STRATEGIES OF BREEDING AND PRODUCTION MANAGEMENT OF MANGO (*Mangifera indica* L.) ON FOCUS TO THE DYNAMIC OF MARKET

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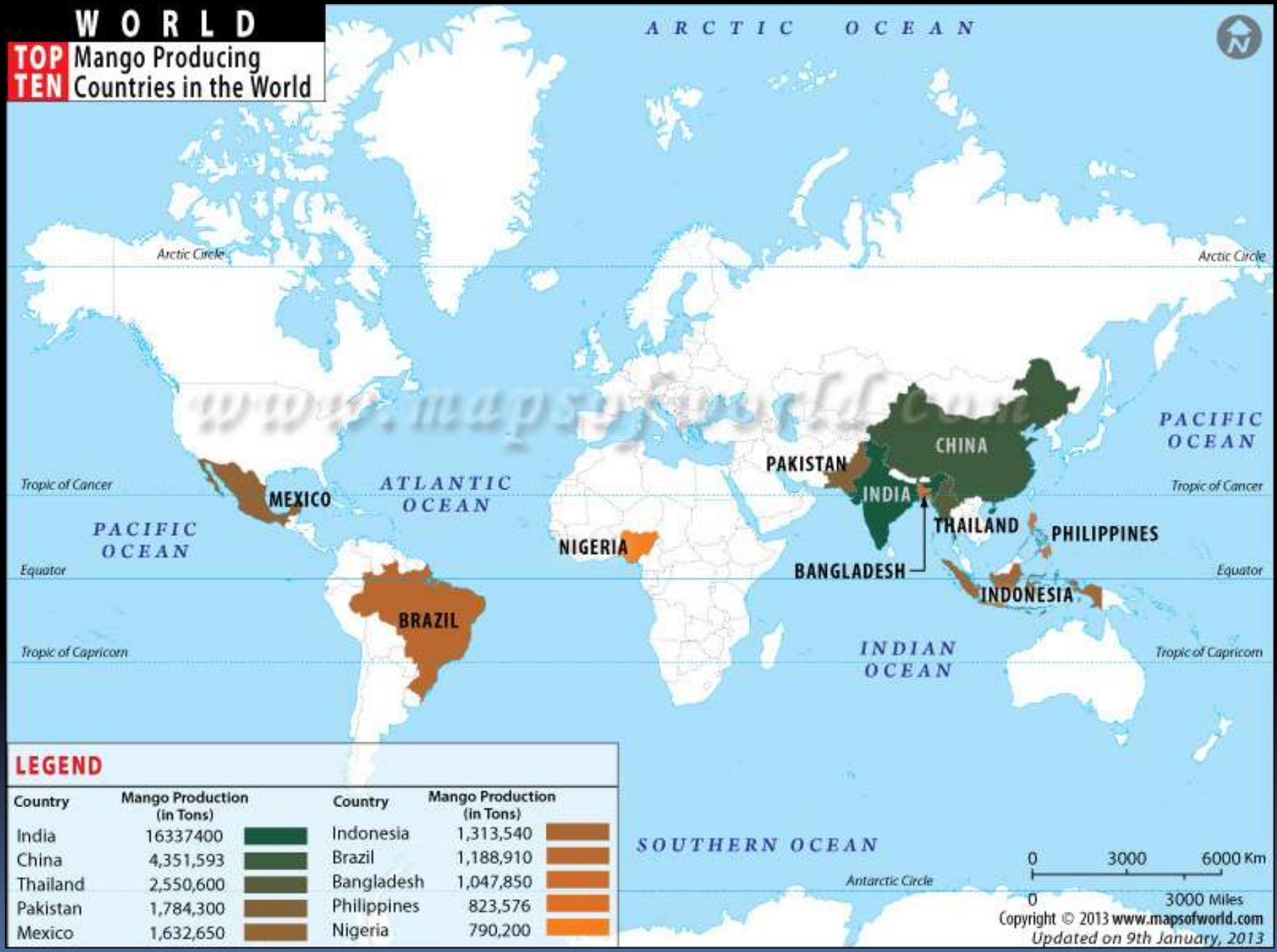
WORLD

TOP TEN Mango Producing Countries in the World



LEGEND

Country	Mango Production (in Tons)	Country	Mango Production (in Tons)
India	16337400	Indonesia	1,313,540
China	4,351,593	Brazil	1,188,910
Thailand	2,550,600	Bangladesh	1,047,850
Pakistan	1,784,300	Philippines	823,576
Mexico	1,632,650	Nigeria	790,200

Updated on 9th January, 2013

TABLE 1 – PER CAPITA CONSUMPTION OF FRESH MANGO IN THE MAIN EXPORTING (PRODUCER) AND IMPORTING COUNTRIES IN 2011.

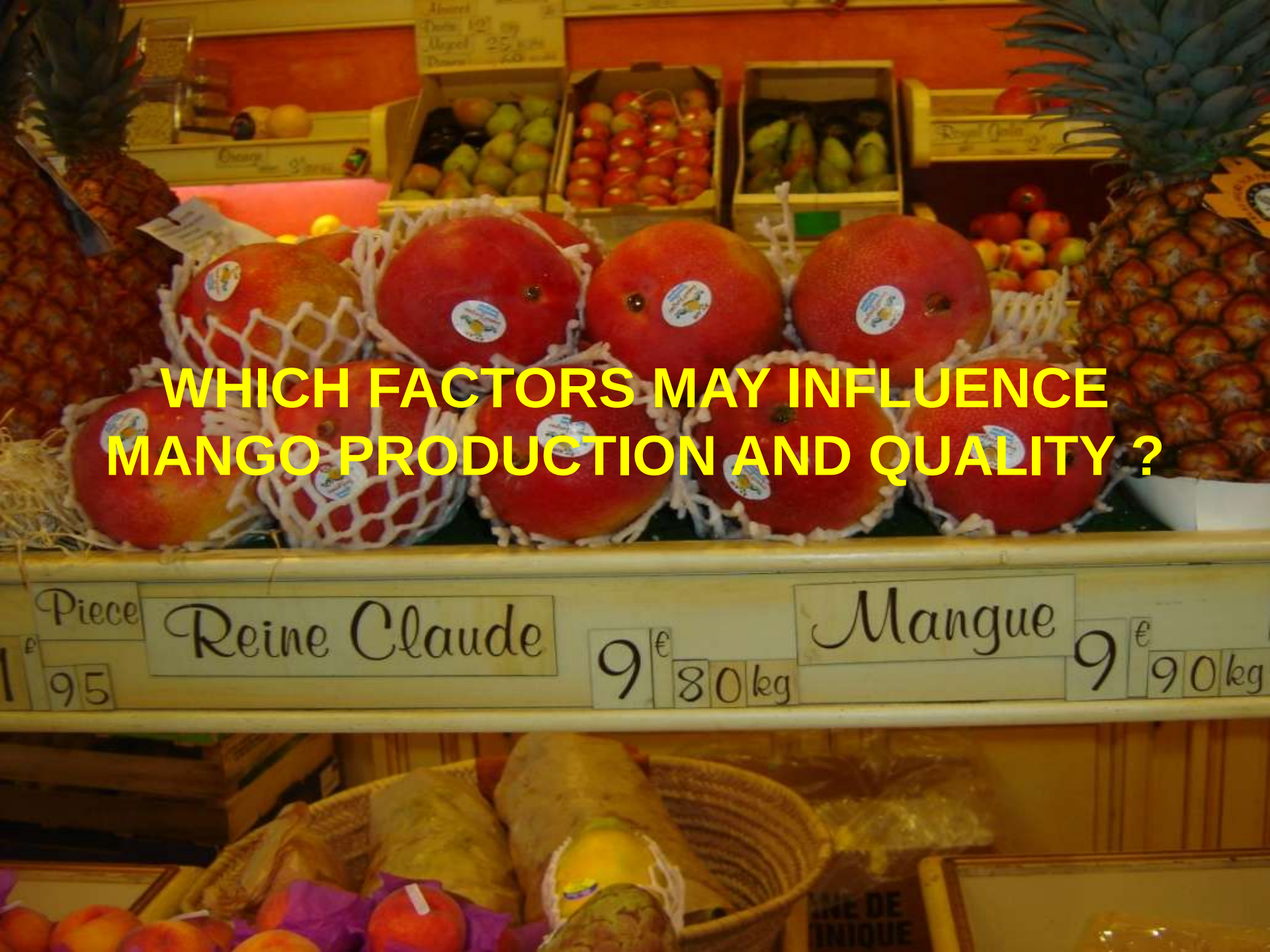
Country	Consumption (kg/hab/year)	Population (X 1000)	Consumption (total: t / year)	Production (total: t / year)
India	11,29	1.210.000	13,7 millions	16,3 millions
China	2,57	1.347.000	3,5 millions	4,4 millions
Thailand	21,89	66.000	1,4 million	2,6 millions
Mexico	4,62 *	110.000	508,200	1,6 million
Brazil	2,68	192.924	517,000	1,2 million
France	0,29	65.400	19,000	none
Germany	0,26	81.800	21,300	none
Holand	1,72	16.558	28,500	none
England	0,37	62.000	23,000	none

Source: Adapted from Granço (2010) estimated population in 2011;
* Camargo Filho et al. (2004)

FIVE IMPORTANT COUNTRIES AS FRESH MANGO PRODUCERS AND EXPORTERS IN 2011

Countries	Production (t)	Exportation (t)	Participation (%)
India	16,337.400	286.775	1.75
Mexico	1,632.650	232.643	14.24
Brazil	1,188.910	127,002 *	11.00
Peru **	130.000	101.060	77.00
Equador ***	76.774	46.065	60.00

Sources: adapted from www.mapsoftworld.com (updated in jan/2013); * Secex, Brasilia, 2012; ** Promango, Piura, 2013; *** Fundación Mango, Guayaquil 2013


WHICH FACTORS MAY INFLUENCE
MANGO PRODUCTION AND QUALITY ?
Piece
Reine Claude
95
9 € 80 kg
Mangue
9 € 90 kg

INADEQUATED PRE-HARVEST MANAGEMENT








BLEMISHES FROM LATEX, PULP COLLAPSES (“SOFT-NOSE”), AND SEVERAL POSTHARVEST DISEASES RESULTS MOSTLY FROM USE OF NO IMPROVED CULTIVAR AND BAD PRODUCTION MANAGEMENT.

ADEQUATE PRE-HARVEST MANAGEMENT








HIGHER PRODUCTIVITY AND QUALITY COME MOSTLY FROM USE OF EXCELLENT CULTIVAR + ADEQUATE PRE-HARVEST MANAGEMENT (INTEG. PEST AND DISEASE CONTROL) UNDER FAVOURABLE CLIMATE.

MANGO PRODUCTION AND QUALITY
(Pre-Harvest Factors)

- **MANAGEABLE FACTORS**

1. BREEDING

2. PRODUCTION MANAGEMENT

- **DIFFICULT MANAGEABLE FACTORS**

1. CLIMATE

    1.1. INFLUENCE ON FRUIT GROWTH AND GROUND COLOR

2. PHYSIOLOGICAL ANOMALIES AND INNOVATIVE PRODUCTS (?)


MANGO BREEDING:
TO WHOM A BREEDER SHOULD ATTEND ?

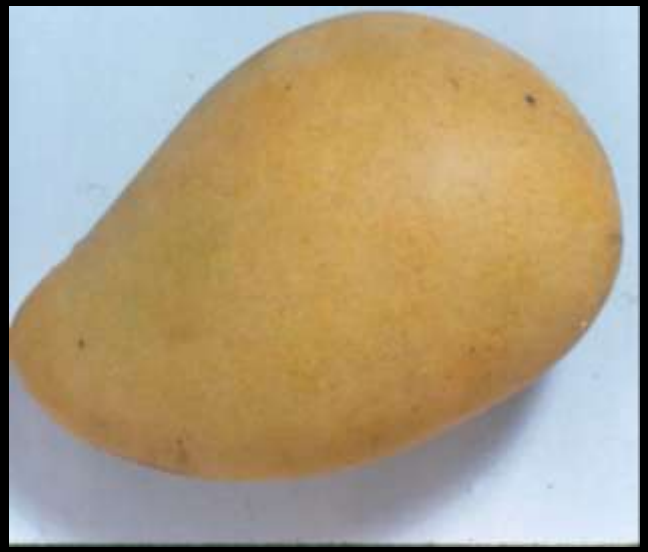
...TO **GROWERS** ?

...TO **WHOLESALERS, RETAILERS AND TRANSPORTERS** ?

... **TO PROCESSING INDUSTRY** ?

...**OR TO CONSUMERS** ?

SEVERAL AND DIFERENT OPTIONS AND INTERESTS OF A SAME PRODUCT

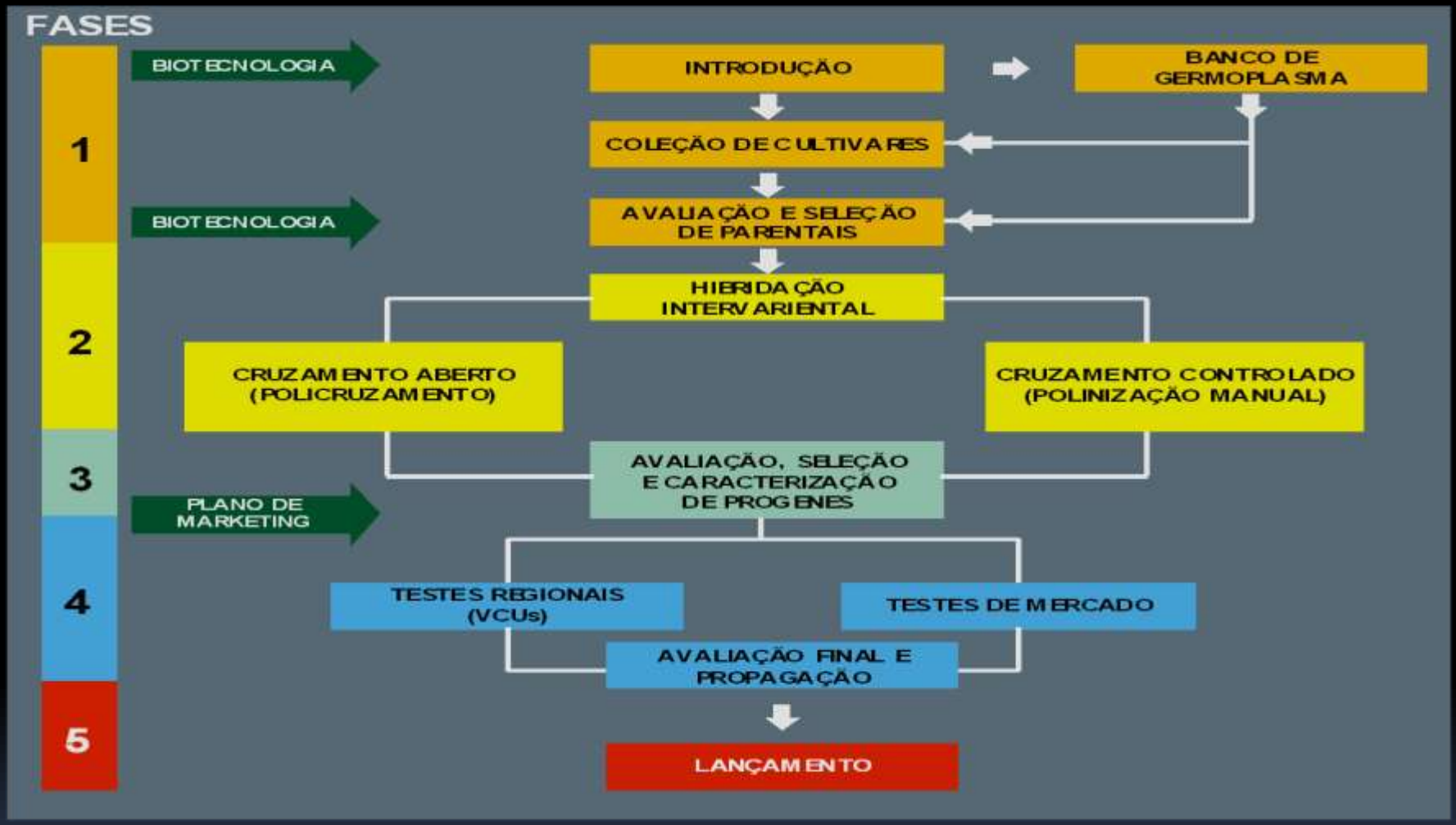


SEVERAL AND DIFERENT OPTIONS AND INTERESTS ON A SAME SPECIE


SOMEONE HAS
ALREADY RELEASED AN
IDEAL MANGO ?

SOME MANGO BREEDING STRATEGIES AND DECISIONS

MANGO BREEDING PROGRAM



A BREEDER MUST ESTABLISH A GOAL, IDENTIFY THE RESTRICTIVE FACTORS THEN DESIGN A STRATEGIC PROGRAM !

ENRICHMENT OF THE GENETIC BASE

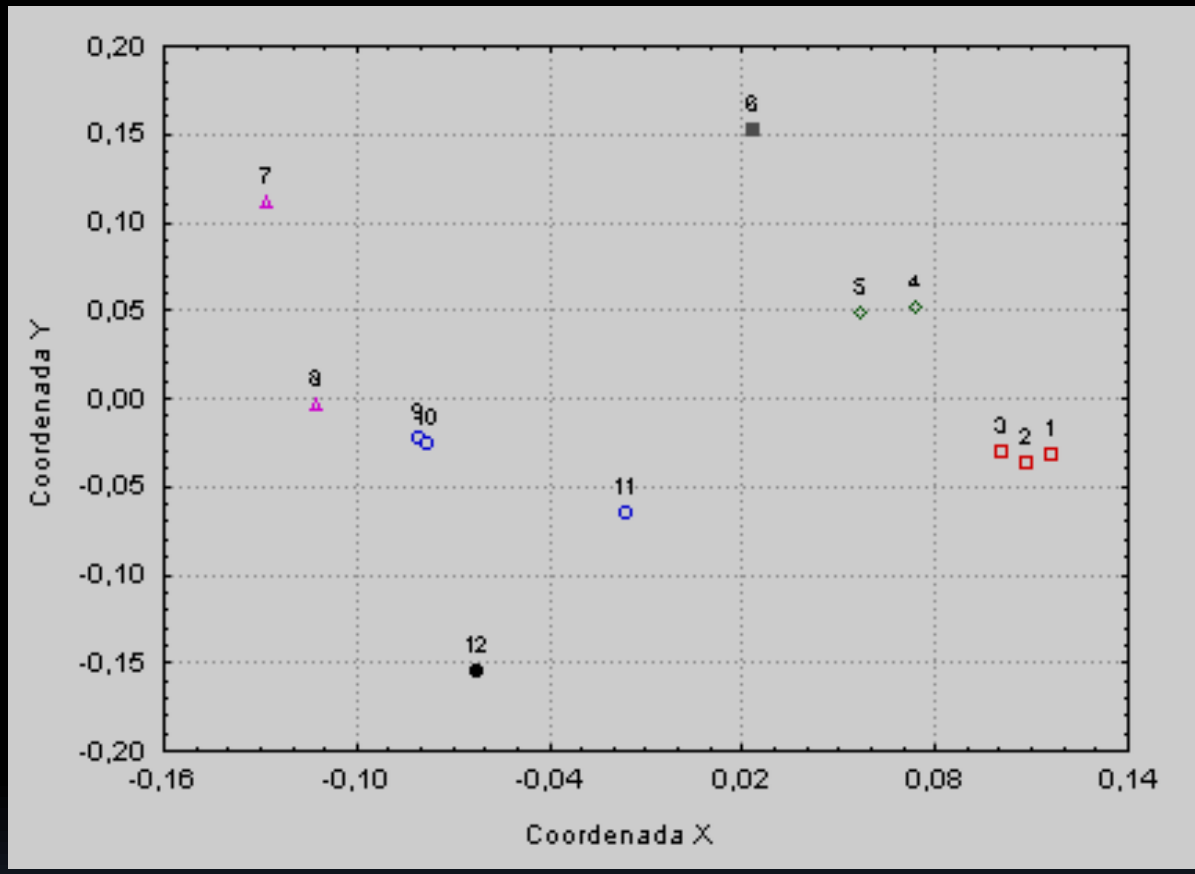
***Mangifera pajang*, easy peeling as if were a banana**

Variety Madame Francis, about 400 g, sweet and juicy flesh

Cultivar Osteen, Haden seedling, about 600 g, sweet and firm flesh

Kesar variety (india), about 300 g, very sweet, juicy and firm flesh

BIOTECHNOLOGY SUPPORT



- SELECTION OF PARENTS BY USING MOLECULAR MARKERS;
- MULTIVARIATE ANALYSIS SHOWED THAT THE FLORIDIAN PARENTAL GROUP (1, 2, 3, 4 e 5) IS GENETICALLY FAR FROM INDIAN CULTIVARS MALLIKA AND AMRAPALI (7 e 8) LARGER NUMBER OF PROGENIES

EXCELLENT PARENTAL SELECTIONS

VARIETIES FROM INDIA

VARIETY FROM FLORIDA

IMPROVEMENT OF BREEDING METHODS

IMPROVEMENT OF INDIAN HAND POLLINATION METHOD WITH USE OF PERFORATED PLASTIC BAG, BETTER PROPORTION ANTHER : STIGMA, WATER SPRAY ON THE YOUNG FRUITS AND PROTECTED BAG WITH LABEL, **INCREASED THE SUCCESS FROM 1,47% TO 9,0% OF FRUIT SET.**

OPEN POLLINATION STRATEGY

E	C	A	D	B
C	A	B	E	D
B	E	D	A	C
D	B	E	C	A
A	D	C	B	E

Selected parental cultivars established in the field as latin square design may also facilitate the progeny control

EMBRAPA SEMI-ARID´S NEW STUDY - SELECTED MONOEMBRYONIC PARENTALS UNDER OPEN CROSSES IN THE FIELD OR INTO CAGES WITH IRRIGATION + PBZ APLICATION THEN PROGENY IDENTIFICATION BY MICROSATELLITE ANALYZES FACILITATES THE OBTAINMENT OF A LARGER NUMBER OF PROGENIES.

DWARF TRAIT

DWARF IS AN IMPORTANT **TRAIT** USED ON SEVERAL MANGO BREEDING PROGRAM; WITH **THE ADVENT OF PRUNING,** AS AN ALMOST **OBLIGATORY TECHNIQUE** FOR A GOOD COMMERCIAL MANGO CANOPY ARCHITECTURE, THIS BREEDING GOAL SEEMS TO HAVE LESS IMPORTANCE TODAY.

PRODUCTIVITY AND QUALITY TRAITS

SEVERAL **EXPORTING GROWERS** DO **NOT ACCEPT PRODUCTIVITY LOWER THAN 30 t/ha** WITH CROP DENSITY OF 476 PLANTS/ha, at 7 YEARS OLD.

FRUIT GROUND COLOR, **TASTE** AND **SANITY**, **FLESH COLOR**, **JUICY**, AND **FIRMNESS** ARE ALL EXCELLENT TRAITS

RESISTANCE TO PEST AND DISEASE

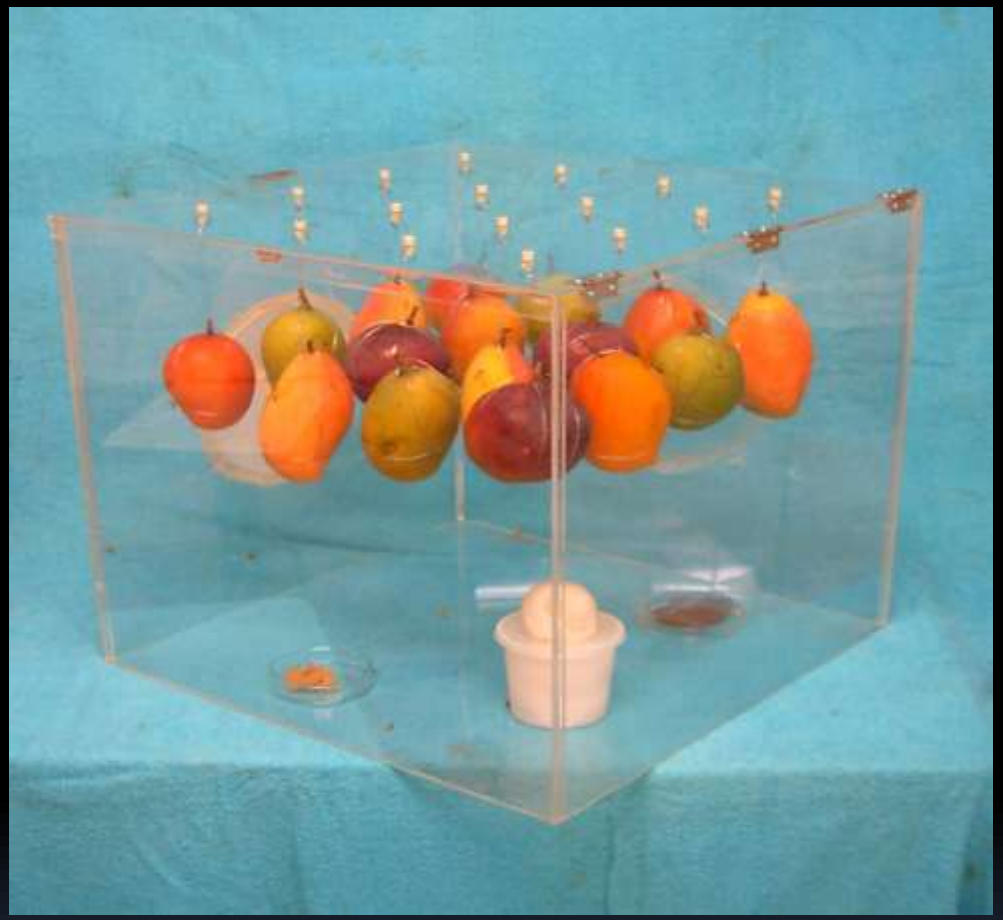
‘ALFA’ - BESIDES THE GOOD **FRUIT QUALITY,** ITS HIGH **RESISTANCE TO FRUIT FLY** AND **ANTRACNOSIS** AND TO TURNED IT INTO AN OUTSTANDING IMPROVED MANGO CULTIVAR.

THE PERCENTAGE OF INFESTED FRUITS OF 5 MANGO CULTIVARS IN THE FIELD, DURING 3 YEARS, VOTUPORANGA - SÃO PAULO (Dr. Rossetto´s study)

CULTIVAR	2003	2004	2005	AVERAGE
Espada Stahl	5,0	0,0	1,3	2,1 a
IAC 111	3,3	13,3	2,5	6,36 a
Alfa	10,0	7,1	5,0	7,37 a
Tommy Atkins	56,7	43,3	28,8	42,93 b
Sensation (F1)	96,7	100,0	100,0	98.90 c

Mean avg column with same letter do not differ statistically – Tukey test 5%

CULTIVAR EVALUATION AT LAB CONDITIONS



TO STUDY RESISTANCE OF 4 MANGO CULTIVARS BY KEEPING THEM IN AN ACRILIC BOX WITH ADULT FEMALE FRUIT FLIES OF *ANASTREPHA OBLIQUA* FOR *2 HOURS*.

Mean of attempt of *Anastrepha obliqua* oviposition and number of pupa developed into 4 mango cultivars at acrilic box condition.

Cultivar	Attempts of Oviposition	Number of Pupas
Alfa	4,62 a	5,75 a
IAC 111	34,87 b	24,87 b
Espada Stahl	37.00 b	53,00 b
Tommy Atkins	34,50 b	40,37 b

Mean in the column with same letter do not differ statistically – Tukey test 5%

DOUBLE PURPOSE:
PROMISING HYBRID SELECTIONS

GROUND COLORS, EXCELLENT TASTE, COLOR AND COMPACTNESS OF THE PULP OF THESE HYBRID SELECTIONS HAVE BEEN HIGHLY ACCEPTABLE BY CONSUMER AND FAMILY PROCESSING INDUSTRY.


SOME PRODUCTION MANAGEMENT
STRATEGIES AND DECISIONS

COMMERCIALIZATION OF BRAZILIAN MANGO *

- ABOUT 80% FOR FRESH CONSUMPTION

- ABOUT 20% FOR PROCESSED PRODUCTS

- AS NUTRI-PHARMACEUTICS AND FUNCTIONAL FOOD, AN INSIGNIFICANT PERCENTAGE (ALTHOUGH A PROMISING FUTURE !)

* Estimation based on total production, population, fresh consumption, fruit loss (30%) and exportation.

IMPORTANT DECISION

CAMPOSOL FARM, A PERUVIAN & NORWEGIAN GROUP EXPORTS 60% OF ITS 400 Ha OF KENT AS FRESH FRUIT (EXCELLENT QUALITY) AND 40% AS FROZEN MANGO CUBES TO SCANDINAVIAN COUNTRIES.

MANGO INTEGRATED PRODUCTION

MONITORING PEST AND DISEASES

STRONG CONTROL OF PESTICIDE SPRAYING

NO PESTICIDE RESIDUES IN THE FRUIT

SAFE AND EATABLE FRUIT

TO RESPECT THE HUMAN BEING AND ENVIRONMENT; REDUCTION OR ELIMINATION OF PESTICIDE USE (SUSTAINABILITY) WITH REDUCTION OF COST OF PRODUCTION; HIGH FRUIT QUALITY; IDENTIFICTION OF THE PRODUCT FROM FIELD UNTIL MARKET (TRACEABILITY).

FLORAL INDUCTION FOR OUT OF SEASON PRODUCTION

PBZ APLICATION

STRONG FLOWERING

PRODUCTION & HARVEST

	Jan	Febr	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Production and Harvest												
	Period of Harvest							Period of Low Harvest				

OBS: NOWADAYS, **UNICONAZOLE** HAS BEEN EVALUATED WITH CHEAPER AND SIMILAR RESULTS ON MANGO PRODUCTION.

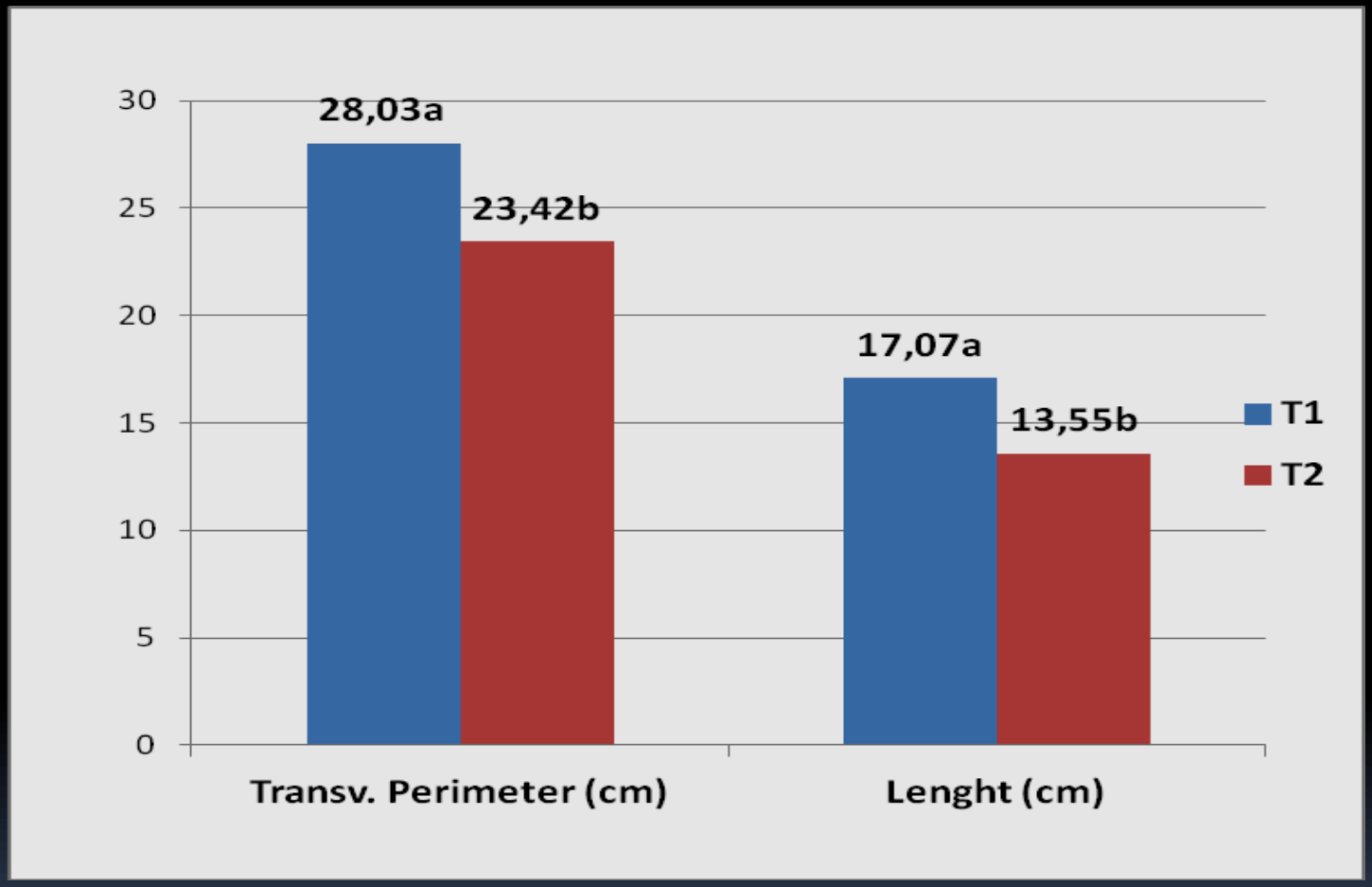
IMPROVEMENT OF MANGO CALIBER

SOME EXPORT FARMERS TOOK A BAD DECISION – THEY THREW OUT (BURY) THOSE MANGO FRUITS WITHOUT APPROPRIATE CALIBER TO EXPORT;

✓EUROPEAN MARKET PREFERS FRUIT CALIBERS BETWEEN 8 and 10; CALIBERS 12 AND ABOVE ARE SOLD TO INTERNAL MARKET;

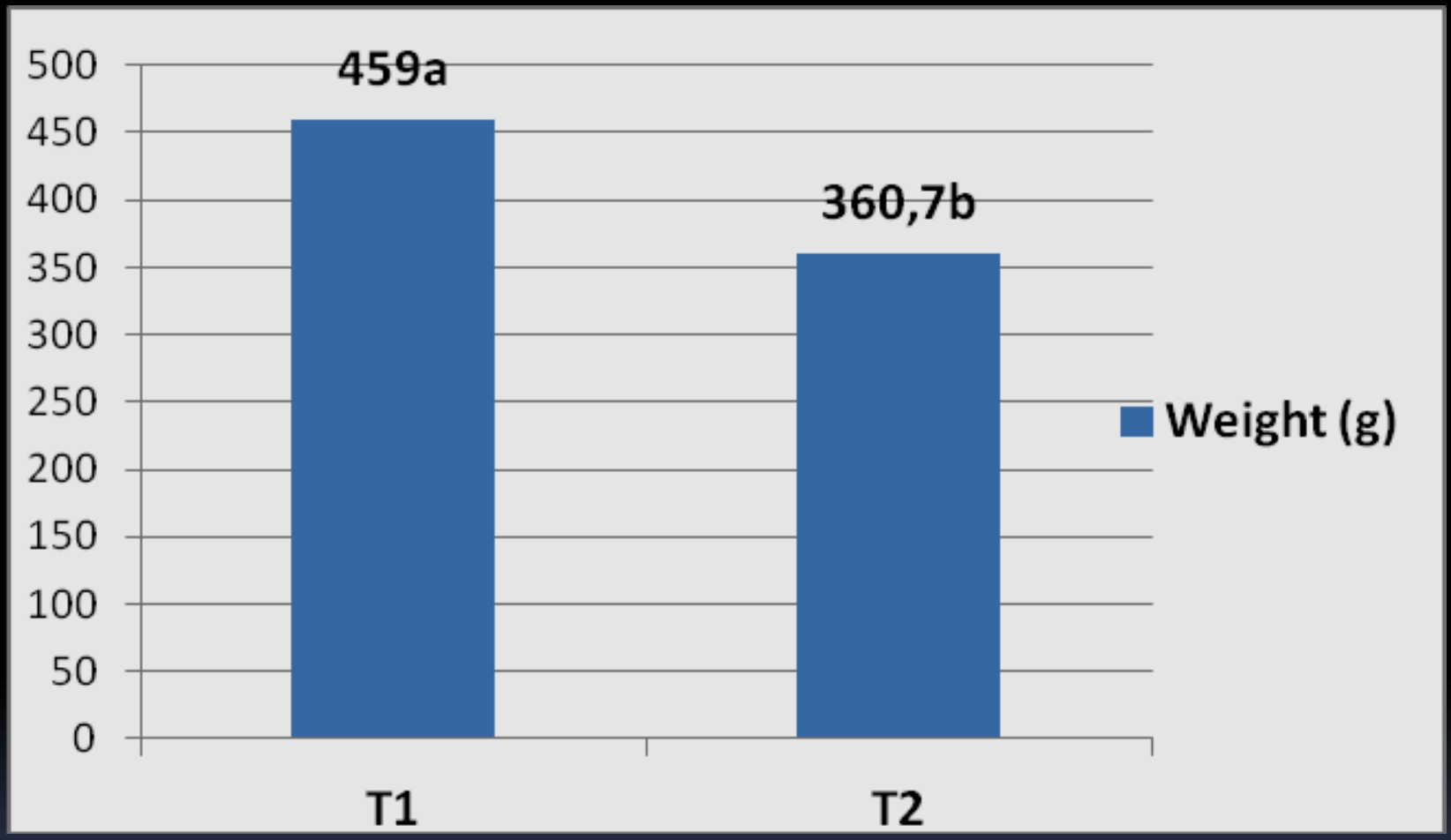
✓ Silva´s study: THREE FERTIGATIONS (BEFORE AND AT FULL FLOWERING THEN 35 DAYS BEFORE HARVEST), WITH FULVIC ACID + ADDITIONAL POTASSIUM SULPHATE (T1) COMPARED WITH TRADITIONAL FERTILIZATION TOMMY ATKINS MANGO (T2) USED IN PETROLINA, PERNAMBUCO STATE.

FIELD TRIAL TO IMPROVE MANGO CALIBER



FULVIC ACID + K SULPHATE (T1) INCREASED MANGO SIZE AND...

FIELD TRIAL TO IMPROVE MANGO CALIBER



... IMPROVED FRUIT WEIGHT ABOUT 21% BESIDES...

MANGO PRODUCTION AND QUALITY

...PROMOTING A BETTER MANGO UNIFORMITY AT HARVEST THUS IMPROVING PRODUCTION AND QUALITY.

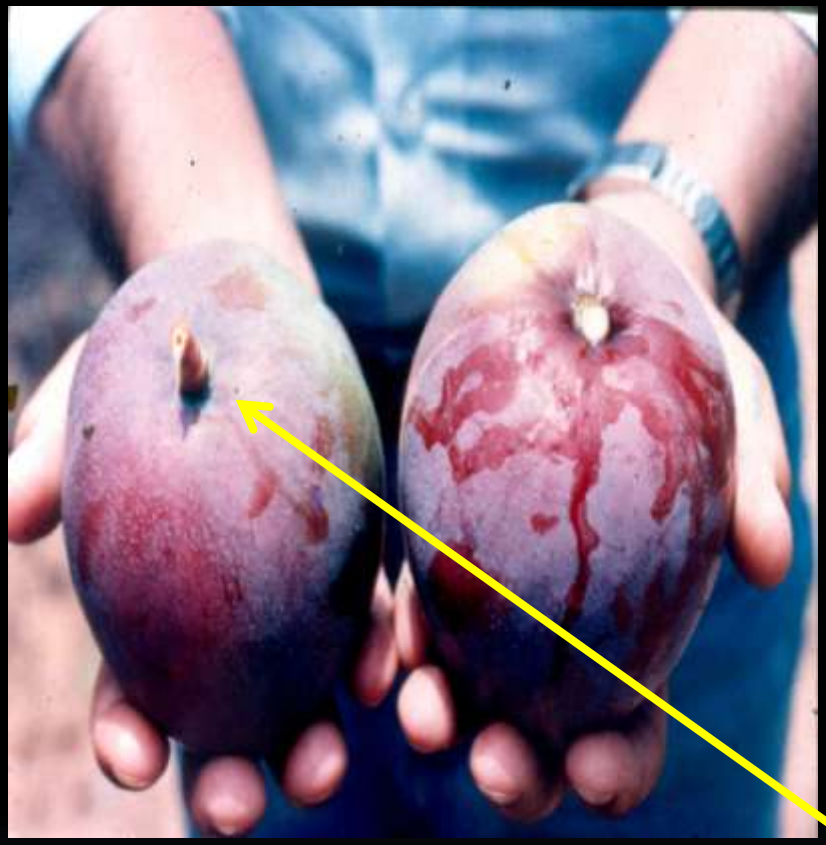
RATIO Ca:N ON MANGO PULP QUALITY

Poor root system from control treatment (left); mango fruit with strong pulp collapse (right)

Good root system from gypsum treatment (left); mango fruit free of pulp collapse (right)

Mango Pulp Collapse has high frequency in acid soil of Cerrados Ecosystem; a 7 years study of Pinto and colleagues on cv T. Atkins using gypsum (290 g/m2 at planting) in the recommended mango fertilization then monitoring the ratio of Ca:N at leaves; a minimum of 2,2 Ca:1 N promoted a reduction from 60% to 3% of mango pulp collapse – HIGHER AND BETTER MANGO SUPPLY IN THE MARKET !

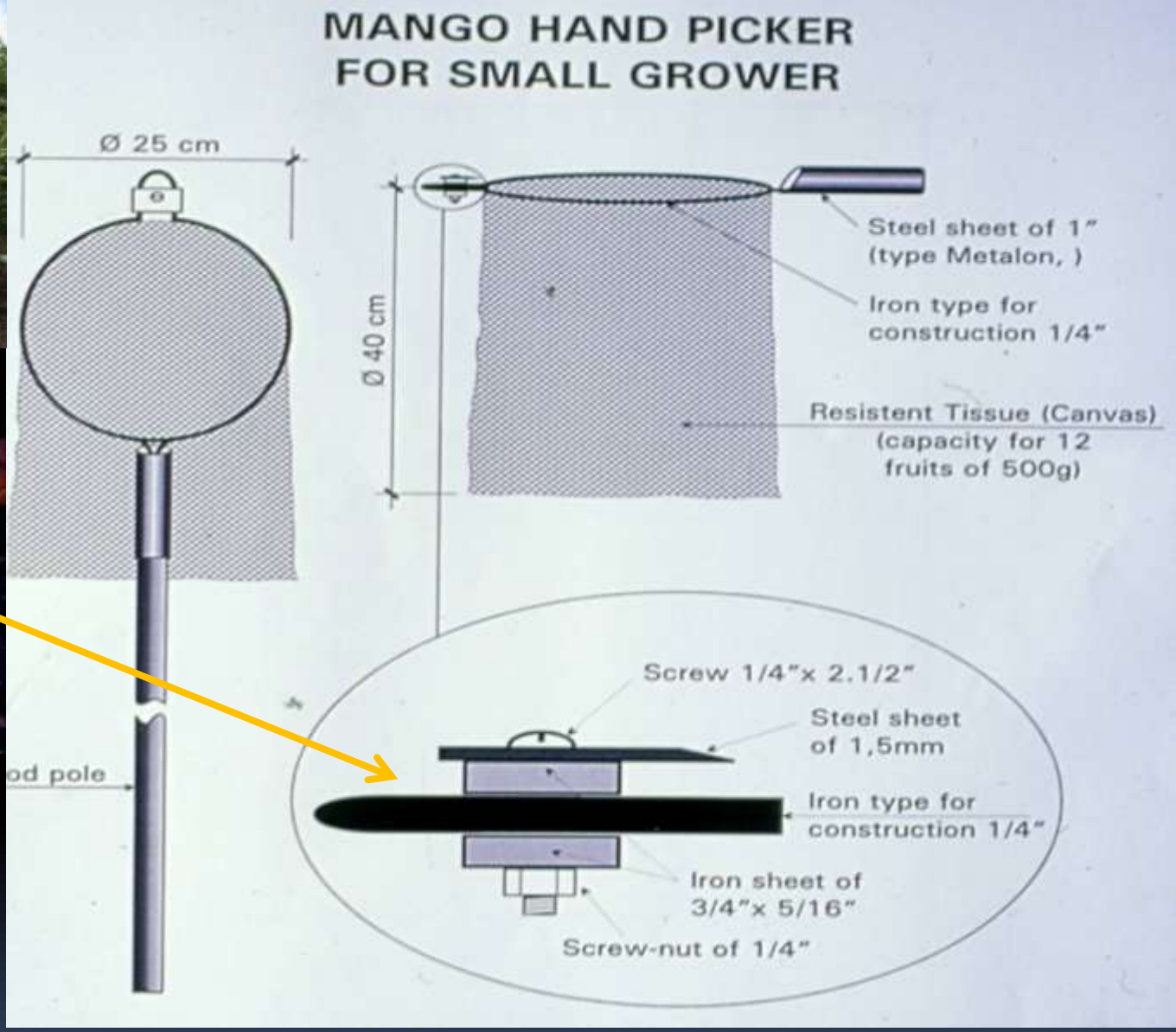
TO AVOID BLEMISH FROM LATEX



✓THE LATEX EJECTION DEPENDS ON THE TIME OF HARVEST AND THE LENGHT OF THE PEDUNCLE ; CUT ABOUT 1,5 cm ABOVE PEDICEL

✓HARVEST AID - IN AUSTRALIA, MANGO IS PULLED FROM THE TREE OR DE-STEMMED IN FIELD AND THROWN ON TO THE TARPAULIN COVERED WITH WATER AND DETERGENT (Ian Bally´s photo)

Common Mango Picker:
about 60% of the harvested mango presented latex in the skin;

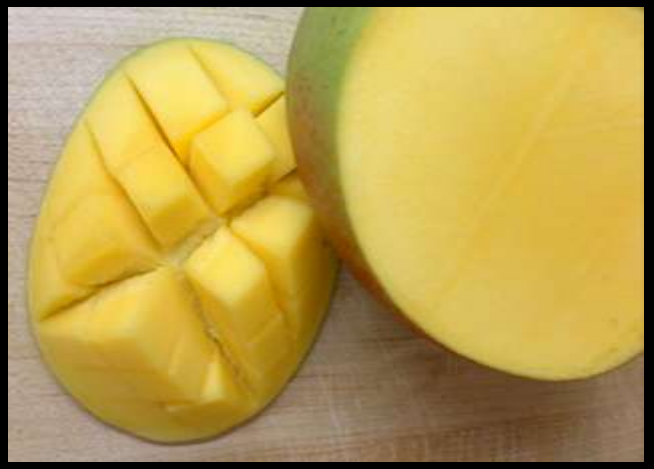


NEW MANGO HAND PICKER:
LESS THAN 10% OF THE FRUITS PRESENTED LATEX IN THE SKIN


CLIMATE MAY INFLUENCE MANGO
QUALITY AND DYNAMIC OF MARKET

GENOTYPE AND ENVIRONMENT INTERACTION






INTENSE SUN RAY + REFLECTION FROM SANDY SOIL + HIGH IRON CONTENTS IN LEAVES (50-75 ppm in Petrolina vs 104 ppm in Piura) =

BETTER GROUND AND PULP COLOR

INFLUENCE OF MANGO GROUND COLOR

SOUTH AFRICAN ´KENT´ MANGO
AT SUBTROPICAL CLIMATE

´KENT´ MANGO FROM PIURA, PERU
AT TROPICAL CLIMATE

HADEN FRUIT S CASE

´HADEN´ HAS A BETTER ACCEPTANCE IN THE WHOLESALE MARKET IN SÃO PAULO (R$ 4,33/Kg in May 03/2013); ´PALMER´ (R$ 2,90/Kg) AND ´TOMMY ATKINS (R$ 2,61/Kg).

TEMPERATURE ABOVE 30ºC DURING FRUIT GROWTH IN NORTHEASTERN BRAZIL PROMOTES HIGH PERCENTAGE OF STENOSPERMOCARPY AND MORE THAN 20% OF FRUITS DO NOT REACH ITS NORMAL SIZE OF THE VARIETY THUS INFLUENCING ITS COMMERCIALIZATION.

RIGHT DECISION ?

DUE TO THE SMALL AND SUPPOSELY UNSAILABLE FRUIT, SEVERAL GROWERS (at 90´S DECADE) CHANGED MANGO CANOPY FROM ´HADEN´ TO ´TOMMY ATKINS´ OR ´PALMER´ THUS INFLUENCING DYNAMICS OF MARKET.

SIZE INFLUENCING DYNAMICS OF MARKET

HADEN FRUITS

VERY LITTLE (Mini-Haden)

NORMAL

LIKE “THE VERY LITTLE MÔNICA APPLE” (Mini-Apple; left) WITH GOOD ACCEPTANCE IN THE MARKET, ‘MINI-HADEN’ FRUIT WAS SIMILARLY RELEASED (by Mr. Zé Pires) IN THE MARKET OF RECIFE CITY, WHICH GOT AN EXCELLENT PRICE THUS CHANGING THE DYNAMIC OF MANGO MARKET.

INNOVATIVE PRODUCTS ?

A MUTANT PURPLE SKINNED SUGAR APPLE

SQUARE WATER MELON BY KEEPING GROWING FRUIT INTO AN ACRILIC BOX

SQUARE MANGO ? WHY NOT?

CURIOSITY: WHAT ABOUT HORN MANGO ?

THIS PHENOMENON WAS FOUND AT AREA OF ‘TOMMY ATKINS’ JOIN WITH ‘HADEN’ IN PARAGOMINAS, PARÁ STATE; HIGH TEMPERATURE AND HUMIDITY AT FLOWERING AND FRUIT GROWTH PERIODS;
A HIGH PRICE GIFT (R$ 15,00/fruit) PAYED BY THOSE WHO WANT TO MAKE JOKE WITH “FRIENDS”.

HYPOTHESIS: ABNORMAL GROWTH OF SYNERGID CELLS ?


“Love begins when a person feels another person´s need to be as important as his own”
Harry S. Sullivan