

the animal metabolism. Hence, the development of a process to obtain predigested high protein foods might be necessary. With this purpose, enzymic treatments was outlined in this paper. Although the reaction of an enzyme is milder than that of acid hydrolysis, which produces by-products unfavourable as food, it often gives bitterness to the hydrolyzed product due to the production of certain polypeptides. This problem could be solved by fermentation in the presence of salt or by hydrolysis at lower pH employing acid-proteinase.

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A Book Review of "Crop Science in Rice" —Theory of yield determination and its application— by Dr. S. Matsushima

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For obtaining high yields of rice, it is of great importance to make a correct diagnosis of the plant itself and its growth, because through diagnosis one can easily make clear the defects of rice growth and find out the key to improve cultivation methods. Numerous books on rice have been published in Japan, but there are few books except this one that were written from the viewpoint above. The author of this book has been working with rice for thirty years at the National Institute of Agricultural Sciences and Prefectural Agricultural Experiment Stations in Japan, and has released many valuable scientific papers on rice.

Several years ago (1959), he published a book "The Theory and Technique of Rice Cultivation" in Japanese. The book has been in such great demand in Japan, that the tenth edition has already been issued. Based on the Japanese edition, this English edition has been re-written with some additional notes acquired from his experiences and experimental results on Indica rice during his stay in Malaysia from 1960 to 1962, when he offered

technical assistance on rice as FAO expert, and also from further additional results of his experiments in recent years.

The book is not composed of the many results of researches in the past by other researchers at home and abroad, but chiefly of the results of the author's own research, the fruit of his investigation so laboriously conducted based on his own ideas. Accordingly, the book is marked by his own strong individuality. The author often expressed his regret that many books on rice cultivation seemed to be mere collections of individual phenomenon of findings not only unrelated with each other, but also not considered from the viewpoint of the whole growth process of the rice plant, and that there were few books which intended to clarify systematically the whole growth process and yield determination.

The author has written the present book with the intention to bridge such gaps as described above. Therefore, the reader will easily recognize in every page the originality of the author as well as his desire to satisfy

the above demand. The reader may sometimes find difficulty in understanding some parts of the book, because of the citation of numerous experimental results. However, when he reads through it, he will be able to understand fully the quite systematically written content. This book deals mainly with when and how the grain yield of rice is determined, can be predicted and increased.

The author analyzes grain yield into four yield components, viz., the number of panicles per unit area, the number of spikelets per panicle, the percentage of ripened grains and the weight of 1,000 kernels. Precise study was made regarding when and how each yield component is determined, can be predicted and increased.

As a base of these studies, he first clarified the growth process of the rice plant, in particular the development of the young panicle, dividing the whole development period into 21 stages. Furthermore, he invented methods to distinguish each developmental stage without microscopic investigation or dissection of the plant.

The author emphasizes that one of the most necessary things to make rice cultivation technique scientific is to identify the developmental stage of the rice plant and know the proper time to apply various cultural practices according to the developmental stage of rice plant. Therefore these findings of his give valuable guidance to identifying the developmental stage of the plant.

Next, the author explains when and how each yield component is determined. The following may be given as an example:

The number of spikelets per panicle is the difference between the number of differentiated spikelets and the number of degenerated spikelets. The number of differentiated spikelets is determined mainly during the period from the time of neck-node differentiation to the late stage of secondary rachis branch differentiation, the period from 32 to 26 days prior to heading. While the number of degenerated spikelets is mostly determined around reduction division of pollen mother cell, the period from 15 to 5 days prior to heading.

The largest number of pages were devoted to clarifying the process determining the percentage of ripened grains, which is the most important in rice grain yield, and are based on his many experimental results concerning the effects of carbon assimilation, translocation of carbohydrate, light intensity, temperature, fertilizer application, the number of spikelets and the combined effects of some of these factors on the ripening of the rice plant.

For increasing rice yields, the author laid stress on diagnosis of the defect in rice cultivation by an examination of the rice plant, as already pointed out.

By diagnosing a representative rice plant or hill of a given paddy field, with the guidance of this book, one can easily find the yield component which is limiting the yield in each field, and take necessary steps for increasing the magnitude of the limiting factor through the improvement of cultivation techniques, viz. the shifting of growing period, spacing of plant, amount of fertilizer, time of fertilizer application, and the selection of the rice variety planted.

Furthermore, the author has presented a new principle of maximizing yield, based on the result of his recent works concerning the carbon assimilation of rice with special reference to the plant type. Applying this principle the author has obtained a yield of 10.2 tons of brown rice per hectare under community conditions, using water culture method, and a yield of 7.3 tons of brown rice per hectare under paddy field conditions. The author's new principle is now being getting much attention from Japanese agricultural scientists, agents and advanced farmers.

This book is sure to bring a new light to improving the cultivation method through the broadening and deepening of the knowledge on rice available to scientists, agronomists and others contributing to yield increases of rice in all the rice growing countries of the world. It must be added that this book has been published in commemoration of the 1966 International Rice Year of FAO.

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