9. PRODUCTION AND RESEARCH ON FOOD LEGUMES IN THAILAND

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Present Situation and Future

Legumes are important economic crops cultivated in Thailand. Although no definite record exists as to when they were introduced to this country, it seems that Thai people have been familiar with them for a long period of time in both cultivation and utilization. Several traditional foods are prepared from certain legume grains and their related products. Also, they are frequently involved in state and religious ceremonies in the kingdom.

Although legumes are cultivated for many purposes in the country, human consumption ranks first among them. Statistics indicate that mungbean (*Phaseolus aureus* and *P. mungo*), peanut (*Arachis hypogea*) and soybean (*Glycine max*) are widely used. Other species consumed to a lesser extent include cow pea (*Vigna sinensis*), dry bean (*Phaseolus* spp.) sugar pea (*Pisum sativum*), chick pea (*Cicer arietinum*) and pigeon pea (*Cajanus* spp.). Grains of these legumes are ferquently found in local markets, but accurate data on their production are difficult to obtain. A similar situation exists for those vegetable legumes which are grown on small acreages and consumed locally. Economically, it is reasonable to state that they may be important at the village level but not on a national basis. Accordingly, the main emphasis in this text will be limited to the three most important legumes namely, peanuts, soybeans and mungbeans.

The national acreage, production, crop cost and export value of these three crops for the seven year period (1961–1967) are given in Table 1. It is evident that the production of these three legumes has increased markedly during this period. However,

Table 1. Statistics of mungbean, peanut and soybean production in Thailand.

Year	Mungbean				Peanut				Soybean			
	Acreage 1,000 ha	Prod. 1,000 tons	Value mil. $	Export mil. $	Acreage 1,000 ha	Prod. 1,000 tons	Value mil. $	Export mil. $	Acreage 1,000 ha	Prod. 1,000 tons	Value mil. $	Export mil. $
1961	37	40.6	4.7	3.0	83	108	10.7	2.6	24	24.2	3.1	0.26
1962	50	53.7	8.2	3.1	87	112	12.2	2.9	28	30.0	3.7	0.03
1963	100	116.0	14.7	3.0	83	113	12.4	2.9	34	33.3	4.1	0.5
1964	101	110.2	12.7	4.1	87	120	14.4	2.5	34	31.3	3.3	0.47
1965	121	124.8	13.1	5.1	99	131	16.0	3.7	19	19.1	2.6	0.23
1966	134	131.5	16.9	4.0	157	220	24.2	3.6	46	37.9	4.8	0.73
1967	132	122.5	20.4	1.2	107	132	17.2	1.8	63	52.8	6.4	0.75

Average yield, kg/ha; (for period of 10 years) mungbean 900; peanut 1,263; soybean 900
Average price, U.S. cent/kg. (for period of 10 years) mungbean 16; peanut 222; soybean 11
Source: Agricultural Statistics of Thailand, 1967 Ministry of Agriculture.

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almost all of the production has been consumed domestically leaving only a small tonnage for export. It seems logical to assume that consumption of grain legumes in the country whether as conventional or industrial food products has gained popularity at a rapid pace. This suggests that the future production and utilization of these three legumes will continue to increase at a fairly rapid rate. Among these three legumes, soybean has recently received special attention. In the past, soybean production was rather low compared to mungbeans and peanuts due to two main factors. Low yields averaging about 900 kilograms per hectare were due to the lack of technology and tended to discourage the expansion of farm acreage. The other major reason was the lack of a steady demand in the local market and resulted in low prices whenever over production occurred. At present, the situation soybean production has significantly changed. Demand has increased rapidly due to the expansion of domestic oil extracting industires and new markets in neighboring countries. The Thai Government decided to include a soybean accerelation program in the Third Five Year Plan (1972–1976) and a goal of 300,000 tons of soybean grain for 1976 was set. To achieve the target, it is estimated that an area of about 200,000 to 300,000 hectares will be required for planting. In accordance with the Third Five Year Plan, mungbean and peanut production are expected to increase at the rate of only five percent per annum since there is no strong demand for these crops in both the domestic and international markets.

Climate and Location

The areas which produce the majority of these legumes are located in the North, Central Plain and Northeast region of the Kingdom which range in lattitude from 13 to 20 degrees north. Since it is a tropical country, the climate of Thailand is devided into a dry and wet season. The monsoon or rainy season starts in May and continues until October. This is the critical period for Thai farmers since their crop cultivation depends substantially on natural rainfall. The dry season occurs during the rest of the year and crop cultivation can only be done where adequate water is available. At present, it is estimated that about 30,000 hectares are provided with sufficient irrigation water for dry season and about 200,000 hectares are projected for 1976. Since they have a short growing season, these legumes can be practically grown three times a year as follows.

a) Early rainy season planting starts in May and June on the high land. The farmers in the Upper Central Plain are well experienced with planting mungbean and soybean in the early part of the rainy season. Later, cotton is planted either following mungbean or in between soybean row. Unfortunately, in the this season the legume crops must be harvested during the peak of the heavy rains which cause grain quality to be somewhat inferior, Furthermore, most of the farmers are unable to afford artificial dryers.

b) Late rainy season planting. The farmers in the highlands of the central plain generally harvest their corn in late July and August. This leaves a period of about 60 to 75 days before the monsoon rains end. Immediate sowing of mungbean and soybean seeds can produce crops with a fair yield. (The yield of 2 to 2.5 tons had been obtained in some good fields). Since the crops are harvested in the dry period the grain quality is relatively good and brings a premium price.

c) Dry season planting could be done only in the irrigated areas after rice is harvested. January sowing has proved to be the most suitable since the crops can be harvested in April, thus, damage caused by early season rain is avoided.

In the case of peanuts, only two planting seasons are recommended, one in the rainy and the other in the dry season. Late rainy season planting is prohibitive, since hand harvesting of peanut in the dry soil is difficult and unprofitable.

Research Organization

Field experiments on the grain legumes have been conducted for approximately three decades but in a very limited scale. Thus, the information is not sufficient to provide answers to major problems. The need for more comprehensive research has been recognized for sometime but strong support was delayed until recently.

In response to the Third Five Year Plan previously mentioned, the Department of Agriculture as a part of Ministry of Agriculture was assigned the task of undertaking a research program from the production standpoint. The "Oil Crops Project" was set up in 1970 to serve the purpose. As stated earlier, soybeans are given more attention than the other crops. Mungbeans are also included in the program since they possesses several characteristics agronomically similar to soybean so far as research is concerned.

A number of scientists within the department were recruited and assigned technical work in various phases of the research. At this moment, the Government of Japan, through the Colombo Plan, has provided valuable assistance for a period of five years starting in 1970. The assistance provided by experts and provision of technical equipment and materials have proved to be very beneficial for the initiation of the program.

To increase the national production on these legume crops, the project has aimed at two successive steps. Firstly, the average yield must be raised from 900 to 1,500 kliograms per hectare for soybean and mungbeans and from 1,200 to 1,800 kilogram per hectare for peanuts (unshelled). At this projected yield level, which is consideerd the optimum return per hectare, it has been shown that there is a profit incentive to farmers. Experimentally, the yield of soybean and mungbean can be raised up to 4 tons per hectare but it is considered impractical and most farmers can not afford the high cost investment.

The second step concerns an increase in area planted. This means up to three growing season per year must be utilized with subsequent improvement of the existing cropping pattern (rotation) which presently permits land to remain idle after the main season crops are harvested. To implement the above plans, research is in progress and should play a vital role in solving fundamental problems and those that arise in the future.

Even though research work has been intensified many problems still exist. For example, scientists working on the Oil Crops Project are relatively new and inexperienced. Additional practical and academic education are urgently needed for the long term program. Experts from Japan and other countries can assist on a short time basis, but well trained local staffs are needed to assure the successful continuation of the program.

Secondly, adequately equipped research facilities are considered necessary. Experimental fields, modern equipments and laboratories for various disciplines should be provided for each region representing a major legume growing area. This should also include financial support to cover the cost of operation.

Some Aspects of Research

Several problems presently exist and must be solved in order to make legume cultivation more profitable, reliable and competitive. Some of the more important ones are discussed briefly in the following paragraphs.

1) Varietal Improvement. Fortunately, the standard varieties for soybean, mungbean and peanut have been established and released as the result of past research. In the case of soybean, it has been shown that two standard varieties, S.J.1 and S.J.2. consistently outyield local and introduced varieties when tested in several locations during both growing seasons. Furthermore, their oil content of more than 20 percent make them comparable to standard varieties throughout the world. These varieties are re-

latively resistant to shattering which makes them suitable to hand harvest. The breeding program has as its major objectives higher yield and oil content, larger seed size and resistance to the major diseases. About 30 crosses have been made and about 30,000 segregating lines were grown during the past two years. Additional crosses aimed at rust resistance and nodule formation have been made for the purpose of expanding soybeans into new areas.

In the case of mungbeans, the standard varieties have given a satisfactory yields. However, some characters must be improved especially those concerned with uneven maturity and pod shattering. At present hand harvest is performed by picking 4–5 times which makes it difficult for farmers. The introduced varieties originated from the Philippines where they are uniform in maturity and highly resistant to pod shattering under their conditions are under tests for adaptability.

Only Spanish and Valencia peanut varieties have been successfully grown in Thailand up to the present time. The attempt to introduce the Virginia Runner was unfruitful in the past due to its long growing period which makes it susceptible to leaf spot diseases. Recently, Virginia bunch imported from Taiwan has given promising results in field tests. If this finding is confirmed in farmers fields, it would appear that the Virginia bunch could replace the Spanish and Valencia types because of its higher yield.

As a result of assistance by Japanese experts, about 1,500 lines of soybean, 70 lines of mungbean and 60 lines of peanut are presently involved in various studies. After careful evaluation on individual performance, it is hoped that some of them can be released for production.

2) Management. The aim in this field is to improve the existing techniques of crop culture in order to obtain better yields from an optimum input. In other words, it is to search for ways to utilize the farmer's land, time and labour to its full efficiency. Examples are studies of land preparation, time of planting, spacing and plant population, weed control both by mechanical and chemical means, irrigation and crop rotation.

The results from two years of research indicate that yields of soybeans and mungbeans could be doubled by proper cultural practices. These are considered to be practical techniques which could be applied by farmers without difficulty.

3) Soil fertility. No conclusive results concerning the benefit of applying lime and fertilizers to soybeans in major growing areas can be given as yet. Cost of chemical fertilizer in Thailand is considered expensive and prevents their widespread use. Whenever possible a minimum amount of phosphate is recommended in order to maintain soil fertility. A mixed formula of 20–60–40 kg/ha of N, P_2O and K_2O is generally suggested for these three legumes especially for the infertile soils of the Northeast region.

Results of investigations for two years have shown that inoculation is not a serious problem in Thailand on mungbean, and peanut. Even on soybeans response is minimal as compared to Western countries. In the relative fertile soils representing the major soybean growing areas, Rhizobial bacteria occur naturally. Heavy nodulation usually results on the standard varieties with or without inoculation, even in newly cleared land. However, in the infertile soils with low pH value in the Northeast, proper inoculation did not induce nodulation on the standard varieties. In contrast, the old native varieties produced root nodules under the same conditions without inoculation. It is suspected that there is a specific relationship between genotype of host and naturally occurring Rhizobia in this symbiotic system. More attention is being paid to clarify this complex situation. Soil microbiologists are conducting a search for more effective strains of Rhizobia, the production of inoculant on a large scale and

more efficient methods of inoculation. Transfer of nodule forming ability from the native varieties to the standard ones by hybridization is also underway.

4) Thus far, there has been no indication of a serious pest problem. For soybean, rust seems to be an important disease during the heavy rain period when planting is made in the late part of the season. Sanitation and rotation are recommended to alleviate the problem while breeding for resistance is underway. Damping off, collar and stem rot appear to be common diseases for these three legumes wherever fields are not drained properly. Leaf spots and virus diseases have been noticed in certain locations, a strict seed certification is suggested for control measure.

Bean flies (*Agromyza* spp.) sometimes create problems on mungbean and soybean seedlings in the Central lain and Northeast regions while leaf hoppers, leaf rollers and leaf cutters, have been observed in all three crops elsewhere. Dimethoate spraying has given satisfactory control for these pests.

5) In addition to the research work, a seed multiplication program aimed at supplying high quality seed to farmers is just beginning. At present, the most optimistic estimates indicate that not more than ten percent of the seeds of the standard varieties are available for sowing in each season. The remainder is left to the farmer to find as best as he can. The shortage of seed is a serious problem and the cost is prohibitive. Unfortunately, soybean and mungbean seeds lose their germination rapidly if stored in the usual way. As a consequence, the farmer must spend more money for seeds, more time for replanting and obtain less return due to improper stands and ripening. Recently, it has been found that keeping the seeds in the air tighted polyethylene plastic sack could prolong germination ability for more than one year.

The Department of Agricultural extension in cooperation with Department of Agriculture has started a seed multiplication program. Only soybean seeds are being given special attention at present. According to this program, the Department of Agriculture produces Breeders, Foundation and Registered seed. The Department of Agricultural Extension, after receiving Registered seed increase it in farmers' field under their supervision and inspection. The seeds are then processed and distributed to the farmers for next season. It is questionable whether the supply will be sufficient to meet the demand in the future unless private firms are encouraged to engaged in this business.

It is also hoped that the seed multiplication program can be started with mungbeans, peanuts and other crops when the technical and financial support are available.

Dissemination of research results on these legumes is mainly conducted by the Department of Agriculture Extension, however in certain localities, other governmental agencies also play important roles in encouraging farmers to grow more grain legumes.

Other Related Activities

Besides the Department of Agriculture, several other governmental agencies and Universities are also conducting some phases of research on these legumes but to date no significant results have been reported.

In addition to providing assistance to the Oil Crops Project, the Government of Japan is helping in the establishment of a Pilot Oil Laboratory which is now under construction within the Department of Agriculture. Upon its completion the modern laboratory facility will be able to render service in extraction, analysis and utilization of all oil producing crops including soybeans and peanuts.

Kasetsart University's Institute of Food Research and Product Development also engages in research on the exploration and utilization of plant protein. These three legumes are the main sources of their raw materials for the development of new food product which are gaining in popularity. Some of the new produtcs include soybean milk, noodles, meat analogues and confectionaries made from soybeans and mungbeans.

This institute, in cooperation with the Department of Health, has initiated a lunch program for school children aimed at using plant food protein to improve nutrition.

The Vegetable Project also under the Department of Agriculture is responsible for research and development of vegetable legumes. At present, some work is being conducted on sugar peas, cow peas and string beans.

Conclusion

Recent production and research on the major food legumes in Thailand have been on a larger scale and a more scientific basis than in the past. It is anticipated that if it is given the continued technical and financial support, efforts to improve production of legume crops will be successful. Recent technological advances suggest that the consumption of grain legumes and its products as a supplement for animal protein and fats can be significantly increased in Thailand. Expectations are that the local demands for these legumes and their by products will continue to increase.

Discussion

N. Yamada, Japan: If I understand correctly, you found varietal difference in nodule formation. Is this actually a varietal difference or an individual difference within a same variety?

Answer: Yes it has been observed that there is a specific relationship between host genotype and strain of Rhizobia. The progeny of the selected lines will perform uniformly nodule formation on the given strain of Rhizobia.

Sadikin, S., Indonesia: Do you have *Phaseolus radiatus?* Four to five times picking is a tedious work, do you have a variety which can be harvested simultaneously?

Answer: Yes we have *P. radiatus* grown in Thailand, but it is considered a minor importance. The acreage for this crops is rather limited. We found out that a few of these varieties originated from the Philippines are rather resistant to pod shattering. Besides they are uniform in flowering and maturity. If this finding is confirmed in our condition they will soon be released for production.

M. K. Baluch, Pakistan: Page 9, Para. 5. About seed multiplication program. (1) Is seed multiplication program being carried out under some Act.? (2) Could you elucidate the Role of Registered Growers in the production of registered seed? (3) Do you feel some necessity of breeding the varieties having a uniform maturity of pods in your country?

Answer: (1) We are hoping to have Seed Law in the future. The drafting committee is working in details. (2) Registered seeds are grown only in the government seed multipliaction at present. The selected farmers are given the foundation seed and grow it on their farm. Inspection and certification are done by extension officers. Then the seeds are brought back by the Extension Department for processing and packing. The seeds are distributed to the farmers as certificed seeds. (3) Of course, especially for soybean and mungbean, harvesting could be done at once to reduce the labouring cost. Purification of standard varieties gives a satisfactory result in uniform maturity to certain extent. Breeding program to obtain the even maturity and resistance to pod shattering is under way.

C. P. Cheng, Republic of China: An agricultural technical team from Taiwan has worked in central Thailand for almost three years, to extend the "rice-stubble soybean" cultural method is one of their objects. Do you know what is its prospect at present?

Answer: Taiwanese are helping us mainly on the establishment of farmers cooperation. They also involve in the "rice stubble soybean" in the extension phase. Mostly the soybean grown under their supervision are being consummed as green or vegetable soybean which obtained the premium price. They are making a good progress in the

central plain growing soybean as a second crop in the paddy fields.

J. Fukui, Japan: In Thailand, in which crop of peanut or soybean do you place more weight? I think that soybean is more delicate crop than peanut.

Answer: We are concentrated on soybean even the present acreage but its production is much lower than that of peanut. The soybean grain is in great demand for oil extracting factories. Now the price of soybean in Thailand is twice higher than that in the world market. If the plan to produce 300,000 tons in 1976 is successful, 250,000 tons will be utiilzed in domestic oil extracting industries.

T. Narikawa, Japan: In your country you have two seasons, dry and rainy. Would you please explain the breeding technique of soybean varieties adaptable to these two seasons?

Answer: We want the comparatively easy shattering variety for the rainy season since the threshing is done in the period of high moisture. While those varieties grown in the dry season should be resistant to shatter due to the dry atmosphere. Practically, the character to separate soybean into two growing season is the ease of pod shattering. Some special attentions must be paid for the breeding program, unless the threshing machines are devised and used in the future.

F. Hasegawa, Japan: From my observation in your country, adding to these insect pests which you pointed out now, several stink bugs, especially southern green stink bug, *Nezara viridula,* and *Cletus porgnator,* are abundant everywhere. I think, these pests also should be regarded as major insect pests for soybean in your country. Would you like to tell me your comment abuot the degree of injury by these pests.

Answer: Thanks for your comment. I regret that I could not answer you properly. Thai entomologist had made the survey on the species of insects damaging the soybean in both farmers' and experimental fields. More than 30 species of insects had been observed in the fields with various degree of injury. Only those that they considered severely dangerous are given special attention. Accordingly, I mentioned on my discussion.

N. Hatai, Japan: Do you have any nematode problem in soybean cultivation?

Answer: As a hot and humid country, I am sure that we do have nematode problem in soybean field. Since the investigation on these aspect has not been made yet, I just pretend we don't have nematode at all. It is my intention to stimulate this kind of study in Thailand as soon as possible.

P. P. Kurien, India: What is the mode of consumption of many bean? Cooked whole? as processed products? What is the nature of the food processing industry based on grain legumes in Thailand.

Answer: Mainly mungbeans are used to make transparent bean thread or noodle which we consumed and exported it to a certain extent. Mungbeans are also cooked as foods, sweets, desserts and porridge.

For food processing, as I can recall, they are used for making flour first, then several products are manufactured.

Bean sprouts hold also a big share in our traditional foods.

T. Sato, Japan: Sometimes we must harvest the beans under rains, even if we expect to escape this risk. What kind of legumes is the most suit or tolerant to harvesting under this bad conditions in Thailand?

Answer: We could escape the damage in two ways. First those harvested during the rainy season are kept under the roof until the monsoon season is over, they dry and thresh. This method has been largely employed in Thailand. The second way is growing the easily shattering varieties which could be threshed conveniently during the rain free period in the rainy season.

K. Oda, Japan: You show two species as mungbean, that is, Phaseolus aureus and

Ph. mungo. Are there any differences between them? We usually hear of the former, Ph.aureus. Is it more common in your country, also?

Answer: Phaseolus aureus is known as "green gram" in Thailand. They are used mainly for local consumption. Ph. mungo is known as "black gram", the plant is rather twiny and hairly. The seeds are smaller than the green gram. All of the black mungbean are exported to make bean sprout which would give a long slender sprout. Sometimes there is a big demand for black mungbean in the foreign country and obtained a high price, so the farmers grow it.

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