TRIAL GERMINATION – PRELUDE TO PROPAGATING CINCHONA IN MINDANAO STATE UNIVERSITY, MARAWI CITY

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The higher death rate throughout the world, especially in the tropical regions of the Americas, Asia and Africa has been identified with the dreadful disease known as Malaria. Estimates show that about one-third of the earth's population is affected and no less than two million people die from malaria annually. The fact is that the World Health Organization announced in 1975 that its program to eradicate malaria has failed.

The Philippines is no exception from this disease, especially during the Second World War when the acute scarcity of drugs for malaria was very much felt. Thanks to the Bureau of Forestry under the leadership of then Director Arthur F. Fischer who initiated to establish the Cinchona plantation as early as 1926, the saving of the lives of several thousands of soldiers and civilians in Mindanao, Visayas and Luzon was achieved. The plantation was a source of cinchona bark, which brought a great relief to those who were victims of malaria.

Historical Notes

In the 16th century, a plant indigenous to South America and which was known to the Peru Indians as "quinquina" was discovered by Spanish explorers in the eastern slopes of the Andes Mountain of Peru and Ecuador. About the 17th Century, Linneaus named the "quinquina" after Countess Chinchona, wife of the then Viceroy of Peru. After Linneaus' death the first "h" in Chinchona was unintentionally dropped giving rise to the plant's generic name "Cinchona."

The explorers noted that the Indians were using the dry bark from the stem and roots of cinchona—so-named as either "cinchona bark," "Peruvian bark," or "Jesuits' bark"—for medicinal purposes.

Soon these Europeans were chewing the bitter unpleasant taste of the bark, and observed that it was an effective relief for fever. From then on the search was on for other ways to extract the medicinal substance from the bark to make it easier to take. After the initial discovery of the cinchona tree the medicine from the bark was crudely drawn out by soaking the bark for a time in wine. Draining the medicine from the bark made it easier and faster to swallow because the bitter taste was tempered by the wine. However, there still remained the difficulty of fully extracting the medicine from the bark especially so the bark had to come all the way from South America which made quinine a monopoly only to the moneyed members of the society.

Traveloque of Cinchona From The Andes Mountain

By the middle of the 19th century the cinchona tree had started dying out in South America and had to find exit somewhere in Europe. Considering the tremendous medicinal value of the cinchona, several European countries started to grow the tree in quantity but failed. Practically at the same period, the Dutch in Indonesia started introducing the Cinchona in Java and Sumatra, where it succeeded. For many years, therefore, Indonesia was the main supplier of quinine.

Again, the Spanish explorers in the Philippines as early as 1893, like those explorers in South America who discovered cinchona, attempted to introduce the plant in Mt. Banahaw, Tayabas province (Quezon) and Antipolo, Rizal province. The attempt failed. The Bureau of Forestry made the next attempt in 1912 in Baguio and Los Baños. It also failed. A missionary institution known as the "Igorot Exchange" conducted trial planting of *Cinchona ledgeriana* from Madras, India, in Sagada, Mt. Province in 1919. This too failed.

In 1926 Director Arthur F. Fischer of the Bureau of Forestry initiated the establishment of Cinchona Plantation in Bukidnon province. The passage of Act 3283 in 1926 known as the "Reforestation Act" duly approved by the President of the United States on February 10, 1927 had the Bureau of Forestry start intensely the culture of cinchona. Actual work begun on July 27, 1927 using *ledgeriana succiruba* and hybrid species from Java. The plantation was started on two sites—in barrio Impalutao, Impasugong and in sitio Kaatoan, barrio Alanib,

Malybalay, both in Bukidnon province. Of these sites, sitio Kaatoan had shown a very impressive results under the established "Quinine Reserve" under Proclamation No. 122 dated October 5, 1927. It is located on the southern slopes of the highest landmark in Central Mindanao—Mt. Kitanglad. The reservation in 1934 covered 1,322.33 hectares. An additional area of 1,912.00 hectares was included in 1941 making a total of 3,234.33 hectares.

From the early stage of introducing cinchona in the Philippines, representative areas were tried from the width and breadth of the country where great failures and frustations were encountered. Culture of cinchona is so delicate, tedious and very expensive, because of the germinating media and site factor requirements for growth, fragility of the seedlings and its susceptibility to pests and diseases. It could easily be susceptible to "damping-off" and other insect defoliators.

The failures encountered in various occasions before the final success of establishing the plantation in sitio Kaatoan triggered a strong false silvical concept that propagation of cinchona in other parts of the country may not succeed elsewhere except the present site in sitio Kaatoan. As a matter of fact ever since the "Cinchona Reserve" in Bukidnon succeeded, attempts to propagate by means of seeds and seedlings in various reforestation projects as a reforestation crop also failed.

With the creation of the Forest Research Institute (FORI) as the principal arm of the National Government in terms of research-wide program in forestry, the top two executives Dr. Filiberto Pollisco and Deputy Director Martin R. Reyes motivated a challenge to try the germination of cinchona seeds as the first phase of propagating the tree in the MSU campus through the College of Forestry. The challenge was accepted in the interest of research. The FORI field office in Malaybalay, Bukidnon were given specific instruction to provide the necessary seeds to the Dean, College of Forestry, MSU.

Other known area where culture of the cinchona attained a commercial success was in the region of Kivu, Republic of Zaire. It was introduced in the area way back in 1938 where it succeed making the Republic of Zaire, which recently became a large supplier of quinine.

Botanical and Physiological Characteristics of Cinchona

Within the cinchona plantation in Bukidnon seven known species are propagated, namely: *Cinchona calisaya* (CC), *Cinchona hybrida* (CH), *Cinchona ledgeriana* (CL), *Cinchona succiruba* (CS), Cinchona *tijinjirocan*(CLVT), *Cinchona officinalis* (CO), and *Cinchona kartamanah* (CLVK).

Cinchona is essentially a tropical plant characterized with a long, smooth, pointed ever-green leaves with clusters of deliciously scented lilac-like cream-colored flowers that sometimes come in pink and white. Cinchona grows as tall as 80 feet with a diameter as wide as 60 centimeters.

Cinchona can be propagated by seeds, cuttings, grafting and by coppice. Statistics from the Cinchona plantations in the Republic of Zaire show that a two-gram weight of cinchona seeds contain between 4,000 to 7,000 grains. A kilo of seeds may cost as much as $700.00 but this weight too can produce millions of seedlings.

Site Factor Requirements

Generally, most cinchona species love rolling to rough mountainous terrain at an elevation between 3,000 to 7,000 ft. In known places where Cinchona has been introduced successfully have the following altitude:

Java	4,125 to 5,940 feet
Kivu region, Republic of Zaire	6,600 feet
Barrio Impalutao, Impasugong, Bukidnon	2,541 feet
Sitio Kaatoan, Malaybalay	3,960 to 4,950 feet

Compared with the above elevations, the Mindanao State University campus, Marawi City, is 2,800 feet above sea level. It may be mentioned here that within the environs of the City of Marawi elevations as high as over 4,000 ft are not difficult to find.

Precipitation is an important factor in the culture of cinchona with an annual average requirement ranging from 2.5 to 4.0 meters evenly distributed throughout the year.

The "Quinine Reserve" at Mt. Kitanglad, Bukidnon, is within the

Rainfall and Temperature for the Year
1977 as recorded by the AGROMET STATION
at the MSU Campus, Marawi City

MONTHS	No. of Rainy Days	MONTHLY RAINFALL		MEAN MONTHLY TEMP.	
		MM.	CM.	°C Maximum	°C Minimum
January	15	137.0	13.70	25.8	20.3
February	15	238.5	23.85	24.9	19.9
March	17	213.5	21.35	24.7	19.2
April	4	76.8	7.68	27.1	20.3
May	18	222.2	22.22	27.0	20.2
June	22	422.0	42.20	26.5	20.7
July	23	386.4	38.64	26.6	17.5
August	25	335.5	33.55	26.1	19.0
September	15	207.4	20.74	26.7	19.2
October	18	250.7	25.07	27.2	18.1
November	19	205.2	20.52	26.9	18.3
December	8	98.6	9.86	25.4	18.1
Average	54.37%	2.2	meters	26.4°C	19.4°C

third climatic type of the Philippines with seasons not very pronounced --relatively dry from November to April and wet during the rest of the year. Lanao del Sur is within the fourth climatic type, with rainfall more or less evenly distributed throughout the year. The average annual rainfall as recorded for 1977 at the MSU Agro-Met Station registered 2.2 meters.

As to the rainfall distribution in the Philippines, Java and Western Sumatra and the Kivu region of the Republic of Zaire has the following annual average range:

Philippines	2.0 meters
Java & Western Sumatra	2.0 to 4.5 meters
Zaire	2.0 meters
Philippines (MSU) area	2.2 meters

As to temperature, the "Quinine Reserve" in Bukidnon is approximately within 7^{o} to 8^{o} south latitude which maintained a five-year average temperature of $15^{o}C$. Java is located 7^{o} south latitude with an average minimum and maximum temperature of $12.5^{o}C$ and $26.1^{o}C$, respectively. Compared with the above ranges of temperature, the MSU campus, Marawi City, is located approximately within 8^{o} south latitude, with an average minimum and maximum temperature of $19.4^{o}C$ and $26.4^{o}C$, respectively.

Economic Values of Cinchona

Cinchona is a multi-dimensional source of a mixture of about twenty-five alkaloids. The effect of these alkaloids may either be beneficial or disadvantageous. Alkaloids from cinchona are known as quinine, quinidine, cinchonine and cinchonidine. However, quinine as a basic drug against malaria and quinidine for treating atril fibriltation are the most important alkaloids from cinchona. In some cases, cinchona has been used as a tonic, as an antiperiodic against recurring episodes of malarial fever and as antipyretic.

Quinine is not only an exclusive drug for malaria, but it is also used in making film for the camera, because of its sensitivity to light. It is also used in the preparation of beer, especially Pilsner. Various plastics also contain quinine.

On the other hand, quinidine as a drug may treat and correct certain disorders of the heart rhythm.

As adverse effects, some cinchona alkaloids, like quinine and quinidine, may cause abnormalities in unborn children. For this reason, pregnant women are advised to consult a doctor before using these drugs. Cinchona can also produce impair hearing and vision.

Methodology

Some time in the early part of June 1977, Forester Pedro Bahian and Ranger Ignacio Sususco, both field personnel of the FORI Regional Office in Malaybalay, Bukidnon, brought to the College of Forestry, MSU, seeds of the seven species of cinchona propagated in the "Quinine Reserve" in Sitio Kaatoan. The seeds were collected by Forester Bahian in April 15 to 25, 1977.

Under the direct guidance and supervision of the author, laborer Jun Arañas of the College of Forestry, MSU, and Ranger Ignacio Sususco, FORI "belo boy grantee" to the College, were requested to prepare the seed beds for closer observation and protection in the residence of the author within the University campus. Considering all the factors of difficulty of propagation including the testing of the survival sensitivity of cinchona under Marawi City condition, the trial germination of cinchona seeds in a sophisticated method was set aside in favor of the simple and rugged system.

The seedbeds are lined with 2 x 4 x 8 inches concrete hollow blocks partly buried upright lengthwise in the ground. Each plot measures 8 x 16 inches and were laid in contiguous, even arrangement with four seedbeds, each on the upper and lower end. (Figure 1)

The soil ground level in the seedbeds was cultivated and pulverized. Unsterilized top soil sieve in a ½ inch mesh was introduced on top. The seedbeds bore horizontal eight furrow rows in each plot. The whole plot has been fenced with a hog wire to prevent stray animals and shaded with a transparent white corrugated plastic roofing.

Two grams of seeds per species were weighed in a "Harvard Trip Balance." The sowing took place in June 28, 1977. The seeds of each species were broadcast in the furrow rows assigned in their respective plot as indicated in the diagram above. Then the seed beds were

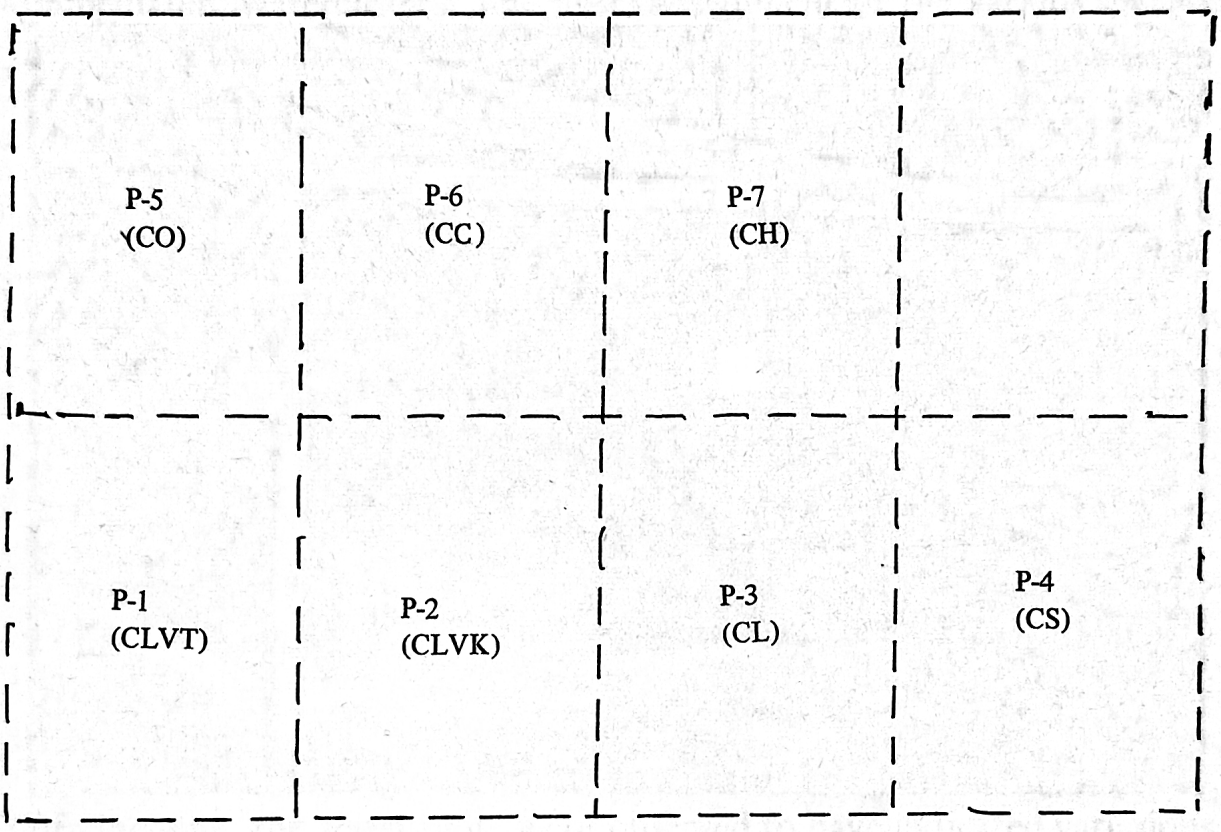

Fig. 1. Seeded Furrows

Fig. 2. Seedbeds

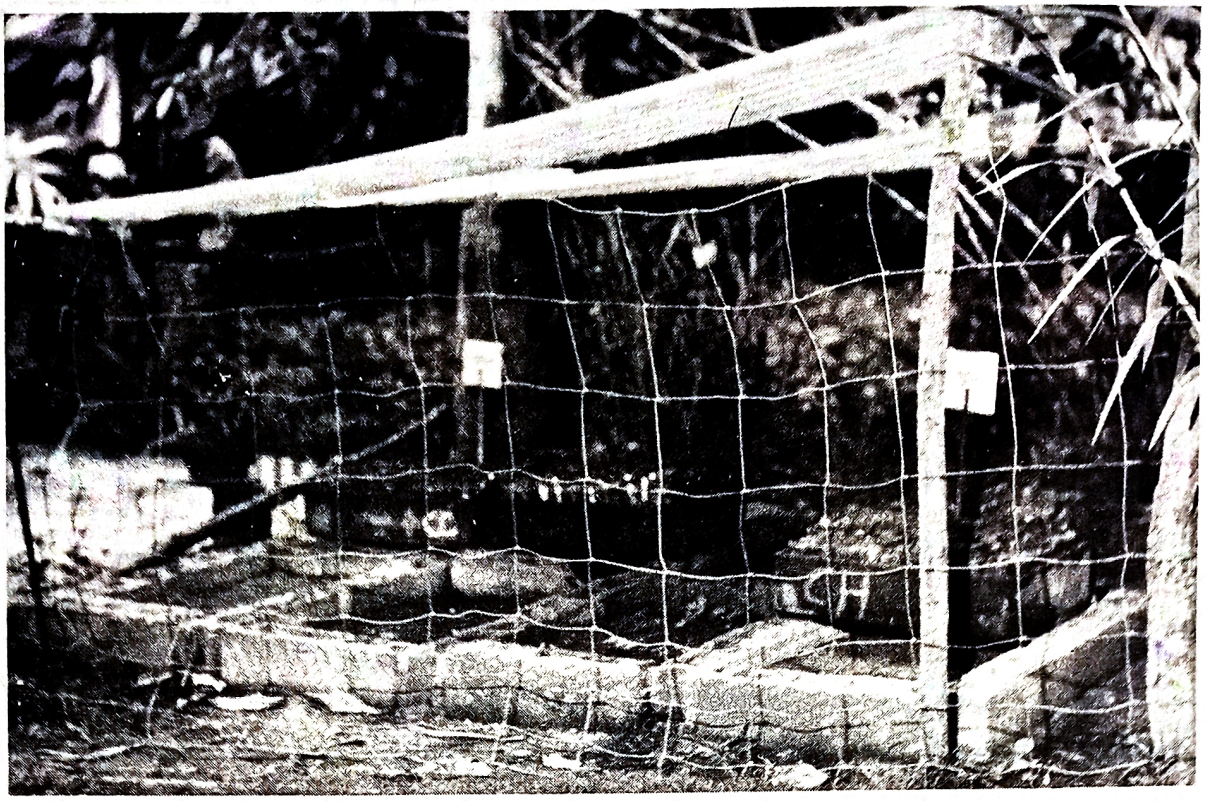

Fig. 3. Seedbeds with plastic corrugated roofing and hog wire fence

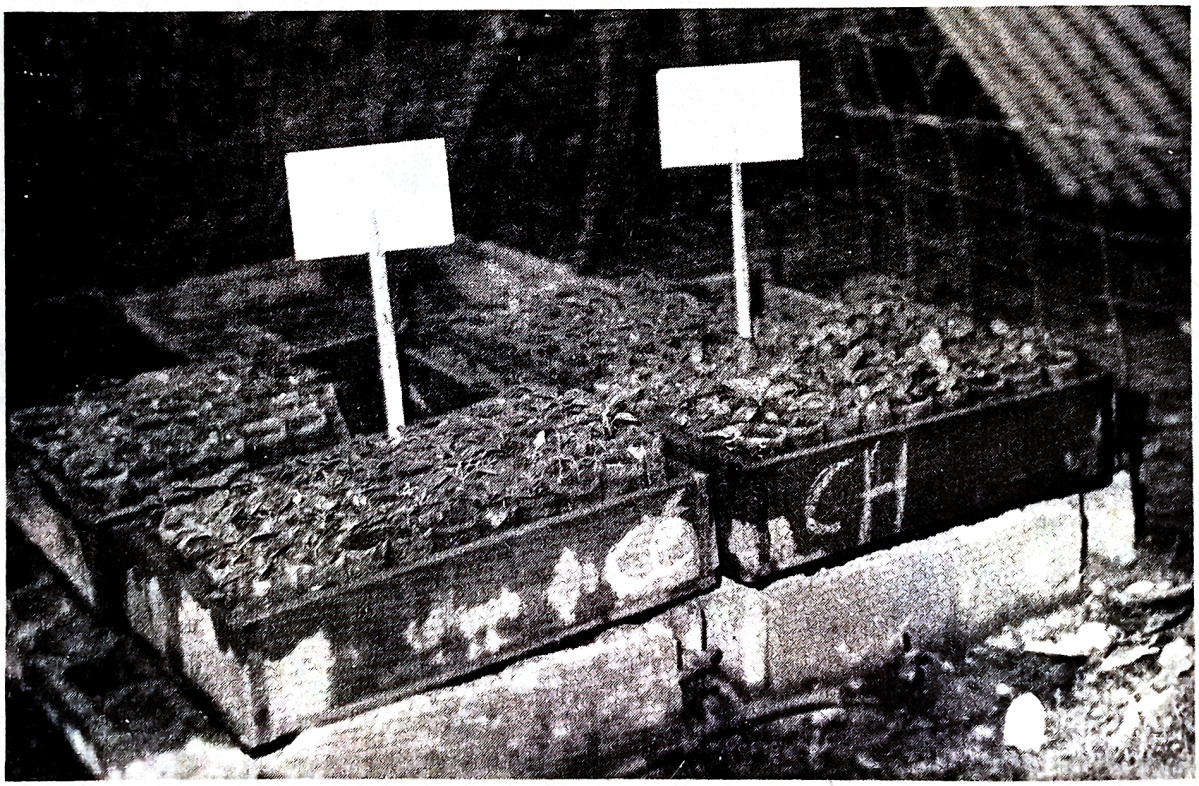

Fig. 4. Seedlings ready for the plantation.

immediately watered by a fine mist. Assignment of the various species by plot are as follows:

P – 1 CLVT	P – 2 CLVK	P – 3 CL
P – 4CS	P – 5 CO	P – 6 CC
	P – 7 CH	

Watering the seedbeds with the fine mist was judiciously scheduled every other day.

Potting in cellophane bags 2 x 6 inches was done in January 11, 1978.

Observations

Observation started ten days after sowing. On the 12th day signs of germination were noted in P-2, P-3, P-4, P-6 and P-7. On July 14, seven seedlings in P-2, seven seedlings in P-3, six seedlings in P-4, eight seedlings in P-6, and five seedlings in P-7 were counted.

In the ascending order on the trends of the germinating capacity of cinchona, the seven plots were observed to have indicated variations in the concentration of growth as follows:

July 18	P-2,	P-1,	P-3,	P-5,	P-4,	P-6 & P-7
August 4 & 16)	P-5,	P-4,	P-1,	P-2,	P-6,	P-3 & P-7
September 15)						
October 15	P-1,	P-5,	P-4,	P-2,	P-6,	P-3 & P-7
December 28	P-2,	P-3,	P-6 & P-7			

In the potting process only three plots remained, P-3, P-6 & P-7. While P-3 appeared to have sufficient seedlings but the height and poor physical appearance of the seeds were setbacks for potting purposes. Eventually, P-3 gradually thinned out until insignificant number of seedlings appearing to be sickly were disregarded. There were no insects observed attacking the seedlings but the most vulnerable enemy appeared to be the "damping-off." Of the seven species, P-7 remained the most resistant followed by P-6 & P-3 under the ordinary method of utilizing medium for germination with less regard to the kind of surface soil and its proper sterilization. From P-7 & P-6 were potted only 100 healthy selected seedlings.

Conclusion and Recommendation

The method used in this research is a trial attempt although roughly done to test the degree of probability of germinating cinchona seeds and to determine the survival from among the most tolerant of the seven species now growing in the "Quinine Reserve" in Kaatoan, Malaybalay, Bukidnon. Early indications of the research have shown the feasibility of propagating successfully all the seven species to succeed in MSU by adopting the methods used in areas where cinchona have succeeded and by exerting extra effort to effect closer attention and observation.

In the finale of this research two species under the rugged method came out to withstand all adverse conditions. P-7 has ranked as the most tolerant and P-6 as the next tolerant species. Results obtained, however, may not yet indicate conclusive evidence of success but merely indicate strong probability cause that if the research will be conducted in a more sophisticated method as had been done in other areas like Java, Zaire and in the "Quinine Reserve" in Kaatoan, Malaybalay, Bukidnon, there could always be a great hope to propel success.

There is a need for the government to support another "Quinine Reservation" in Lanao del Sur, considering the value of the alkaloids derivatives from the cinchona bark and the increasing demands in several European countries like Germany, France, Holland and the Netherlands.

With the assignment of fity hectares to the College of Forestry, MSU, for tree-plantation purposes, cinchona could be another plantation project to be experimented by the College of Forestry, MSU.

REFERENCES

Altamirano, G. M. 1933. "Cinchona (Quinine) cultivation in the Philippines." *Makiling Echo* Vol. XII, No. 2, pp. 85-91.

Awake, No. 8, 1976 pp. 9-11

Duldulao, A. C. 1974. "Let us grow the life saving tree," *Forestry Digest,* Vol. 2, No. 3. pp. 50-51.

Encyclopedia Americana, Vol. 6, p. 722.

Fronton, G. 1928. "Cinchona Cultivation in the Western part of Java," *Economic Bulletin of Indo China.* (Translated from the original French by Anne M. Pendleton.)

Juni, R. A. & Gallardo, A. C. 1947. "The Philippine Cinchona Project," *Philippine Journal of Forestry,* Vol. 5, No. 2-4, pp. 173-194.

Reyes, M. F. 1977. "Raising Cinchona" (unpublished)

Taylor, N. 1945. *Cinchona in Java.* p. 57.