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1443

NOTES ON THE DURATION OF EVOLUTION  
OF VARIETIES OF RICE CULTIVATED IN INDOCHINA

by Yves COYAUD

Chief Engineer of Agricultural Services  
in the Colonies

NOTES ON THE DURATION OF EVOLUTION  
OF VARIETIES OF RICE CULTIVATED IN INDOCHINA

The notion of duration of evolution for an annual culture plant, as rice, is of great practical importance. It finds its application in the establishment of cares, in the adaptation to conditions of the milieu, in the research of a reduction of wastage due to animal and vegetable parasites, etc...

The duration of evolution, also called period or still yet vegetative cycle, is the number of days that go by between the dates of seeds and of the crop maturity. We will study later on the influence of displacement on the seed at this period, and that, still more important, of transplanting. But in a determined region the epoques of seeds and transplantings are quite limited in time by the milieu conditions (climatic, hydraulic, and agrolological), the varieties of rice cultivated according to the usual cultural practices present then a relatively fixed duration of evolution. In sum the different varieties have a hereditary tendency to develop according to a certain rhythm when certain conditions of milieu are realized. And agricultural practice distinguishes the full gamut of varieties: very premature, premature, of demi-season, of season, semi-tardy and tardy. However, always in a same region and for a same seeding or transplanting epoque, one verifies, according to the years, light variations in the duration of evolution, the discrepancies with the average being all the more greater than the variations of factors of the milieu are greater. It is thus that in Indo-China, variations attaining 10 to 15 days can be declared in the case of varieties of long duration of evolution, variations reduced from 2 to 5 days for the varieties with a weak cycle and in stabilized cultural conditions (managed rice fields). But, when one changes the milieu or when one modifies the cultural conditions, the period can be greatly modified.

The study of these modifications, in relation with the milieu factors, takes up researches on the physiology of the plant, and would lead to important developments that can not be treated in this note. Without entering into all of the details one must point out the predominant influence on the vegetative cycle, factors of climate and principally of light and heat.

Influences of climatic conditions

The intensity of insulation and photoperiodicity, acting on the photosynthesis and on the migration of reserves, their variations in time, in the seasonal rhythms, can release more or less sooner the reproductive

phase of the plant.

The action of artificial variations of these factors on the evolutionary duration of cultivated rices was studied above all abroad, but gave discordant enough results. In the Philippines ESPINO discerned a feeble action of the reduction of daylight. While in Japan, maturation would have been all the more advanced than the treatment had been practiced earlier. A continuous treatment would slow up the vegetative cycle from one to two months. The extension of the day would have the tendency to augment the evolutionary duration, retarding sometimes very strongly the formation of panicles. In Java, the imported varieties from China, from Siam and from India would show, with the slowing up of the day, an accrued prematurity while the local varieties would present an accrued tardiness, which would be the proof of a different physiological character for these diverse types of varieties.

In Tonkin, attempts of reduction of the duration of the day also demonstrated results clearly different for the imported Japanese varieties and for the local varieties.

If, instead of an artificial modification of the intensity or of the duration of the day, one studies the behavior of rices according to the variations of insulation in the course of the year, one perceives that the Indo-Chinese varieties of rice do not all have identical behavior. But one must notice that, in the unrolling of the calendar, the variations of duration of the day also accompany temperature variations, whose influence is very important and is not similar for all of the varieties. Certain ones of them can vegetate at temperatures, where others can not grow. When these temperatures reign, these varieties take in advance and can arrive more quickly at maturity.

According to studies made abroad (AKEMINE, FOGGENDORF) and FORD) the rices would demand at least 10 to 13 C in the seed bed (optimum 30 to 35 degrees, maximum 40), 22 at flowering (optimum 29 to 30, maximum 39) and 19 at maturity. In fact, the diverse varieties of rice have different needs. Northern varieties demand less heat to germinate. In Tonkin, the varieties of the rainy season support less well winter than the varieties normally cultivated at this epoch. In the northern limits of culture of rice, 50 degrees and even 55 degrees of North latitude in the Maritime Provinces of the U.R.S.S., one must utilize very premature varieties from Japan, whose heat needs are reduced.

Graph I permits to compare the evolution of the varieties cultivated in Tonkin and in Cochin China with the insulation and the temperature curves (monthly averages). One can notice that the dry seasonal rices of Tonkin, where rice from the 5th month (1), flowers when the insulation

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(1) From the name of the harvest month in the annamite lunar calendar 5th month = May-June.



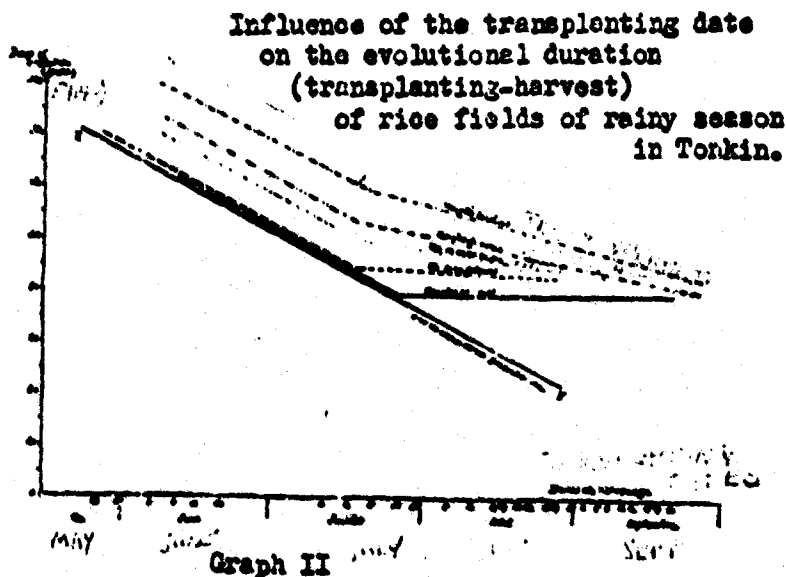
and the temperature augment, while the rices of the rainy season flower when these factors diminish. When one cultivates the varieties of the rainy season in dry season, they flower sooner than the varieties of the 5th month, their needs in insulation and in heat being, at this critical period, probably less elevated and sooner satisfied. Varieties of rice of the 5th month cultivated in rainy season also flower sooner than the normal varieties as their needs are greater.

Among the varieties of Cochin China, only the precocious varieties can be cultivated in Tonkin, as their needs are quite similar; the more tardy rices with difficulty arrive at flowering from the fact of insufficient temperature and insulation. The rices of the rainy season of Tonkin, cultivated in Cochin China, see their evolution slow up.

In general, rices of the Northern regions (Japan, Italy, Spain, etc...) introduced to Tonkin vegetate poorly there. The reduction of the duration of insulation sometimes happens to make them flower in the nursery.

Influence of the seed bed époque and the transplanting époque.

If one shifts the seed bed and above all the transplanting, the evolutive cycle of the varieties is subjected to milieu conditions, (heat and light), which are different. One then perceives that the varieties do not all react in the same way. Certain ones present an almost fixed flowering date and maturity date, whatever be the dates of seed bed and of transplanting. Very precocious or very tardy cultures can thus, in this case, make the evolutionary duration very considerably



(from two, three and even four months). Certain ones, to the contrary, present an evolutionary duration which is more stable and matures after a nearly constant cycle, if temperature and hydraulic conditions take.

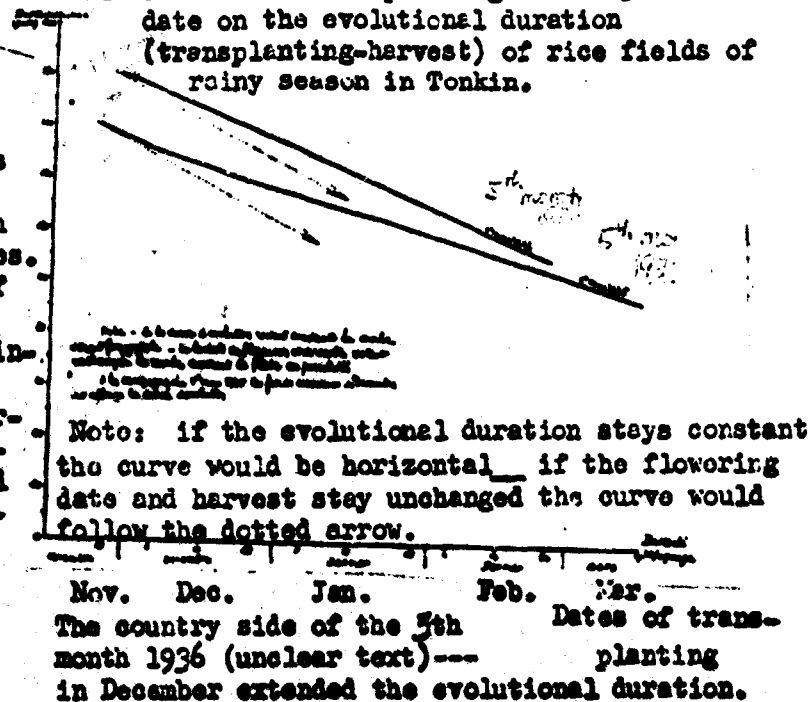
The first group thus seems more subjected to photoperiodicity than the second, that is formed above all

of varieties of short evolutionary duration. If this division is sharp enough in Cochin China, where, from the fact of the regularity of the temperature, the needs of heat are always satisfied, it is not the same in Tonkin. Studies of seed bed and transplantings placed in a series effectuated by the Indochinese Rice Office at Tonkin demonstrated, in transplanted cultures, that the transplanting-harvest period was little modified by a more or less prolonged stay in the nursery (1), (inferior variations at 6 days) (2), but on the other hand experienced the predominant influence of the transplanting date.

Graph II illustrates this last remark for the attempts effectuated with the rainy season varieties. For the transplantings of the end of May to mid-July, the different Tonkinese varieties present a fixed flowering and maturity date. The representative curves are parallel to the XY axis of proportional declines. Every advance to transplanting extends by that much the evolutive cycle.

The transplantings effectuated after mid-July give different reactions, the cycles having a tendency to stabilize themselves and be only a little influenced by the

Influence of the transplanting date on the evolutionary duration (transplanting-harvest) of rice fields of rainy season in Tonkin. Graph III

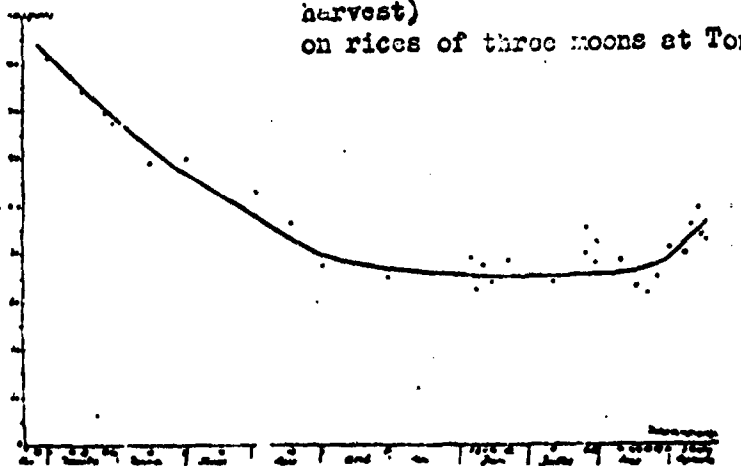


(1) On the other hand, at Formosa, the trials of adaptation of Japanese varieties demonstrated that a very short stay in the nursery (15 to 20 days), was able to modify the evolutionary duration, counterbalancing in part the influence of the different photoperiodicity and permitting to obtain very good results with the Horai-mai varieties.

(2) Trials undertaken with durations of 25 to 60 days in the nursery for the rainy season varieties and from 60 to 105 days for those of the 5th month.

Duration of Evolution (Days)

Influence of the transplanting date on the duration of evolution (transplanting-harvest) on rices of three moons at Tonkin



delay to the transplanting, at least until September (curves tending to be horizontal). This change in the regime occurs nearly 80 days from the harvest for premature varieties, 90 days for semi-precocious one, 100 days for the demi-seasons, 110 days for the seasonal varieties and 120 days for the tardy varieties.

Nov. Dec. Jan. Feb. mar Apr May June July Aug Sept.

However, for the seasonal and tardy varieties, the delay in the transplanting shortens a little the cycle (intermediary curve between the horizontal and the X axis).

For rice varieties of the 5th month, one must note the influence, quite sharp, of the temperature, especially for the precocious transplantings, on the transplanting-harvest period. Graph III shows the difference of these periods for the season of the 5th month 1936 (pronounced cold in December) and for the 5th month 1935 (more gentle winter). The lowering of the temperature retarded the growth and extended the vegetative cycle. In the ensemble, varieties of the 5th month do not behave like those of the rainy season, showing an intermediary behavior: every displacement to divergent transplanting, but in a weaker proportion, the flowering and the harvest (3).

Graph IV shows the influence of the transplanting date on the evolutioral duration of the Tonkinese rice variety "ba-giang" or rice of three moons. The graphic representation shows that the transplanting-harvest period, that attains 160 days for the transplantings in December, lowers itself to 70 days for the transplantings in June-July to then climb again. This variety is normally transplanted in June after a short stay in the nursery (25 j.), its weak evolutioral duration permits to

(3) In India, MITRA established that there existed two categories of varieties: 1 those that present an evolutioral duration, which is fixed, from seed bed to flowering, in direct seeding as in transplanting; 2 those that present to the contrary a variable time in the same conditions (MITRA S. R. and als, Seasonal variations in Paddy. Ann. I. I. India, XX, 1924).

cultivate it before a seasonal rice transplanted late, which allows to do exceptionally three seasons of rice in the same year.

### Influence of cultural conditions

If climatic conditions exercise a predominant influence on the evolutionary duration of rice varieties, cultural conditions modify it a little.

Right at first the practice of transplanting retards the maturity from 8 to 10 days, and, from 15 to 20 days, in the case of double transplanting (works of the Rice Office in Cochin China).

Hydraulic conditions also have an action on the period: it is enough to take a poorly leveled rice field to observe among the parts of the same field of differences of phases from 5 to 10 days in the flowering that reduces however at maturity.

Any condition retarding or extending abnormally the tillering retards and extends the flowering, which adds on to the evolutive cycle a little. This is the case in a dryness or a submersion during the tillering epoch, or of grave attacks of rats, insects and maladies. Too large a spacing in the transplanting prolongs tillering and retards flowering. It is the same thing for an important application of nitrogenous fertilizer too late, that augments the presence of proteins in the foliage and retards the release of the reproductive phase. The beating down and the submersion at the flowering period extends also for a few days the evolutive cycle, maturity being restricted.

On the other hand, the drying of the rice field after formation of the grains, where a dry drought at this epoch facilitates and advances maturity. The phosphated fertilizer have the same result in stimulating the assimilation of the mineral or organic nitrogen (green fertilizer).

### Adaptation of the varieties

The Indochinese rice growers utilized the reactions of vegetal material that they possessed, as a function of the climate of their habitat and chose in this material varieties whose cycle could adapt itself to the hydraulic conditions particular to their terrains.

It is thus that in Tonkin, during the dry season, the different varieties utilized present very few deviations in their flowering dates:

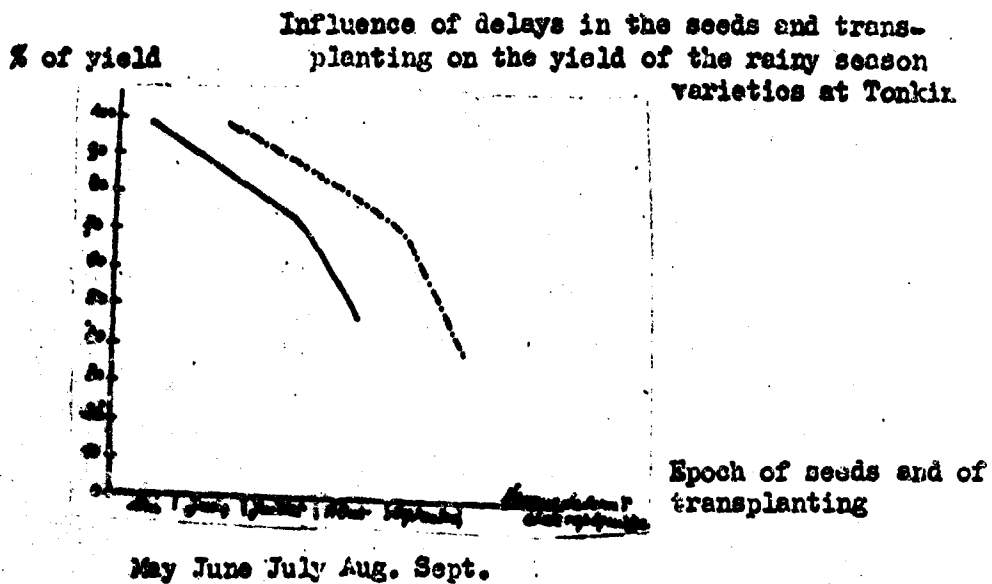
precocious varieties would risk flowering at a period where inferior temperatures of 20 degrees would prevail. On the contrary varieties of too long an evolutionary duration would not allow the terrain to evolve sufficiently in time for the preparation of the principle rice region, or season, that of the rainy season. In the bottom lands, where the culture of rice is possible only from the 5th month, too long an evolution would risk to see the plants submerged by the accumulation of waters from the first rains. For this season, the seed beds are arranged in a series over a long period, from October to December. One had previously seen that the duration of the nursery had little influence on the evolutive cycle, the growth of the plants being reduced, above all at this epoch, as a result of heat and of insufficient insulation along with this lack of heat. The transplanting is distributed from December to March, depending on delays in the preparation of the soil (evacuation of water from the bottom lands, defect in aeration low walls, etc...). One generally is interested in transplanting as soon as possible. Yield would be, when winter is mild, quite proportional to the stay of the plant transplanted in the earth; but, when abnormal cold spells set in, yields vary very much according to the period of life of the affected plant, and, from this fact, according to the transplanting date.

For the rainy season region, the seeds are arranged in a series from May to July, but with different varieties, as the plants grow old quickly in the nursery, due to the elevated temperature, to the intense insulation and favorable hydraulic conditions. The transplantings are distributed, with the complete gamut of varieties from the end of June to mid-August. The possibilities of transplanting early depend on the preparation of the soil, thus on the arrival of the rains and of supplying water to the irrigation network. In light earth, preparation is easy, one can also transplant early but as these lands drain easily and risk to dry out rapidly at the end of the rainy season, one cultivates there by preference precocious or semi-precocious varieties whose flowering will be able to take place at an epoch, where the important needs of water of the plant at the time of this critical phase will be satisfied. Likewise, the late varieties will be cultivated in a semi-low region where the hydraulic availabilities are not used up early. However in a managed region, where one can irrigate or drain at will, the distribution of cultures of diverse durations of evolution depend on economic conditions: more regulated division of manual labor and money returns. An understanding between microwaters, however, is necessary in order to avoid that the isolated cultures and small surfaces are the object of abnormally intense attacks by parasites (rats, birds, thefts). The duration of evolution being shorter than in dry season, any retardment in the transplanting leads to an even more perceptible reduction in yield (cf. graph V).

In the rainy season about 10 % of the rice fields are cultivated in precocious and semi-precocious varieties, while tardy varieties are

Evolutional duration and yield

Graph V



Theoretical graphic representation of the average of several years of trials effectuated with different varieties on diverse locations.

- representation of yield: 100 % for seeds in May (normal period)
- - - " " " 100 % for transplanting in June (normal period)

transplanted on nearly 90 % of the rice fields, and the seasonal varieties on 60 %.

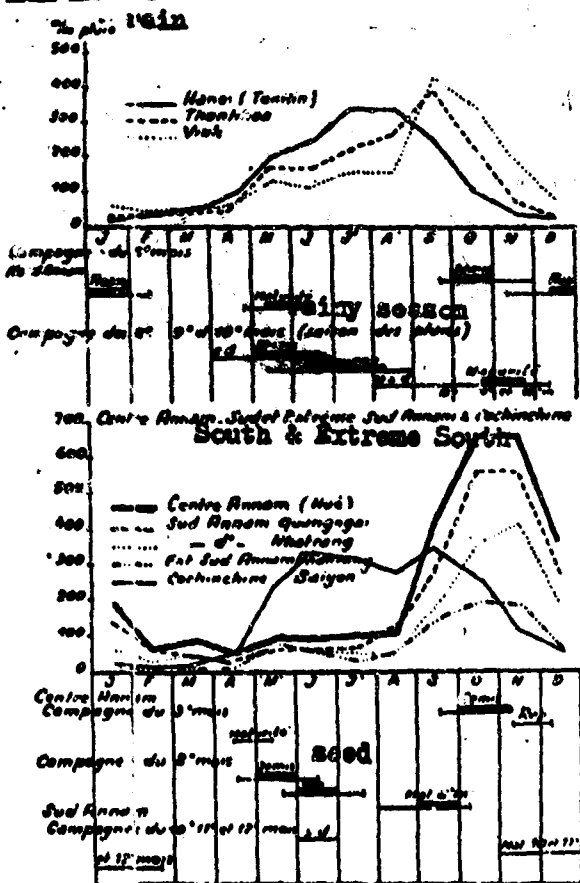
The rices of the three moons are cultivated only on a very small area (10 to 20,000 ha depending on the years); their culture depends on economic conditions (availabilities in manual labor and in fertilizers) and agrolological conditions (light soils, easy to prepare, precocious rains).

In Annam, climatic conditions vary greatly since this country stretches out on nine degrees of latitude (11° to 20° N. Lat.). In North Annam the varieties of rice utilized approaches those of Tonkin. The period of rainy season is about a month in retardment (cf. graph VI). The evolutional durations are also slightly displaced.

Center-Annam is a transitional zone from the climatic point of view. The maximum of rain fall takes place in October-November and often provokes disastrous inundations; the cultivators also cultivate a region before the rains from May to September, say from the 8th month and a region after the rains from mid-November to March-April say from the 3rd month.

Pluviometer Compared Graph VI

and rice growing calendar Tonkin and North Annam



In South-Annam, the pluviometer is less great. One there practices a region of rice of the third month, and, according to the regions, regions from the 8th or the 10th month transplanted or seeded in place in the 10th and 11th month. In the province of Phuyeh one cultivates the same varieties for periods of the 3rd and of the 8th month; the durational evolutions are little modified, however certain varieties slow up in their cycle during the period of the 3rd month.

In the extreme South-Annam, the pluviometer is still more weak and the temperature more regular. The cultivated varieties are in general of short evolutionary duration. Harvests follow one another every trimester in Khanhhoa without clear distinction in period. In Nintthuan and Binhthuan the harvests are made in July (varieties of the 4th to 5th month) and from December to February (varieties from the 7th to 8th month).

Legend of cultural calendars\_ single line  
 extreme period, thick line: principle period  
 Sd Direct seeding

In the south of Indochina (Cochin China-Cambodia), out of all of the healthy rice fields, in out of water land, one transplants varieties of variable evolution, grouped in very premature rices (100 to 120 j.), premature (135 to 155 j.), of demi-season (165 to 185 j.), of season (195 to 210 j.) and tardy (225 j.). However delays in the divisions of

regions (slightly salted lands, delay of the rains, etc...) can reduce these periods. The varieties of very short duration of evolution having a quite stable cycle are sometimes utilized as relief rice before growth or after growth. They are also cultivated for the first of the two rice-growing periods that are practiced in certain regions of Cochin China with great demographic density and well managed (marling). The second region utilizes a seasonal variety transplanted tardily. The demi-seasonal varieties are the most cultivated ones in the zone of the rainy rice fields. The seasonal varieties are transplanted in the low rice fields of this zone and the varieties are distributed in a few provinces. The distribution of different cycles depends on agrological conditions, but also on economic conditions.

A vast depression, whose warping is not concluded, formed from very rich alluviums of organic materials, is cultivated in rice thanks to the practice of double transplanting. One there employs particular varieties, grouped after the evolutionary duration in premature varieties (185 to 200 j.), of demi-season (200 to 210 j.), of season (210 to 240 j.), and tardy (240 to 260 j.). Certain varieties of double transplanting are the same as those of single transplanting and can be indifferently utilized in these two conditions. In principal, every single transplanting variety having a duration of evolution exceeding 180 days can be treated in double transplanting. Double transplanting retards the duration of evolution by three weeks for the demi-seasonal varieties and from four to four and one-half weeks for the tardy ones.

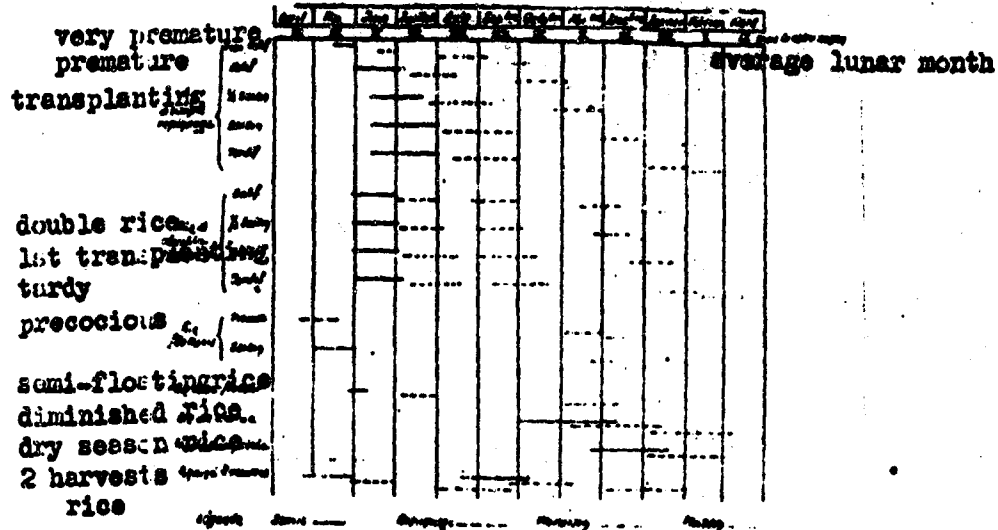
Floating rices, cultivated in an important region of Cochin China and Cambodia, also experience different durations of evolution pertaining to zones where growth arrives more or less early.

Graph VI also carries durations of evolution of semi-floating rices and rices of decrease adapted to different hydraulic conditions. The region of the dry season in Cambodia utilizes premature varieties.

Indochinese rice growers already possess a complete set of varieties of rice, whose durations of evolution are adapted to the different agrological conditions of their country which is so varied. It is illusory to think of reducing the number of cultivated varieties to a very small number. The problem of commercial amelioration for the exporter zones must aim at propagating the culture of varieties selected by evolutions and different cultural qualities, but of the same commercial format. The problem of the amelioration of the yield depends on numerous factors. The research for better adapted vegetal material or better utilizer of manure can be undertaken, among other methods, by the introduction of foreign varieties, of which one will study the reactions in the different environments in proceeding from seeds to transplantings arranged in a

Rice growing calendar: Cochin China Cambodia

Graph VII



Legend Seeds Transplanting Flowering Harvest

series. Certain successes justify the development of this method, above all in the regions where the culture of rice is recent or in case of modification of technique or of milieu (notably hydraulic management).

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