branches spreading, foliage light green, fruit medium, roundish, light green with red blush at maturity, yellow with red blush at ripening, skin medium thick, lenticels medium dense, size small, less prominent, flesh pale yellow, fibers little, flavor medium, sweet.

BRIEF DATA

	Variety		Leaf size	Fruit size	Stone size	Size	Fruit wt	(TSS) / Acidity
			(cm)	(cm)	(cm)		(g)	(%)
1.	Almas	L W T	20-25 12-15 2-3	10-12 7-9 5-8	7-9 4-5 2-3	M	200-350	(25-27) 0.15-0.20
2.	Alphonso	L W T	18-22 4-5 4-5	8-11 5-7 5-7	6-9 3-4 2-3	M	200-350	(21-23) 0.17-0.18
3.	Anmol	L W T	32-35 5-8 2-3	9-11 6-8 7-8	5-8 2-4 2-3	M	250-350	(26-28) 0.17-0.19
4.	Anwar Retaul	L W T	20-30 4-7 3-6	7-9 5-7 6-7	4-6 2-3 2-3	M	150-350	(26-28) 0.17-0.18
5.	Baganpali	L W T	19-21 5-7 2.0	12-15 7-9 7-9	9-11 3-4 2-3	ML	350-600	(18-20) 0.20-0.40
6.	Baramasi	L W T	30-33 8-10 3-4	9-11 5-7 6-7	5-8 2-4 2-4	M	200-350	(25-27) 0.20-0.30
7.	Budhia Muna Syed	L W T	18-22 5-7 2-3	11-14 7-10 6-7	6-9 2-5 2-3	ML	200-350	(25-27) 0.18-0.20
8.	Burma Surkha	L W T	20-24 6-8 2-3	9-12 5-8 6-7	6-9 2-4 2-4	M	200-350	(25-28) 0.18-0.20
9.	Chaunsa Kala	L W T	18-22 4-7 3-4	12-15 5-8 7-9	8-10 3-5 2-4	ML	250-350	(20-24) 0.16-0.17
10.	Chaunsa Late	L W T	27-30 7-10 3-4	10-14 5-8 5-7	7-10 3-5 2-4	ML	400-550	(16-18) 0.16-17
11.	Chaunsa Rampuri	L W T	27-30 8-10 2.0	10-12 6-8 6-7	7-8 3-4 2-3	ML	300-400	(18-20) 0.14-0.17
12.	Chaunsa SB	L	25-28	11-14	8-10	ML	300-	(18-20)

		W T	8-10 1.5-2	6-8 6-7	5-7 2-4		400	0.17-0.18
13.	Collector	L W T	18-20 5-7 2-3	11-14 9-12 8-11	9-11 3-5 3-4	ML	400-500	(13-15) 0.30-0.32
14.	Dosehri	L W T	18-22 4-7 3-4	8-10 6-8 4-7	5-8 2-4 2-4	SM	150-200	(21-22) 0.17-0.19
15.	Early Gold	L W T	16-20 4-6 2-3	10-12 6-8 6-7	7-9 4-5 2-3	ML	225-400	(16-18) 0.18-0.20
16.	Fajri	L W T	18-20 4-6 3-4	12-15 7-10 7-9	8-10 3-5 3-4	ML	350-700	(16-18) 0.19-0.21
17.	Gulabe Khas	L W T	20-25 4-6 3-4	9-11 6-9 6-7	5-8 3-4 3-4	M	250-300	(16-17) 0.27-0.29
18.	Haden	L W T	17-22 4-7 3-4	9-12 8-10 8-9	6-9 4-6 3-4	ML	300-400	(17-18) 0.18-0.20
19.	Jagirdar	L W T	19-20 7-8 3-4	8-10 7-9 5-6	6-8 3-4 2-3	M	150-250	(11-12) 0.29-0.31
20.	Keitt	L W T	18-22 4-7 2-3	10-12 7-9 7-8	8-9 3-4 3-4	ML	250-400	(16-17) 0.26-0.28
21.	Kensington	L W T	25-30 6-8 2-3	9-12 7-9 7-8	7-9 3-5 3-4	ML	300-400	(18-19) 0.20-0.22
22.	Langra	L W T	18-20 5-7 3-4	9-11 6-8 6-7	7-9 4-6 2-3	M	250-350	(20-21) 0.18-0.19
23.	Malda	L W T	16-18 3-5 4-5	9-11 6-8 6-7	7-8 5-6 2-3	M	250-350	(12-14) 0.30-0.32
24.	Malda Late	L W T	20-22 5.5 4.0	5-8 4-6 4-5	3-5 2-4 2-3	SM	160-200	(20-22) 0.17-0.18
25.	Maya	L W	22-25 6-8	9-12 8-10	7-8 5-6	ML	300-450	(16-17) 0.20-0.22

		T	3-4	8-9	2-3			
26.	Mome K	L W T	20-24 5-8 2-3	10-14 6-8 6-8	7-10 4-6 2-3	ML	300-450	(18-19) 0.18-0.20
27.	Neelum	L W T	20-25 4-7 3-4	7-10 6-8 6-7	5-7 3-5 1.5-2	M	130-250	(12-14) 0.19-0.21
28.	Pope	L W T	20-25 4-6 3-4	10-13 6-9 6-7	8-10 4-6 2-3	ML	250-400	(18-20) 0.17-0.19
29.	Retaul Late	L W T	22-27 5-7 3-5	8-10 6-8 6-7	5-7 3-5 3-5	M	150-350	(16-17) 0.16-0.18
30.	Salehbhai	L W T	20-25 5-8 4-5	9-12 5-8 5-6	6-8 4-6 3-5	M	250-350	(17-18) 0.20-0.22
31.	Sanglakhi	L W T	20-30 4-7 3-6	8-10 7-9 7-8	6-8 5-7 3-4	M	250-350	(15-17) 0.22-0.24
32.	Saroli	L W T	18-22 5-8 2-3	10-12 6-8 6-7	7-10 4-6 3-4	ML	200-350	(15-16) 0.20-0.22
33.	Saroli Early	L W T	20-24 5-7 2-3	8-11 6-8 6-7	6-9 4-5 3-4	M	200-350	(15-16) 0.20-0.22
34.	Saroli Late	L W T	20-24 5-7 2-3	10-13 6-8 5-6	8-10 3-5 3-4	ML	250-400	(14-15) 0.22-0.23
35.	Sensation	L W T	25-30 5-7 5-6	9-11 5-8 5-8	7-9 4-6 2-3	M	250-350	(18-20) 0.20-0.21
36.	Sindhri	L W T	16-20 4-7 3-4	15-17 7-9 7-8	10-12 3-5 2-3	ML	350-450	(15-17) 0.14-0.16
37.	Sobhedi Ting	L W T	18-22 4-6 3-4	7-10 5-7 5-6	5-7 3-5 3-4	M	250-300	(15-16) 0.15-0.16
38.	Springfels	L W T	18-22 4-7 3-4	9-11 7-9 6-8	5-8 4-6 3-4	M	200-300	(17-18) 0.19-0.20

39.	Swarnarika	L W T	20-24 5-6.0 2-2.5	12-15 7-9 7-8	9-12 3-5 1-2	ML	350-500	(19-20) 0.30-0.40
40.	Taimuriya	L W T	18-22 4-6 3-4	9-11 6-8 6-7	7-9 4-6 3-4	M	200-350	(14-15) 0.22-0.25
41.	Tommy Atkins	L W T	25-30 6-9 3-4	9-11 6-9 7-8	6-9 4-6 2-4	M	300-350	(18-19) 0.18-0.20
42.	Totapri	L W T	18-22 4-6 4-5	12-14 5-8 7-8	8-10 3-5 3-4	ML	300-400	(15-16) 0.22-0.24
43.	Yakta	L W T	20-25 5-8 3-4	10-14 6-9 6-7	7-10 3-5 3-4	ML	300-400	(19-20) 0.18-0.19
44.	Zafran	L W T	28-32 6-10 7-8	8-11 6-9 5-6	6-8 3-5 2-3	M	150-300	(15-16) 0.22-0.24
45.	Zardalu	L W T	14-16 2-41-2	9-11 7-9 7-8	6-9 5-7 3-4	M	200-350	(18-20) 0.22-0.24
46.	Zill	L W T	22-25 5-7 3-4	8-11 7-9 7-8	6-9 4-6 3-4	M	300-350	(18-19) 0.23-0.24

L Length (cm)
W Width (cm)
T Thickness (cm)
M Medium
ML Medium large
SM Small to medium

MANGO DESCRIPTOR

	Factor	**Description**
2.	Main branch attitude	i. Erect ii. Horizontal iii. Drooping
iv.	**Young leaf** anthocyanin color	i. Pink ii. Brown
v.	Color intensity	3. Weak 5. Medium 7. Strong
vi.	Full developed leaf attitude	i. Horizontal ii. Drooping
1.	Leaf length (cm)	
2.	Leaf width (cm)	
3.	Leaf shape	i. Ovate ii. Elliptic iii. Oblong
4.	Leaf color	i. Yellow green ii. Green iii. Brown green iv. Dark green
5.	Fully developed leaf twisting of blade	i. Absent ii. Present
6.	Leaf shape in cross section	i. Straight ii. Concave
7.	Leaf curvature of midrib	i. Absent ii. Present

	Factor	Description
8.	Leaf position of curvature of midrib	i. Apical ii. Basal
9.	Leaf relief of upper surface	i. Smooth ii. Raised
10.	Leaf undulation of margin	3. Weak 5. Medium 7. Strong
11.	Leaf shape of tip	i. Attenuate ii. Acuminate iii. Acute
12.	Leaf shape of base	i. Acute ii. obtuse iii. Rounded
13.	Leaf fragrance	i. Absent ii. Present
14.	Leaf length of petiole	3. Short 5. Medium 7. Long
15.	Inflorescence length	3. Short 5. Medium 7. Long
16.	**Inflorescence** color of axis and branches	i. Whitish ii. Yellow green iii. Yellow iv. Pale orange pink v. Pink dark pink red purple
17.	Inflorescence pubescence on axis and branches	i. Absent ii. Present

1.	**Factor**	**Description**
18.	Inflorescence pubescence	3. Sparse 5. Medium 7. Dense
19.	Old flower anthocyanin coloration	1. Absent 3. weak 5. Medium 7. Strong
20.	Mature fruit length	1. very short 3. short 5. Medium 7. long 9. very long
21.	Fruit width	1. Very narrow 3. Narrow 5. Medium 7. Broad 9. Very broad
22.	Fruit shape in cross section	i. Narrow ii. Elliptic iii. Broad elliptic iv. Circular
23.	Fruit skin color	i. Only green ii. Green and purple iii. Green and red iv. Green and orange v. Green and pink
24.	Fruit non-green area	i. Small ii. Medium iii. Large
25.	Fruit bloom on skin	i. Inconspicuous ii. Conspicuous

1.	**Factor**	**Description**
26.	Fruit density of lenticels	3. Sparse 5. Medium 7. Dense
27.	Fruit conspicuousness of lenticels	3. Weak 5. Medium 7. Strong
28.	Fruit size of lenticels	3. Small 5. Medium 7. Large
29.	Fruit skin	1. Smooth 2. Rough
30.	Fruit stalk cavity	1. Absent 3. Shallow 5. Medium 7. Deep
31.	Fruit neck	i. Absent ii. Present
32.	Fruit prominence of neck	3. Weak 5. Medium 7. Strong
33.	Fruit shape of left shoulder	i. Rounded upward ii. Rounded outward iii. Rounded downward iv. Sloping downward v. Falling abruptly
34.	Fruit shape of right shoulder	i. Rounded upward ii. Rounded outward iii. Rounded downward iv. Sloping downward v. Falling abruptly

1.	**Factor**	**Description**
35.	Fruit groove in left shoulder	1. Absent 3. Short 5. Medium 7. Long
36.	Fruit lumpiness on left shoulder	i. Absent ii. Present
37.	Fruit sinus	1. Absent 3. Weak 5. Medium 7. Strong
38.	**Ripe fruit** predominant color of skin	i. Green ii. Yellow green iii. Green and yellow iv. Yellow v. Yellow and orange vi. Orange yellow and red vii. Orange and red viii. Red ix. Orange and purple x. Red and purple xi. Purple
39.	Ripe fruit brilliance of skin color	i. Absent ii. Present
40.	Ripe fruit pattern of skin color	i. Even ii. Speckled
41.	Fruit speckling of skin color	3. Weak 5. Medium 7. Strong
42.	Skin thickness	3. Thin 5. Med 7. Thick

1.	**Factor**	**Description**
43.	Skin adherence	3. Weak 5. Med 7. Strong
44.	**Flesh** color	i. Greenish yellow ii. Pale yellow iii. Yellow iv. Pale orange v. Orange vi. Dark orange
45.	Flesh firmness	3. Soft 5. Med 7. Firm
46.	Juiciness	3. Dry 5. Medium 7. Juicy
47.	Flesh texture	3. Fine 5. Med 7. Coarse
48.	**Fruit fiber** beneath the skin	3. Low 5. Med 7. High
49.	Fruit flavor	i. Absent ii. Present
50.	**Stone** relief of surface	i. Grooved ii. Smooth iii. Ridged
51.	Stone length of fiber on cheeks	1. Very short 3. Short 5. Med 7. Long 8. Very long

1.	**Factor**	**Description**
52.	Stone fiber density	1. Very sparse 3. Sparse 5. Med 7. Dense 9. Very dense
53.	Fiber texture	3. Fine 5. Med 7. Coarse
54.	Stone thickness of endocarp	1. Very thin 3. Thin 5. Med 7. Thick 9. Very thick
55.	**Seed** polyembryony	i. Absent ii. Present
56.	**Time** of first flowering	3. Early 5. Med 7. Late
57.	Time of fruit maturity	1. Very early 2, Early 5. Med 7. Late 9. Very late

MANGO ORIGIN AND MORPHOLOGICAL DESCRIPTION

Origin

The Mango belongs to the family *Anacardiaceae*, which is a family of mainly tropical species comprising 73 genera and about 850 species, with a few representatives in temperate regions. The other important fruit trees in this family are pistachio (*Pistacia vera*), cashew nut (*Anacardium occidentale*), *kaju*, also in this family are most of the poisonous plants of the world. The genus *mangifera* consists 69 species mostly restricted to tropical Asia, but the fruit of species other than *indica* are inferior.

The authentic place of origin remains shrouded in the antiquity. It has been in cultivation for 4000 years or even more. Most of the authorities agree that the common mango originated as an alloploid (Chromosomes 2n=40) in its native home which was suggested as Indo-Pak subcontinent and further in the east to Burma or possibly the Malay Archipelago (Popenoe, 1920) and Vavilov (1926).). However the present school of thought considers the center of origin and diversity of the genus *Mangifera* in Southeast Asia. Truly wild common mango trees have been recorded in Bangladesh, Assam valley and Myanmar peninsula. Due to its cultivation and dissemination for thousands of years, semi-wild trees can be found in the forests throughout the subcontinent. The species *Mangifera indica* received the greatest attention in the Indo-Pak subcontinent since times immemorial. A large number of horticultural varieties of high standard were developed which have spread throughout the world. The mango has been cultivated, praised and even revered in its homeland since Ancient times. Buddhist monks are believed to have taken the mango on voyages to Malaya and Eastern Asia in the 4th and 5th Centuries B.C.

Tree

The mango Tree is medium to large; erect growing commonly ranging 10-40 m in height, evergreen with a symmetrical, broad, rounded canopy, which shows considerable variation in different varieties. However, the shape, compactness and branching pattern of the canopy also depend on soil conditions, nutrition and the space available for its development. Mango trees make handsome and beautiful landscape specimens and shade trees. Tree bark is usually dark-brown to black, exudes a transparent dark yellowish brown resin mixed with a gum. Mango trees, grown from seeds are known as “seedlings” or *desi*, which are sympodially branched. Grafted trees on the other hand are comparatively dwarf with spreading

branches. The tree is long-lived. Seedling trees have been reported to live more than 100 years whereas grafted trees live only up to 80 or less. Some *desi* mango trees being known have been reported to be 300 years old and still fruiting.

Root

The mango tree owns a long tap root system, which depending on the type of the soil can grow 6-8 m or more deep in the ground. The tap root system is further supported by a dense mass of additional fibrous feeder roots, which are also called anchor root and develop at the base of the trunk or slightly deeper in the soil.

Growth Flushes

The mango tree does not grow continuously as the case is with majority of other trees but has a unique habit of producing periodic rosette flushes of young leaves. The new flushes of young leaves show various colors varying from green, light green, yellowish green, pale yellow, pinkish, or tan-red and can be used as indicator character for variety identification. Initially the emerging leaves hand straight down but later they take on a more horizontal position and turn green. There are two to five flushes a year, depending on the climatic conditions. In Pakistan the growth flushes normally appear from February-October.

Leaf

The leaves of mango are simple, alternately arranged, usually 15-50 cm in length The phyllotaxy is usually 3/8 but as the leaves are arranged very closely at the tips they appear to be whorled and variable in shapes like oval-lanceolate, lanceolate, oblong, linear-oblong, ovate, obovate-lanceolate or roundish-oblong with apex ranging from acuminate to nearly rounded. The margin is usually entire, sometimes slightly undulated and wavy, rarely twisted or folded. The length and breadth varies depending on variety and growth conditions. The leaves appear in flushes. The upper surface is shining and dark green while the lower is glabrous light green. The leaf stalk is swollen at the base and usually 2-10 cm long. The color of young leaves generally vary form variety to variety like tan-red, pink, yellowish green or yellowish-brown. As the leaf grows the color passing through many different shades finally changes to green and dark green at maturity. The mango leaves usually give out mild to strong turpentine smell generally specific to a particular variety. The odor can be absent to weak or strong.

Flower

The flowers are borne terminally on inflorescences originating from a bud, together with the new leafy sprout and are narrowly to broadly conical panicles up

to a 50 cm long depending upon cultivar and environmental conditions available during growth and development period. The inflorescences are borne on one-year-old shoots. The color of the panicle may be yellowish-green, light green with crimson patches or with pink flush on branches. It is generally pubescent but sometimes may be glabrous. The panicle usually carries 500-1500 flowers and rarely up to 7000 yellowish or reddish flowers which are predominantly male (25-98%) and the remainder hermaphrodite depending on the cultivar and temperature during its development period.

The calyx is usually five partite; the corolla consists of five pale yellow petals, which are twice as long as the calyx. On fading, the petals become pinkish. The androecium consists of stamens and staminodes, of which usually one, or rarely two, are fertile and the rest are sterile. The color of the anther is pink, which turns purple at the time of shedding.

The ovary is sessile, one-celled, oblique and slightly compressed in its lateral aspect. The pollen grains are of variable in size and shapes. Pollen if not separated from the flowers remains viable for 50 hours in a humid atmosphere at 18°-23°C. The stigma remains receptive for 48-72 hours after flower opening.

Flowering and Bearing

Blooming is strongly affected by weather. Dry conditions stimulate flowering and rainy weather discourages it. Flowering starts in Pakistan in December-January up to March. It is about a month earlier in Sindh as compared to Punjab. Time of flowering also varies in different varieties. In early blooming varieties like Dosehri, it has been found that a single mechanical deblossoming in the first bud-burst stage, induces subsequent development of panicles with less malformation, more hermaphrodite flowers, and, as a result, a much higher yield of fruit.

The mango is insect cross-pollinated tree hence the gametic seedlings are the product of cross-pollination, which differ from the mother tree. Mango flowers are visited by a large number of insects like fruit flies, bats, wasps, wild bees, butterflies, moths, beetles, ants and various bugs seeking the nectar and help transfer the pollen. But a certain amount of self-pollination also occurs. Honeybees do not especially favor mango flowers but keeping of honeybee colonies in the orchard definitely improve pollination. Heavy rains wash off pollen and thus prevent fruit setting.

Fruit

The mango fruit is a large fleshy drupe. The skin is the epicarp, the flesh or

pulp is the mesocarp, and the stone is the endocarp. The seed is inside the hard endocarp, which is longitudinally ribbed, pale yellowish-white, somewhat woody shell, flattened, oval or kidney-shaped. Within the shell (stone) is the starchy seed, which may be monoembryonic (usually single-sprouting) or polyembryonic (usually producing more than one seedling). All the commercial mango varieties grown in Pakistan are monoembryonic and therefore do not reproduce true from the seed, so they are generally propagated vegetatively. The polyembryonic varieties found in certain other countries of the world can reproduce true from the seed.

The fruit exhibits great variability in size, shape, color, presence of fiber, flavor, quality, taste and several other characters. The development of a small conical projection laterally towards the apex known as beak is a most important characteristic feature of the mango fruit. The beak is quite prominent in some varieties, less so in others, while almost absent in some varieties. A sinus varying in dimensions is always present just above this beak. The skin is leathery, aromatic, gland-dotted and at maturity its color exhibit different mixtures of green, yellow, and red shades. It may be smooth or rough. The size of fruit in different varieties of mangoes is extremely variable. Some are as small as plums, while others weigh as much as 2kg or more. The flesh ranges from pale-yellow to deep orange. The flesh may be scanty or much more fibrous with a flavor ranging from very sweet to subacid to tart. Fibers may be more pronounced in fruits grown with hard water and more application of chemical fertilizers. Some have a "turpentine" odor and flavor, while others are richly and pleasantly fragrant. In some varieties a thick fluid oozes out from the stalk, which has turpentine like smell, and is irritating allergenic in nature.

Varieties

The present day commercial varieties are the result of gene mutations and natural inter-varietal cross-pollination followed by selection of chance seedlings for higher quality characteristics carried out by the mango growers for the last 4,000 to 6,000 years. The commercial exploitation of improved selected varieties started on limited scale about 400 years back when the vegetative propagation and grafting was initiated. The Mughals particularly Emperor Akber was very fond of mangoes and had established a special mango grove called Lakhbagh (100,000 mango trees) at Dharbangha. About 500-1,000 varieties have been stated selected and cultivated in Indo-Pak subcontinent. Major commercial varieties cultivated and produced in different mango growing countries of the world follow:

Important Horticultural Varieties

In Pakistan mangoes are monoembryonic and seedlings differ invariably from each other. The wide variation among the seedling progeny has been responsible for the evolution of a large number of excellent varieties. These natural selections further multiplied by vegetative means gained popularity as choice varieties and have been produced on commercial scale. Almost all the horticultural varieties have been selected by the mango growers in different areas of the subcontinent, therefore the nomenclature is not systematic and so much confusing that one variety carries many names at various places and in some cases one name is applied to several varieties.

The nomenclature of mango varieties grown in Indo-Pak subcontinent is very difficult to understand. The naming of new varieties or even existing varieties in new localities have been unsystematically based on many aspects like the mango grower who selected the new type; the name of the person who liked it the most; after the names of kings or leaders; the palace of origin; color of the fruit skin; flavor of the pulp; shape of the fruit, time of maturity or duration of fruit bearing.

It has been reported in a nursery catalogue (Ahmad, S 1989) as any as 864 different varieties with 1692 different names have been mentioned along with their fruit characteristics. Some other catalogues with 1000 varieties have also been reported. Mares (Hays. 1953) collected as many as 500 different varieties from various parts of the subcontinent.

It has been said that the mango varieties are beyond number because of genetic nature of the tree. As a result of cross-pollination there are millions of seedling trees each one differing the other. Some of the excellent ones having been selected turned into horticultural varieties assuming a distinct varietal name. The following is a list of important commercial varieties of mangoes produced in various mango growing countries of the world:

COUNTRY	**CULTIVARS UNDER CULTIVATION**	
Australia	Banana	Keitt
	Early gold	Kensington Pride
	Glenn	Kent
	Haden	Zill
	Irwin	
Bangladesh	Aswina	Kishan Bhog

	Fazli	Kohinoor
	Gopal Bhog	Kua Pahari
	Himsagar	Langra
	Khirsapati	Mohan Bhog
Brazil	Bourbon	Maco
	Carlota	Magoada
	Coracao	Rosa
	Espada	Tommy Atkins
	Itamaraca	
China	Baiyu	Macheco
	Guixiang	Sannian
	Huangpi	Yuexi No. 1
	Huangyu	
Costa Rica	Haden	Mora
	Irwin	Tommy Atkins
	Keitt	
Ecuador	Haden	Kent
	Keitt	Tommy Atkins
Egypt	Alphonso	Mabrouka
	Bullocks Heart	Pairie
	Hindi Be Sennara	Taimour
	Langra	Zebda

Guatemala	Haden	Tommy Atkins
	Kent	
Haiti	Francine	Madame Francis
India	Alphonso	Kishen Bhog
	Amrapali	Langra
	Bangalora	Mallika
	Banganapalli	Mankurad
	Bombay Green	Mulgoa
	Bombay	Neelum
	Chaunsa	Pairi
	Dashehari	Samar Behisht Chaunsa
	Fazli	Suvarnarekha
	Fernandian	Totapari
	Gulab khas	Vanraj
	Himsagar	Zardalu
	Kesar	
Indonesia	Arumanis	Golek
	Cengkir	Madu
	Dodol	Manalagi
	Gedong	Wangi
Kenya	Boubo	Batawi
	Ngowe	
Malaysia	Apple Mango	Kuala Selangor 2
	Apple Rumani	Maha-65

	Arumanis	Malgoba
	Golek	Tok Boon
Mali	Amelie	Kent
Mexico	Haden	Palmer
	Irwin	Sensation
	Kent	Tommy Atkins
	Manila	Van Dyke
Myanmar	Aug Din	Sein Ta Lone
	Ma Chit Su	Shwe Hin Tha
Pakistan	Alamas	Neelum
	Alphonso	Retaul late
	Anwar Retaul	Sindhri
	Baganapalli	Saroli
	Chaunsa	Sensation
	Chaunsa late	Swarnarika
	Dosehri	Totapari
	Gulab Khas	Yakta
	Fajri	Zafran
	Langra	Zardalu
	Malda	
Peru	Haden	Kent
	Keitt	Tommy Atkins

Philippines	Binoboy	Pahutan
	Carabao	Pico
	Dudul	Senora
	Manila Super	
Singapore	Apple Mango	Kaem Yao
	Arumanis	Mangga Dadol
	Golek	
South Africa	Fascell	Sensation
	Haden	Tommy Atkins
	Keitt	Zill
	Kent	
Sri Lanka	Dapara	Peterpasand
	Hingurakgoda	Petti amba
	Karutha Colomban	Vellai Colomban
	Malwana amba	Willard
	Parrot Mango	
Thailand	Choke Anand	Ngar Charn
	Kao Keaw	Okrong
	Keow Savoey	Pimsenmum
	Nam Doc Mai	Rad
USA	Keitt	Tommy Atkins
	Kent	
Venezuela	Haden	Kent

Keitt Tommy Atkins

MANGO PRODUCTION

Climate

The mango is evergreen, deep rooted large tropical tree and the climate has great influence on its growth and development. It is naturally adapted to tropical and sub-tropical climates. Temperature, rainfall, wind velocity and altitude are the main climatic factors, which influence its growth and fruiting. It cannot stand severe and prolonged frosts, particularly the young trees in their growth flushes are damaged if exposed to a temperature that causes freezing of sap in their tissues. However mature trees can withstand short periods of frost. Flowers are more tender and are damaged more readily. When terminal inflorescences are frost-killed, usually new inflorescence may grow later in the season. Freedom from rain, clouds and frost during flowering period is very important. High temperature by itself is not so injurious to mango, but in combination with low humidity and high winds, affects the trees adversely.

Summer temperatures also affect the production of good quality mangoes. Cool summer temperature with average minimum temperature 18^0C delay the ripening of fruit. It is stated that the mango trees produce largest crop and most brilliant fruit in regions where there is well defined dry season corresponding with the blooming and ripening periods. Rain during the blooming season (November to March) is deleterious as it stimulates vegetative growth but interferes with flower production and encourages fungus diseases of the inflorescence and fruit. Cyclones and windstorms during the fruiting season can play havoc causing excessive shedding of immature fruit.

Freedom from rain, cloudiness and frost during flowering is particularly important and dry hot conditions during ripening help improve the quality of the mangoes. An annual rainfall of 76 to 127 cm at suitable intervals is desirable for a good crop. Under stress conditions application of artificial irrigation at critical stages will be necessary.

Soil

The mango tree is not too particular as to soil conditions but thrive best in deep and well drained loam type of soils. The subsoil must be free of hard pan, sticky clay, water logged and saline conditions. The pH of the soil must be within 5.5 to 7.5 but not more than 8.7. If the soil is heavy, very fertile, and moist and too well fertilized, the tree will show vigorous vegetative growth and may be deficient in flowering and fruiting. The soils sandy in nature are equally good for mango production. Soils with saline and alkaline conditions are not suitable for

successful mango production.

Tree Spacing

The requirements of spacing depend on the habit of the mango cultivar and the type of soil as different varieties differ in tree size particularly in lateral dimensions and accordingly the varieties are spaced 25 to 60 ft (8-18 m) between trees. Most important factor capable of influencing tree spacing is the growth and development pattern of different mango varieties. Some mangoes are vigorous growing like Langra, Sindhri, Fajri while others are comparatively dwarf in nature as Sensation and Neelum. Closer planting will ultimately reduce the crop except where tree size is controlled by hedging and topping.

The young trees should be placed in well prepared and sufficiently enriched 3x3x3 ft pits. The general recommendation for pit dressing is 20 kg of well rotten Farm Yard Manure or compost, 0.5 kg of supper phosphate, o.5 kg of sulphate of potash to be mixed with the soil of the pit before plantation. Plant firmly is the rule. After placing the nursery tree in the pit care must be taken not to over press the tree so that the earth ball is not damaged. Over compressing the soil may form cracks in the earth ball, which may cause dry up of the young trees. The wrapping material around the earth ball if used must be removed carefully before planting.

Time of Planting

The best time for planting the mango nursery trees is just after a few heavy showers or at close of the rainy season or when it has cooled down and there is good humidity in the atmosphere. In Pakistan the recommended seasons for planting of mango are spring and monsoon but the former is preferred because the trees are dormant and suffer little from ill effects of transplanting. However, it is very short period and is followed by a hot dry spell of low humidity. Therefore, a large number of fresh transplanted field trees are liable to suffer dry stress if not carefully irrigated. In humid regions like lower Sindh and Hyderabad the best season for field planting nursery trees would be August-September.

Interculture

Weeds not only compete for soil moisture and nutrients but also provide harbor and protection for a number of insects, pests and diseases. Weed control must be a regular feature of orchard growing. Weeds can be controlled by interculture, hoeing or through chemical means by spraying suitable weedicides. During early period of establishment and vegetative growth the young trees need more attention and care for protection, weeding and regular irrigation.

Intercropping

In general intercropping in mango groves is not recommended. Principally there should be no intercropping in full bearing mango orchards. However during early periods after planting when the mango trees are young and have just started bearing intercropping can be practiced. During early stages intercropping may offer the farmer a good chance of earning additional income from crop yields. The cultural practices applied for intercropping may also help control severe infestation of weeds.

For intercropping tall growing, excessively leafy and exhaustive crops like maize, sorghum, sugarcane, millet should not be grown at all. Besides being exhaustive in nature, they tend to shade the young trees, which can affect the growth and development of the young trees adversely. The tall growing succulent crops will not only attract different insects and pests but also may provide harboring locations for viruses and other pathogens. Careless land preparation practices for intercropping may increase chances of damaging young fragile trees.

In case intercropping is unavoidable the crop selected for intercropping must be a crop low in height, non-exhaustive, of short duration and not very succulent. Most of the farmers prefer *berseem*, which requires more number of irrigations than required by the mango trees; therefore *Berseem* should not be cultivated. Pulses and trailing vegetable crops can be a good alternative. Pulses being leguminous will not compete the primary crop plants but will help enrich fertility of the soil. While intercropping adequate space must be left crop free for cultural operations. Organic matter plays a very vital role in improving the soil quality and increasing crop yields. It also helps improve the quality of the fruit. Therefore green manuring with a suitable crop like *guara, janter, sainji* may be included in crop rotation.

Fertilization

Mango plantations need a comprehensive nutrient program including all the major elements along with micronutrients and mineral tonics. Mangos require high nitrogen fertilization in the early years of their growth and development but after they begin to bear, the fertilizer should be higher in phosphate and potash. Fertilizer requirements and application formulas will vary with the type of soil and age of the tree. Ground fertilizers can be supplemented by foliar nutrients including zinc, manganese, copper and other micronutrients.

The general recommendation for application of fertilizer to a bearing tree includes 100 kg well rotten FYM, 1.5 kg N, 1.5 kg K and 150 g of zinc sulfate per tree applied in August-September. FYM can also be applied in December and the others in January. Various commercial formulations of micronutrients for foliar

application are available in the market and can be applied in consultation with the fruit specialists and agricultural extension workers. The most appropriate stage of tree growth for foliar application is considered when they are active (April, August-September). The recommended time for foliar spray is in the morning or late in the afternoon.

Irrigation

Irrigation requirements of the mango orchard depend largely on the soil and climatic conditions, amount of rainfall and the growth and development stage of the tree. Moreover the mango tree is evergreen and transpire large amount of water. Irrigation intervals may be long during monsoon season depending upon the amount and frequency of the rainfall. But during hot summers and frosty winters the irrigation frequency may be quite high so as to protect the trees from hot, dry and cold stresses.

Young trees require regular irrigation for the first 3 or 4 years to help develop trunk and taproot. They may need irrigation on a week or 10 days interval. In commercial plantations, irrigation of bearing trees is withheld before the start of blooming and flowering. But after blooming the trees are given irrigation at 2-4 week intervals. Under stress conditions or non-availability of sufficient water for flood irrigation the most appropriate method is the use of sprinklers. In Florida, USA the mango orchards are irrigated by means of overhead sprinklers which not only save irrigation water but also provide frost protection when needed.

Pruning

Usually mango tree does not require any pruning except for training and improving the form when young. The branches, which are apt to crowd each other, may be removed. For facilitating spraying and harvesting, in some countries, the trees are cut at 4.25 m height. Grafted mangos may set fruit within a year or two from planting. The trees are then too weak to bear a full crop and the fruits should be thinned or completely removed.

When malformation of inflorescences is met with, all the affected shoots should be cut back 60 cm below the discolored core of the shoot and sprayed with any suitable pesticide. To help control alternate bearing, some of the flowering panicles are cut back to ensure a better crop the succeeding year.

For training and improving the structural form of a mango tree the following procedure has been recommended by the mango specialists:

In the nursery, after grafting, the scion should be cut down at about knee height (2.5 Ft.) i.e., after attaining about two flushes. The lateral buds will sprout

abundantly.

Then leave four branches on the tree at equal distance well spaced in the four directions and the rest will be pruned at their bases. In this way a well structured bowl shaped tree will be produced in the nursery. At this stage the tree is ready to be transplanted in the field.

After transplanting, when trees assume the hip height, then cut all the branches and leave only eight well balanced / spaced branches to grow further.

When these trees will attain about shoulder height, then cut all the branches leaving about sixteen well spaced branches to make an open structured tree.

The trees trained in this way will be well structured, balanced and in a bowl shape which will allow air and sun light to pass through, resultantly insects / diseases will not proliferate freely there.

For the bearing trees, pruning is required to remove the crossed branches crowding the center of the tree. Dead, diseased branches and malformed inflorescence should be removed and buried under or burnt. Pruning of well formed bearing trees is usually limited to the removal of dead branches.

Pruning of the old unproductive trees is also advised to rejuvenate them, which is only confined to dehorn the trees (12 Ft.) and secure the growth from the main limbs to establish the same structure as mentioned above.

Maturity and Harvesting

In mangoes the rate of fruit development and maturity is much faster then citrus and stone and pome fruits. Mangos normally reach maturity in 4 to 6 months from flowering. Mangoes will not ripen normally if they are harvested before reaching the fully mature-green stage on the tree: they will lack sweetness and be poor in flavor. Some varieties like Dosehri are early in maturity whereas others are medium or late in maturity. The fruit is considered ready for picking when it is fully mature and had attained normal full-grown size.

There are no simple reliable tests to indicate when mangoes are ready for harvest. A number of indicators have been suggested for evaluating maturity, but they are not reliable for all cultivars in all growing conditions. They must be interpreted in the light of local experience. They include:

- The fruit stalk will break easily with a slight pull or jerk. If a strong pull is necessary, the fruit is still somewhat immature and should be given few more days before harvesting.
- The height of the "shoulders" of the fruit with respect to the point of

the stem attachment; when shoulders are above the stem attachment, the fruit is mature;

- The fruit color changes from dark green to light green as the fruit matures; yellowing of the green fruit occurs as ripening begins, appearance of red color on the skin of some varieties is not a dependable maturity index;
- When the "cheeks" of the fruit are full, it is mature;
- In mature fruit the sap flowing from the cut stem at harvest is thick and does not flow freely.
- No single one of the indicators can be regarded as a reliable test of maturity for all cultivars. Observation and experience are the best guides for mango pickers.

Small trees can be picked by hand. A ladder can be used for picking fruits from medium height trees. But for tall trees a long bamboo or pole with an iron hook and picking bag which can hold few fruits is commonly used. Falling of mature fruits causes bruising, discoloration and spoiling at ripening. The picked fruit should not have the fruit stalk longer than 5 mm. Some other changes associated with ripening include starch to sugar conversion resulting increased sweetness, decreased acidity and increased carotenoid contents and aroma strength.

Harvested mangoes should be placed in field containers of not more than 25 kg capacity for movement to the packing shed. The fruit should be kept in the shade and handled carefully at all times after harvest.

Grading

Before packaging, all damaged, decaying, immature and ripe fruits should be removed. Grading is desired for all type of markets. For grading the uniformity of shape, color of skin, fruit size, and firmness of flesh should be taken into consideration. Freedom from decay and defects like sunburn, skin abrasions, stem end cavity, chilling injury and insect damages. Packing materials and packing size may be followed according to the market requirements.

There are large differences among mango varieties in flavor quality and strength indicating sweetness or sourness of the aroma, textural quality of the flesh, fiber contents.

Treatments

Mangoes do not normally need any post-harvest treatment for local marketing. Fruits for urban supermarkets may need to be washed if they are heavily contaminated with latex or dust. If they are washed, they should be dried at once by spreading them in a single layer on a raised mesh or slatted rack, in the shade but with good air circulation. In no circumstances should the wet mangoes be piled up on the ground or left exposed to the sun to dry. Anthracnose is the principal cause of post-harvest decay in mangoes. It is a latent infection, spread by raindrops which collect spores from the tree branches and spread them on to the fruit, where they germinate only after harvest as the fruit ripens. The disease respond to some extent to a post-harvest fungicide dip alone having Benomyl 0.1%. On a commercial scale, mangoes for export are sometimes dipped in hot water containing fungicide for the control of this disease.

Packaging

The packaging in Pakistan in general is quite unsophisticated and rough in wooden crates or paper cartons. The fruits are usually packed 10-12 kg in each container without grading and washing. In Florida and some other countries for local and international markets, a certain number of fruits are packed in standardized cartons after proper washing and grading. Fruit can be loose packed or in a single layer with dividers. Boxes should not be over packed or the fruit in lower boxes may suffer damage from the weight of boxes above. Under packing will result in excessive movement of the fruit within the box, which may cause bruising or abrasion.

Ripening

In Pakistan mangos are picked quite green without caring for proper maturity. All the fruit on a mango tree do not mature at one time but it is common practice with the grove contractors particularly in Punjab to pick all the fruit of a tree once. The fruit is then shifted to markets in containers or loose in trucks.

For quick and uniform ripening and developing attractive color, ethylene treatment is a common practice in Pakistan. Ethylene treatment causes green mangos to ripen and develop full color in 3-5 days depending on the degree of maturity, whereas untreated fruits require 10 to 15 days (pal). Some growers in Florida depend on ethylene treatment.

Storage

Mature-green mangoes have only a short life at ambient temperatures. Green

matured mangoes can be stored for only about two weeks at 13^0C. At temperatures below this they suffer chill damage and fail to ripen afterwards. At ambient tropical temperatures they ripen in four to seven days. At such temperatures they can be held for only two to four days when ripe.

Food Value

Food Value Per 100 g of Ripe Mango Flesh as determined by the Food Technologist Mango Research Institute, Shujabad follows:

Nutritional Status of Pakistani Mangoes (Ripened)

COMPONENT	PARTS PER 100 g EDIBLE FLESH
Food energy	69.0 calories
Moisture	82.5 g
Protein	2.1 g
Fats	0.5 g
Carbohydrates	14.1 g
Fiber	0.4 g
Ash	0.4 g
Calcium	19.0 mg
Phosphorus	15.0 mg
Iron	0.2 mg
Sodium	7.0 mg
Potassium	45.0 mg
Vitamin B_1	0.1 mg
Vitamin B_2	0.2 mg
Niacin	0.2 mg
Vitamin C	20.5 mg

Mango Research Institute, Shujabad

MANGO PROPAGATION

Mango like most of other tropical fruit trees can be propagated both sexually and asexually. The mango is a cross-pollinated and heterozygous tree. The seedlings obtained from stones collected from such trees may show quite different growth and morphological characteristics from that of the mother tree. Moreover there will be enormous variability in the progeny population. To get true to type trees with qualities of the parent tree, asexual propagation through budding, grafting or tissue culture is practiced.

The mango trees propagated sexually through seed are called *seedlings, Tukhmi or desi* trees. The trees of horticultural varieties produced using vegetative means like grafting are called *grafted*, *paiwandi or Qalmi* trees. The vegetative propagation of superior mango varieties using technique of grafting has been reported to be in use in Indo-Pak since centuries.

Seed Propagation

Seed propagation is now restricted to only raising rootstocks which are not true to type because of monoembryonic nature of the seed. Most of our local mango varieties are monoembryonic; that is, the embryo usually produces a single sprout, a natural hybrid from accidental crossing, and the resulting fruit may be inferior, superior, or equal to that of the parent tree.

Mangos in some Southeast Asian countries are mostly polyembryonic. In the state of polyembryony, generally, one of the embryos in the seed is a hybrid (zygotic); whereas the others (up to 4) are vegetative in nature. These vegetative growths can faithfully reproduce the true characteristics of the parent variety. However due to high resemblance at early stage the distinction is not easy.

Stone Collection

It is easy to raise mango seedlings from seed. Germination rate and vigor of seedlings are highest when seeds are taken from fruits that are fully ripe. Generally in Pakistan the nurserymen collect the mango stones from local trees, mango orchards and market places. The stone collection is repeated every year during mango season without caring for the variety or quality of the stone. Although in Pakistan there are no scientific studies about the influence and effect of rootstock on the production and quality of the fruit. However to produce pedigreed, healthy and genuine nursery trees the seed stones must be collected from mango trees registered and notified for the production of rootstock.

The stones should be fresh, as the stones are rather perishable and unable to

stand much drying. Preferably fresh stones obtained from fruits which have ripened on the trees should be used for sowing. They are usually planted during June through August. The viability and germination of mango stones decline very quickly. It has been reported that the mango stones sown within one month of extraction germinate about 80% and none after that. The stones prior to sowing should be washed pulp free and preferably treated with 1 percent organomercurial compound to check the incidence of fungal attack causing collar rot. The treatment will help reduce mortality of young seedling trees and grafts.

Stone Storage

If the seed cannot be planted within a few days after its removal from the fruit, it can be covered with moist earth, sand, or sawdust in a container until it can be planted, or kept in charcoal dust in desiccators with 50% relative humidity. Seeds stored in the later manner have shown 80% viability even after 70 days. Nevertheless it has been reported that the mango seed a “stone” is recalcitrant in nature, meaning that they cannot tolerate desiccation, drying or low temperature, and consequently do not store well and give poor germination.

Stone Sowing

To raise the mango seedlings, mature seed stones taken from ripe and healthy fruits are spread in well prepared seedbeds. The stones are placed in the seedbeds without leaving any space among them. The stones after placing in the nursery beds are covered preferably with a thin layer of rotten compost, leaf mould or well rotten Farm Yard Manure. Care must be taken that the compost or manure is well rotten and free of insects, pests and diseases. The nursery beds must be prepared in semi shaded areas. The piece of land selected for nursery bed must be clean, free of soil borne diseases, insects and pests.

The stones should be sown by placing them on back and not flat. The plumule point is kept upwards so that straight tap root and stem are produced. The seedbed may be covered with plastic sheet which is supposed to accelerate germination, conserve moisture and help control weeds. The open beds are water sprinkled regularly to keep them moist.

Stone Germination

Normally under natural open conditions the seeds germinate within 3 weeks of sowing. When the stones start germinating the plastic covering if used should be removed. In the initial stages the color of young seedling leaves remains coppery red or purple red. When the leaf color changes from coppery or purple red to green, the seedlings should be carefully lifted and transplanted in the standard

nursery beds keeping row to row distance at 30-45 cm and 25-30 cm from tree to tree. The young seedlings should be handled carefully and planted in the soil firmly without leaving any space around. The most suitable time for seedling transplanting is soon after the start of monsoon season in August. The transplanting of the nursery seedlings should follow irrigation immediately. This will help establish the seedlings in the soil and continue growing without any serious shock.

The seed stones can also be planted in situ at proper distance in the nursery bed. But in this case there is liability of excessive gaps and weed attack. The gap filling is not easy and if managed the new seedlings will be much younger, the growth and development will not be uniform creating problems in the later stages. Moreover it will not be economical as it will require more labor to cover larger area for weeding, irrigation and nursery bed management.

Rapid Germination

To speed up germination, the seed stones can be sown after carefully opening of the husk with a sharp knife, taking care not to cut the kernel, which is then placed on its ventral (concave) edge and not flat. In well moist warm conditions placing the seed with 1/4th protruding above ground level has given good results. The sprouting occurs in 8 to 14 days. The seed stones sown directly may take three to four weeks to germinate. The seed stones can also be sown in pots of suitable size. The pot sowing helps easy handling as its hard bottom checks the tap root growth.

Disadvantages of Seedling Trees

There is immense variation in mango seedlings raised even from a single tree due to highly cross pollinating nature of the mango tree. It has been observed that the seedling trees are generally very heavy bearers of fruit but the fruit size and quality is usually inferior and does not fetch good price in the market. The seedling trees have comparatively much longer juvenile growth period and come in to bearing (6 or more years before flowering and fruiting) than trees vegetatively propagated (by grafting or other means).

The other drawbacks of seedling trees include their rapid growth, extra height and large size which create obstacles in providing plant protection measures and also make fruit picking more time taking, cumbersome and difficult. A large variation in the maturity of the fruit on the seedling trees has also been observed as the fruit do not mature at the same time thus affecting the marketing negatively.

Vegetative Propagation

To reproduce true to variety superior mangoes vegetative propagation is necessary. The vegetative methods of mango propagation have been in practice in Indo-Pak Sub-continent since ancient times. Vegetative propagation is preferred over seedage method to produce superior mango fruit of uniform size and quality, maturing at the same time and comparatively easy to harvest. The graftage methods of mango propagation are also preferred as such trees take 2-3 years less than seedling trees to in to bearing stage.

Various traditional methods of vegetative propagation are practiced by mango growers in Pakistan. Choice of rootstock is important but due to cross pollination and monoembryonic nature of the seed it has not received the attention of the researchers as deserved. The vegetative methods of mango propagation can mainly be divided in to the following groups:

1. Grafting
2. Layering
3. Cutting
4. Top working
5. Tissue culture

Grafting

Inarching or Approach Grafting

It is the most commonly used technique of vegetative propagation of superior mango varieties with a guarantee that the offspring produced will be identical to the parent tree. This technique involves grafting the terminal portion of a branch on a selected tree onto a seedling understock. This technique of grafting is successful even on difficult-to-graft species because both the scion and the seedling understock remain attached to their own root systems during the period of graft union formation. Normally after 8-10 weeks the scion grafted to the understock is cut away from the selected tree and left for hardening off before planting in the field.

For inarching the seedling to be selected as understock should be carefully examined for growth characteristics. Any seedling with symptoms of vegetative malformation should be culled and rejected for inarching.

Inarching or approach-grafting although is useful for obtaining true-to-type grafted varieties but has some disadvantages. The root stock seedling nursery trees

are to be brought near the scion tree; watering and care of the inarched nursery trees; only one tree is obtained from a long scion shoot which is uneconomical and it requires more labor and time.

Veneer Grafting or Side Grafting

Veneer grafting, Side grafting or Detached Method of grafting is one of the best method of preparing true-to-type cultivars as it is easier, more successful with high percentage of graft success, more economical and ideal for establishing *in situ mango* orchards. In this method 1-2 year old seedlings are selected and the scion is also selected of similar thickness preferably a non-flowering terminal shoot.

Specially prepared scion is inserted into a suitably designed slanting downward and inward cut made on rootstock seedling about 15cm above the crown portion of the stock. The graft union is tied lightly usually with a strip of transparent polythene sheet. When scion shoot on the understock starts growing giving out a vigorous sprout, the rootstock just above the graft union is cut back. After graft care and maintenance is done in the nursery.

Bud Grafting

The method of developing mango nursery trees using bud grafts has very little application in commerce. In this method a wedge shaped scion is inserted in to a similar split on the rootstock, sealed with wax and tied lightly with polythene strip.

Layering

This method is not used on commercial basis. In this case the shoots are ringed about 3cm wide. On the upper portion of the ring IBA (Indole butyric acid) 5000-10,000 ppm is applied and covered all over with some suitable moist material and wrapped in a polythene film. The polythene sheet is fastened on top and bottom side to make it air-tight ensuring that there is no loss of moisture through evaporation. Generally rooting is initiated within two months of operation and become visible through the polythene film. The air layered shoot is then cut from the mother tree by giving 3 successive cuts at week to 10 days interval.

Cutting

Shoot cuttings, even when treated with growth regulators have not shown encouraging results. However under good conditions of temperature and moisture and treatment with growth regulator 40% success has been achieved. Best results are shown by cuttings obtained from mature trees. But neither cuttings nor air

layers develop good root system therefore the horticulturists do not recommend them for establishing commercial plantations.

Top Working

Old trees of inferior types are top-worked to better cultivars in Indo-Pakistan sub-continent by either side-grafting, inarching, budding or crown-grafting. For top-working the tree-top is beheaded to stubs on the major limbs of the tree. Such trees need protection from sunburn until they are strong enough.

Tissue Culture

This is the most successful and economical method of mass production of true-to-type cultivars of fruit and ornamental crop varieties but in mangoes it has not so far been applied on commercial scale. However clonal propagation of superior varieties through tissue culture is expected to provide a good alternative for producing true to type nursery trees.

Bud Sport

Sometimes on vegetative propagated trees mutations have been noticed in the form of bud sports. This phenomenon is very important for the fruit growers and researchers because the fruit in such cases may differ radically from the others on any grafted tree. The resultant fruit may be larger in size, superior in quality or otherwise. The foliage on such branches commonly show quite unlike characteristics found on other branches of the same tree. Such branches if noticed must be identified and the fruit carefully examined. The fruit may be a new excellent variety and the bud can provide the scion for further multiplication of the new superior variety.

PESTS AND DISEASES

Several insects, pests and diseases attack mangoes at all stages of life. Not only the fruit but all the parts of the tree, namely, trunk, branch, twig, leaf, petiole, and flower are attacked. Some of the major insects, pests and diseases follow:

PESTS

There are more than 500 species of insects, mites and nematodes, which have been reported to be infesting mango trees all over the world. Out of these quite a large number of insects and pests have been found attacking the mango to varying degrees in Indo-Pakistan subcontinent. The major pests of mango causing considerable damages to the crop are given here briefly:

Mango Hopper

Mango hopper, *Am ka tela* is considered as the most serious and widespread pest attacking the crop throughout the mango belt. It has been identified as *Idioscopus clypealis, Idioscopus nitidulus* and *Amritodus atkinsoni*. It is a jumping insect causing a particular noise when the population is great. It has the characteristic habit of hiding during daytime in dense foliage and during winter in the cracks of bark for over wintering. This pest has been recorded as attacking the mango almost in all the mango growing countries and sometimes in severe cases is responsible for the total failure of the crop.

Large number of nymphs and adults puncture and suck the sap of tender parts; particularly the attack is severe at the blooming time thereby reducing the vigor, causing curling and drying of the infested tissue. They also damage the crop by secreting a sweet sticky substance which encourages the development of the fungus *Maliola mangiferae*, which affects adversely the photosynthetic activities of the leaves. Close planting and neglected groves encourage its spread.

The best control of the pest is through integrated pest management (IPM); combining regular spray of suitable pesticides, use of biological control by predators and improved cultural practices like weed free clean cultivation and pruning of overcrowding and overlapping branches before blooming. The best time for spraying insecticides is when the flowers have not opened, as at later stages of blossoming, insecticides may affect fruit setting. Main emphasis should be laid to completely sweep out its population before flowering. One spray in the month of August / September after fruit harvesting has proved very effective.

Mango Mealy Bug

Mango mealy bug *(Drosicha mangiferae)* is another major pest of mango which causes heavy losses to the tree and the crop. Nymphs and adults suck the tree sap from panicles and leaves. The fruit stalks are rendered so weak that with the slightest jerk by birds or wind shake the fruit drop. The mealy bugs exude a sticky sweet viscous fluid, the honeydew which encourages development of sooty mould.

The female crawl down the tree in the month of April-May and enter in the cracks in the soil for laying eggs in large numbers. The eggs are found in clusters of 300-400 all encased in white egg sacs like pouches of silky material. The eggs are deposited in installments over a period of 7-15 days after which the female dies. The eggs hatch in November-December and newly hatched pink to brown colored nymphs crawl up the tree, insert their needle like projections in the tender parts and start sucking the sap.

IPM control measures are the most suitable and include cultural, mechanical, chemical and biological methods. To stop crawling of nymphs on the tree, slippery bands (Polythene) or sticky bands should be fastened around the main stem of the tree. Dusting of some suitable pesticide in the soil around the trunk kills the newly hatched nymphs on coming in contact with the chemical. Some predators have also been reported in controlling the nymphs. The cultural practices include flooding of orchards in October, hoeing and ploughing the field underneath the trees in November will help killing the eggs and also exposing them to predators.

Mango Fruit Fly

The mango fruit fly *(Daccus dorsalis, D. zonatus* and *D. correctus)* is among the most serious pests in many mango growing countries. It causes serious damage to mature fruits. The female punctures the outer wall of the mature fruits with the help of its sharp pointed long ovipositor and insert eggs in small clusters inside the mesocarp of mature fruits. The fly on an average lays 100-150 eggs in its entire life. The eggs are white, tiny and hatch in 1-2 days and the maggots are white, broader at the posterior end and pointed at the anterior end. After hatching, the larva feeds on the pulp of fruit, which appears normal from outside, but drops down finally. By the time, the maggots attain their full development, the fruit rots and drops down for pupation; the maggots leave the affected fruit and disperse, making an arch of their body by bringing the two ends together and then jump. Pupal period lasts for 7-10 days. The adults can live from only a few to 300 days or even longer.

The control measures include spraying with suitable pesticides, hanging of

traps containing recommended chemicals during fruiting. The recommended cultural practices like collection and proper disposal of the infested and dropped fruits, ploughing the orchards, releasing of parasite and predators, and use of pheromones are helpful in reducing the pest population.

Inflorescence Midge

The mango inflorescence midge (*Erosomyia indica)* has now become a major pest of mango fruit. In some pockets its attack becomes very serious, causing severe damage to mango crop. It attacks both the inflorescence and the small fruits.

The adult midges are minute flies, which are short lived and die within 24 hours of emergence after copulation and oviposition. The flies lay eggs singly on inflorescence. The eggs hatch within 2-3 days. Upon hatching, the minute maggots penetrate the tender parts on which the eggs have been laid and feed on them. The floral parts finally dry up and shed. The larval period varies from 7-10 days. The mature larvae drop down into the soil for pupation. The pupil period varies from 5-7 days. There are 3-4 overlapping generations of the pest, spread over the period from February-April. Thereafter, as the weather conditions turn unfavorable, the mature larvae undergo diapauses in the soil instead of pupating. They break diapauses on the arrival of favorable conditions in following February.

The midge infests and damages the crop in three different stages.

i. The first attack is noticed at the floral bud burst stage. The eggs are laid on newly emerging inflorescence; the larvae tunnel the axis and thus destroy the inflorescence. The mature larvae make small exit holes in the axis of the inflorescence and slip down into the soil for pupation.

ii. The second attack of the midge takes place at fruit set. The eggs are laid on the newly set fruits and young maggots bore into these tender fruits, which slowly turn yellow and finally drop.

iii. The third attack is on the tender new leaves encircling the inflorescence.

The most damaging one is the first attack in which the entire inflorescence is destroyed even before flowering. The inflorescence shows stunted growth and its axis bends at the entrance point of the larvae. It finally dries up before flowering and fruit setting.

Cultural and chemical control may be observed at the same time to manage the insect successfully. The cultural control includes ploughing and hoeing of the

orchards at the stage the larvae pupate in the soil. It will expose pupating as well as diapausing larvae to sun's heat, which kills them.

The larvae don't have the ability to bore into the soil and search for natural cracks and openings to pupate in the soils, so, the ploughing of the soil cracks and holes may stop them to complete their life cycle.

Irrigation of the orchard at this stage also kills most of the population present in the soil.

The chemical control includes soil application of suitable pesticide like Chloropyriphos, which kills the pupating as well as diapausing larvae in the soil. The doses of the insecticides need to be standardized. The insecticide in the soil should be applied after monitoring larval population on white sheet below the tree.

Gall Forming Insects

Cecid flies *diptera* have been observed to lay eggs in mango leaves. The larvae develop inside the tissues of the affected leaves and form galls. Physical injury to the trees, caused by heavy oviposition and continuous drain of the sap by larvae feeding inside the galls, renders the leaves useless. In cases of heavy attack, the tree itself suffers considerably. The adult flies appear in March and lay eggs in the tender leaves. The eggs hatch in 3-4 days and larvae continue to develop until July. Control measures include spraying of the trees with suitable pesticide like Supracide or Methyl parathion.

Scales

Scale insects belong to the family *coccidae* and are scale like in form. They are further divided into two groups based on the nature of the scale. Lard armored and soft unarmored. The former have a shield like covering and vary in shape, while the later are unprotected and are easy to control. The damage is done by the young known as crawlers and by the females. They usually attack on tender shoots, twigs, leaves and flowers and suck the vital sap of the tree. These exude the honeydew on which sooty mould develops. The honeydews being sugary in nature also attract a number of other insects such as ants, flies and wasps. The affected trees lose their vitality, cease to grow, and the leaves turn yellow and may even die.

Usually the attack of these scale insects is severe on young mango trees, particularly in their nursery stage and on tree up to three years of age. The female lays beneath her body 650-700 eggs, which hatch in 2-3 days. Most of the larvae crawl; soon die and about 250 crawlers migrate from beneath the parent and settle

on leaves and stems, generally on veins. There are two egg laying periods, one from January-June and other from September-December. The crawlers can live for 4-5 days without food, whereas adults can do so for about 2 months. In severe cases pruning of infected branches is suggested. Spray of suitable chemical like Supracide or Methyl parathion gives excellent control of the insect.

Termites

Microterms obesi and *odoktotermes wallonensis* also known as white ants are social insects that live in colonies. The colony consists of workers, soldiers, the royal couple king and queen, winged forms, nymph and eggs. The damage to mango crop is done by workers and soldiers, which run up earthen galleries along the trunk and main branches of the tree. The termites destroy the bark tissues within these galleries as they creep through; young trees up to 3-4 years of age suffer the greatest damage. The workers cover a long distance inside the soil in search of food and attack the feeding root, which they chew and destroy; this may result in the death of the trees. The control measures include manually scrapping of termite colonies and by using of appropriate chemicals. Use of unrotten FYM should be avoided.

DISEASES

Powdery Mildew

Powdery mildew *(Oidium mangiferae)* is one of the most serious diseases of the mango affecting almost all the varieties in almost all mango growing areas of Pakistan. The decline in fruit yield has been noticed 25-80 %. The disease occurs mostly during warm and humid weather and prevalence of such weather during blooming and flowering causes heavy crop losses. It affects the flowers, fruits, axils, leaves and stalks and causes young fruits to dehydrate and fall. It manifests itself by the appearance of wefts of white mycelium on the affected parts. The whole surface is later on covered with a powdery substance, which is blown away by even a slight disturbance caused by the wind. The powdery mass consists of millions of spores. It is controllable by regular spraying with some suitable fungicide.

Anthracnose

Anthracnose caused by *Colletotrichum gloeosporioides (Glomerella cingulata)* is a very common and widespread fungal disease of mangoes. It is also known as blossom blight. It causes serious damage to flowers, leaves, twigs and fruits, both young and mature. The later shows black spots externally and the

corresponding flesh areas are affected. Numerous oval or irregular brown spots of different sizes express the disease on the leaves.

Under humid or damp atmospheric conditions, these spots increase at a fast pace and form elongated necrotic areas, which when old, become ruptured. Young leaves are most susceptible to its infection. If the petioles are affected they turn gray or black, the leaves droop down, become dry and are ultimately shed, leaving a black scar on the twig. The tips of very young branches are first to show the symptoms. Black and necrotic areas are formed on the affected twigs, which begin to dry out from the tips downwards. Younger trees may completely dry out but on the older trees, only the young branches are affected.

Diseased twigs or leaves, which fall on the ground, are a prolific source of fresh infection. Its advance form the tree completely dries up and dies. Another destructive manifestation of anthracnose or blossom blight is its attack during flowering season, which causes blackening, and finally shedding of flowers. The disease also has the potential to infect the mango fruits in storage. The severity increases with excessive rains and humidity. The fruit affected by the fungus cannot be marketed as it rots soon after picking. The control measures must be taken in advance of flowering.

Applying copper-based fungicides can control it. Application of fungicopper paste in linseed oil to the cut stem has proved very useful. Sterilizing storage compartments with Formalin 1:20 helps control the disease spread during storage.

Dieback

Dieback *(Botryodiplodia theobromae)* is one of the serious diseases of mango. The disease is characterized by drying of twigs and branches followed by complete defoliation, which gives the tree an appearance of scorching by fire. The control measures include pruning of the diseased branches 5-8 cm below the affected portion and spraying with copper oxychloride (0.3%) on infected trees.

Sudden Drying of Mango Trees

The quick declining of the mango plants showing drying of bark (Xylem & Phloem) at the collar site (just above and below the soil surface of the plant), coming out black colored stink liquid from the stem and dying of the tree within a few days is becoming a serious problem. The yellowing and drying of roots is a rather response to the imprisoned plant's transportation system. The roots function at the expense of carbohydrates coming from the leaves through phloem, due to blockage of xylem and phloem by the secretions of the pathogens, and degradation of the cells at the collar site, the movement of water and nutrients from roots to

the top of the tree and the transportation of the carbohydrates from the upper portion to the roots is stopped. Consequently, upper part of the tree (canopy) and the lower portion (root system) die at the same time.

This problem is appearing in every corner of the mango tract and is a raising threat to the industry. The disease has been observed for the last few years. Its intensity is increasing day by day and becoming a challenge for research scientists and growers. The following facts have been collected through primary survey and studies on the development of the problem:

Observations

1. No commercial variety has been found resistant to this disease.
2. The problem is more common in the ignored and canal irrigated orchards.
3. Over irrigation of the orchards is conducive for the development of the disease.
4. Problem is more common near the canal bank.
5. Problem is more severe in the orchards where *Sheshum* trees are planted as wind breaks.
6. Already dieback affected plants show black colored stink liquid from the stem.
7. Inter cropping with cotton, rice, sorghum and sugar cane seems to be major contributing factors.
8. This malady is being observed in the orchards where mango growers are not using Farm Yard Manure and the soil is deficient in organic matter.
9. Irrigational water has been observed as a main source for its spread.
10. The incidence of this disease has been recorded as 0.4 – 5.0 % in District Multan.
11. This menace can be observed during the whole year but it is more conspicuous in the months of April – July.
12. The pathogen enters through the injured roots to attack on the collar portion where it collapses the phloem and xylem tissues. Hence, translocation of the food material is chocked. Resultantly, wilting of the tree takes place.
13. Oozing of the blackish material on the stem near the collar portion has

been observed as primary symptom of this disease. This stage prior to wilting can easily be judged through close examination of each tree in the orchard.

Causes

To explore and find out the causal organism soil, roots and bark samples from affected plants were collected at Research Station Shujabad and analyzed in the laboratory. The fungi isolated from infected parts follow:

Roots	Phytophthora sp. Fusarium oxysporum
Bark and bleeding points	Phytophthora sp. Dothiorella mangifereae Dothiorella dominicana (Isolated and purified at Mango Research Station Shujabad and identified at AARI-Faisalabad)

In the light of current research work, the causal organism of this disease is not very well understood and probably a fungus i.e., Pyhtophthora sp. seems to be pathogen according to symptoms observed on the tree but its pathogenicity is still to be determined.

Control

In the absence of definite causal organism exact remedial measures and chemicals can not be recommended. However in the light of preliminary evaluation some preventive measures have been proposed:

i. Immediately root up the completely died and showing 80% disease severity on the collar portion of the plants.

ii. The plants with less than 80% of the disease severity must be treated in the following manners.

iii. Make the basin around its effected area to save irrigational water from contamination and exposure of the soil to sunlight has exerted additional effects.

iv. Scratching of the infected portion of the stem with sterilized knife

followed by pasting with Metalaxyl @ 1:20 is recommended.

v. Use of Metalaxyl @ 250g / plant as soil treatment as precautionary measure may reduce the disease up to the considerable extent.

vi. Addition of Copper Sulphate @ 250 – 500 g or Benlate @ 100 g / plant in the soil may also help lower disease intensity.

vii. Some other chemicals such as Formalin with Sodium chloride and Farm Yard Manure have been reported for good results but needs more research and standardization.

MANGO DISORDERS

The mango crop has some special disorders, which need systematic research studies for finding exact reasons and effective control measures. The major ones follow:

Alternate Bearing

Young mango trees when they start taking fruit bear regularly. After 10-12 years most mango varieties tend toward alternate, or biennial bearing. The term biennial, alternate or irregular bearing means the tendency of mango trees to bear a heavy crop in one year and a poor or no crop in the succeeding year. It is said that when a tree produces heavy crop in one season, it gets exhausted and unable to produce new flush for the following season. The shoots produced in the first year fruit in the second year. These shoots are more often than not 9 to 12 months of age. The problem has been attributed to the causes like genetical, physiological, environmental and nutritional factors.

This is a complex problem and the factors affecting the flowering and alternate bearing may be genetic, environmental, physiological and nutritional. Alternate bearing may be due to genetic reasons as some of the commercial varieties like Baramasi, Neelum, Totapari and Fazli bear regularly. The environmental factors like frost, heavy rains, hail storm, severe attack of insects pests and diseases at blooming time may affect blooming resulting in light crop that year and a heavy crop the next year. A heavy crop may exhaust the tree and failing in to recoup, a light crop next year. The branches that fruit one year may rest the next year. The physiological reasons may include an imbalance in the carbohydrate-nitrogen ratio, deficiency of certain minerals, more shoot growth in one year and less in the next, old age of the tree, low intensity of blooming.

There are no established control measures and it needs a great deal of research by mango research organizations. However improved cultural practices, including de-blossoming (removing half the flower clusters), ringing, girdling, pruning, and control of insects, pests and diseases have been found helpful in lessening the problem. It has been reported that almost any treatment or condition that retards vegetative growth will have this effect. Spraying with growth-retardant chemicals has been tried, with inconsistent results. It is also reported that soil application of Paclobutrazol (PP333) in the month of September resulted in early flowering with higher fruit set and yield. The following control measures are generally recommended:

1. Application of additional fertilizers during the on year especially

the nitrogenous fertilizer, due to which maximum number of shoots will be obtained which will ultimately bear fruit in the next year (off year).

2. Thinning of the fruit in on year will encourage maximum vegetative growth.
3. Early picking of the fruit during on year.
4. Protection of plants from natural hazards.
5. Foliar application of chemicals i.e.2, 4-D (25 PPM) at marble stage of the fruit in off year.
6. Pinching of 25% inflorescence during on year induces the shoots to grow in the same season, bears in the next year, and helps in minimizing the irregular bearing.
7. The attack of powdery mildew, anthracnose and mango hopper etc. should be checked by providing effective plant protection measures. This will also aver alternate bearing cycle.
8. Ringing and girdling should be done which bring C/N ratio more favorable for the formation of fruit buds on the seasonal shoots. Ringing should be done in August, just before the bud differentiation in off year. However, it is not feasible on large scale.
9. Prolific varieties regular in bearing should be cultivated.

Mango Malformation

Malformation is becoming a very serious disease rather threat to mango production in Pakistan. It affects both of inflorescence and vegetative buds. The malformed panicles remain unproductive and are characterized by a compact mass of male flowers, greenish in color and stunted in growth. The main and secondary rachis become swollen and short and bear flowers with relatively larger bracts, sepals and petals as compared to normal flowers. The malformed panicles remain intact on the trees for a considerable period.

The exact cause and control of the malady is yet to be established. However the disease is attributed to the combined action of many factors like cultural practices, nutritional imbalance, mites, fungal, viral infection and hormonal imbalance. However now it has been shown that the causal organism of the disease is *Fusarium subglutinans*. The other countries facing this problem are India, South Africa, Egypt, El Salvador, Nicaragua, Mexico, Brazil and

Venezuela. The pathogen is easily spread by grafting and infected nursery trees are a common mode of dispersal

Good orchard management and clean cultural practices can reduce disease incidence, particularly planting of pathogen free nursery trees. Removing and burning the inflorescence has been the only remedy to reduce inoculum level. It has been found that malformation can be reduced by a single spray of NAA (200 mg in 50 ml alcohol with water added to make 1 liter) in October, and deblooming in early January.

Quick Decline

During the recent years, a new malady has been observed whereby apparently healthy looking trees collapses within days. That is why; it is named as "quick decline". Otherwise, this disease is actually known as collar rot, stem rot or crown rot. This disease does not demonstrate any sign initially, until it covers the noteworthy segment of the stem at collar site. The black spots on the stem come into view at the start and emergence of the black fluid from the stem is the next indicator by which this syndrome can be recognized. Some time these acnes on the stem are not conspicuous which may be overlooked by the growers. Afterward the collar portion of the infected tree looks dark brown and is found putrid. Gumming out of the bark can also be noticed in advance arena. The rottening of collar progresses and engulfs the whole stem. This is a stage where collapse occurs. The affected portions also emanate a stink when scratched.

Exact causes of the malady are not definite. However the fungi isolated from the infected parts include: Phytophthora spp; Fusarium solani; Fusarium oxysporum; Diplodia /botryodiplodia; Polyporus spp. and Dothiorella dominicana.

The infection starts from the roots, moves upward rapidly, and spreads at the collar portion and stem. The movement of water and nutrients from roots to the top of the tree and the haulage of carbohydrates from upper portion to the roots are blocked. Consequently, tree upper part (canopy) and lower portion (root system) collapse simultaneously.

This disease may become visible in any time of the year and its treatment must be done immediately. The following control measures proposed by the specialist pathologists may help control the disease:

Root up the severely infected or dead trees immediately and expose the soil to the sunlight, treat the same area after a weak and its sided four trees with Metalaxyl.

Watch the trees carefully and note blackish spots on the stem, which are the

initial symptoms of this disease. Scratching of the infected portion of the stem with knife followed by three pastings with Metalaxyl @ 1:20 at 15 days interval is recommended (slaked lime can also be mixed to increase the adhesive quality of the slurry).

Because *Phytophthora* occurs sporadically, it is seldom economical to treat entire orchard with soil treatment on a regular preventative basis. Therefore, it is best to target those sections of the orchard having *Phytophthora* problem. Use of Metalaxyl @ 2.0 g / sft as soil treatment as precautionary measure may reduce the infection. Addition of copper sulphate @ 250-500 g/tree in the soil may also help lower the disease intensity.

1. Preventive spray of Foestyl aluminum twice a year in the whole orchard may give significant results against this disease.
2. Keep the irrigation water 3-4 feet away from the stem so as it should not come in direct contact with the stem.
3. Strictly, avoid over irrigation of the orchard, as duration of soil saturation serves as infection periods for Phytophthora.
4. Injuries to the stem and roots provide invading sites for the fungus so deep ploughing and hoeing may be avoided. Attack of insects (termites and white ants) may also cause injuries therefore should be controlled by the application of suitable pesticides.
5. Formation of 6-9 inches deep basin under the tree canopy, to collect the water is a common practice in the growers, it is strongly suggested that the area should be kept at the field level.
6. Well rotten Farm Yard Manure should be applied regularly to hasten the activities of antagonistic fungi in the soil.

Fruit Drop at Different Stages

Abnormal fruit drop at any stage is unbearable for the mango grower. Every grower wants to have maximum crop so that he should get more returns. However, it depends upon the personal interest of the growers to get maximum returns by wisely managing different aspects of gardening. Normally 0.03 % of the total flowers, after fruit sets reach the maturity. If this percentage is achieved, it is said that the crop is commercial. Mainly the fruit drops in four stages:

i. MUSTARD STAGE

In this stage, there is abundance of fruit on the tree and at this stage 95 % weaker fruits drop. This stage normally persists from the last two weeks of

March to first two weeks of April.

ii. PEA STAGE

During this stage, the size of the fruit is equal to pea grain. This stage covers the 1st two weeks of April and during this stage about 4.02% fruits drop, which is considerable less than the first stage.

iii. MARBLE STAGE

At that time, the size of the fruit is equal to the small sized tomatoes. During this phase, about 1.7% fruit drop. This phase covers first two weeks of May.

iv. JUNE DROP

That drop occurs near the maturity of the fruit and cause unbearable losses to the fruit growers. If this fruit would be left on the plant, good returns could be received. That phase covers the period of first two weeks of June.

The fruit drop is mainly attributed to be seasonal fluctuations such as heavy wind storms, hail storms and powdery mildew, attack of mango hopper, difference in time of maturity of male and female parts of flowers, incompatibility of different varieties, ovule abortion, heavy irrigation during flowering, deficiency of many hormones and nutrients, inter cropping with *berseem*, cotton, Sorghum, rice, wheat etc. as their agronomic requirements do not coincide with the mango cultivation.

CONTROL

1. Scheduled irrigation, with held irrigation only during the flowering period and then flood irrigation during the period of fruit growth.
2. Strictly, follow the departmental recommendations regarding irrigation, fertilization, hoeing, interculture, inter-cropping and plant protection measures.
3. Windbreaks should be installed around the orchards like *Jaman*, *Shishum* and seedling mango, which absorbs the heat and high velocity of the wind.
4. Spray of planofix (NAA), 2,4-D (25 PPM) reduces the fruit drop up to a considerable level.

Splitting of Unripe Fruit

The time when fruit is passing through its developmental stages, deficiency of potash, irregular irrigation or sudden rains after a long spell of drought may result in imbalance of internal and external growth rate. The skin is still inflexible,

cannot withstand the internal pressure of the growth of flesh, which ultimately results in rupture of the fruit. After splitting, it hangs for few days and then automatically drops. Proper cultural management can reduce the fruit loss.

(DRAFT)
FRUIT CROP CERTIFICATION STANDARDS - MANGO

1. Introduction

The purpose of certification program is to ensure sanitary status and true-to-type characters along with horticultural value of the propagating materials in commercial propagation. Certification also controls and regulates the setting up of nurseries. The certification program only ensures the absence of prescribed pathogens. The requirements and certification standards follow:

2. Nursery Location and Land

i. Any applicant shall be eligible to establish a nursery for production and marketing of mango nursery trees subject to fulfilling the following requirements:

ii. The nursery site shall be subject to recommendation of the Nursery Registration Committee (NRC), and approval by the Federal Seed Certification and registration Department.

iii. The nursery location shall be in an area with minimum risk of infection, preferably an area free from root rot, mango malformation, mango milly bug and anthracnose and other pests and diseases as prescribed by the Federal Seed Certification and Registration Department. The nursery shall be away at least 20 meters from thoroughfares, roads, and croplands.

iv. The land must be free from nematodes, and other pathogens as prescribed by the Federal Seed Certification and registration Department from time to time. An area of 25 meters feet around the nursery must also be kept free of prescribes nematodes and other pathogens. The nursery must have an effective nematode and root rot control program.

v. The nursery area must have a suitable drainage system to lead run-off irrigation or rainwater out of the nursery area and also the drainage system must ensure that run-off or flood water from outside particularly from other mango plantings in the vicinity of the nursery is prevented from entering the nursery area.

vi. All rootstocks shall be grown under field conditions on raised beds or preferably in polythene bags or other suitable containers.

vii. The soil, all growing media, manure, compost, potting mix or mulch added to the nursery field, bags, containers or raised beds must be free of prescribed nematodes and pathogens.

viii. The containers to produce mango nursery trees must be stored on concrete or polythene material ensuring that the containers do not come into direct contact with ordinary unhygienic soil or growing media.

ix. Any field site will not be eligible for mango nursery tree production, which had previously been planted with mango for two years.

x. All nursery use implements like pruning shears and saw shall be sterilized prior to any bud collection, pruning, cutting or fruit picking from any registered tree in any block.

xi. Each registered nursery shall maintain a detailed and accurate record of all agricultural events in the nursery particularly the field history, history of each registered tree with full record of budwood collection and fruit production, number of rootstock seedlings grown and certified nursery trees produced and sold.

xii. The Nursery Registration Committee shall inspect the site annually and trees shall be sampled and indexed routinely to verify the phyto-sanitary status of the nursery and freedom from prescribed nematodes and other pathogens.

xiii. In case the requirements have not been met with, the phyto-sanitary conditions are substandard, the trees have been found to be infected with prescribed nematodes or other pathogens or have knowingly sold such plants, misrepresenting the nursery stocks as certified, the registration of the nursery shall be cancelled.

3. Establishment of Scion Source Blocks

The mango certification program of Pakistan shall base on the following three categories of scion source blocks:

A. Pre-basic Block (Primary Block)

B. Basic Block (Foundation Block)

C. Certified Block (Field Increase Block)

A. Pre-basic Block: (Primary Block)

The Pre-basic Block shall consist of registered field grown or container grown trees, which will serve as the primary source of propagating materials of the variety. Major requirements follow:

i. The Pre-basic block shall be maintained at the Horticultural Research Institutes, Universities or any other organization registered and licensed for this purpose. The GPU of Agricultural Research Institute, Tarnab established at D I Khan, can serve as pre-basic block for mango varieties provided the registered mother trees are disease free and indexed regularly.

ii. In case the mother trees are infected with vector transmitted diseases, the healthy trees shall be regenerated through micro-grafting technique or shoot tip grafting *in vitro* from infected bud lines of true to type trees.

iii. To avoid contamination with vector transmitted diseases, the trees shall be grown in field or in containers under insect-proof screen houses or greenhouses. The protected block shall be located not less than 30 meters feet distant from any commercial orchard of the same genus. A distance of about 5 meters all around the block shall be kept open, weed free or clean cultivated.

iv. The block shall contain true-to-type, normal growing healthy and virus free trees possessing high horticultural values.

v. The trees in this block will be the primary source of budwood for the establishment of the Basic block.

vi. To verify horticultural value 2-3 trees for each accession shall be maintained under best management conditions, pruned and trained if necessary and should produce fruit regularly. The trees shall be adequately spaced so that their branches do not touch each other.

vii. These trees shall be described, registered and labeled individually. The Registration number of each tree shall be clearly marked on the bark with a weatherproof marker.

viii. These trees shall be inspected and indexed annually to examine their health status.

ix. To detect any growth or fruit abnormality the specialists shall periodically examine the trees particularly on fruiting and flushing stages.

x. Any tree showing disease symptoms or behaving abnormally shall be removed immediately.

xi. To verify field performance a group of at least 2-3 trees originating from

the same parent tree and rootstock shall be planted outdoors in the adaptability area for assessment of growth habit, trueness to variety, horticultural qualities and disease response.

B. Basic Block (Foundation Block)

The Basic block means field or container grown plantings propagated with budwood from pre-basic block to serve as source for further propagation as Certified block. The requirements follow:

i. The Basic block shall be maintained by the Horticultural Research Institutes and registered nurseries.

ii. The trees in this block shall be field or container plantings propagated with budwood from pre-basic block. To protect trees from vector transmitted diseases this block shall be established in screenhouse or greenhouse.

iii. The trees shall be examined annually for identification of any growth or fruit abnormality, which could be removed at the advice of the horticulture specialist.

iv. The budwood shall be collected only from those trees, which have produced enough fruit to verify their genuineness and have been registered by the Federal Seed Certification and Registration Department.

v. The amount of bud-wood collected from each tree should be limited to allow some fruit production each year.

vi. The number of trees to be maintained for each accession shall be 4-6 or more, each one identified by a registered number clearly marked on the bark with weatherproof marker.

vii. To verify field performance 2-3 trees originating from the same parent tree and rootstock shall be planted outdoors in the adaptability area of the variety for assessment of growth habit, trueness to variety, horticultural qualities and disease response.

C. Certified Block (Field Increase Block)

The Certified block shall mean a planting of mango nursery stock of a variety used as scion source for producing certified nursery trees. The requirements follow:

i. A public organization or a registered nursery shall maintain the Certified block.

ii. The certified block shall contain field grown trees propagated directly

from registered trees of basic block or pre-basic bloc.

iii. The Certified block trees shall also be registered and identified with a registration number, which shall be clearly marked on the bark with weatherproof marker.

iv. The number of trees in a Certified Block for each accession can be 4-10 or more depending upon the availability of nursery facilities.

v. Separate blocks shall be maintained for each accession or mango variety.

vi. Certified Blocks shall be inspected by Horticultural Specialists annually to detect any growth and development abnormalities and disease symptoms.

4. Seed Source Block

The seed source block shall mean the registered trees to produce seed as a result of sexual recombination, which is used for the production of rootstock for mango propagation and shall meet the following criteria:

i. The Federal Seed Certification and Registration Department shall register a mango tree as a seed source tree subject to an application and description of the tree.

ii. The department on receiving the application will ask the Nursery Registration Committee to cause a visual inspection of the perspective tree and the surrounding trees during the fruiting stage to determine that:

iii. The tree is healthy and free from symptoms of prescribed complex of viruses and other mango diseases.

iv. The tree type is true *desi* seedling, vegetatively propagated from a true parent or a nucellar tree in case of polyembryonic variety and the morphological characteristics of the tree are normal.

v. The tree is high yielding and the fruit quality is horticulturally true-to-type.

vi. The committee shall collect bud samples from the tree for indexing against prescribed viruses and pathogens.

vii. If it is found to be negative and there is no evidence of bud mutation in the foliage, the Federal Seed Certification and registration Department shall register the tree and will allot a registration number, which shall

be clearly marked on the bark with a weatherproof marker.

viii. The Federal Seed Certification and registration Department shall carryout annual inspection of the source tree and shall cancel in consultation with the Nursery Registration Committee the registration of the source tree if an annual inspection during fruiting reveals evidence of:

ix. Symptoms of virus or other bud-transmittable diseases on the seed source tree or any of the trees immediately surrounding that tree;

x. High degree of mutation on the fruit or foliage of the source tree;

xi. Improper keeping of records which are likely to confuse the identity of the source tree;

xii. Careless handling of seeds collected from the seed source tree (mixing or poor storage etc.).

xiii. Mango rootstock trees may be produced from seed, vegetative propagation or nucellar seedlings.

xiv. The seed must have a minimum of 99.9% purity with maximum 0.1% inert matter and 80% minimum germination.

5. Inspection and Indexation of Nursery Trees

To assess the health status of the propagating materials the Federal Seed Certification and Registration Department in consultation with the NRC shall cause an examination of the stocks and take samples for indexation: The procedure follows:

i. Roots stocks shall be inspected twice: firstly before grafting for purity of the stock and general health conditions and secondly two weeks after grafting to check the procedure and health.

ii. The certified nursery trees shall be routinely inspected and sampled by the FSC&RD to verify that trees are free from prescribed nematodes, other pathogens and vector transmitted diseases.

iii. Any nursery tree or rootstock found to be off-type on any inspection or showing excessive mutation or abnormal growth; symptoms of vector-transmitted viruses or other pathogens shall be removed immediately.

iv. The collection of the budwood from pre-basic, basic and certified blocks shall be witnessed by the representative of the Federal Seed Certification and Registration Department and proper records will be

maintained.

v. The budwood shall be collected in budwood bundles which shall carry a certificate mentioning the variety, nursery registration number, tree registration number, number of buds collected and date of collection.

vi. Budded seedlings shall be kept in separate rows providing sufficient gaps between rows from different budwood sources.

vii. Each row shall be clearly labeled with the bud source; rootstock used and date of budding.

6. Production of Certified Nursery Trees

The certified mango nursery trees shall be produced using the budwood collected from registered trees in the following manners:

viii. Only the nurseries registered under Pakistan Fruit Nursery Rules, 1998, shall produce certified nursery trees.

ix. Certified mango nursery trees shall be produced using the budwood collected from registered trees using recommended rootstock seedlings that have not previously been budded.

x. In case the re-budding is necessary, budwood from the same bud source as the original shall be used.

xi. Every registered nursery shall maintain a detailed and accurate record of history of each registered tree, collection of budwood, budding and re-budding and the movement of the certified nursery trees.

7. Registration of Source Trees

All trees in pre-basic, basic and certified blocks and approved rootstock shall be registered on the basis of the following criteria:

i. **Genuineness:** The tree must be true-to variety description as established jointly by the Federal Seed Certification and Registration Department and horticultural specialists of the maintaining organization.

ii. **Health status:** The tree must be healthy and free from diseases and pathogens.

iii. **Horticultural value:** The tree must be high yielding and possessing high horticultural qualities, which shall be assessed jointly by the Federal Seed Certification and Registration Department and the Horticultural specialists on the basis of at least two years field performance.

8. Labeling

All the nursery trees offered for sale or hold in stock for sale or distribution at any nursery or sale point shall bear a tag according to the following schedule:

Pre-basic nursery stocks	White with violet diagonal line
Basic nursery stocks	White
Certified nursery trees	Blue
Truthfully labeled trees	Yellow

9. Truthfully Labeled Nursery Trees

Any nursery offering for sale mango nursery trees other than certified nursery trees shall have to label such nursery trees under Seed (Truth in Labeling) Rules, 1991 with a yellow tag.

Each of the nursery trees of any category shall be labeled with an appropriate tag bearing the following information:

Name and Registration Number of the Nursery

Kind of fruit Mango

Name of variety

Date of budding 00-00-200

Source of budwood (registered # of the scion tree)

Rootstock variety *Desi*/other

Category Basic/Certified/Truthful

GERMPLASM UNIT TROPICAL, RAKHZANDANI, D.I. KHAN

S. #	Fruit Species	Varieties	Source
1	Date Palm Total Varieties = 23	Dhakki Basra Gulistan Haleeni Hussaini Begum Jhangi Aabidandan Kuzan Abad Kahraba Mozawati Rabai Burni Sabzo Jawansore Aseel Karblain Pathri Halavi Makran Shamran Khudravi Deglet Noor Zaidi	Agricultural Research Institute, D.I. Khan Date Research Centre, Turbat, Balochistan Agriculture Extension Farm, Panjgur, Balochistan. Date Palm Research Station, Kot Digi, Sindh Date palm Research Center, Jhang

2	Mango Total Varieties = 14	Salehbhai Saroli Bagan Pali Sawarnarika Alphonso Sindhri Dosehri Chounsa Anwar Retaul Yakta Chounsa Sufaid Late Retaul Sensation Langra	Sindh Horticultural Research Institute Mirpur Khas, Sindh Mango Research Station Shuja Abad, Multan, Punjab. Horticultural Research Institute, Faisalabad.
3	Guava Total Varieties = 11	Ramzani Sindhi Gulabi Riali Thada Rami KAZI PG-001 PG-005 PG-010 PG-013 Guava seedless	Quaid-e-Awam Research Institute Larkhana, Sindh FTIP- BAU – Dhaka, Bangladesh ARI-Tarnab, Peshawar.
4	Ber	Sufi Sangarh	Ber Research

	Total Varieties = 11	White Gola Late Gola Chambalee Gooba Sufi Sialkoti Ajmairi Gilli Delhi White Mahmood Wali Karella Sufan Goar	Institute Tando Jam, Sindh Horticultural Research Station, Bahawalpur
5	Falsa Total Varieties = 1	Falsa Large	Sindh Horticultural Research Institute Mirpur Khas, Sindh
6	Litchi Total Varieties = 4	Bedana Gola Surahi Shoi Thung (C)	Horticultural Research Institute, Faisalabad Fruit Nursery Farm, AED, Haripur