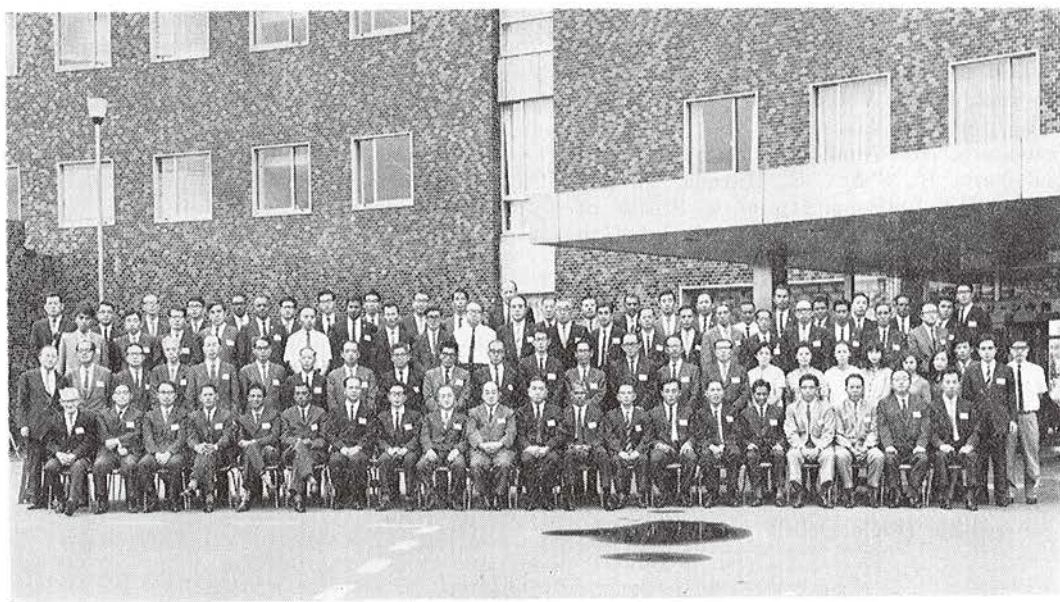


Symposium of Optimization of Fertilizer Effects in Rice Cultivation

September 8 to 13, 1969 in Tokyo

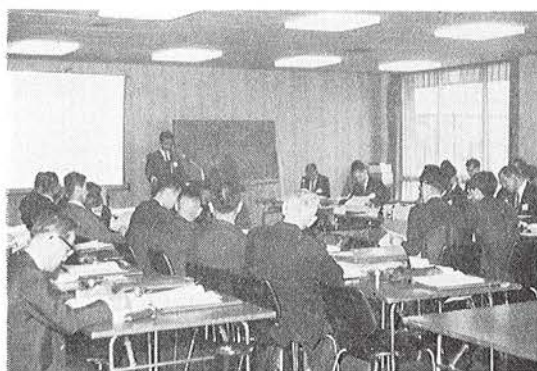


Increased rice production is urgently needed for stabilization of the people's livelihood and development of the countries in Southeast Asia. With a view to increase rice yield constant efforts have been made in every country

in the area.

Application of fertilizers is the easiest and the most reliable method for increasing rice yield as it is seen in the history of rice cultivation in Japan. But rice varieties of the *indica* type, which have been cultivated in Southeast Asia, are low in fertilizer response, and use of fertilizer has not resulted in yield increase. It is for this reason that, since the success in breeding IR-8 and IR-5 varieties by the International Rice Research Institute (IRRI), more attention has been paid recently to high-yielding rice varieties which respond well to heavy fertilization, and an increased rice yield by fertilizer application is now an important subject of rice cultivation in these countries.

In the third symposium, one of the series of the symposia being held by the Research Coun-



cil since 1967 for the furtherance of the study on the tropical agriculture, the subject "Optimization of Fertilizer Effect in Rice Cultivation" was taken up last year. This symposium was held in Tokyo for three days from September 8 to 10, 1969. After the session the participants made a three-day field study trip from September 11 to 13 in Niigata Prefecture to see fertilizer factories, rice cultivation areas, and the Hokuriku Regional Agricultural Experiment Station.

Ceylon, Republic of China (Taiwan), India, Indonesia, Malaysia, Pakistan, Philippines, Thailand, Australia and IRRI were invited to send a delegate to this symposium. Although unfortunately we could not receive a delegate from India for certain reasons for his government, participation from Australia for the first time was regarded as a new development of the symposium.

Constitution of symposium and outlines of reports

In this symposium the following was taken up as the main subjects:

(1) Fertilizer response in connection with varietal characters and growth stages, (2) Environment and fertilizer practices and (3) Nutritional disorder and its improvement by fertilizer.

Before the reports are presented by the delegates, Dr. K. Nomoto, Director of the Central Agricultural Experiment Station, Japan, explained the characteristics of agriculture in Japan and emphasized the importance of fertilization in rice cultivation on the basis of the data in Japan.

1) Fertilizer response in connection with varietal characters and growth stages

Dr. H. Ito and Mr. K. Hayashi were the first to report in their paper, "The changes in paddy rice varieties in Japan", that the breeding of rice varieties responsive to fertilization started in Japan in 1920's, and varieties have been improved generally to the following directions: early and medium ripening; short stem; resistant to lodging; and larger number of panicles.

And they showed that recent high-yielding varieties are especially high in the efficiency of solar energy conversion during the ripening period as a result of the improved plant type.

The second paper on "Physiological basis for fertilizer response of rice varieties" was read by Prof. A. Tanaka, Japan, reporting as follows. The yield of rice is generally determined by interrelation between the yield container and the yield content, and the interrelation is influenced by the time and amount of nitrogen absorption. The response of varieties to nitrogen must be examined through the influence of nitrogen on the container and content. In this case the yield container is represented by a product, number of panicles per area \times number of spikelets per panicle \times size of hulls, and the yield content by the net assimilation after flowering. Generally speaking, though increase in the size of the containers is possible by heavy fertilizer application, to secure the content cannot be expected through only this means. Increased dry matter product during ripening period is even more important. Desirable varieties must be comparatively short in the period from seeding to flowering, appropriate in leaf area index, short in stem length, short and vertical in leaf shape and long in the period from flowering to ripening.

The third paper on "Fertilizer response of new rice varieties in Malaysia" was read by Mr. Chee Sek Pan, Malaysia. In this paper he explained how the importance of varieties in rice cultivation had attracted notice in Malaysia, and reported results of fertilization experiments in new varieties as follows. The yield of Ria variety amounts to 7,398 kg/ha at the maximum per 198 kg/ha of nitrogen applied and 4,730 kg/ha in average per 132 kg/ha of nitrogen, while that of Bahagia is 4,730 kg/ha in average per 88 kg/ha of nitrogen. Ria is thus superior in the point of high productivity to Bahagia, but the latter is expected to be a promising variety from a viewpoint of its adaptability to various conditions of soil and water.

Fourthly, a paper on "The responses of new less-photo-sensitive rice varieties to different

levels of nitrogen fertilizer applications during the dry and wet seasons" was presented by Mr. Chalermkiat Saisoong, Thailand. In this paper fertilizer responses in different varieties and seasons were investigated using three less-photo-sensitive varieties, which consist of two varieties recently bred out and one native variety. It was indicated that nitrogen contributed to an increased yield through an increase in number of ripened grains. The most promising variety was C₄-63 which was medium in stem length and large in number of stems, requiring 120~135 days for its growing period.

Fifthly, a paper on "Nitrogen responses to the rice plant at different stages of growth" was read by Dr. S. Matsushima, Japan. He pointed out that nitrogen has the most important effect on the yield of rice in the 4 stages, just after rooting, neck-node initiation, just before reduction division and full heading. He analysed quantitative relations between the absorption of nitrogen at each stage and the yield or yield constitutional component on the basis of many experimental data, and investigated the result of the top dressing of nitrogen fertilizers in each growing period. From these data, he also mentioned of his ideal plant type to obtain the maximum yield and the V-shaped cultivation method for realization of the ideal plant type.

The sixth paper on "Response of rice varieties to time of nitrogen application in the tropics" was read by Dr. S. K. De Datta, IRRI, which may be summarized as follows. When rice plants of native varieties, which are apt to suffer damage of lodging, are cultivated in fertile land, it is favorable to delay the time of nitrogen application for prevention against overgrowth and lodging. But in such a variety as IR-8, which is resistant to lodging and responsive to fertilization, basal dressing of nitrogenous fertilizers is effective to increase the number of stems and results in an increased yield. The result of experiments with the N¹⁵-labelled nitrogen showed that split application of nitrogen increased the absorption rate of nitrogen, but does not result in a significant

increase of the yield. Drainage at the time of top dressing has also no positive effect on the yield, showing that the practice is not necessary in a paddy field where irrigation and drainage are not an easy task as in Southeast Asia.

The last paper in this session on "The roles of root systems of rice plant in relation to the functions of aerial parts" was read by Dr. Y. Ota, Japan. He reviewed influences of the root systems of rice plants on the photosynthesis and other functions of the aerial parts, putting emphasis on the important roles of the root system in attaining a high yield of rice.

2) Environment and fertilizer practices

The first paper, "Development of fertilization for rice culture in Japan," was read by Dr. N. Murayama, Japan. He explained that the increased rice yield in Japan had been dependent on the development of fertilization technique since about 100 years ago, making reference to the development of such techniques as the whole layer application and the top dressing at the ear primordial formation stage. He reviewed a tendency that the well-balanced fertilization by application of calcium silicate, fused magnesium phosphate and bases as well as such fertilization technique as split application or top dressing of nitrogen had contributed to the increase of rice yield in recent years.

The second paper on "Regional patterns of fertilization in Japan" was presented by Dr. H. Shiga, Japan. He pointed out that fertilization technique in rice cultivation is showing differences from south to north in Japan according to the geographical position of each area, and gave an outline of its plant nutritional ground on the basis of sufficient data. And he reported a recent tendency that a fertilization technique to maintain the plant nutrition in good condition in the later growth stage is considered important throughout the rice cultivation area from south to north in the country.

The third paper was on "Field test on split applications of nitrogen-An application of fractional factorial design" by Messrs. K. Arikawa and M. Shinozaki, Japan. They reported an analysis of their fertilization test of nitrogen

by a new statistical method.

The first presentation of a paper by foreign delegate in this session was made by Dr. S. C. Hsu, Republic of China, on "Present situation of fertilizer use in Taiwan," which may be summed up as follows. In Taiwan consumption of fertilizers is increasing every year, and she has attained self-sufficiency in nitrogenous and phosphatic fertilizers. A standard ratio of components recommended for compounding fertilizers is 98-49-65 (N : P₂O₅ : K₂O kg/ha), but farmers' practical ratio is 149-36-44, showing a tendency to attach too much importance to nitrogen. A recent increase in the amount of fertilizer applied resulted in an increased yield of brown rice, amounting to about 3,180 kg/ha in average. Ammonium sulfate is the main nitrogenous fertilizer, but urea consumption is also rapidly increasing recently. Calcium super-phosphate and potassium chloride are the main phosphatic and potassic fertilizers, respectively.

Secondly, Mr. Soebijant, Indonesia, read a paper on "Present situation of fertilizer use in Indonesia." His report may be summarized as follows. In Indonesia where food is short and the rate of population increase is high, an increase production of food is a pressing problem of the day. The demand for chemical fertilizers is increasing, and the demand for nitrogenous fertilizers is estimated to reach 550,000 tons in 1972 except those to be used in plantations. This is an amount 500,000 tons larger than the present production in the country. Accordingly, urea plants which are estimated to produce daily about 1,000 tons of urea in total from natural gas, are now under construction. However, to meet the demand of fertilizers sufficient for the expected increase of rice production cannot be insured only by this measure. Import of fertilizers, therefore, is under consideration. Both IR-5 and IR-8 (called Baru Peta in Indonesia) varieties show an increase of 60 per cent in yield over native ones when they are supplied with 60 kg/ha of nitrogen, and 7.6~7.8 ton/ha of rice yield was achieved by nitrogen application of 120 kg/ha in the dry season in 1967. But such

cares as early seeding, weeding, diseases and insect pests control together with water control are necessary for obtaining an increased yield.

Thirdly, Dr. E. Rayes, Philippines, presented a paper on "Present situation of fertilizer use in the Philippines". The Philippines are now changing from a rice importing country into exporting country.

This is mainly due to introduction of improved rice varieties and improvement of cultivation techniques. The acreage under cultivation of improved varieties covers 11.9% in the rainy season and 6.0% in the dry season of the total area of paddy field (the area is larger in the rainy season than in the dry season), and the yield reaches 3.25 ton/ha in average. According to fertilization experiments, IR-8 yields about 9.5 ton/ha by nitrogen application of 120 kg/ha. Split application of nitrogen is generally effective only in the dry season and seems to be less effective in improved varieties which are resistant to lodging and short in the length of growing period.

Fourthly, a paper on "Rice fertilizer use in Australia" was read by Mr. E. C. B. Langfield. According to his report, rice cultivation in Australia is not limited to the Darwin district but there are highly productive areas yielding more than 10 ton/ha of rice in the southern part. In South Wales, where rice cultivation by direct seeding has been continued since 1924, the yield in an area of 30,000 ha averages 7.275 ton/ha under the condition of only nitrogen application of 22 kg/ha. Such a high yield is due to the rotation of rice with pasture plants and irrigated cultivation under abundant solar radiation in summer. Irrigated cultivation of rice is also being tested in Northern Queens Land. In both districts improved varieties are cultivated, obtaining 6~7 ton/ha of rice yield.

The last paper in this session on "The present status of fertilizer production in Japan and characteristics of new fertilizers" was read by Dr. T. Hayase, Japan. He made a report on the status of fertilizer production and the consumption of fertilizers in Japan and the char-

acteristics of new fertilizers.

The paper of Dr. S. Patnaik of India who could not participate in the symposium this time on "Fertilizer use for increasing rice yield in India" was read by the chairman of this session on behalf of him.

3) Nutritional disorder and its improvement by fertilizer

Firstly, Dr. T. Kiuchi, Japan, read a paper on "Nutritional disorders of rice plant and its countermeasures in Japan." He made a report on the progress of fertilization study and practice that starting from analytical studies of degraded paddy fields and plant nutritional studies on the 'Akiochi' diseased rice in Japan, use of sulfur-free fertilizers, silicic materials and of materials rich in various cations had gradually popularized in the farmers' field, and resulted in establishment of the conception of well-balanced fertilization.

Secondly, a paper on "Effectiveness of silicate fertilizer to Japonica varieties" was read by Dr. M. Kono, Japan. He made a report on the history of silicate fertilizers in Japan, the effect of silicate fertilizers in different soils, the method of judging the necessity of silicate fertilizers in the field, and the effect of their continuous application on the physical and chemical properties of soil.

Among the foreign participants, Dr. M. W. Thenabadu, Ceylon, was the first to present a paper on "Nutritional disorders and their countermeasures in Ceylon." Starting from the agricultural condition and the classification of agricultural areas in Ceylon, he covered

various subjects, as the problem of nutritional disorder represented by Bronzing and the effects of nitrogen, phosphoric acid, potassium, silicic acid and granular-compound-fertilizers.

Secondly, a paper on "Zinc deficiency of rice plant in West Pakistan and its improvement" was read by Dr. M. Shafi, Pakistan. According to his report, the zinc deficiency of rice plant in West Pakistan is observed in calcareous alkaline paddy fields under the condition of little rain, and it has been thought to be an ill-defined strange disease. But it is known by now that the disease is due to zinc deficiency, and measures are being taken to improve the situation.

Before the closing of the symposium a general discussion was held on the breeding of high-yielding rice varieties and the improvement of fertilization techniques for one hour and a half. After the discussion a special request was made by foreign participants to have such a meeting at least once in some years. They also wanted to be provided with facilities of computers to introduce new statistical methods into the analysis of data obtained by fertilization experiments.

A three days' field study trip was made after the symposium to see fertilizer factories, the agricultural experiment station and the project areas of land improvement and agricultural structure improvement in Niigata Prefecture. This trip gave the participants more time to hold less formal debates, promoting a better understanding and friendship with one another.