SOYBEAN PRODUCTION IN THAILAND

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Abstract

Soybean production is largely based on soybean' s role as a minor component of cropping systems. In irrigated areas it is grown in paddy fields in the cool season. In upland areas it is planted in the early rainy season and intercropped with cotton. In the late rainy season it is intercropped with corn or more commonly grown after corn harvest. The day-neutral cultivars grown can be planted in any of the three seasons. Minimum inputs are used in soybean cultivation, and yields average 1 ton/ha. Production in these systems has provided a sufficient quantity to meet the national needs in soybeans which are largely used for food in traditional ways. Recently, production has not kept pace with the expanding demand for soybeans, especially as a protein supplement in animal feeds. Production packages available could double the present average yields. Economic incentives, efficient marketing and more effective technology transfer are needed to encourage farmers to adopt new technology. Mungbean is a major competitor in cropping systems.

Soybean production in Thailand

Speculation has been made that the Chinese immigrants brought soybean into Thailand during the past three to four centuries. After periods of association with the crop, Thai people adopted soybean as an additional food and began to cultivate the crop for household consumption. The first record of soybean promotion in the Kingdom appeared in 1930 when soybean was introduced into the Northern Valley to be grown after the main rice crop in the paddy fields where traditional irrigation was available.

During the Second World War, there was a strong demand for cotton for domestic use. Soybean was found to be a suitable crop to be sown in the early part of the monsoon season in upland areas where it could be followed by an intercrop of cotton planted in the middle of the rainy season. This cropping pattern has been practiced in the Upper Central Plain area where about two-thirds of the national soybean grains are produced. Since the crop matured and was harvested during the rainy season, grain quality was inferior due to lack of proper drying and storage.

In the Lower Central Plain, corn is planted in the early rainy season, i. e. May to June, and harvested in August to September. Following harvest of corn, soybean can be grown as a second crop to utilize the remaining period of some two months before the rainy season closes in October. Since the termination of the rainy season varies considerably soybean yields are unstable and often very low. Thus, the planted area is rather limited.

With these cropping patterns, Thailand produces about 50,000 tons of soybean annually which covers the requirements for domestic consumption.

The Thai people utilize soybean in traditional Chinese methods, i. e. making various beancurds, pastes and sauces. Only small amounts are exported to neighboring countries, usually following good crop years.

During the past few decades, modern soybean industries have been established for processing of vegetable oils, animal feeds and human food. Domestic bean production has not kept pace with the rapid expansion of agro-industries. Increasing amounts of grain and cake have been imported to meet the growing demand.

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Statistics for soybean production in Thailand are given in Table 1. It should be noted that there were trends of expansion in both production and area during the period covered. Export and import data are shown in Table 2. Prices of soybean at different locations are presented in Table 3. International or Chicago prices have had some effect on soybean trade in Thailand.

Table 1 Soybean acreage, yield and production in Thailand (1971—81)

Year	Average (1,000 ha)	Yield (kg/ha)	Production (1,000 ton)
1971	57.4	944	54.3
1972	84.5	863	72.4
1973	122.6	850	104.2
1974	131.7	837	110.4
1975	118.1	963	113.9
1976	101.6	1,119	113.6
1977	153.1	631	96.3
1978	161.6	981	158.9
1979	108.6	938	102.1
1980	126.1	994	100.0
1981	127.5	1,031	131.5
Rates/Year	+5.5	+0.27	+5.81

Source : Office of Agricultural Statistics, 1981.

Table 2 Balance of soybean export and importation during 1976—1930

Year	Exportation (grains)		Importation			
			Grains		Cakes	
	1,000 ton	US$1,000	1,000 ton	US$1,000	1,000 ton	US$1,000
1976	8.1	2.1	0.05	0.03	9.8	2.3
1977	11.5	3.6	4.0	1.1	53.6	11.0
1978	8.1	2.3	10.8	2.6	82.4	16.9
1979	9.7	3.0	0.005	0.002	58.6	14.6
1980	3.4	1.2	15.3	4.4	154.8	42.8

Sources : Office of Agricultural Statistics, 1981.

Table 3 Soybean prices at different locations (US g/kg) (1977—1981)

Year	Farmgate	Bangkok		Government guarantee	Export	Import	Chicago
		1st grade	2nd grade				
1977	20	28	26	—	31	25	25.7
1978	23	24	23	24	27	25	23.9
1979	21	27	26	27	30	30	25.9
1980	24	38	29	29	36	28	25.5
1981	26	33	31	32	38	30	27.4

Source : Office of Agricultural Statistics, 1981.

Cropping patterns and practices

Historically, Thailand has been mainly a rice-producing country. Soybean and other grain legumes were treated as marginal or minor crops to be grown when extra-land and labor were available. These crops were cultivated with very minimal inputs. Little attention or management was directed to them between sowing and harvest. The farmer was content to harvest whatever he found in the field when harvest labor was available.

A recent trend in soybean cultivation has involved a shift from subsistence to semi-commercial practices. Farmers are paying more attention to management of this crop. More frequent use is made of inputs such as good seed of improved varieties, inoculum, weeding and insecticides. However, the pace of yield improvement is very slow. Increased production has been mainly from expanded area or cropping frequency.

In upland fields for early season plantings, land preparation may be done either with animals or with hired tractors. One, or rarely two, plowings are practiced with one harrowing. When heavy rains come early in the season, and thoroughly soak the soils, seeds are sown and covered immediately. Heavy seeding rates, generally twice the recommended rate, are used to assure adequate stands because of the poor quality of seed which is available. Where cotton is to be intercropped, row spacing is set at one meter to allow proper spacing for the cotton. For late rainy season and dry season plantings, row width is reduced to 50 cm. In paddy fields, seeds are directly dibbled into the rice stubbles followed by an irrigation to provide moisture for germination. Hand weeding is practiced in the rainy season, but seldom in the dry season. Seed inoculation has not become popular and is employed by only a few farmers. Only a few growers apply fertilizer directly to soybean, mostly when soybean is the first crop in a sequence. In the dry season plantings, the crop typically receives two or three furrow irrigations during the season.

Experimental results have indicated that the optimum plant population is about 200,000 per hectare. This can be obtained in 50 cm rows with 20 cm between hills and 2 plants per hill. If plantings are made into furrows rather than in hills, there should be 10 plants per linear meter of row. For such a population, with recommended varieties, 50 kg of good quality seed per hectare should be sufficient. Proper inoculation increases yield by about 15%. Adding $P_2 O_5$ at a rate of 50 kg/ha during land preparation could double total grain yield in general, but the majority of farmers do not apply it for a variety of reasons. Fertilizer costs are quite high in comparison to the price received for soybean. Credit may be difficult to obtain, and interest rates may be very high. Under upland conditions, rainfall patterns are quite erratic and the risk of yields being restricted by moisture stress may discourage farmers from making a fertilizer investment. Soil analyses revealed that on most soils where soybean is grown application of potassium is unnecessary. Where weed populations are high, weed control during the first six weeks could raise yields up to two or three times in comparison to uncontrolled plots.

The results of these studies are urgently needed by farmers. Lack of efficient communication and demonstration of results has limited farmers capabilities of obtaining higher yields. Recently, extension units have been expanded to village levels. It is hoped that improvement will be achieved in the future.

Varietal adaptation and improvement

Variations among those varieties introduced by Chinese immigrants opened choices for Thai farmers in the past to make their own selections. The first requirement was to sort out plants that matured early enough (100 days) to fit their existing cropping patterns. Photoperiod insensitivity was considered essential to enable them to use one variety for all plantings during the year (cropping systems involve three distinct planting seasons) . The use of a single variety also facilitated seed propagation. Seeds produced in one season could be used in the next, thus avoiding the necessity of storing seed from one year to the next.

In the present breeding program undertaken by the Department of Agriculture, these two

phenological traits of early maturity and photoperiod insensitivity are maintained as prime objectives. Other desirable characteristics to be added to varieties for improved consistency of performance at higher levels include: resistance to shattering and lodging and drought tolerance. Resistance to major diseases such as rust, downy mildew, bacterial pustule and mosaic has been achieved. Programs for adding resistance to anthracnose and pod and stem blight are in progress. The newly recommended varieties, SJ4 and SJ5, are of about 100 day duration and daylength neutral with high and stable yielding ability. They are well accepted by farmers. However, additional work on varietal improvement is considered necessary in order to obtain more widely adapted and more productive cultivars. Other objectives in the breeding program are to obtain varieties of different growth duration to fit specific locational constraints and for different cropping systems. For certain areas tolerance to edaphic conditions such as salinity and high acidity is required. Multiple sources of resistance to major diseases and insect pests are desirable to protect against the eventuality of breakdown of present sources of resistance and introduction or evolution of biotypes of pathogenic organisms and insect pests which could attack the resistant commercial cultivars.

Pest management

In the hot and humid tropical countries, wide ranges of diseases and insect pests capable of attacking soybean prevail the year round. More than 100 species of plant pathogens have been recorded as attacking soybean crops. Twenty-five of these cause yield reductions to various degrees. However, only six diseases are considered of economic importance. They are:

Diseases	Causal agents
Soybean rust	*Phakopsora pachyrhizi* Sydow.
Anthracnose	*Colletotrichum dematium* (Pers. ex Fr) Grove var. *truncata.* (Schw) Arx.
Pod and stem blight	*Diaporthe phaseolorum* var. *sojae*
Bacterial pustule	*Xanthomonas phaseoli* (Smith) Dawson
Damping off	*Pythium* spp. , *Rhizoctonia* spp. , *Fusarium* spp.
Soybean mosaic	Virus

Cultivars with satisfactory resistance to rust, bacterial pustule and mosaic have been developed while resistance to anthracnose and pod and stem blight is being incorporated in the breeding program. Management practices including sanitation and crop rotation help to reduce damage from these diseases. Chemical treatments are relatively ineffective and uneconomic at present.

Ten serious insect species have been identified and control measures have been developed for recommendation to farmers. Two miners which universally attack legume crops at the seedling stage and cause severe growth reduction constitute a first group. These are the stem miner (*Melanagromyza sojae* Zehn.) and root miner (*M. phaseoli* Try.) . Systemic insecticides are required for spraying at about ten days after emergence in order to eradicate the pests and prevent seedling damage. Aphids (*Aphis glycines* Mat.), leaf hopper (*Empoasca* spp.), leaf rollers (*Lamprosema* spp. and *Archips micaceana* Wkr.), leaf miner (*Stomopteryx subsecivella* Zell.) and white fly (*Bemisia tabaci* Genn.) constitute a second group that often damages soybean heavily in the dry season and during drought periods. In addtion to direct destruction of plant tissues some of them serve as vectors in transmission of viral diseases.

The third group of important insect pests includes the pod borer (*Heliothis armigera* Hubn.) and cut worms (*Prodenia litura* Fab. and *Agrotis ypsilon* Rott.) . They have been found abundantly during the rainy season and especially in the pod developing stage. Heavy infestations result in great reductions in growth, yield and seed quality. Seed beetle (*Callosobruchus chinensis*) is a commonly observed storage pest. It can cause extensive damage if left unattended.

In general, farmers seldom apply chemicals although commercial insecticides and recommendations for their use are available. Yield losses due to insects have been observed in all soybean-growing locations. Spraying is done only when pests threaten to destroy the whole crop. Strong programs of pest management are needed to improve production.

Certain vertebrates including birds, rodents and rabbits are sporadically observed to cause minor damages in a few localities.

Harvest and storage

When the soybean crop has reached maturity, plants are cut by hand and left in the field for a few days until the leaves have dropped from the stems. Plants are then piled together and tied into bundles of 30 to 50 cm in diameter. The bunches are then stored under a shed during rainy periods, otherwise they are spread on a hard surface to sun-dry until ready for threshing. The time required for proper drying varies depending upon atmospheric conditions. Drying usually takes longer for soybeans harvested from early plantings, i. e. when intercropped with cotton.

After plants have cured and dried properly, threshing is commonly done by beating with a bamboo stick which forces pods to split and the beans to fall out. In some cases, the bundles are spread on a hard flat surface and a tractor or pickup truck is driven repeatedly over them.

Within the past few years tractor-powered threshers have been developed in being operated to provide custom services. These machines have proven to be very efficient. They save time, reduce losses and make it possible to preserve grain quality. Although the number of units presently available is limited it is increasing and the use of the machines is gaining in popularity. It is hoped that this development will replace the tedious manual threshing practices. The cost of labor is increasing, and it is becoming difficult to get workers, especially when soybean threshing coincides with peak labor periods for other crops.

With the traditional threshing method, after the threshing has been completed the grains are sorted from the stems and pods by hand. Cleaning is accomplished by placing the beans, and any included plant and soil residues, onto a loosely woven bamboo sieve which is shaken by hand. The beans are then redried in the sun until moisture has been reduced to a level safe for storage. After the grains have been dried adequately they are mostly placed in gunny bags, although some are stored in metal containers. The bags are then stored temporarily under a protective roof.

Post-harvest studies confirmed that multiple handling during harvesting, threshing and drying caused considerable losses of grains—up to 50%. Effective means to overcome these constraints are urgently needed. In addition to large losses in quantity, inferior grain quality also resulted from poor handling and storage. Quality is a major issue in price setting by the local merchant who purchases the product from the farmer. Processing factories are very cautious about accepting sub-standard lots.

Marketing

The majority of the farmers sell their soybean crop immediately after it is dried to local merchants or "middlemen" who come to the village. Some prefer to take their grain to a market town and negotiate a sale there. Because of the sharp competition, few farmers trade their beans with the local Farmers Association or Cooperative.

Middlemen transport the soybean grain from the up-country market towns to large warehouses in Bangkok after price negotiations with the Bangkok purchasers. From these warehouses they are then distributed te processors. Farmgate prices tend to be depressed because of the several transaction steps involved in the present marketing system.

Consumption and utilization

Thai people consume soybean in various ways. Soybean sprouts have their place in most local markets and are included in restaurant menus. Because of their beany flavor, sprouts are not as popular as those from mungbean. Fully developed pods before reaching maturity are picked and boiled, with a small amount of salt, to make market vegetable soybeans which have become very popular snacks.

The traditional methods of processing of dry grain are those adapted from Chinese ways of preparation mentioned earlier. Local food processors, by employing new technology, have developed modified processing methods which are more economical and yield a more standardized and hygienic output. Numerous products that have recently been developed in the western countries are also locally manufactured on a commercial scale and are distributed throughout the country. Government programs to promote improved nutrition have substantially influenced the people' s diet. This, in turn, has increased the demand for soybean and other grain legumes.

Soybean, along with rice bran, cotton and kapok seeds, is used as a raw material in the oil extracting industry. Vegetable oils are widely used in cooking. Recently, importation of palm oil to blend with other cooking oils has partially relieved the shortage of the local supply.

Bean cakes or meals are important sources of protein for use in animal feed. The rapid growth of animal industries, especially poultry, has created great shortages of this raw material. Increasingly larger amounts of cake have had to be brought into the country to meet the growing demand. Re-exportation of animal feeds as well as export of animal products is also taking place. These activities are occurring in response to the availability of local materials and labor for processing.

Prospects and constraints

In the promotion of soybean production, the Thai government has set the target first for self-sufficiency and then for exportation. Production tripled from about 50,000 tons in 1971/72 to over 150,000 tons in 1978/79. Thereafter, the expansion of production has slowed. Close analysis shows keen competition with mungbean. These two legumes compete with each other in many aspects of production, including land use and labor. Mungbean is a tropical crop, well adapted to the Thai climate and soils. Soybean requires approximately 100 days to complete the cropping cycle and yields about one ton per hectare. Mungbean, on the other hand, takes only 65 days to produce about 0.75 ton per hectare, and it can be grown anytime of the year when moisture is available. The price of mungbean currently is about US$ 0.45/kg while that of soybean is only US$ 0.30/kg. In addition, Thailand is a major exporter of mungbean and the international market for mungbean is not yet saturated. In the case of soybean, domestic price is about at or somewhat above Chicago price. Farmers tend to grow soybean only when they can not grow mungbean because of rainfall or temperature patterns or price outlook of mungbean does not appear to be favorable.

From an agro-ecological standpoint, soybean is regarded as a crop with considerable potential in Thailand's agriculture. Soybean yields now being obtained by farmers could be doubled by application of present knowledge and technology as has been shown in demonstration plots. There is still ample land involved in cropping systems in which soybean could be included if socio-economic problems can be solved. There are several steps which can be taken to promote soybean production. These include a stronger government effort in transfer of technology, some subsidy on necessary inputs, increased farmer access to credit, and increased efficiency of the marketing system.

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Discussion

Hidayat, O. O. (Indonesia) : In view of the very low viability of soybean seed in the tropics, how do the farmers in Thailand store soybean seed as well as how long do they store the seeds before planting?

Answer: The use of seed produced in the wet season for the dry season and *vice versa* was found to be one way to solve the problem of low viability and germinability of seed.

Summerfield, R. J. (United Kingdom): We must be careful in the use of terminology and in particular I refer to your use of the term "adaptability" . On the basis of your data mungbean and soybean produce 11 kg seed/day/ha and can be said to be equally well adapted. Should we think in terms of protein and oil production/ha/day to make valid comparisons? Adaptability can be defined as the exploitation of space and time or output of a particular product per unit of agricultural resource (such as water, fertilizer, land, etc.) . A crop which is poorly adapted and produces small yields could command a large market, price, while another well-adapted crop, giving high yields only a small price. Economics does not reflect "adaptability of crops to agro-climates" .

Answer: In my presentation the term "adaptability" is used since mungbean can tolerate adverse conditions such as soil acidity, drought, heat, infestations with pests much better than soybean under tropical conditions. From the evolution standpoint, mungbean originated in the tropics whereas soybean was introduced to the tropics from the temperate zone, hence mungbean is very well adapted to tropical conditions. In addition the higher price of mungbean is another incentive for the Thai farmers to grow mungbean whenever time, land and labour are available.

Palaniyappan, K. (India) : Is there any advantage in modifying the level of fertilization you recommended so as to increase production?

Answer: I would like to mention that there are indigenous populations of *Rhizobium* in the soils of Thailand. Also inoculants are produced in Thailand and recommended rather than nitrogen. In the soils of Thailand the available potassium level is 100 ppm.

Okabe, S. (ESCAP) : I noticed that Thailand imports large amounts of soybean cakes for use as feed. Is the price of soybean competitive enough in Thailand compared with that of other feeds such as rice bran, maize, etc. ?

Answer: The feed industry which is expanding rapidly requires large amounts of protein sources which are only represented by fish meal and soybean cake. Rice bran, maize and other products cannot be used as substitutes. Soybean cake even imported is cheaper than fish meal.