Disscussion

Chairman : H. K. Jain
C. T. Tung
H. Akemine
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Discussion

Chairman (Jain): We have had two and half days of very useful discussion and a number of important points have emmerged as the result of the discussion. You will be highlighting some of these important points. It became obvious that food legumes offer perhaps most practical means of solving the protein-malnutrition problem in many developing countries. Of course, there are number of problems. At first, we must increase the production of food legume of good quality in our various countries.

Topics for Discussion

1. Production

This is a very complex problem. Although we are not going to consider it in all different aspects, but there are some areas of dealing for yield, dealing for producti vity which we could highlight in the course of our present discussion. We all agree, I think, that even though some high-yielding varieties are available particularly in soy bean, they are not available in many other legumes. For instance, chick pea, which is one of our most important legume, we do not really have so good variety as we have in soy bean. By and large, one could say that even in soy bean, we do not have varieties which give as good yield as high-yielding varieties of cereals. So there is the major limitation of yield, and as I said, we cannot expect it in all these various aspects. We can focus attention on some of the major problems, and I thought one of the major problems was that of the plant type. I would like to invite your suggestion as to how we can improve the plant type in soy bean and in other green legumes.

2. Protection

Well, associated with this yield problem and with the question of breeding for resistance to diseases and pests, more important problem is the insect pests control by chemical method. I think it is not very often appreciated that very high level of production in the case of cereal has been made possible largely through the selection of geno types responsive to fertilizer. One of the major instrument of increased production in the case of wheat and rice has been the high application of chemical fertilizer.

We are fortunate, in one sense, that food legumes do not require such high doses of fertilizer. They require P_2O_5, but not so much of nitrogen. On the other hand, food legumes are far more suceptible to insect pests and diseases than cereals. Therefore, the major approach to increase the production of food legumes would be to make much better use of plant protection measure, including pesticide application. We would very much like to invite your suggestion in the course of the discussion as to how we can solve various problems associated with the use of the pesticide. There is a probem of residual toxicity, there is a much widely discussed problem of polution, and above all, there is a problem of high cost of pesticide, particularly for some of the developing countries. So I hope we will be focusing attention on some of these problems which arise from pest and diseases.

3. Crop rotation

Another very important problem would be nitrogen balance sheet. We all know that the demand for chemical fertilizer in the developing countries is increasing very rapidly. In my own country, in India, our present requirement of nitrogen is known as estimated in the border of four million tons. But we are producing only about one million ton of fertilizer at present. In the year of 1975 we would be needing eight million tons of nitrogen. It is more widely proved that many of the developing countries would be needing more and more chemical fertilizer, if we are to ctach up with

their food production keeping with the population growth. In this context, food legume becomes very important, because this is one group of crop which has fertility (mostly nitrogen) fixing ability. So we, in India, are making more and more extensive use of food legume in the enrichment of soil fertility. I was very happy to listen to some of the remarks that are made particularly from Ceylon and Taiwan that it is possible to introduce some of the leguminous crop as winter crop.

4. Processing

Finally, there is a major problem of processing. I am sure my colleague, Dr. Kurien will be discussing that, introducing the problem and focusing attention upon that.

But we will not be able to discuss all the problems within the limited time. Therefore, I request all the participants to use chance as far as possible in the available time.

Summarization of the Data

To begin with, I like to request Dr. Oda who will be presenting the tables summarized from the paper of each delegate in the symposium.

Oda: I would like to explain for a few minutes about the tables. It was prepared to save time by summarizing all the papers of this Symposium, to compare the data of common items among the countries as well as to find the relation between scientific names and common names of legumes in every country. I think there are somewhat confusion, and it refers only to the papers presented to the Symposium. But as for the list of food legumes, FAO statistics of 1970 was referred in the case of the countries who did not attend the Symposium. As you see in the table many important items still remain unfilled, also I am afraid there may be some mistakes in summarizing. Would you kindly tell me about any complement or correction if you have.

Seed Viability

Chairman (Jain): The second part of the problem is viability of seeds. This was emphasized to be a major problem, particularly in the case of soy bean. We have an excellent paper, where some simple techniques are suggested to improve the viability. Now I am requesting first, Dr. Konno to speak on this.

Konno: Principally, the best way to keep the viability of seeds is to store them under low temperature and low humidity. Yesterday Mr. Sanbuichi asked me about the varietal difference of germinating activity of soy bean seeds. Since I had once studied on the varietal difference of the germinating activity of soy bean seeds, I would like to explain some of the results.

The experiment was carried out in Chiba prefecture, near Tokyo, in 1964 and 1965. The early variety was grown being seeded in early spring, middle March. As

Seed viability, size and components of the early variety of soy bean cultivated in Chiba

Varieties	Germination activity %	100 Seeds weight g	N %	Oil %	Sugar %	Total Carbohydrate %
Ichigowase	98	10.3	7.44	16.06	7.30	17.00
Shirasaya 1	90	17.4	7.84	16.79	10.41	17.13
Tokachinagaha	46	22.9	7.12	20.55	7.14	14.50
Koganejiro	34	26.3	7.44	20.18	7.40	14.50
Wasemidori	30	40.9	6.88	20.08	7.35	17.87

to the germinating activity of the harvested seeds, a remarkable varietal difference was recognized. That is; the variety bred out in Kyushu, southern Japan, showed normal germination, while the variety bred out in Hokkaido, northern Japan, showed a extraordinary decline of germination. We made analyses on the components of those seeds and obtained the results hereunder.

Among the varieties described in the Table, Ichigowase and Shirasaya 1 are the varieties bred in Kyushu and others in Hokkaido. The soy bean varieties cultivated in Kyushu usually mature under high temperature in summer, while those in Hokkaido mature under low temperature in autumn. Since, in this experiment, these two types of varieties were cultivated in the same season starting from early spring at Chiba prefecture near Tokyo, it seems that they had matured under comparatively high temperature. As shown in the table, the germination of the varieties bred in Hokkaido were not good. It might be caused by inadequate ripening temperature.

From the results of seed size measurements and analyses of N, P, K, Ca, Mg, total carbohydrate, sugar, starch, protein and oil contents, it can be said that, among these varieties, the variety of less germinating activity is possessed of larger seed size, higher oil contents and lower protein contents.

This results may coincide with Mr. Sanbuichi's opinion reported yesterday, namely, he said that the higher the protein contens, the higher the germination activity. But, since the number of the varieties used were not so many in my expermiment, further trials must be made using much more varieties in the future.

On the other hand, as to the seeds of the same variety cultivated at different seasons, no correlation was recognized between germination rate and seed size, oil or protein contents.

In any way, since the varietal difference of germination activity seems to exist, we will be able to get the variety of higher germination activity, and by using it, it may be possible to breed out the variety of far higher germination activity.

Germination is a vital phenomenon, while protein, oil or other substances can be considered as the reserved substances independently of the vital phenomena.

We can recognize, in the fields, many examples of incomplete germination of various grades which can not appear above the ground at last. These phenomena seem to be caused by the restriction of the utilization of reserved substances such as protein (protein source) and oil (energy source). It can be considered that the soy bean cotyledon contains sufficient amount of protein, oil or other reserved substances for germination. Therefore the contents of these substances can not be considered to be directly related with germination.

It is presumable that the substances directly related with germination are those of extremely small quantities, such as certain enzyme or hormon which can directly act upon vital phenomena during the stage when the reserved substances are being converted into available form for germination.

Arwooth: I also would like to support Dr. Konno's idea about the loss of the viability of soy bean seed. In Thailand, of a hot and humid climate, we found the loss of seed viability causes a serious problem in our soy bean production. In the past, most farmers used old local variety of quite low oil content, and we did not have difficulty in storing soy bean seed for next season, over the year. But after we tended to have the standard variety SJ and SJ[2] which have oil content of 15 or 20%, we ran into difficulty. Because these seeds, if we keep them in our ordinary room, they lose the germination activity. The germination percentage goes down below 80%, if it is kept for three months. After seven months, it goes down below 50%. We tried to solve this problem with my colleagues and Japanese experts. We found that soy bean seeds can be stored more than one year without deteriorating

the germination activity, in a desicater under room temperature. Being encouraged by the findings, we tried to develop such a practical way to store soy bean seeds that every farmer can follow. After some trials, we found out that if we put the properly dried soy bean in a plastic bag, just an ordinary plastic bag which means keeping air-tight, we could maintain germination activity for more than one year. That is enough for practice. Now, we are trying to demonstrate this method to farmers whoever participate in soy bean seeds production. I believe, that this air-tight plastic bag will be accepted.

Fernando: Regarding the storage of soy bean seeds, I think this is a very important problem in our country as well. Because we can't keep the seeds more than three months. Now, for instance, the extension service in our country wanted the high quality of soy bean seeds, we were to grow at the experiment station. We grew it. Generally the cultivation was delayed and three months passed before sowing. And there was a complaint from the extension division that soy bean did not germinate. This is a very important problem. So as suggested by Dr. Arwooth, I think it's very important problem of soy bean, and you must find out the reasons and method of storing.

Murakami: I would like to add some information about soy bean seed longevity. Our Division has a seed storage house. We are storing many breeding materials of crops. So the staff of our Division is studying the storage techniques of leguminous crops. At present we have had some information. The first: As Dr. Konno said, there is a correlation between the seed size and the seed longevity. The second: rapid drying is not good to maintain the seed longevity. Drying should be made slowly.

Protection

Chairman (Jain): We like to continue this discussion, but we are short of time. With your permission I would like to pass on to the next important problem. This includes the control of the diseases and insect pests through chemical means, biological control, control of nematode, and breeding for resistance, in other words, a whole package of practices which some of us now call "integrated concept of pest control". I think this is very important to discuss here.

I know from our own experiences that one of our major difficulty in breeding for disease resistance, particularly in crops like chick pea we do not really have so good resistance, particularly resistance for Fusarium wilt. This is our most serious problem. In fact, we are unable even to identify all the physiological differentiations which may be existing in this pathogen. We do not know how many races of Fusarium wilt are involved. I think this causes very interesting study, because we can make much progress in relation to breeding for resistance. We would be very happy, if someone could give us suggestion or information on Fusarium wilt control or genetic approach which makes the crop resistant to Fusarium wilt, or any other information regarding this.

Yunoki: Until recent years we have had insufficient information on the control methods for Fusarium wilt. However, it has been observed that actual injury from this disease varies depending upon the varieties and circumstances. In Japan, Obakohikari and Tohoku No. 12 are resistant. But Harosoy and its derivertives are susceptible.

Chairman (Jain): I also like to know whether there are some environmental conditions or cultural practices which dispose the crop to be attacked by the Fusarium. In our own experiences there is moisture stress. Under too much stress of moisture, the disease comes in the most serious form.

Yunoki: I think so. The characters of the soil are considered to influence the amount of infection. Severe infection occurs in sandy fields.

In order to control soybean diseases, the cultivation of resistant varieties is most effective. Actually, differences in varietal reaction to many diseases are known to exist. However, the genetic basis of resistance versus suceptibility has been reported for only few diseases.

For instance, the resistance to bacterial pustule leafspot which has been found in the CNS variety is reported to be due to a single recessive gene. This gene has been widely used in breeding program. Resistance to frogeye leafspot is controlled by a single dominant gene. This gene also has been used extensively in breeding.

The inheritance of varietal resistance to rust and Fusarium blight is not clear yet. But, it is observed that Aso No. 1 and Iyodaizu are resistant to rust. Rikuu No. 27 and its derivertives are highly resistant to Fusarium blight, but Harosoy and its derivertives are susceptible.

Present commercial varieties in Tohoku District are Nemashirazu, Raiden, Raiko, Waseshirome and so on. These varieties are tolerant to cyst nematode and scab. So, in the fields infested with these pathogens, the yields of these varieties increase several times comparing with susceptible ones. But, to purple speck and virus diseases, they seems to be moderate susceptible. So, soy bean breeders are trying to breed resistant varieties against these diseases.

Chairman (Jain): I think all will agree that breeding resistant varieties is the most effective. But it is, at the same time, the very difficult task, particularly in several races of pathogene. What I would like to add is, for example, the degree of what we call adult plant resistant or seed resistant. I hope that we have this kind of resistance made available in cooperation in our variety.

Yunoki: To deal with these problems, it is necessary to get enough information on the differentiation of races of pathogene. But, there is not enough information.

Gene Stock

Chairman (Jain): The last problem, as far as we are concerned on production phase, leads to exchange of germ plasm between our different countries. I myself would like to suggest it and I hope to get some ideas from all of you.

I explained a moment ago that in cereals we have high yielding varieties. Actually in food legumes, by and large, we do not have such high-yielding vareties. The food legumes have been cultivated for hundreds of years under relatively marginal conditions, that is, under upland condition without irrigation or with only limited irrigation, and even more important, without the use of fertilizers and pesticides. Consequently, we seem to have lost very valuable genetic variability or genes which could have taken advantages of more favorable condition for the growth of food legumes. We are only sampling small portion of the variation which might have been available at one time of the evolution of the crop.

I would like to mention here Norin 10 gene of wheat and Dee-geo-woo-gen gene of rice. Both of them have contributed so much to increase production in many countries. In my country the production of wheat has increased from twelve million tons to twenty-six million tons in six years mostly due to the dwarf variety which has the gene of Norin 10 from Japan.

We are looking for counter genes in food legumes in many countries. I don't know whether the present food legumes have those genes or not but I think it is obvious that whatever favorable genes existing at present should be reserved. It is possible if we make etxensive selection of the genetic sources in all of our different countries. What is more important is to exchange these materials with each other.

I think, we have quite a fair amount of genetic variability in soy bean according to the data presented yesterday and we hope the same thing in others like chick pea or pigeon pea. If we have such variability, the progress of plant breeding would be far more rapid. I would like to emphasize even at this stage, to start various collection of germ plasm of food legumes and to exchange them. I understand that FAO has constituted a consultative group based on this problem.

Collection of local varieties is very important for gene stock because in the process of the expanded cultivation of high yielding varieties, local ones seems to be lost rapidly and this is actually occurring in wheat and rice. Although food legumes are not in such status the same process may be developed in the future.

Arwooth: We couldn't increase the yield of the legume so much as we have done in the cereal crops. But if I recall correctly from my plant physiological course, soy bean is superior in calory for 20 percent or more than rice.

Cheng: Breeding of soy bean varieties is very difficult even though we have the materials in hand. I would like to say that except the conservation of germ plasm we must find out some breeding techniques for soy bean. Another point I wish to emphasize is exchanging materials. I think for Taiwan, we would like to exchange with you upon request what we have.

N. Yamada: Mr. Chairman has already pointed out the necessity and importance of collecting all available gene resources and preserve them as a genetics stock. As a matter of fact, the collection and evaluation of genetic stock, to collect as much as possible and evaluate the various agronomic characteristics such as the resistance to diseases and insect pest, and plant type, and so on, should be the first task to be taken up when we initiate scientific research works on any kind of crop. The International Rice Research Institute and other international research institutes are doing such kind of work before they select parents for hybridization programmes. As a result, for an example, the International Rice Research Institute found a very useful variety, TKM 6 which is grown only in limited area in Madras State of India, showing very, very strong resistance to stem borer. Many of the similar examples have already been shown. Thus, gene resource collection and preservation are very important tasks to be taken up in any country. In my country, several years ago, the trans-Kyushu Highway connecting the east coast to the west coast of Kyushu Island was constructed. Immediately before the construction Dr. Akemine organized a survey team to collect all kind of traditional local varieties. Because there was a misgiving that the invasion of civilization through the high way might lose traditional varieties so far grown by the farmers. We are doing such kind of collection and evaluation of varieties and strains even now.

I would like to add one more thing. A new international research institute is going to be established in India. That is ICRISAT, International Crop Research Institute for Semi-Arid Tropics, now in the process of creation under the agreement between the Government of India and Rockefeller Foundation. The Government of India already offered a very big land, more than one thousand hectares, near Hyderabad. It is expected that in that Institute sorghum, millet, pigeon pea, and chick pea will be studied. So I am expecting that the collection and preservation of gene resources of these kinds of crops will be made in that new Institute. And most of the people in the region will be able to utilize them, because it is an international research institute.

Chairman (Jain): You are quite right .We have a new institute and we have just started to collect genetic variability. But this is something which I think all of us could begin all we can.

Well, I am afraid I have to stop this part of the discussion right now, because

we have only about half an hour for the rest of the discussion relating technology for processing. I request Dr. Tung to be the Chairman on the topic.

Processing

Chairman (Tung): Thank you, Dr. Jain. Ladies and Gentlemen, concerning the processing and utilization of legumes. Dr. Kurien from India gave us a paper this morning, but because of the shortage of time it was not open to discussion, so this time I would like to have this paper open for discussion now.

The discussion about Dr. Kurien's paper is inserted at the end of the paper (page 234), similarly as other papers.

Jain: I would like to make a brief comment on what my friend Dr. Kurien has made just now about the acceptability of soy bean. Now one of the point is made clear regarding the inhibiting factor which affects the utilization of soy bean.

Perhaps some of us in India have over-emphasized the inhibiting factor, and probably by doing that, we are really not subjected to the acceptability of soy bean.

Perhaps we should be cautious in speaking about this factor, particularly when we have the experience from Japan and Taiwan where so much soy bean is consumed.

Chairman (Dr. Tung): I understand Dr. Nakano of Japan has developed a unique food made of soy bean. May I ask Dr. Nakano about that?

Dr. Nakano: I would like to express my opinion on a few points. As far as the nutritional evaluation of soy bean is concerned, I believe that there is no problem. The problem remained unsolved is how to develop the suitable food processed from soy bean. There are four basic conditions for making a new food, that is, palatable taste, acceptability, nutritional value and to be free from toxic substances. And our traditional fermented soy bean foods can satisfy these four basic conditions.

We have long lasted traditional foods, but frankly to say, our traditional foods cannot be accepted by the peoples except Japanese. But the acceptability of soy bean foods can be transformed into another type which is accepted everywhere in the world through the development of food technology.

As a conclusion, according to the food habit of that region, we must develop the food technology which can be easily industrialized or processed in that region.

Chairman (Tung): It seems time is up. I think before closing discussion, I must turn back to Dr. Jain.

Chairman (Jain): Concluding this session, I like to thank all of you who have given suggestion and I hope our discussion will be of some help, particularly to countries like mine, where we are trying to make a success of soy bean. Let me say that we predict many about the suggestion of the subject, and I hope all of us have gained from depth of general discussion.