Utilization of Wild Relatives for Mungbean Breeding in Thailand

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Abstract

The utilization of wild mungbean varieties (*Vigna radiata* var. *sublobata*) as a source of bruchid resistance was first started at Chai Nat Field Crops Research Center, Thailand in 1988. TC 1966, an accession of var. *sublobata*, showed complete resistance against *Callosobruchus chinensis* and *C. maculatus* which are the most serious storage pests of mungbean in Thailand. The TC 1966 was crossed with the recommended varieties, Chai Nat 60, Kamphaeng Saen 1 and Kamphaen Saen 2. The bruchid resistance of TC 1966 was controlled by a single dominant gene. After successive generations of backcrossing, the lines obtained displayed a high resistance to both bruchid species. The resistant lines were characterized by a short stature and early maturity in the case of the crossing with Chai Nat 60, an early maturing variety. However, the yield was comparable to that of the best check variety. The bruchid resistance was again re-examined in some selected lines in 1991-1992. Only 34 lines were selected for the preliminary yield trial in the dry season planting of 1993. The seed yield of some of the resistant lines was not significantly different from that of the recommended varieties.

Introduction

Mungbean, a major exported commodity, is widely grown in Thailand. It occupied about 500,000 ha, and its production amounts to around 300,000 tons (Table 1). Nearly 60% of mungbean production is exported to foreign countries such as Japan, India and the Southeast Asian countries, while the rest is domestically consumed as flour, vermicelli, bean sprout and sweets (Chinuvati *et al*., 1988). Mungbean is usually grown as a second crop or cash crop, and is often grown before and after main crops. Farmers do not pay much attention to mungbean. They invest as little as possible, and are not very much concerned about the return.

Mungbean seed is mainly sown by broadcasting. Neither, rhizobium inoculation nor fertilizer is used. Few farmers spray insecticides against the insect pests. Under these circumstances, therefore, the average yield is only 650 kg/ha.

According to the seventh national economic and social development plan of Thailand from 1992 to 1996, the expansion of mungbean production will depend on the increase of seed yield per unit area, instead of planting area. Under this plan, mungbean yield will increase from 600 kg/ha to 730 kg/ha within 1992, and will gradually increase up to 830 kg/ha within 1996. The planting area will be maintained at around 340,000 ha (Table 2). As a major exported commodity, seed quality must be improved to suit the foreign market requirements, in terms of seed size, uniformity of seed size and seed color, absence of contamination by diseases and seed damage by insects.

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Table 1 Planting area, production and yield of mungbean in Thailand, 1982-1991

Crop year	Planting area ('000 ha)	Production ('000 t)	Average yield (t/ha)
1982/1983	485	281	0.63
1983/1984	483	288	0.63
1984/1985	525	352	0.73
1985/1986	548	323	0.61
1986/1987	507	301	0.61
1987/1988	464	267	0.61
1988/1989	474	333	0.72
1989/1990	513	356	0.72
1990/1991	449	303	0.71
1991/1992	441	304	0.73

Source : Adapted from Center of Agriculture Statistics (Anon. 1992).

Table 2 Planting area and production goals of mungbean from 1992-1996

Year	Planting area ('000 ha)	Production ('000 t)	Averageyield (t/ha)
1992	340	246.5	0.73
1993	340	252.9	0.77
1994	340	261.4	0.77
1995	340	272.0	0.80
1996	340	282.5	0.83

Source : Seventh National Economic and Social Development plan of Thailand. (Anon. 1991).

Losses caused by bruchids

Bruchids have been a serious constraint on the production of mungbean in Thailand for a long time. These insects reduce the seed weight, seed quality and seed germination. Since mungbean is still a low price and low input crop, the use of insecticides against bruchids may be uneconomical. Alternative methods such as the use of vegetable oil, neem seeds as well as drying of seeds have been successfull in protecting the crop against the insects (Talekar, 1988).

Visarathanonth and Promsatit (1989) reported that in Thailand, *Cellosobruchus maculatus* causes more seed damage than *C. chinesis*. When seeds were kept at room temperature for more than 10 months, they were completely destroyed. However, drying of seeds to a moisture content below 10% before storage considerably reduced the infestation with bruchids. Thanomsub (1991) applied 0, 0.5, 1, 2, 3, 4 and 5cc of neem oil to 1kg of mungbean seeds, and kept them at a room temperature of around 29-30°C and at 70-80% RH. The seed samples were taken randomly to examine the bruchid damage every 2 months. The results indicated that within 6 months, the percentage of damage with a 2cc, dosage was only 1.25 which was not different from higher dosages, compared to 95.7% for the control. Furthermore, the germination percentage of the seeds with a 2cc dosage was 84%, compared to 16% for the control. In a study with crushed neem seeds, Thanomsub (1989) reported that after storage for eight months, only 9.8% of the seeds were damaged in the treatment with 2 g of crushed neem seed per 100 g of mungbean seed, whereas 59% of the seeds were infested with bruchids in the control treatment.

Differences in bruchid resistance between varieties or accessions of mungbean, however, have been reported, and breeders are making some progress in developing bruchid-resistant varieties or lines. The mungbean accessions, V 2709 and V 2802, have been found to be highly resistant. TC 1965 and TC 1966, the wild mungbean accessions were also reported to be resistant to several bruchids species (Taleka, 1988 and Fujii *et al*., 1989). Therefore, the use of resistant accessions or characters from germplasm sources is an effective strategy for controlling damage of seeds by bruchids, although the use of either crushed neem seed or neem oil has been effective in the protection against bruchids.

Utilization of wild mungbean varieties for bruchid resistance

Breeding for bruchid resistance in mungbean in Thailand has been initiated since 1987 under the cooperative projects between the Tropical Agriculture Research Center and Chai Nat Field Crops Research Center, Field Crop Research Institute, Department of Agriculture of Thailand. The results obtained from tests for bruchid resistance showed that TC 1966 was completely resistant to *C. chinensis* and *C. maculatus*. Tomooka *et al*. (1991) found that TC 1966 could be easily crossed with cultivated varieties such as Kampang Saen 1, Kampang Saen 2 and Chai Nat 60 without any genetic barriers. The genetic segregation of the progenies suggested that the resistance of TC 1966 was controlled by a single dominant gene, supporting the results obtained by Kitamura *et al*. (1988). After successive generations of backcrossing, aresistant line of TC × CN 60 produced yields and showed agronomic charaters comparable to the best check variety, KPS 1 (Tomooka *et al*., 1992).

Since *C. maculatus* is the most serious mungbean pest in storage compared with other bruchids in Thailand, Watanasit (personal communication) therefore, reexamined 270 mungbean lines from the previous experiment, which were resistant to both bruchid species. Only 34 lines were found to be completely resistant to *C. maculatus*. In the dry season of 1993, a simple lattice design was laid out to evaluate the yielding abilities of the 34 lines, compared to the standard check, KPS 1 and Chai Nat 36. The results revealed that the lines 1-3, 1-6, 1-8 and 1-9 from the CN 60 × TC 1966 were very promising in terms of high yield, large seeds, erect plant type, early maturity and resistance to powdery mildew (Watanasit, 1993). These promising lines will be tested again in multilocation trials.

Future prospects

For a wider genetic base for improvement, both wild species and primitive cultivars are necessary for variety improvement, especially for resistance to major diseases and insect pests. The survey for mungbean germplasm collection in Thailand was initially conducted in November 1989. Four wild species of

Table 3 Average yield (t/ha), 1,000 seed weight, days to harvest and powdery mildew resistance of bruchid resistant lines tested at Chai Nat Field Crops Research Center (Dry season, 1993)

Lines	Yield t/ha	1,000 seed weight (g)	Days to harvest	Powdery mildew resistance
1. (CN 60 × TC 1966)-1-3	1.6 a-d	66.0 a-e	64	HR
2. (CN 60 × TC 1966)-1-6	1.5 a-e	64.8 a-f	64	HR
3. (CN 60 × TC 1966)-1-8	1.5 a-e	70.1 ab	64	HR
4. (CN 60 × TC 1966)-1-9	1.4 a-d	65.2 a-f	64	HR
5. KPS 1	1.7 ab	70.3 a	67	MR
6. CN 36	1.3 a-f	69.8 abc	67	MR
F-test	*	**		
CV (%)	17.5	4.5		

A column followed by the same letters is not significantly different at 5% level according to DMRT
* Adapted from 36 entries in simple lattice design (Watanasit, 1993)

Ceratotropis were collected in this survey (Tomooka, 1991). Under the cooperative program between TARC Japan and the Thai Department of Agriculture, the collection of wild mungbean varieties is now continuing in all parts of the country. The significant traits will be evaluated and utilized in the mungbean breeding program.

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Discussion

Iwanaga, M. (IBPGR): 1. What is the mechanism of bruchid resistance? Could the resistant materials exert an effect on human consumption?

Answer: Tomooka, N. (Japan): Dr. Kitamura and his colleagues at the National Agriculture Research Center have isolated a toxic substance in the seeds of wild accessions of mungbean. According to Dr. Kitamura, the substance(s) show similar characteristics to those of blackgram (*V. mungo*) which is also resistant to the bruchid (*C. chinensis*). As blackgram is currently consumed in India, it is assumed that the substance(s) contained in wild mungbean may not be harmful to human beings. However tests on animals should be performed.