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By Hsu Hsing

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From 20 to 24 July, the Academia Sinica held a conference in Shanghai on submerged paddy research reports. Aside from the internal research institutes of the Academia Sinica, the Kiangsu Branch of the Chinese Academy of Agricultural, the Institute of Crop Strains and Culture, the Shanghai Municipal Committee for Rural Work, the Shanghai Municipal Agricultural Experiment Station and other related units were invited to send delegates. The conference was supervised in person by Comrade P'EI Li-sheng, Secretary-General of the Academia Sinica, and Comrade HU Yung-ch'ang, Secretary-General of the Shanghai Branch of the Academia Sinica.

The conference was inaugurated by the delegates' visiting the bumper submerged paddy crop and the experimental fields at the Sung-chiang operations base of the Institute of Plant Physiology. By way of introduction the Sung-chiang Hsien Committee gave an account of submerged paddy production conditions and the Institute of Plant Physiology gave an on-the-spot summary of its experience and research on the bumper submerged paddy production at the Sung-chiang base.

The conference began with a report by each unit on 1959's bumper submerged paddy production experience. Judging by the reports made by the units, the early crop work in 1959 was centered on the problem of close planting; the more penetrating and systematic the research, the greater the accomplishment.

Observation of early rice planting at the Sung-chiang operations base of the Institute of Plant Physiology generally established that there was a relationship between stemming (fen-nieh) from the stalk and the formation of panicles. For each mou of land planted with 410,000 basic (chi-pen) seedlings, the increase in the number of effective panicles as compared with the number of basic seedlings planted was estimated at 20 percent; while in the case of land planted with 550,000; 800,000; or 1,180,000 basic seedlings per mou, the number of effective panicles was found to approximate closely the number of basic seedlings planted.

Therefore, within the density range of planting indicated above, it was revealed that the higher the density the greater would be the number of effective panicles per mou. For this reason it is necessary that a sufficiently large number of early rice basic seedlings be planted to assure the growth of an adequate number of effective panicles.

A similar conclusion was reached at the Kiangsi operations base of the Institute of Pedology. While basic seedlings were outnumbered by stemming from the stalk and the development of panicles, the number of effective panicles was still found to be lagging far behind the number of basic seedlings planted. It was therefore essential to maintain adequate close planting and to raise the number of seedlings planted.

However, from the standpoint of individual growth, wider planting was preferable to closer. A survey conducted by the Sung-chiang operations base on 20 May 1959 indicated that the average above-ground dry weight of plant stalks in 410,000 seedlings-per-mou, plantings were 47.2 milligrams per stalk as against 34 milligrams when 1,180,000 seedlings were planted per mou. A numerical sufficiency in effective panicles should therefore be sought without over-weakening individual growth.

At the Sung-chiang operations base, where relationship between the main stalk and stemming from the main stalk was studied in the light of P^{32} and C^{14} nutritional functions, it was revealed that the stems [i.e., branches off the main stalk] on obtaining P^{32} at their roots [junction with stem] were observed to have passed on a fairly large portion of the nutrition to the main stalk whereas

little nutrition obtained by the main stalk was transferred to the stems. Apparently the stems figured significantly in the absorption of inorganic nutritional matter by the main stalk. In testing C^{14}, it was tentatively proved that there was mutual transference of organic nutritional matter between the stems and the main stalk.

In observing changes in the expanded portion of a leaf with reference to the accumulation of dry matter, the blade was found to be one of the important contributing factors to the growth of dry matter, which accumulated in proportion as the unit area of the blade was enlarged. Under different planting density and in early embryonic stages the expansion of a leaf approximated, basically speaking, the accumulation of dry matter.

But this parallel development between the leaf and the dry matter became irregular as blades became overlapped and shaded after the embryonic period, which restricted in a way the expansion of the leaf. Leaf coverage expanded as density in planting was raised (1,180,000 elementary seedlings planted per mou of land); but after reaching a rather high index (8.5) this expansion dropped rapidly, with the result that the group rate of assimilation and productivity was lowered.

Therefore, rational close planting should be followed by a high index of leaf expansion, but in the course of its embryonic development the expansion of the blade should be commensurate with the growth of dry matter. Any unwarranted rise or drop in the leaf expansion index would be considered disadvantageous.

In a study on the effect of nutrition on the growth of the panicle it was explained that the chief cause for the panicle to shrink following close planting should be sought in nutritional deficiency prior to panicle split rather than in rapid deterioration of the spikelet as a result of the split. No distinct discrepancy was observed in the growth rate of the spikelet under various close planting conditions.

The problem is therefore, how to assure group propagation and maximum development without over-weakening individual growth at the same time. It is especially important that after close planting the primary nutritional

needs for the individual plant be adequately met. This is an important factor for the development of a healthy stalk.

The mass structure of a large farm and the utilization of sunlight under submerged paddy close planting conditions was studied by the Assimilation Division of the Institute of Plant Physiology. Much similarity in mass structure prevailed in the three submerged paddy fields examined under different close planting conditions of 410,000; 800,000; and 1,180,000 basic seedlings per mou of land. Extreme numerical differences at various layers, due to difference in the number of seedlings planted in the early stage, became less and less noticeable later, proving that plants were potentially strong in mass growth adjustment.

Study of the effect of farm climate on the mass structure of the three fields examined under different close planting conditions indicated no important discrepancies, either in the amount of CO_2 present or in the volume of vapor content. Although the possibility of differences due to wind velocity could not be ruled out, neither shortage of CO_2 nor excess humidity was to be ascribed to close planting. Our previous anxiety over the deteriorating influence of density in planting on farm climate was preliminarily clarified.

Only when assimilation of light by massed plants is considered from the viewpoints of actual exposure of the leaf area to light; changes in the intensity of light at each layer; changes in the light intensity on the blade itself; the size of the blade due to farm operations; the disposition, angle of divergence, and distribution of chlorophyl in the blade itself; and strain characteristics and so on, can an overall understanding of the light problem under massed planting production conditions be reached. Hereafter, the course of our study should mainly be directed to the evaluation of changes in these different factors by means of formula designed to [measure] the assimilation of light.

Through isolated culture and testing while stemming of early rice seedlings by P^{32} formula, a preliminary study of the utility of fertilizer in plant growth was undertaken by the Organic Fertilizer Division of the Institute of

Plant Physiology. It was verified that following the application of fertilizer the root system was stimulated to absorb, circulate, and secrete phosphorus when nutritive material was added to the fluid substance of the soil. At the same time the life of the root system itself was activated, and it was tentatively established that the stimulus was mainly derived from the presence of the products of the metabolism of microorganisms.

In a test by the Sung-chiang operations base of The Institute of Pedology, in which fertilization was synchronized with close planting, it was ascertained that under similar fertilization conditions the stemming rate of an individual stalk dropped significantly as the density of planting was increased. Density of planting being held constant, the effect of fertilization level on the rate of stemming, height of stalk, coloring of leaf, etc., was observed.

The number of grains per panicle increased as fertilization was stepped up, it was pointed out in an experiment on rational fertilization methods.

In summarizing mass cultivation and intensive fertilization of the submerged paddy, experience indicated that any analysis of submerged paddy soil models should consider primarily the problem of cultivation. It was learned through peasants' experience and through experimentation that the rate of starch assimilation and the fluid saturation capacity should be used to establish standards for a representative submerged paddy soil in order to ascertain a fertilization index by use of the fluid saturation weight.

Furthermore, an improved submerged paddy "land nursery bed" operated by The Peking Institute of Plant Physiology and a "oil-paper seedling culture" conducted by the Institute of Forestry and Pedology contributed to the solution of local submerged paddy production problems substantially.

Corresponding tests made under different densities in planting, fertilization, and soil conditions by the South China Institute of Botany and the Institute of Botany; a study of the effect on different close planting conditions of minor climatic changes, made by the Institute of Geography; and an analysis of soil microorganism

distribution conditions under different irrigation and deep ploughing conditions, made by the Wuhan Laboratory of Microbiology Research all attained definite research results.

Based on the reports submitted by various units, committees were designated to discuss spiritedly such problems as the evaluation of studies, attitudes, toward academic accomplishments, the direction of future research on submerged paddy production, and the method of operation. The debate concluded with a statement by Comrade KU Hsing-hsien, Academic Secretary of the Department of Biology.

It was felt at the conference that, compared with 1958, important advances and great accomplishments were made in 1959 on the study of the submerged paddy. At a meeting for exchange of biological operation experience on the submerged paddy, held in February 1959, investigable data of a general and hypothetical character were deliberated upon. Now through six-months of "pin-point" research; through learning from peasants; and through observation on high-yield experimental farms and comparative experimental fields, rich, practical scientific data were accumulated. Farmers' high-yield experiences were verified; and study on such general theoretical problems as high-yield assimilation and large farm mass structure were preliminarily launched.

The February meeting was exploratory in nature. With new theories study has broadened and with the accumulation of precious data for research, the work is unprecedented and research becomes increasingly significant in helping to open new paths for study.

The relationships between changes in blade area under close planting and accumulation of dry matter, between increase in nutrition and growth of panicle, and between main stalk and stems from the stalk were only hypothetically exploded in the past. We are now provided with explanatory data for the study of submerged paddy soil structure. Saturation point and fluid weight now serve as indices for gauging soil fertility. This valuable contribution will be regarded as historically important.

It was felt at the conference that the work already accomplished revealed the following advantages:

(1) Scientific theory was tentatively combined with the experience of the masses, and, by further improving peasants' vital experiences, the spirit of production theory was injected into the work.

(2) New techniques were employed in summarizing high-yield production experience, which factually proved that operational efficiency had risen and that many problems examined had been solved.

(3) Coordination among participating units was most gratifying, and the role which communism played in fostering large-scale coordination was most helpful.

It was pointed out at the conference that these achievements were still preliminary. The work was not without drawbacks; its development was still marked by imbalance; and it was not systematic and deep enough. In summary, high-yield experience should be accompanied by even greater research effort if greater accomplishments are to be made.

Discussion at the conference was centered on such issues as rational close planting, fertilizer, moisture content, etc. Those present at the meeting felt it important to tackle the problem of rational close planting through the light assimilation theory. Close planting, the closeness of planting, the number of panicles and other related problems should be examined from the standpoint of light assimilation.

The production volume of submerged paddy (economic production volume), depended upon total light assimilation product (biological production volume), but the assimilation product owed its growth to the light intensity on the leaf, the area index of the blade and the duration of maximum blade area. It was felt that for the blades to reach their optimum development, their distribution should be balanced. An 8-10 area index would be disadvantageous to the blade growth insofar as light assimilation was concerned. The development of the blade would be hampered if its area expanded too rapidly. In this connection the crop would grow vertically.

In dealing with the relationship between close planting and soil fertility, it was unanimously agreed that the higher the fertility of soil the broader would

be the range for close planting, and vice versa. Well-fertilized, multi-stemmed stalks should be sparsely planted while under-fertilized, thinly-stemmed stalks should be closely sown.

As to the relationship between the main stalk and its stems, it was felt that inasmuch as stemming is a characteristic peculiar to the growth of submerged paddy, it should not be resorted to unless necessary. It is a proven fact that stemming helps the main stalk to absorb and transmit nutritive matter. When it is realized that a stemmed main stalk yields a panicle larger than an unstemmed, the significance of the relationship between stemming and the development of the main stalk becomes apparent.

In discussing the direction of the study of close planting, it was felt that the problem was to be considered as one of rational planting, depending mainly on the exercise of reasonable control over the number of stems. At the same time limitations to production-increase potential and close planting should be emphasized in examining maximum planting capacity. It should be stressed that high productivity could result from low planting capacity.

Most discussion on fertilizer was concentrated on CHEN Yung-k'ang's "three-yellow-three-black" high-production experience, opinions were divided. To some the good results were a matter of farm technique; to others they were a matter of biological law. Many thought biological law combined with farm technique were responsible, but finally all agreed that words alone could not impact clarity to the meaning and that the high-yield production experience should be examined from the standpoint of vegetative nutrition and reproduction. It was pointed out that only through an analysis of plant physiology could scientific discoveries be made.

Regarding moisture content, opinions on wet-process irrigation differed. Some contended that Kwangtung Province, by reason of its vastness, was well adapted to wet-process irrigation while regions in North China, characterized by deep ground-water level, were ill-suited to this irrigation method. Although some argued that it would be difficult to control wet-process irrigation because of its resistance to standardization, all seemed to recognize

that one should acquire further high-productivity experience from the farmers.

All agreed that the field be "roasted" to maintain its effectiveness for planting. In North and South China this was carried out at about the same time, when nodes appeared at the cylindrical stem of submerged paddy. Whether this was biological behavior inherent in the growth of submerged paddy would be examined later.

The views expressed by the various committees of the conference toward the object and content of research came under the following categories:

(1) With rational close planting as a pivot, the biological aspects of close planting study should be mainly confined to the relationship between large-field structure and collective assimilation, the relationship between stem and mainstalk, the law of stem growth and decay, large panicle and full grain factors, and the causes for, and the control of under-developed panicles and grains as a result of close planting.

(2) On the one hand, CHEN Yung-k'ang's "three-yellow-three-black" fertilization formula should be examined from the viewpoint of a biological law; on the other hand, because of fertilizer production handicaps, the study should be geared to maximum yield with economic and skillful application of fertilizer.

(3) As to moisture content and irrigation problems, the combined dry and wet-process, the shallow-water-diligent-watering, and the wet-process irrigation methods should be examined on their individual merits. The question of "field roasting" should be studied from the standpoint of its biological objective.

(4) Means to prevent stalks and stems from withering would be examined.

(5) The effect of organic fertilizer application on plant growth should be studied.

Concrete proposals relative to production measures were brought up for consideration after the Shanghai Municipal Committee had submitted to the conference a proposal to produce a gross volume of three billion chin

of grains in suburban areas in 1959, to assure a late rice crop of 300,000 panicles per mou of land, and to achieve the target of 70-80 grains to a panicle.

The conference was brought to an end with the following reports: "Biological Reaction to Radioactivity" by LO Chung-lo, Director, Institute of Plant Physiology; "Summarizing Observations on High-Yield Farm Production Experience" by YIN Hung-chang, Deputy Director, Institute of Plant Physiology; "From Close Planting of Rape to Its Nutritive and Reproductive Relationship and Production-Increase Potential" by Comrade I Chin-shan of Rape Work Team, Institute of Plant Physiology; and "Summarizing Some Important Problems On High-Yield Wheat Production" by Comrade YU Shu-wen of the Wheat Operation Team, Institute of Plant Physiology. The delegates to the conference were greatly enlightened and helped by these reports.

During the conference Secretary-General P'EI, by way of summarizing the important effects of high-yield production experience on achieving results, declared that from the great-leap-forward agricultural foundation laid out in 1958 had come the high-productivity experience, and that, while our thousands of years of production experience was a treasure-trove, the application of science to this experience was still indispensable. The task of the National Science Committee was taken over and acted upon by the Academia Sinica. He declared that performing experiments on the farm instead of conducting research at the laboratory brought about a great change because we re-charted the course of our research effort by coordinating scientific research with the activities of the farming community and also permitted peasants to come in contact with scientific theories.

Elaborating further on the new activities arising from research work, he stated that the history of the expansion of Chinese science merited commemoration and that this expansion would continue. It was an occasion for rejoicing that so many people had acquired this high-yield production experience.

Concerning the course to be taken in summarizing high-yield production experience, Secretary-General P'EI stated in his clear, exact directive that we should on the one hand pursue research work immediately associated

with present-day production while promoting somewhat remote, exploratory studies on the other.

He directed that laboratory tests performed at the people's commune should be in line with the production level of the local masses in order to be acceptable to them. For this experience to be applied to present-day production it behooved us to collaborate with the people's commune. For remote, exploratory studies the cooperation of institutes, farms, and agricultural research organizations could be sought; and an experimental farm could be set aside for comparative testing.

We should henceforth devote our energy to the solution of a series of theoretical problems and should learn from and profit by the peasants' accumulated high-yield production experience, and as CHEN Yung-k'ang's "three-yellow-three-black" high-yield experience. For the sake of accuracy all scientific assertions should be biologically sound.

Pointing out the necessity of employing new techniques for research, the Secretary-General declared that a host of theoretical problems, such as the problem of individual and collective relationship and that of nutritive and reproductive relationship, could be tackled in the light of accumulated high-yield experience. New techniques and new physical and chemical achievements should be taken into consideration in order that the nature of the problem might be understood.

Young science workers were exhorted to devote their efforts to the study of physics and chemistry so that a new era might dawn in the field of plant physiology through the application of new physical and chemical formulas.

As to the problem of coordination, the Secretary-General gave his directive in principle by saying that each unit should pursue its work toward a common objective and that cooperation might develop in the direction of unity or otherwise. Important problems should be unified within the "framework of a chessboard," and the method should be one of exchange of experience and data.

Secretary-General P'EI also elaborated on the problem of work plan and scientific evidence. In conclusion,

he hoped that by summarizing high-yield production experience in the farm a path might be opened in the interest of plant physiology and pedology in China.

Being greatly inspired, the delegates present at the conference unanimously agreed that it would be an epoch-making task to summarize high-yield experience and that they should learn henceforth from the peasants with determination, effort, and humility. The application of new techniques to agriculture should be strengthened and the high-yield experience of the peasants should be summarized with more painstaking effort, penetration and systematization in order to solve important theoretical problems and to achieve even greater results.

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