The Discovery of the Mango Flower Induction
Technology and the Research Process



#### Dr. Ramon C. Barba

National Scientist
National Academy of Science and Technology (NAST)
Department of Science and Technology (DOST)

## BACKGROUND

- √ 'Carabao' mango considered by many as one of the best mangoes of the world
- ✓ Before 1974, not reached commercial importance

#### Before 1974, mango trees are:

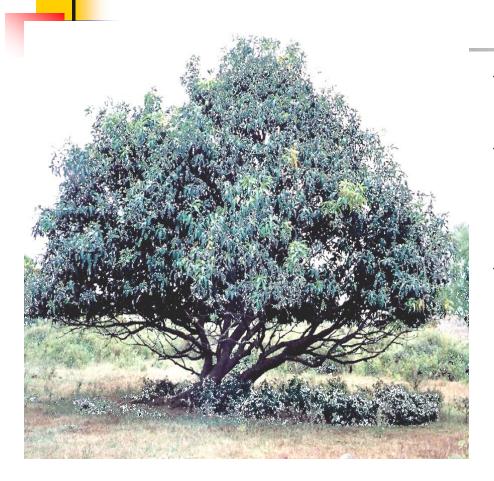
- Highly seasonal (fruits available one month in a year)
- Alternate bearing (good year of harvest followed by a year of poor yield)
- Fruiting, erratic, often yield poor even on "ON" years
- Prevalence of pests and diseases that destroy flowers and fruits



### Problems partly solved by smudging

- Smudging => building smoky fire continuously for at least 2 weeks to force flowering
- Tedious and expensive

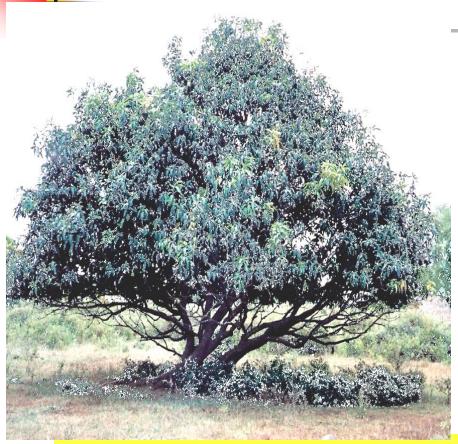
### \*\* Dr. Leon G. Gonzales\*, first to study "smudging of mango trees" (1923)



- Filipino discovery
- Heat in smoke caused flowering
- Others include gases, CO<sub>2</sub> and ethylene

"Smudging of Mango Trees"

### \*\* Dr. Leon G. Gonzales\*, first to study "smudging of mango trees" (1923)



- Ethylene considered to be active ingredient
- Ethylene difficult to apply because gas

"Better solution => induction with chemicals, good alternative



### 1940's advent of plant growth regulating (PGRs) chemicals

\*modified many growth processes in plants, e.g. rooting of cuttings, flowering among others



- In 1942, Sen of India proposed research of chemicals to induce flowering
- In 1972, Sen of India experimented chemicals to induce flowering, but did not work



# I. JOURNEY through ACADEMICS

#### **UPCA** College of Agriculture

#### □ 1957, Start of Interest on Mango Flower Induction

- ❖ BSA student (1954-1958), with thesis adviser \* Dr. Leon G. Gonzales\*, first to study "smudging of mango trees" (1923)
- Published in Philippine Agriculturist 1923 (now Philippine Agricultural Scientist)

#### **UPCA** College of Agriculture

Inspired by book on growth regulators

Pioneering book, "Auxins and Plant Growth (1955)" by \*Dr. Aldo Carl Leopold\*

#### Postgraduate Studies, USA

**1960-1967** 

gained more knowledge & ideas on flowering

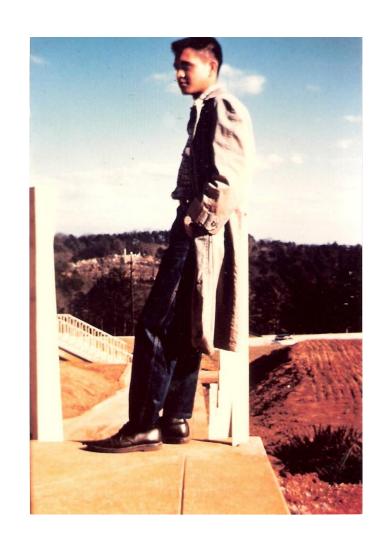
from publications, experiments & interactions with professors & fellow students

#### University of Georgia, USA

• 1960 to 1962

### Adviser Dr. Franklin Pokorny

- Thesis: Flowering of azalea using GA & KNO3
- New ideas on mechanism of flowering



#### University of Hawaii, USA

- > 1967
  - PhD in Horticulture
  - Adviser:
     Dr. Toshio Murashige,
     (famous for MS tissue culture medium)
  - RC Barba,
     1st Ph.D. advisee of Dr. Murashige





#### Ph.D. University of Hawaii, USA

Dr. Toshio Murashige, RC Barba's adviser moved to University of California Riverside

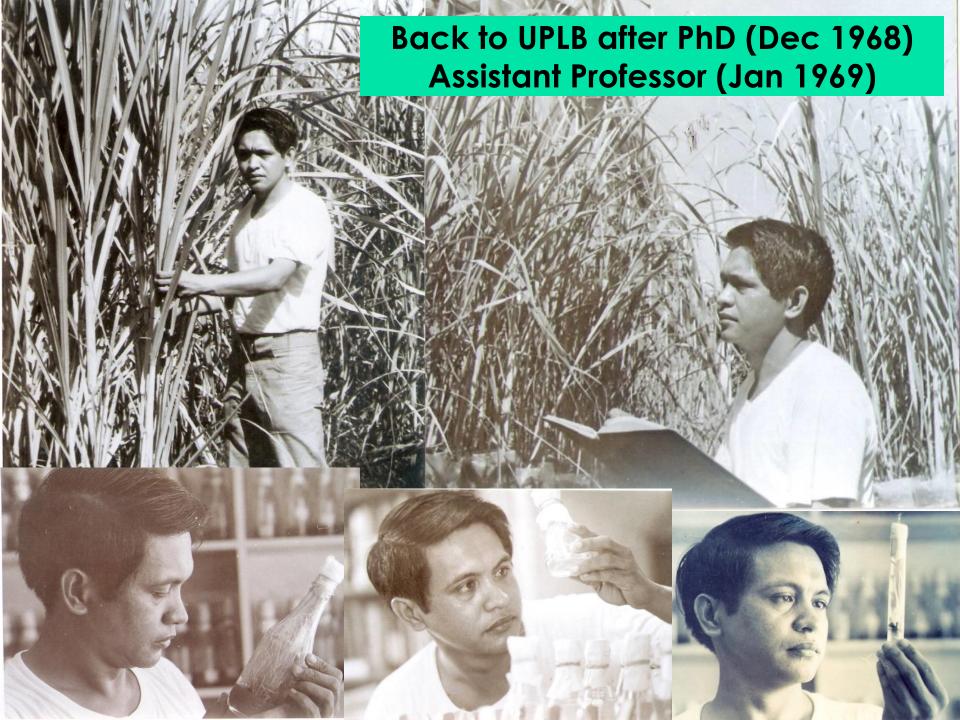
However, RC Barba did not go with Dr. Murashige to UCR

Dr. Roman Romanowski, new adviser endorsed by Dr. Murashige

Thesis: mechanism of action of herbicide ametrine in banana

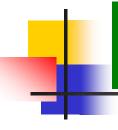






#### □ 1969, back to UP College of Agriculture (UPCA)

- Assistant Professor 1
  Fruit Crops Section, Dept. of Agronomy,
  UP College of Agriculture (UPCA)
- Idea to induce flowering in mango using chemicals



### The Beginning

### Challenges to find chemical flower inducer of mango

#### The Beginning (Cont.)

□ 1960-1967, postgraduate studies

During Ph.D. at University of Hawaii, a favorite author of book on "growth regulators" taught advance course in "Plant Physiology"

Dr. Aldo Carl Leopold, Professor

### The Beginning (Cont.)

- 1967, Warner & Leopold patented "Ethrel"
- Ethrel (2-chloroethylphosponic acid
- Growth regulator that produces ethylene when sprayed to plant
- RC Barba brought back to UPLB 1 liter of Ethrel

### Challenges to find chemical flower inducer of mango (Cont.)

- ☐ 1969, back to UP College of Agriculture (UPCA)
- June 1969, Proposal to induce flowering in mango using ethrel
- Chair, Dept. of Agronomy, UPCA rejected the proposal

### Challenges to find chemical flower inducer of mango (Cont.)

#### □ Proposal was rejected:

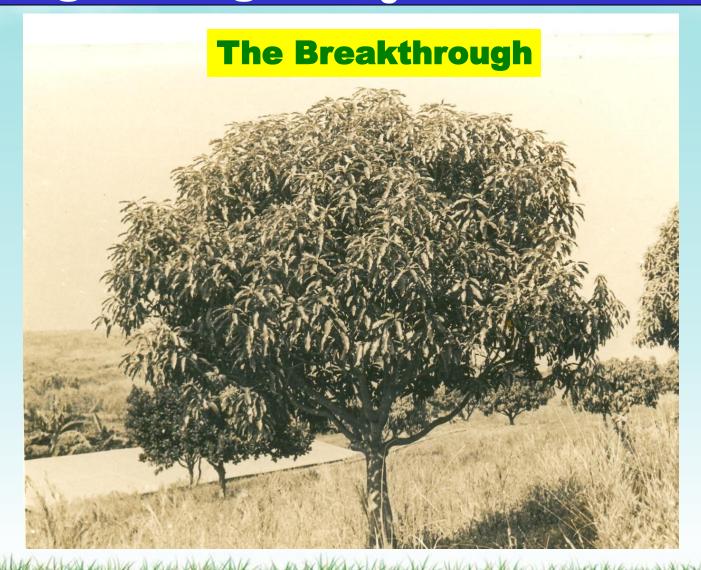
- redundant because a PhD exchange student from Cornell University doing thesis on mango flowering
- mango not assigned crop to conduct research

### Challenges to find chemical flower inducer of mango

Research on mango flowering was conducted at a friend's (Jose and Rita Quimson) orchard on personal capacity (Saturdays and Sundays):

- Done in private using a PhP 27.00 hand sprayer
- \* 10kg KNO<sub>3</sub> worth PhP5.00

### Discovery of Flower Induction in Mango Using KNO<sub>3</sub> @ Quimara Farm



### Discovery of Flower Induction in Mango Using KNO<sub>3</sub>

- Personal budget of PhP500.00
- Exploratory test of several chemicals on selected shoots



> 1% KNO<sub>3</sub> induced flowers in 2 weeks

### Discovery of Flower Induction in Mango Using KNO<sub>3</sub> (Cont.)

- Within 2 weeks, 100 trees, 10 yrs old & never flowered, were sprayed.
- > Produced abundant fruits in 4 mos.
- Complete technology including field application & farmers' adoption in 4.5 mos.

### Perils of a Commercially Important Discovery

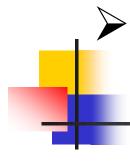
- >1971, realization of the perils of the discovery and innovation
- Former Research Assistant (RA), Fruits Crops Section, Dept of Agronomy, UPCA, requested to visit Quimara Farm
- RC Barba divulged to the RA the chemical, where to buy, conc and method of application

### Perils of a Commercially Important Discovery (Cont.)

- The Research Assistant (RA), promised not to reveal the discovery without RC Barba's permission.
- The RA even requested RC Barba to be his M.Sc. adviser, & the discovery as his thesis.
- RC Barba expected the RA to respect his discovery, and
- that the technology was already completed, rejected RA's proposal to be his M.Sc. thesis.

### Perils of a Commercially Important Discovery (Cont.)

- The Research Assistant (RA), <u>disobeyed his own promise</u>, used the technology without RC Barba's permission & <u>divulged the</u> <u>discovery to the Department Chair</u>.
- They tested the technology, claimed the discovery and results published in several publications.
- Another person applied patent for the mango flower induction technology using same chemical (KNO<sub>3</sub>).



#### Patents from the Philippines, USA, Australia, New Zealand, and United Kingdom

> Never enforced

So, free use of technology by growers



October 4, 2007

Mr. Ramon Barba Inventor

Dear Mr. Barba,

Intellectual property (IP) assets like trademarks, patents and trade secrets, have become more valuable than physical assets in today's competitive knowledge based economy.

To showcase success stories on successful IP asset management, the World Intellectual Property Organization (WIPO) is producing a documentary film about inventors and entrepreneurs who have used IP effectively. These short features will be uploaded on the WIPO website to serve as an educational tool to promote creativity and innovation. It is hoped that these documentaries will also inspire inventors and entrepreneurs to know more about intellectual property rights and manage their IP assets. You may visit WIPO's Webcast homepage to see some examples of previous works at http://www.wipo.int/multimedia/en/webcast/

After a rigid selection process, the Philippines was chosen as one of the two countries from the Asia and the Pacific Region for this project. Among many candidates from around the world, you were chosen as one of the individuals to be featured in this documentary.

We hope that you will agree to participate in this project, which not only gives recognition to your achievements but also brings honor and pride to our country. .

The WIPO documentary team will be visiting our country on the second half of November, during which they would like to interview our proposed candidates. If you agree to be interviewed and featured, please let us know and we will communicate your decision to WIPO.

I would like to invite you to an informal meeting on Friday, 19 October, so we can discuss the project in detail. We shall call your office to arrange this meeting at a mutually convenient time.

Thank you and best regards.

Sincerely,

Atty. Adrian Cristobal, Jr.
Director General

Republic of the Philippines
INTELLECTUAL PROPERTY OFFICE

351 Sen. Gil Puyat Ave., Makati City 1200 Philippines • www.ipophil.gov.ph Telephone: +632-7525450 to 65 • Facsimile: +632-8904862 • email: mail@ipophil.gov.ph After a rigid selection process, the Philippines was chosen as one of the two countries from the Asia and the Pacific Region for this project. Among many candidates from around the world, you were chosen as one of the individuals to be featured in this documentary.

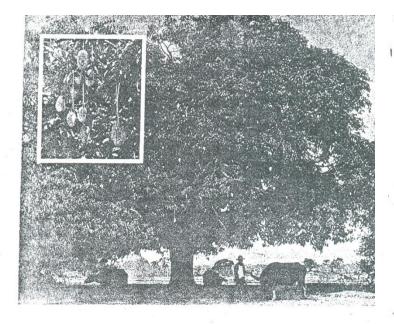
"After a rigid selection process, the Philippines was chosen as one of the two countries from the Asia and the Pacific Region for this project. **Among many candidates** from around the world, you were chosen as one of the individuals to be featured in this documentary."



- > Flower induction quickly became worldwide practice
- Generated interest on research on flowering



Mexico used it since 1975, 41% share of world trade



### The Magnificent Mango

By WILLIAM WARREN

This worldwide taste-pleaser has become leading candidate for king of tropical fruits



"Mango, mango, he so delicious. Soothes the body and calms the mind."

In the West Indies they sing this calypso in praise of the fruit which, until recently, was for most only an exotic name in travel books. Now the mango is enjoyed all over the world and is likely to become the king of tropical fruits.

One of the pioneers is the Philippines, where researchers are developing ways to increase production.

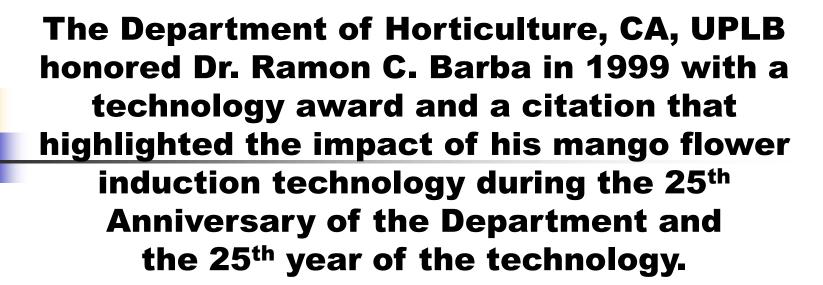
Scientists at the Los Banos College of Agriculture have found that potassium nitrate sprayed on mangoes in a one percent concentration induces the trees to flower early and profusely. And a chemical plant hormone sprayed on young fruit the size of corn kernels increases their final weight.

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> To speed up growth and advance fruiting of trees

First used for a 3,000 ha mango and cashew plantations in the Magat and Pantabangan watersheds (1980's)



"The advent of flower induction in mango with potassium nitrate is the single most important factor that stimulated growth of the industry. Its multiplier effect is wide and far-reaching benefiting the economic well-being of growers, investors, pesticide manufacturers, baggers, contractors, kaing-makers, bamboo raisers, viajeros, truck and jeepney operators, drivers, middlemen, wholesalers, retailers, exporters, processors, consumers, employers, and employees of mango establishment among many others. A neglected crop grown for fun, shade, and shelter before and after the introduction of the technology, yield of mango was 2 and 6 metric tons per hectare, respectively. Whereas few or none existed in the past, by 1995 alone there were at least 174 professional mango contractors, 33 "dried" mango manufacturers, 105 processed mango products, and about 20 mango growers associations. These and mango's contribution to the national economy, estimated at 7 billion pesos in gross value and 43 million dollars in foreign exchange earnings, are largely due to the technology unraveled at UPLB".



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## YIELD OF MANGO IN TONS PER HECTARE IN RELATION TO FLOWER INDUCTION



PHILIPPINES				
Before adoption	1970	-	3.3	
Early adoption	1975		5.1	
Full adoption	1980	- <u>-</u>	9.6	
		- An - H N		
WESTERN VISAYAS				
Before adoption	1970	-	1.5	
Early adoption	1975		3.5	
	1977	· · · · · ·	12.9	
Full adoption	1980	- "	22.6	
	1985	· -	22.6	
Ref. Mango Statistics,		, 1996	22.6	

#### **VOLUME OF PRODUCTION IN THOUSAND METRIC TONS**



	1995	1996	1997
Banana	1,540	1,521	1,581
Pineapple	840	845	652
Mango	495	520	574
VALUE OF PR	ODUCTION IN M	ILLION PESOS	
Mango	7,342	9,188	10,338
Banana	5,035	5,978	7,052
Pineapple	2,973	4,193	6,521
FARMGATE P	RICE PESO PEI	RKG	
Mango	7.48	14.83	17.65
Banana	1.91	3.54	4.96
Pineapple	1.80	3.27	3.93
		t t	

BAS, 1997

### ESTIMATED COSTS AND RETURNS FROM 50 FULL-GROWN GRAFTED TREES. BONDAD, 1985

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Item	With Flower Inducer	Traditional Method
Yield ("Kaing")	1,200.00	170.00
Gross Income (P)	124,800.00	11,050.00
Total Production Cost (P)	30,401.80	3,317.60
Net Income (P)	94,398.20	7,735.00

## PHILIPPINE MANGO – AFTER FLOWER INDUCTION

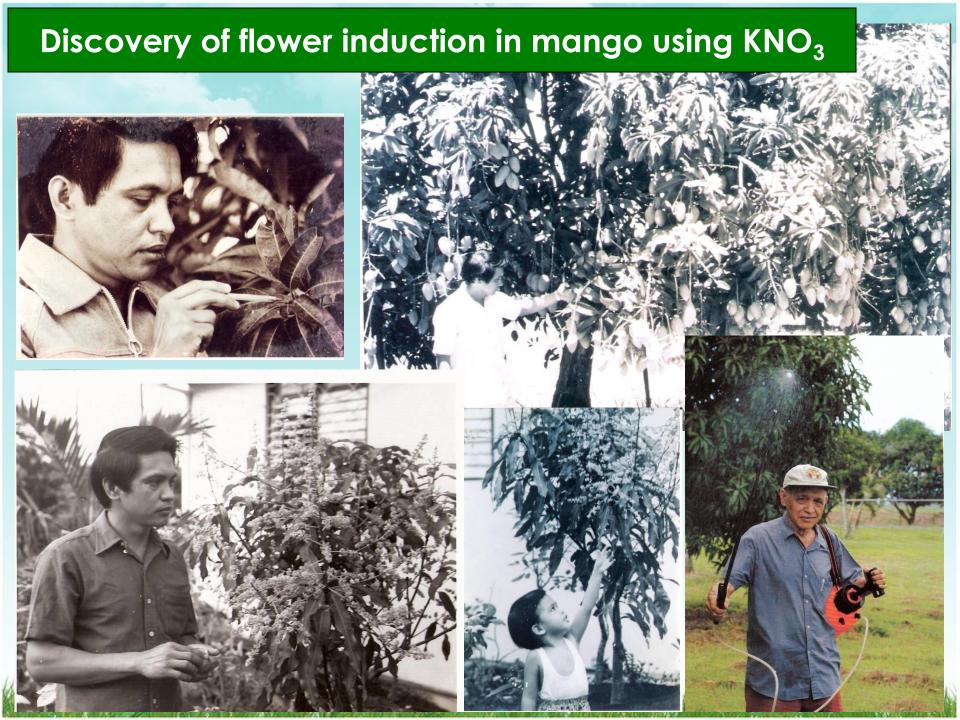
Harvested area increased from 36,000 ha in 1980 to 159,000 ha in 2005, mostly from backyard trees

#### 2. Plantation Development:

- > 1980 4,000 ha in Negros, 2,000 ha in Digos, ECJ
- ➤ 1992 4,000 ha in Mindanao, GEM-USAID
- > 2005 100,000 more in Davao and Cotabato, GEM-USAID

## Other countries that have favorably used KNO3:

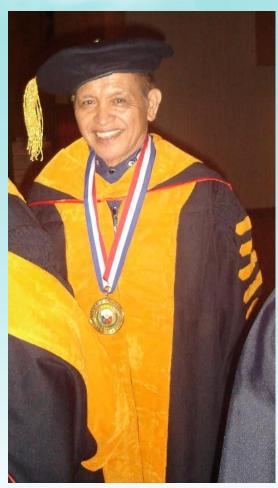
- 4
- 1. Puerto Rico
- 2. Kenya
- 3. Australia
- 4. Hawaii
- 5. Africa
- 6. Venezuela
- 7. Vietnam
- 8. Latin American countries
- 9. Southeast Asia



### **AWARDS**



## National Academy of Science & Technology NAST, DOST



Academician, 2004



National Scientist, 2014





#### TOYM (1974)



#### 5 Filipinos break into top 100 Asian scientists list

03:00 PM May 1st, 2016

Five Filipinos were included in the <u>maiden "Asian</u>

<u>Scientists 100" list released</u> recently by <u>The Asian</u>

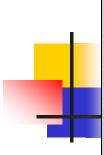
<u>Scientist magazine.</u>

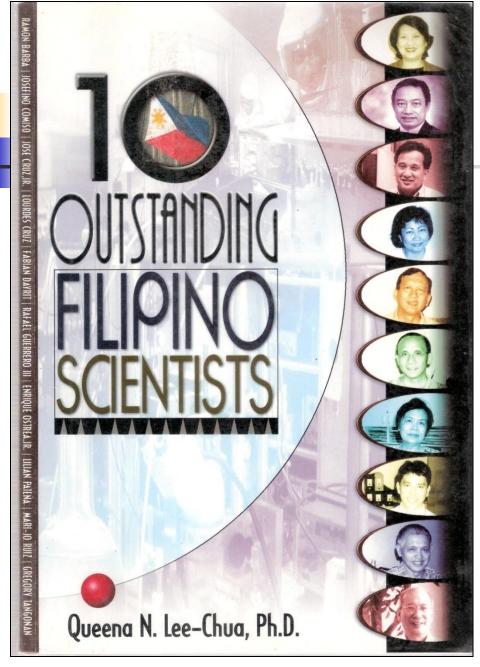
Leading the Filipino
scientists on the list is
National Scientist
Ramon Cabanos Barba,
ranked third on the list.



#### National Academy of Science & Technology (NAST) -Featured in SALINLAHI, Philippine Heritage Center

- Flower induction of mango by KNO<sub>3</sub>, 1997
- Micropropagation of banana, with LF Pateña & OP Damasco, 1997

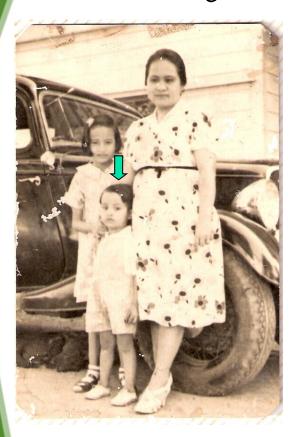




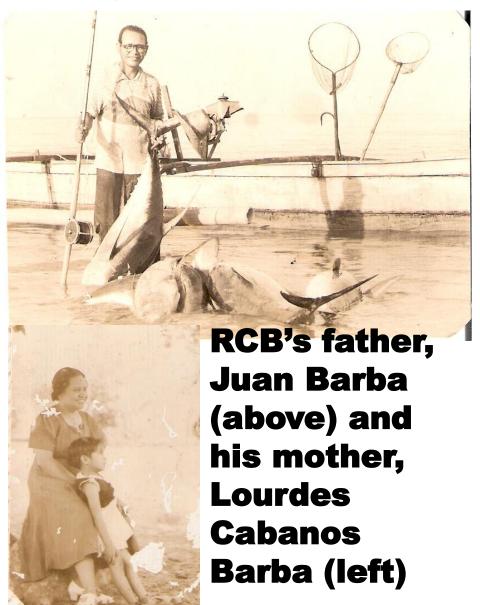


# "EARLY EDUCATION and FAMILY"

> 1946-1951, Elementary school, Sta. Rosa Academy, San Nicolas, Ilocos Nortre



RCB (with blue arrow) and his mother and sister, Rachel



> 1950 to 1954, High School at UP High, Diliman, Q.C.



## UP HIGH SCHOOL JUBILED CLASS'54 @ 50 UP CAMPUS MANILAPOLO GLUB CAYLABNE BEACH RESORT

# The Scientist is married to Corazon Veron Cruzand is now a proud Lolo to 9 year-old grandson, Carlitos, son of Ricky and Danie Largo Barba





9 year-old grandson, Carlitos, The future NATIONAL SCIENTIST

# Research Guide

A key to Scientific Research Literature

DR. RAMON C. BARBA
National Scientist
National Academy of Science
and technology